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Human Evolution : Is it purely Nature Dependent?



- Is Global Warming a Result of Human Activity?
- Is Ramsetu or Adam's Bridge still a mystery?
- Exploring Our Universe

Editorial

After a long wait we are bringing out the english organ of Bigyan Manashko 'Insight'. Since 2011 our bangla organ 'Samikshan' has been published regularly but the demand for an english version has been gradually gaining momentum, especially from non-bangla speaking science lovers of this and adjoining states. Although at the first conference, 2013 we decided to bring out an english organ but we failed in keeping our promise. To fill this lacuna we've tirelessly worked on our pledge and finally have shaped this first edition of 'Insight' for your critical views, comments and suggestions. The major part of this edition has been translated and edited from 'Samikshan', our bangla organ. The programme of our organisation, 'Bigyan Manashko' has been included to impart a deep insight into our ideological foundation for the benefit of our readers. This will help them distinguish scientific facts from pseudo science.

We welcome our readers to join us in our effort to raise the consciousness of the masses by propagating science through various writings and vigorously struggle against the elements who are bent on perverting the scientific temperament. ■

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INTRODUCTION TO SPACE SCIENCE

Exploring Our Universe

When we goggle at the clear night sky, we get captivated by the view of the innumerable twinkling light spots. They are stars, some comparatively brighter, some dim. Our Sun is also a star like them. It is moderate in size. Eight planets revolve around the Sun, one of which

is the Earth, our lovable blue planet. Our Earth has a satellite - the mesmerizing Moon! Even other planets have their own satellites (moons). All these comprises our small family – The Solar System. Now the question arises, “Dose each of the stars have a family of its own?” That is exactly how it is ! Billions of stars are held together by gravity to form the bigger family which is called Galaxy .The name of our Galaxy is Milkyway. It is spiral in shape. The Sun existing in the inner edge of one of its spiral arms (Orion Arm) revolves around the centre of the Milkyway.

In this way billions of galaxies come together to form a cluster – a yet bigger family. So what is the distance between two such Clusters of Galaxies? Several thousand kilometers? Several million kilometers? The figure is still bigger, indeed so big that it becomes messed up (i.e. difficult to express). Thus astronomers came up with a method of calculating the distance in terms of

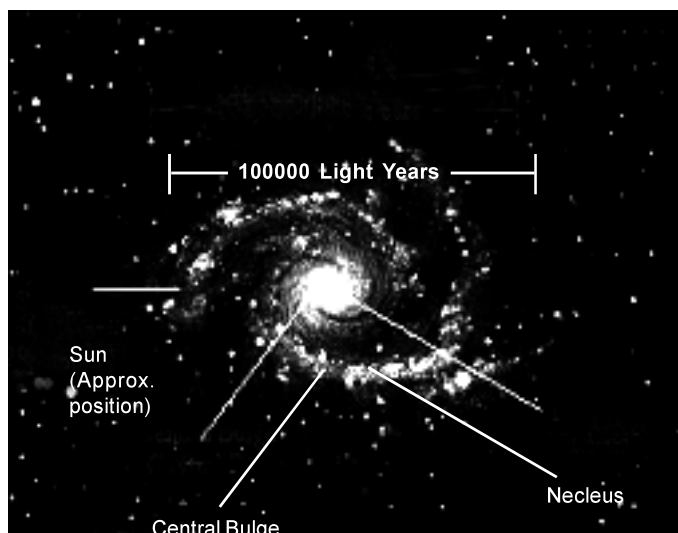


Fig. 1 : Our Galaxy

Light Year. The time taken by the light from a faraway star to reach the Earth (or anywhere else) is measured in the terms of light unit (as applicable), as in the rays from the Sun take approximately 8 minutes to reach the earth. Hence the distance between the Sun and the Earth is 8

light minutes.

Our nearest spiral Galaxy Andromeda is at a distance of 22,50,000 light years. So now lets imagine for how many hundred thousand years the points of light must have travelled, the ones that we are able to visualize in the night sky ! It is not possible for us to be aware even if the original star has been destroyed in the meantime , as the rays of light emitted from it was on its course of journey towards the earth.

Yes, stars do die just the same way they are born. But how are they born? It is like Phoenix of fairy tales? But indeed it is not a fairy tale. Galaxies are separated by the distance of millions kilometers and the distance between every other star or galaxy is called free space. But that does not mean the space is void. It contains hydrogen, dust particles, plasma and cloud of other interstellar gases. This makes up Nebula. Since this cloud stretches over vast area, its density is

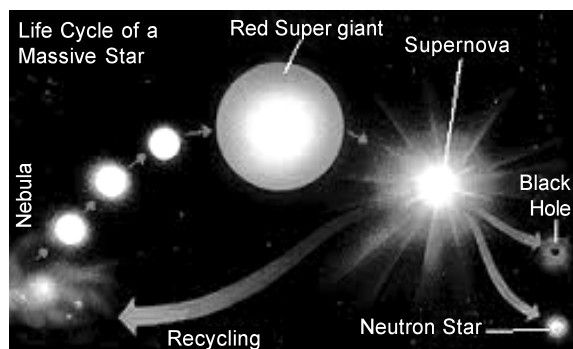


Fig. 2 : Life cycle of a star

very low. That means the particles are far away from each other. Thus in a Nebula each cubic centimeter of space consists of approximately 10 hydrogen atoms. Though the density of the Nebula is low, due to its huge structure (volume) a considerable mass of the Galaxy lies in it. Nebula waits patiently for millions of years with the desire that nascent stars would be born from it and glow in the universe.

These particles play a strange game in the Nebula. In a suitable condition, they start attracting each other. The scientists still could not figure out the actual reason behind it. When they become a little larger the gravity plays main role. Due to strong gravitational pull, an enormous cloud of hydrogen gas (other particles also) collapses. This gives rise to friction, thereby producing immense heat (enough to burn nuclear fuel). Due to this heat the nuclei of two corresponding hydrogen atoms combine to form 1 helium atom. The mass (rest mass) of the newly born Helium nucleus is slightly less than the sum of the masses of the hydrogen nuclei. This difference of masses (very small in amount) is called mass defect. However, when this tiny amount of mass (mass defect) converts to energy, it manifests as huge quantities of energy. We come to know this from Einstein's famous formula $E = mc^2$, wherein E =kinetic energy, m = mass of the body (mass defect), C = velocity of light. Thus the magnitude of 'E' is huge. For instance, if you possess any

substance 1kg in weight and you can convert this mass completely into electric energy, then you will get 2500 crore electric units (Kwh or B. O. T. unit). This huge amount of electrical energy is capable of fulfilling the need of electricity for your family, for more than 10 million years, even you end up spending 200 units per month. Anyways in this way lacs of tones of hydrogen atoms burn to emit immense amount of heat and light which reach us in form of radiation. This radiation provides us warmth and keep us alive.

Now we have atleast come to know that stars are born in space (Nebula) and Hydrogen acts as their fuel. But what will happen when all hydrogen will run out? You guessed right – death of the star. In this way new stars are born, pass from childhood to youth, reach old age and finally die. However the end of the star is not a smooth one. Some of stars explode-burst into small pieces and are thrown out in space (Supernova). Thus it vanishes in the same space where it was born. May be it waits for millions of years in the possibility of the birth of a new star. Some star, in their last phase collapse and convert themselves into White Dwarf which shine in the sky. This is indeed the fate of our Sun. But please don't be horrified, you need to wait for more 5000 million years to experience this dreadful vision. Some other stars also convert to Neutron Stars. Pulsars are these kind of Neutron Stars. Some stars contract their enormous mass (beyond Chandrasekhar's limit) completely and get converted to black holes. The gravitational pull of black hole is extremely high, thus it swallows everything surrounding it. This kind of massive black hole (at least one, sometimes two) is located at the centre of almost every galaxy. Billions of stars of the Galaxy continuously revolve around these black holes.

The Moon revolves around the Earth and the Earth around the Sun. All other stars similar to the Sun revolve around the center of their

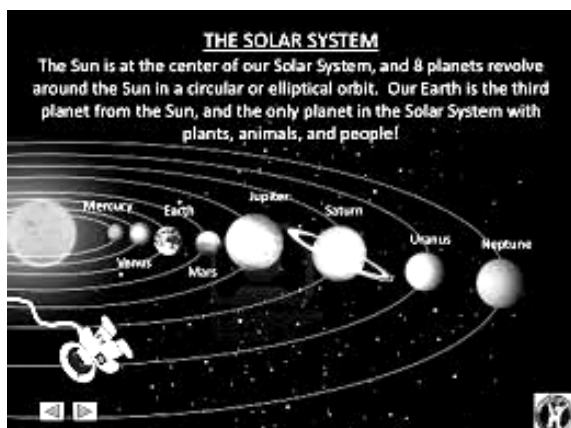


Fig. 3 : Our Solar System

Galaxies. So are Galaxies in motion? Absolutely correct ! The Clusters of Galaxies are constantly moving apart from each other. Does that mean that our Universe has no fixed size ? Is its size constantly increasing ? Scientists confirm so. The universe is expanding constantly. But where does the journey end? How did it ever begin ?

Can we get to the beginning of the Universe if we analyze the entire expanding phenomenon in a reverse manner? In other words the Universe was previously small in size and yet smaller if we move back in time. Thus moving back, if we reach the time when the Universe was created what do we find ? Was the Universe just a tiny point? Was its mass and energy completely packed up at that point ? Was there an explosion in the point of infinite density and mass (singularity) that kicked off the journey of creation of the universe. The great Big Bang theory confirms the same.

However it is not the right time to come to a conclusion that the theory of Big Bang is utmost correct. New observations give rise to several questions in our minds every day. Our attempt to answer these questions takes us more closer to the truth (fact).

We can't say exactly since when men started questioning several aspects of the Universe. But it is the true that man had not only observed the

wide open sky and the glorious stars with awe, but had also tried answering several questions that came to his mind. However he did not possess advanced technology to answer his questions. Thus he guessed that some super natural power must have created these. However the law of nature did not stop at this conclusion. Man has constantly been observing the Universe to know it more.

According to the Greek philosopher Aristotle, the shape of the Earth resembled that of a flat dish . Later he changed his statement saying that the Earth was spherical. Greek scientist Eratosthenes found out the circumference of the Earth with the help of suitable calculation. In 3rd century B. C. Aristarchus mentioned the existence of an Universe with the Sun at its center. In other words the Earth revolves around the Sun. 500 years down the time, Ptolemy spoke just the opposite. He mentioned the Sun revolved around the Earth. Now we are aware that Aristarchus was right. However astrologers still follow the concept of Ptolemy (old model). A thousand years later, Copernicus revived the heliocentric theory, with the Sun at the centre and the Earth revolving in a great circle around the Sun. Other planets also revolve around the Sun in their respective circular orbits. Johannes Kepler mathematically proved that the planets move in elliptical orbits. In the meantime the telescope was invented. Galileo emphasized the necessity of experiment in gaining knowledge of nature. He observed with the telescope that Kepler was correct. He also observed that satellites revolve around the planets. As we all know he had to face harsh consequences for exposing this truth about the Universe.

Newton was born in the year in which Galileo expired. He explained the law of attraction of celestial bodies. Every celestial body attracts one another (Law of Gravitation). This indicates the inexistence of the state of absolute rest. Due to

the attraction and counter attraction, it is not possible for cosmic particles to remain in the state of absolute rest. That is why the Earth revolves around the Sun and the Moon around the Earth.

The theory of Relativity by the great scientist Albert Einstein brought about a massive attack on the existing concept. He proved that there was no existence of either 'absolute rest' or 'absolute time'.

Could there be a more severe attack on religious doctrine? However Einstein did not have to face severe consequences for this. Unlike Bruno he was not burnt alive after cutting off the tongue. Unlike Galileo he did not have to face immense torture by the religious fanatics. Time has changed. But does it mean our society has changed into an open forum that is ready to accept the scientific truth liberally? Let us not get into that discussion.

Aristotle and Newton, both of them believed in the concept of absolute time. They believed that the time gap between two incidents could be successfully measured – whosoever calculates it. In other words time is completely independent of space. Most of us think the same. This thought is in relevance with our day to day life. This thought helps us to analyse the motion of bodies surrounding us. It also helps us to analyse motion of planets that are comparatively slow moving. But the issue arises regarding the speed of light, just the way there has been issue regarding the planet Mercury. Newton's Law of Motion does not explain perfectly the locus of Mercury. However it was explained in an astonishing manner by Einstein's Theory of Relativity.

Einstein stated that time is not independent of space. Combination of space and time makes up the space-time continuum. In other words an event needs to be analysed in four dimensional space. For doing this, we need to consider 3 co-ordinates for space (length, breadth, height) and one for time – all these four co-ordinates together. This is called space-time.

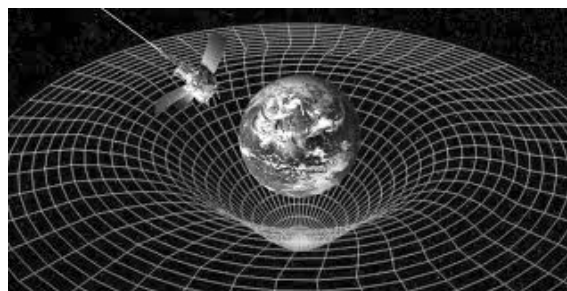


Fig. 4 : Space-Time Curvature

We need to be super-humans if we got to visualize the four dimensional structure of space-time. Because, we used to see our world in a three dimensional form. Our brains can easily visualize three dimensional images (structures) of things. Then what is the way out ? We can imagine three dimensional space as two dimensional on horizontal surface and the rest is the dimension of time.

Hence we can visualize the four dimensional form of space-time as 3-dimensional, where the 2-dimensional surface actually refers to the space of 4-dimensional space-time. The essence of the General Theory of Relativity says that gravity is the 4-dimensional space-time curvature. The mass of an object gives this curvature in space. Thus the space near massive stars will be more curved. The gravity is more powerful there. Far from the star, where the gravity is weak the space is comparatively flat. It is like a flat sheet of rubber in which an iron ball is placed. The iron ball makes the sheet curved. The structure of space-time is like this. Thus the rays of light become bent near heavy stars. Space-time of a Black hole is extensively (infinitely) curved. Thus once light enters it, it can never revert.

And what about time ? The more the space-time curvature, the slower the time (time-dilation). Thus if you travel towards Black Hole, your time will run slower with the increasing curvature of space-time. Eventually when you reach the Black Hole (event horizon), time will stop. But you will fail to realise that as your heart beat, metabolic

rate and your nervous system will slow down. Only if you can maintain contact with one of your friends, who is on the surface of the Earth you will

realise that your watch is running slower than usual. Einstein's Theory of Relativity trifled with the concept of absolute time. It made Newton's Gravitational Law stand in witness box. Some people mentioned that the rectified Theory of Gravitation is named as General Theory of Relativity. The Russian scientist Alexander Alexandrovich Friedmann used the equation of General Theory of Relativity for the research regarding creation of the Universe. It seems that in General Theory of Relativity, the clue supporting the explanation of the Universe was hidden. After his death a priest and physicist in Belgium

Georges Lemaitre again started his work on Friedmann's model of Universe. Finally he published the Big Bang model in 1931 A.D. [Fig6].



Fig. 5 : Black Hole

In this twenty first century several researches and observations have confirmed several fact in support of Big Bang Theory. In the year 1929 A.D. scientist Hubble discovered that the Clusters of Galaxies are moving away from each other.

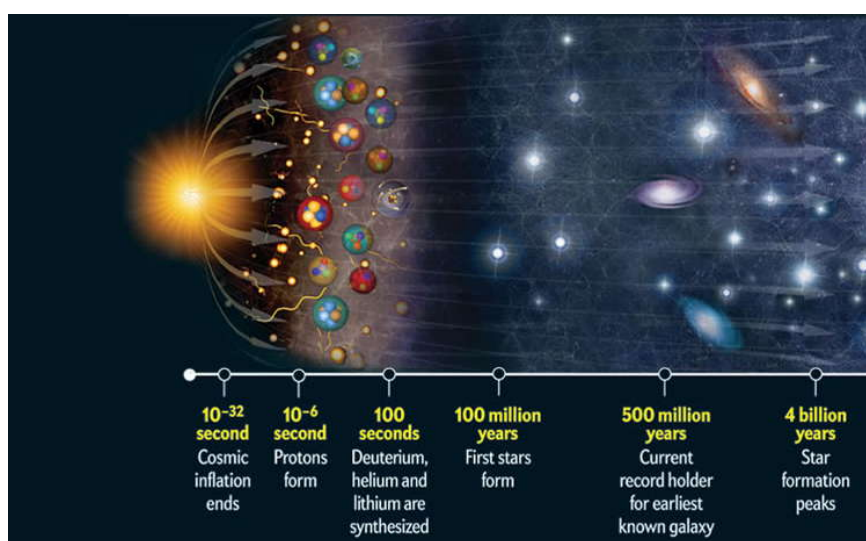


Fig. 6 : Big Bang Theory

He used the theory of scientist Doppler (Doppler Effect). The Cosmic Microwave Background Radiation (CMBR) has been discovered. Plank's

spectrum of black body radiation is similar to the space radiation at 2.725 k temperature that supports the Big Bang Theory. In the year 1990 A.D, NASA sent a space-ship called COBL (Cosmic Background Explorer) which found the cosmic background radiation temperature to be 2.727 k which was the same as the one confirmed by CMBR. Recent discovery of Gravitational Wave in LIGO equipped us with another strong evidence supporting Big Bang Theory.

The astronomers have measured the rate of expansion the Universe. They have found out the average density of Universe. From this it can be calculated that the Big Bang explosion happened approximately 1.37 ($\pm 1\%$) billion years back. That was the time when the journey the Universe began. In other words the age of the Universe is 1.37 billion years.

However this is not absolutely correct. There is some amount of complexity in the measurement of average density. Moreover the rate of expansion of the Universe is not uniform. With the advancement of time we are getting newer facts and the perfection in mathematical calculation is increasing.

The scientists are not ready to draw the final conclusion regarding the same. However till now you can say Big Bang is the limit of human knowledge regarding the Universe. But as mentioned earlier, we are stunned by the recent researches. With the progress of time, the doors of unknown mysteries seem to open in front of



Fig. 7 : L shaped LIGO, 8 Km. long

our eyes. Every moment it tells us the true story behind the creation of the Universe. It is much more adventurous and attractive than the folk tales and the theological doctrines related to the creation of the Universe. Would you still like to keep yourself locked in imagination of the supernatural power or would you like to bravely

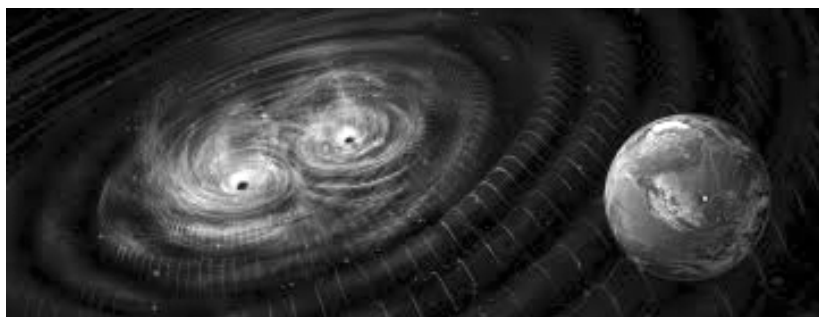


Fig. 8 : Gravitational Wave

face the fact? Would you like to hit round the bush or prefer to welcome the attempt of knowing the Universe through suitable scientific researches and thus look for the true identity of the Universe? The decision is all yours ! ■

Human Evolution

Is it purely Nature Dependent?

Where from did I appear on earth? – this query of a little child is eternal and is a natural question. Equally natural and related question is that how and where from human being appeared on earth.

In this context although there exist different theories, the first scientific theory was put forward by the biologist **Charles Darwin**. According to Darwin through natural selection, evolution of living being has taken place and through this process of evolution human being appeared on earth. During the lifetime of Darwin his theory of evolution was buried with the sound of church bell. But under the necessity of time and age it re-emerges from burial. During the 150th anniversary of Darwin's theory, the pope has confessed the mistake of burial of his theory while it was active.

The phases of Darwin's theory of Natural Selection are as below :

- (a) Struggle for existence – intra-species struggle, inter-species struggle and struggle against nature,
- (b) Survival of the fittest,
- (c) Variation,
- (d) Natural Selection

ORGANIC EVOLUTION

What it is and how does it happen?

The basic idea of organic evolution lies on the mechanism of transition from an aboriginal, undeveloped, simple living-body into a modern, developed creature having a complex body system, the process of change being at a very slow pace through ages. Evolution related evidences are as below :–

- i) Morphological or anatomical evidence,
- ii) Evidence related to vestigial organs,

- iii) Fossil related evidence,
- iv) Embryo related evidence,
- v) Geographical evidence and
- vi) Bio chemistry related evidence.

By a process of adaptation with the changing environment the living creatures develop new characteristics which make the creature adjustable with the environment. Under similar environment, creatures of different species develop similar adaptation which is known as **Convergent Adaptation**. This results in development of **Analogous Organs** amongst different creatures, such as, Fins of Grasshopper, Wings of Birds, Wings of Bats. Although these organs do not have any internal structural similarity, they have the similarity in their working. On the other hand creatures of same or similar genus get adapted differently due to their livelihood in different environments, which we call a **Divergent Adaptation**. Such adaptation leads to development of Homologous Organs on different creatures, such as, Flippers of Whale, Forelimbs of Horse, Hands of Man. These organs have internal structural similarity, but have no similarity in their working. Sometimes, Divergent Adaptation leads to creation of new species. According to Darwin, as a result of struggle for existence and variation, the future generation shows a tendency of getting adapted with the environment.

According to Viceman and his followers adaptation of living being becomes possible by virtue of co-ordination of various events – Theory of Natural selection is one of them.

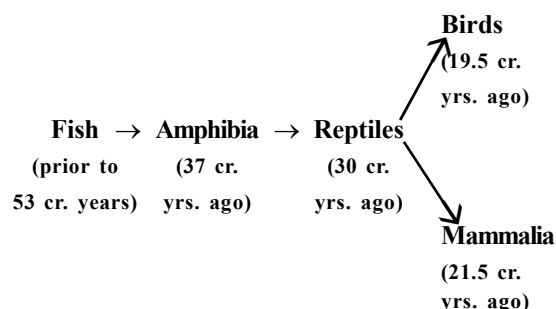
We shall have to keep in mind that the organic evolution did not happen in a rectilinear way. Also it is not that it has happened on a spiral way and at a uniform pace. The pace of evolution was dif-

ferent at different ages and never that was balanced. But evolution was never in a backward direction. The different ways of evolution has come to a halt at different ages, but never did it revert. Therefore, **evolution is a progressive process**. The pace of evolution is not uniform, as also, the number of creation of species is not balanced. At any time-interval the number of species in the animal kingdom exists at a progressive equilibrium. This progressive equilibrium is maintained through a positive addition i.e. creation of new, advanced and dominating species on the one hand, and a negative deletion i.e. extinction of old undeveloped species on the other. Since the pace of addition of species and that of extinction of species are not equal, the number of species in earth is therefore not a constant. The creation of species is not merely controlled by natural selection, it happens through heredity, generation, mutation and genetical drift. The change in species or in genus, as also, the creation of new species of new genus are all long drawn processes, yet their manifestation is abrupt. It results in complete extinction of old species or genus. A change in local natural environment has brought about a change in local animal kingdom. Likewise, a change in worldwide environment has brought about a change in the animal kingdom of a geographically widespread area. Extinction of species is an integral part of adaptation. Naturally the animals of the intermediary period of transformation from one species or genus to other species or genus are all extinct. The missing link between the different species are the best evidence of evolution.

For example,

- (a) Ichthaiestega – Missing link between Fish and Amphibia,
- (b) Semuria – Missing link between Amphibia and Reptiles,
- (c) Archeopteris – Missing link between Reptiles and birds,
- (d) Platinosaurus – Missing link between Reptiles

and Mammalia.



If the fossils of these missing links are chained in the geological time scale according to their age, we can understand the following :-

On the way of evolution creatures of one group or genus have appeared from another group or genus on the one hand and similarly successive evolution of same creature has also taken place. For example, evolution of horse, elephant, camel etc.

On the way of evolution, at the dynamic equilibrium stage of number of species, the balance in the energy cycle of environment is badly disturbed and as a result huge number of species become extinct at a time which we call **Mass Extinction**. Till today such events have occurred repeatedly on earth, of which an important mass extinction happened during the last phase of Mesozoic age about 65.5 million years ago. As a result of this, many kinds of Reptiles including Dinosaurs and marine Amonoids etc. were extinct. In general, mass extinction has happened during every global cooling phase.

On the way of evolution another important addition is mutation. Mutation is the chemical change in the gene or DNA molecule and its result. There are two types of mutation i.e. Gene Mutation and Chromosomal Mutation. It is comprehended that in every 12000 reproductive cells only one gene gets modified or mutated. Generally the mutation in living bodies is of decaying nature, because mutation occurs abruptly and in an uncontrolled manner. Mutated genes exist in Fauna as heterozygote, they come to light in homozygus

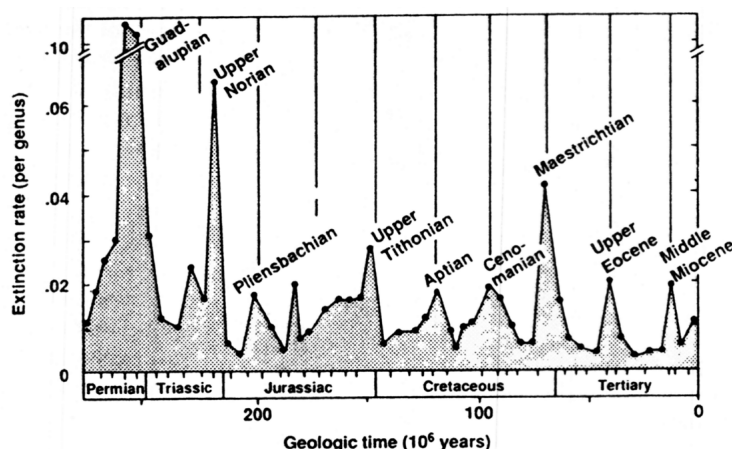


Fig.1 : Mass Extinction of different species according to Geologic time scale

condition and if such revealing is not adjustable with nature then they are dismissed by Natural Selection. It is observed in nature that in the struggle for existence, heterozygotes are more successful than homozygote. Hence the process of Natural Selection considers the heterozygotes more fit and selects them. Since the revealing of mutation is abrupt, the scientist Hugo DeVries considers the evolution as an isolated process which is contrary to the Darwin's evolution related theory of a continuous process. Later on, according to the scientist Dobzhinsky mutation at a large scale goes against the stability of adapted characteristics of species, as a result of which instead of acquiring natural selection it abolishes. Adaptation is the collective result of step by step advancement of small mutations. Therefore, evolution takes place at a slow pace and is a continuous process. It is the result of mutation by virtue of which variation is observed within the offspring of future generation. Again at the time of cell division through meiosis, variation is ob-

served due to crossing over. At any natural environment majority of the creatures of the population carries normal gene and only a small number of creatures carries mutated gene.

Change in the environment is actually the change of external conditions. And mutation is the change of internal conditions of creatures caused due to slow and continuous change in the external conditions. Again evolution is the collective result of mutation – which creates new species or genus or group. The existence of the new species or

genus created after evolution, that wins over Natural Selection, is maintained through reproduction

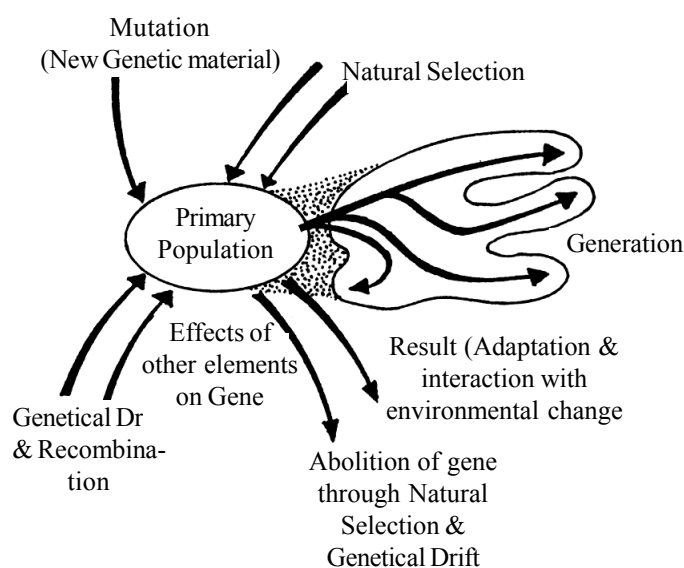


Fig 2 : Synthesis theory of Evolution

and heredity. Any species or genus or group has appeared first on earth. After that through reproduction their offsprings have been produced either by direct hatching or by indirect hatching.

Therefore the controversy like “egg comes first or the hen” is irrelevant.

Improvement in the Mutation theory of Hue go Devraise, Germ Plasm theory of Viceman, theory of heredity by Mendel, Genetical Evolution theory of Dobzhonsky, Molecular Biology and Biochemistry have made the theory of evolution by Darwin and Lamark transformed into a synthesis theory of evolution. According to the outline given by the scientist Savage, by a co-ordina-

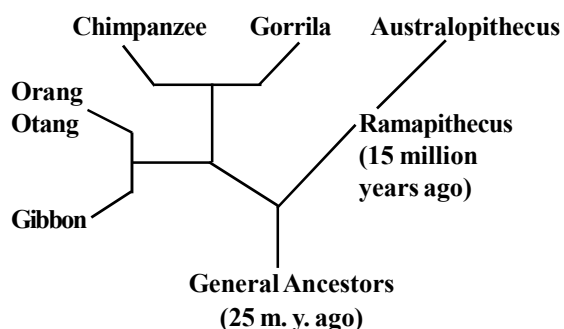


Fig. 3 (A)

tion and Genetical drift, the Primary Population gets modified. [Fig 2] The modified population after getting adapted with the environment is infused to heredity.

Evolution of man

In the animal kingdom man has appeared through evolution as a result of divergent adaptation among mammals. In this regard our ideas have flourished in accordance with the outcome of our researches and discoveries from time to time.

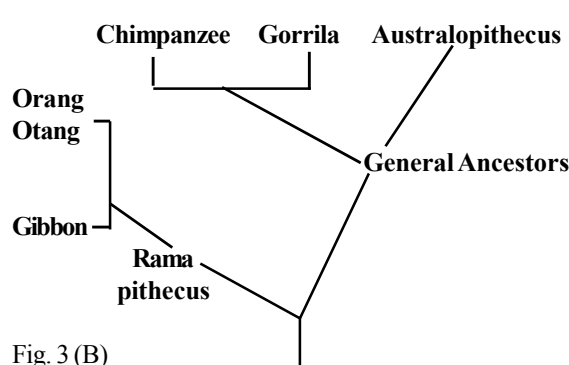
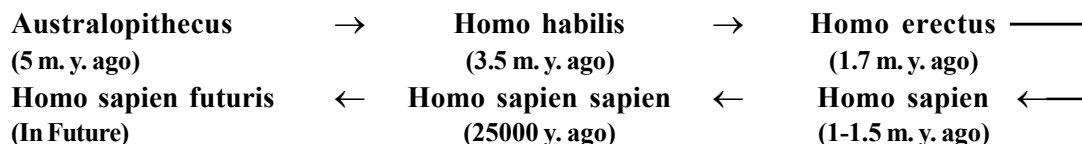


Fig. 3 (B)



In the animal kingdom, evolution of man has occurred from Group to class, class to genus and from Genus to species on the one hand and again there also happened evolution within the species. The first species of Homogenera i.e. ancestors of man is Homo habilis. The pattern of evolution of such species is as below :

Now it is observed that during evolution of man, the rate of evolution from Homo habilis to Homo sapien sapien [Fig 4] was much higher than that of contemporary other animals and that man was not extinct even during the Paistocene Mass Ex-tinction period, where as, many other creatures, much stronger than man, have become extinct

(such as, siberian tiger having long teeth, big size elephant like Wooly Mammoth etc.). But what was the reason behind this?

Natures control over human life has been consistently foiled due to social labour and use of tool by united man. That is why naturally evolution of man can not be fully explained through the theory of Natural Selection. In respect of evolution of man the consistently important matters are as under :-

- 1) Use of tools
- 2) Discovery of language
- 3) Use of fire
- 4) Rearing of cattle or animal husbandry

5) Discovery of agriculture

6) Housing and use of clothes

1) **Use of tools**

Half of the human brain is covered by a co-ordinating system of the functions of eyes and hands. The necessity and effort for the use of tools have primarily established this co-ordinating system. Likewise, due to improvement in the co-ordinating system

for the functions of eyes and hands in brain, man was able to make developed tools at later stage. Homo sapiens are the first who made the tools for making tools, because man was able to think through language. Thoughts have come into existence from the practical situation of that time and through thoughts in tackling of situation initiated. Therefore thoughts have been originated from objects and not that objects have been originated from thoughts. Man has acquired all these qualities through consorted social efforts of millions of years. Creatures of every species contribute labour individually in collecting food, but not collectively. That is why they could not achieve good result of social labour. In ancient times man used to distribute the prey after hunting equally amongst them. There was a necessity of distributing equally among them for survival of physically weak man, everyone's help was needed by others.

Except man, other animals utilise their teeth for crushing hard food. As a result, their teeth and

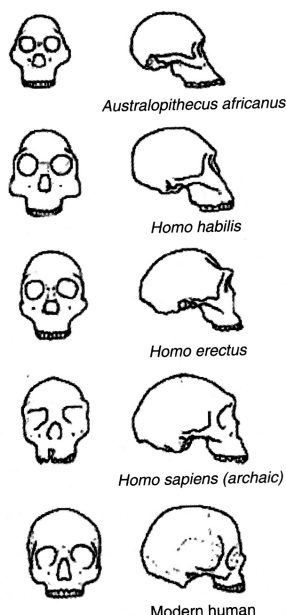


Fig 4: Development of human brain through evolution

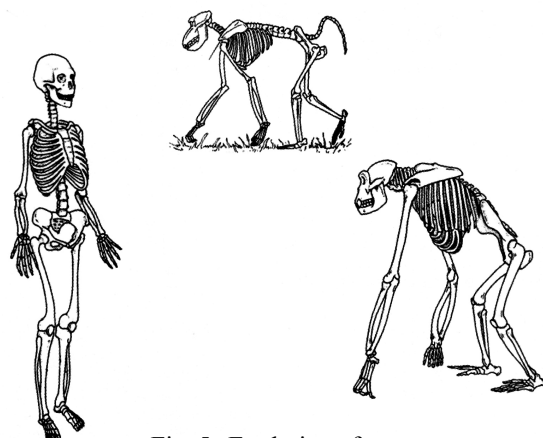


Fig. 5 : Evolution of man from quadruped to bipedal man

jaws have become strong. On the other hand primitive men used to take hard food after crushing them by a tool i.e. after making them into pieces. Due to this the pressure inside mouth was reduced and consequently the possibility of getting the size of the mandible i.e. the jaw-bone reduced. Other than man some creatures of Ape nature are also seen to crush hard food with some tool.

At the time of fighting, there is a direct clash between the two animals. In case of man, at the time of fighting with some opponent, man has used a tool which acted as his weapon and in majority of the cases that has made the man as victorious. So, in such case, man's struggle for existence remained no longer dependent on nature.

When by nature the forest got diminished and meadows expanded, the branch of Primates that descended in the plane land and in course of time transformed into a man, they initially acquired the system of biped locomotion and thereafter in course of time they were able to stand erect [Fig. 5]. This is inferred after a study of the structure of the skeletal system obtained in the fossils found at different parts of the world and after determining their age [Fig. 6]. It was possible for the man to stand erect only under millions and million years of urge of using the tools fully and also under an urge of encountering the enemies from a safe dis-

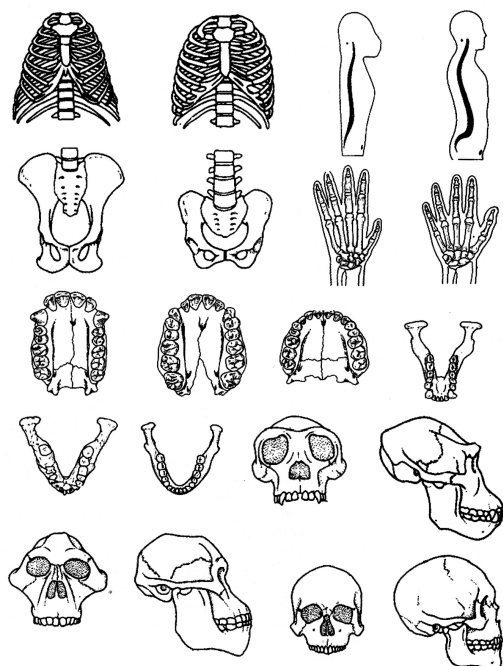


Fig. 6 : Evidence of fossils of different parts of Hominid

tance that can ensure self-defence. By standing erect their hands became free and they could see a long distance.

Use of tools for self-defence has declined the use of teeth for the job. As a result, the teeth became shorter in size which, in turn, allowed the jaws to grow shorter. For example, the canine teeth found in fossils of Ramapithecus are very short in size.

2) Discovery of Language

Discovery of language has made the man completely different from other animals. With the help of language man to man exchange of ideas could be possible. Man can think with the help of language. Acquired education and knowledge has been transmitted from one generation to other through language. In Pre-historic age language has carried the education through 'shruti' i.e. by the process of hearing and memorising. And in the historic age this is one combinedly by 'shruti' & 'lipi' i.e. by hearing, as well as, writing with the

help of alphabatical letters. In some point of time and in some places shruti has ceased to function, lipi i.e. writing with the use of letters has maintained its continuity. But how man has discovered language? Language is a social discovery. Probably the Homo-habilis fauna used to hunt other animals for their livelihood. With a view to defending themselves from the attacks of gigantic and ferocious animals, in a group and at a later stage during hunting of large-size animals, man felt the necessity of co-ordinating among themselves and co-operate each other and very soon man tried to exchange their thoughts and ideas which led to discovery of language. In ancient times, at different corners of the earth, the isolated groups of men discovered separate languages under a common necessity and urge. To put a speech to the lips of men, it was necessary for a developed brain, a co-ordination between ear and tongue and also to give direction, advice, reply or a counter-reply. The way the co-ordination of ear, tongue and vocal chord happened at the brain, in the same way, in carrying out and order that is heard through ear, there was a co-ordination between ear and hands. This was the reason that made the discovery of script or alphabet possible. Due to such co-ordination of the nervous system in the human brain, the measurement of the crenium of the brain of Homo-habilis has become 450-600 C.C. The birds are the only creature which can learn to talk or can imitate a talk. But to express an idea through a speech in an improved and orderly manner is not possible for them.

Language is not acquired by heredity, but is learnt through society (i.e. environment). But to learn a language the construction of nerve in the brain is hereditarily transmitted. Due to the presence of a hereditarily acquired modern human brain through evolution it was possible for a blind, deaf and dumb Helen Kellar to become world famous. But behind her becoming 'Helen Kellar'

contribution of her teacher Anne Salivan is the manifestation of extreme practice of another human brain. According to Einstein, achievements of Anne is more glorious than all the discoveries of modern educational science.

3) Use of Fire

Use of fire and its preservation has made the man advanced to a much extent. At the Homo-erectus stage man has started using fire. The practical necessity to develop the brain that arose, has been made possible by the reduced size of jaws due to intake of burnt and boiled food which was very soft. The measurement of crenium for Homo erectus was 775-1225 cc. Although the jaws were small, the teeth were also reduced in size and therefore sufficient space was available for movement of the tongue inside the mouth. As a result the phonetic sound became clear. The stream of Primates from which men appeared on earth was vegetarian. Hence initially the use of tools was only for self-defence. Afterwards, during the age of food-crisis when man became carnivorous, they utilized the tools for the purpose of hunting. Use of bow and arrow has made the hunting easier. It is presumed that for want of prey, at certain phase man used to take flesh from dead bodies from the graveyard as well as other dead animals. Inclusion of animal protein in the diet has helped development of brain. Burnt or boiled flesh helped in digestion. Successively giving up the habit of taking raw food and adopting the habit of taking cooked food has brought about a change in the digestive system. In present days appendix of men is almost a vanishing organ, but it is not the case with herbivorous animals. Use of fire has made the life comfortable in winter climate. Use of fire was also introduced in the job of hunting. Use of fire also helped the man in taking the possession of caves by driving out the ferocious animals. The environment inside the cave has given the man a safe shelter against natural calamities (like storm, rain, and flood). Drawing pictures inside the dark

cave was possible with the light coming from fire. In the pre historic age, most of the cave-paintings show examples of hunting of animals. It is presumed that the cave-paintings were done so as to maintain the acquired 'hands on' education and to pass on the education to the next generation and those tasks were, of course, taken on hand during the recess period. This was the introduction of education and culture for the mankind which could not be observed on any other species.

4) Animal Husbandry (Rearing of cattle)

After inclusion of meat in the diet of man rearing of cattle was initiated. Primarily dog was domesticated so as to help man in hunting other animals. By such domestication man has not only stopped perishing food stuff in nature, it has started adding to the food store. In man's diet milk and egg were included along with meat. By the use of fire he has learnt to cook which was actually the first lesson of chemistry. Through rearing of cattle supply of meat was smooth even without going for a hunt. By virtue of addition of non vegetarian food in the diet, man's power of thinking and physical strength were increased and therefore man could spread themselves at every corner of the earth. In matters of spreading throughout the world, an important discovery was that of clothing. And as a result of this discovery man could get rid of mass extinction during the Pleistocene ice age. Other than man the creatures that were accustomed with all climatic conditions, were the domestic animals and the microbes or micro-organisms. And that was possible due to their accompaniment with man. By rearing of animals man could unconsciously control, along with domestic animals, the interspecies encounter of other related animals.

During the hunting life, the aborigines used to give cognizance of an animal or a fruit or a tree of different groups as 'Totem'. Men of a particular group will never eat the totem-recognized animal and they will wish multiplication of that animal.

This prohibition was called the Tabu or 'Taboo' of that group. This Taboo resulted in an opportunity to increase the animals in quantity. 'Totems' of each group were separate from each other. Taboo-restriction has diminished the possibility of different animals and plants from being extinct. Subsequently, there was improvement in the above idea by preserving the food-stuff that were found excess to requirement. No other animal can preserve food consciously, although signs of preservation was observed in ants and mice.

5) Discovery of Farming/Agriculture

According to the historians about 8-10 thousand years ago agriculture was discovered during the new stone age. Therefore, agriculture was discovered during the Homo sapien sapien period. Due to improvement in making tools & weapons since the time the importance and necessity of women has been reduced in matters of hunting, the women used to engage themselves more in the domestic works rather than the job of hunting. Besides this, to conceive and after the child birth to bring up the child it would take a longer time in case of men. As a consequence, it became possible for the women to observe successively the life-cycle of different plants near their habitation for a long period. This suggests that agriculture was probably a discovery by women. Initially although agriculture, i.e. work of cultivation was indicated as a job of women, later on when use of ox and plough was necessary in agriculture it was turned into a job of male.

Natural environment was not the same at all the places of the earth. This was so because of geographical reason. Therefore, depending on natural environment in pre-historic age in the eastern hemisphere there was almost all animals which were fit for rearing in the house and almost all food grains that were cultivable except one. Introduction of rearing of cattle necessitated the collection of food for them. That is why in the eastern hemisphere there was introduction of cul-

tivation out of the urge to collect food for the domestic animals and afterwards this cultivation met the requirement of nutrition in men. But in the western hemisphere only one animal (Lamma) was available for rearing and nothing else, and one food grain (maize) was available for cultivation. As a result, in the western hemisphere agriculture appeared as the main way of collection of food grain for men. In the eastern hemisphere, mainly ghee, milk, egg and meat was added in the diet list of Aryan and Semitic races and to meet this necessity creation of farm house by then perhaps made them somewhat distinguished from other tribes of the world. In fact, the size and volume of brain of the Puerto Indians of New Mexico, who were mainly pure vegetarians, was a comparatively smaller than that of Aryans and Semities. Discovery of agriculture has stopped eating of human flesh although religious rites has made the practice continued for a long period.

Just as the animal husbandry has stopped the serviceable animals from becoming extinct, in the same way, discovery of agriculture has caused introduction of production of food, although that was completely nature-dependent. And this nature-dependent agriculture was the beginning of using nature after learning from nature itself. There was an interruption in the process of maintaining life completely depending on food that were naturally produced in the storehouse of nature. Man's nomadic life also came to an end. This initiation of production of food has turned the relation of nature as between the predator and prey into a relation as between the Production and the consumer in respect of man. The nature dependent theory of Natural Selection once again received a big blow in respect of man. At different corners of the earth human civilization has emerged mainly at the basins of rivers based on agriculture.

The nature that compelled the man to become socialized, the socialistic life of man itself, in turn,

has started utilizing the same nature. In course of time, man's livelihood has become society-dependent rather than nature-dependent.

6) Housing and clothing

There is variety of opinion as to how and from which time the construction of houses as well as use of clothings were initiated. But the opinion of the majority was that use of clothing was first initiated during Plietocin Ice Age or in winter climatic condition. Although it is presumed that it has happened after the initiation of Animal Husbandry. The usefulness of living inside caves has directed the man towards construction of houses. After cave, initially man could build a tent using the skin of animals and thereafter it was possible to build houses using plants. Again, use of clothing for a prolonged period has brought about a change in the skin of man in one hand and on the other hand, has enabled a change in the cultural sense of man, as a result of which clothing has become his companion all the year round for maintaining decency. Feeling ashamed to control sex was probably the result of using clothes.

To get rid of extreme climate both clothing and shelter were necessary. The experience of living in caves and development of brain have made the construction of house complete by the use of both hands. The birds also build their nest; but that is only for laying eggs and hatching them. House building has made the struggle against nature very easy in human life. It has made the process of preservation of food easier. As a result of this, development of human civilization was possible. House was the man-made artificial environment within the natural environment which has restrained the effect of natural environment from being conclusive in human life. The temperature inside the house being different from that of external environment, sex of man started getting controlled by internal house environment rather than by natural environment (temperature); as a result of which human sex was possible to con-

tinue round the year instead of being completely controlled by seasons. This resulted in man's giant leap towards retaining the existence of species compared to other animals. Modern medical science of present times had added a new dimension to it.

These discoveries have advanced the man to such a height that the relation of man with his ancestors has become beyond imagination. The entire life cycle from hairy caterpillar to butterfly (metamorphosis acquired through evolution) is believable since it is over within a very short time span. But in case of man, his becoming a human is the result of rotational adaptation and evolution through millions and millions of years and that is why this is not apprehensible through the life cycle of any creature, be it man or other animals. It has been possible to establish this fact only through the fossils preserved in nature and through analysis of other archaeological evidences.

By a close observation on the life style, culture, regulations and custom of different tribes living at different corners of the world and from their historical descriptions, some idea can be comprehended regarding the livelihood of civilized man at the primitive stage. The aboriginal tribes may be treated as the "living fossils" of primitive men. Change in the system of marriage (sexual relation) has no bearing with the development of brain. Based on the inheritance of properties the relations in marriage has changed as per social custom. Marriage within a family-relation has been forbidden. Within the family the addresses like father, mother, brother, sister, uncle, maternal uncle and aunt, husband and wife etc. indicate a specific relation through which mutual responsibilities are distributed and free sexual relation is forbidden. Intra-family marriage after being forbidden, the area of cross-gene was widened which made the man socially fit for natural selection. In this way social culture started taking an important role in the evolution of man. Starting from Homo-

habilis, in matters of their transformation into Homo-sapien sapien, a concerted social co-operation, collective use of weapons and their outcome have made the man completely distinguished in the animal kingdom. Successively and periodically man has developed an improved brain.

In community life, the social discoveries, that have transformed the Homo habilis into Homo sapien sapien, were possible after discarding Darwin's theory of inter-species struggle. In matters of struggle against nature, man has supersede all other animals.

In human life, these discoveries have helped in the development of brain to such an extent that the feelings of man's senses have become different from that of other animals. As for example, the eyes of Eagle is more powerful than that of man and they can see objects at a long distance. But man's eye can feel the identity of an object better than Eagle's eye. Most of the creatures are colour blind. Man is not so, although some of them are colour-blind (which is hereditary). Different colours are due to different feelings on our eyes on light rays of different wave lengths. This is possible for the man to feel in that way. Besides this, man possesses the sense of musical tune, time and rhythm, which other animals do not have. In the animal kingdom, only man has the sense of humour, that is, they can make fun. This gradual development of the cultural sense has made the man distinct from other animals.

Other animals can not work according to situation or after a pre-plan. Responding to external stimuli and thinking by exercising brain – are two different matters. A conscious and planned action is possible at the ratio of development of nervous system. This matter is much advanced in case of mammals. In respect of human child, the development of brain after birth is manifold compared to the same inside the mother's womb.

In the human brain there happens direct and indirect adjustments between different sensory

organs which are advanced and having a complex relationship among them and as a result of which, realization of minute feelings, imagination and thinking were possible. In this regard role of language is very important. Human child masters in language after a good number of days from birth.

After birth human child takes a longer time compared to baby child of other mammals to develop completeness of brain although their rate of

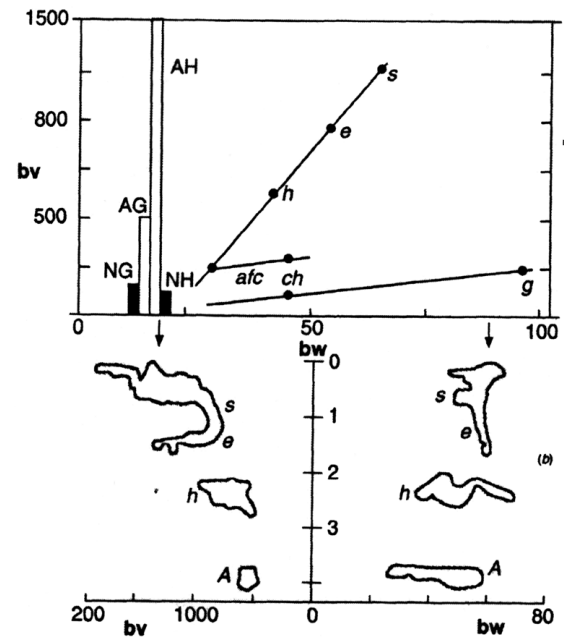


Fig.7 : Comparison between volume (bv) and weight (bw) of adult man (AH) & adult gorilla (AG), newborn man (NH) & newborn gorilla (NG)

development of brain shows an increasing trend. This is because the volume of a fully developed brain of human child and their co-ordination in the nervous system is very complex and advanced. For this reason, milk teeth of human child is replaced by permanent teeth at an older age compared to young babies of other animals. [Fig.7]

Social labour and use of tools have caused such development of human brain. And this gradually developed brain has brought about continual im-

provement in the tools for self defence, which has successively denied the necessity of having the organ for self-defence. For this reason human babies are required to be brought up for a long time, although depending on the socio-economic levels, the length of the childhood of children from different families differ.

Such blooming of human brain has, even in case of physically handicapped people, discarded rejection through Natural Selection, on the contrary has accepted them socially. The glare example of the above is scientist Stephen Hawkins. The result of exercise of the brain of Stephen Hawkins has added to the social wealth, although the area of exercise of brain of majority of the mankind is obstructed socially.

Agriculture and Animal Husbandry has given an apparent solution to food problem and therefore there was a rise in population and small areas have become crowded with inhabitants. This growth in population has again appeared as a cause of scarcity of food. Since production was lesser compared to their demand it was necessary to increase production. Classification of labour done with the above object has increased productivity and given a temporary solution to food crisis, but it again appeared as a cause to the problem. Society becomes classified which once again includes the inter-species struggle into human races in a new form (in the form of class struggle). Society-based human life changes with the evolution of society. "Struggle for existence" in the nature has turned into "struggle for livelihood".

In the classified society the rules and regulations of society, the laws, the cultural understanding, increase in production, all these things happen at the interest of the propertied class. Advancement of entire mankind is converted to advancement of propertied class. The human relationship of mutual co-operation has turned into production relation. In case the dispute in production relation becomes acute, then in practical

situation, there is a change in the relationship of production also. That is, there is a change in the total social system which causes to solve the earlier conflicts and necessities. But society being divided into classes, contradictions become inevitable within the relationship of production also. In the above process, feudal system was evolved from the slave system in the world. Similarly, from feudal system the capitalistic system and in some places from capitalistic system socialistic system was evolved. Although same pattern of social system did not exist throughout the world simultaneously. In each case, production got increased compared to that in the previous system. But except in case of capitalistic system, in all other cases of classified society the development of production was nature-dependent and has happened with the object of personal consumption. As a result, that could not fulfil the social needs. Darwin could not imagine about the modern and science-based over production and that is why he has supported the **Malthusian theory of Population growth as cause of the food crisis**. **Karl Marx** said **Malthus has no idea of productivity of man**. Nobel laureate and economist Amartya Sen was compelled to comment that present day famine does not occur due to lack of production, but it occurs due to inability to purchase the produce for want of money. The discoveries of modern science and their practical application has improved the growth of production to such and extent that the production process is not in a position to be continued further without the destruction of the produce. In the capitalistic system, the development of production has created a crisis of over-production which eradicates the practice of classification in the advancement of society and society-dependent people. Therefore, at present evolution of the entire mankind, that is, their advancement is dependent on the abolition of class based society. ■

Is Ramsetu or Adam's Bridge still a mystery?

Since long time a myth is propagated that in Coromondol coast of Bay of Bengal (Tamilnadu), near Rameswaram, from Dhanushkodi to Talai Mannar island of Sri Lanka, within the shallow sea a bridge is there. According to Hindu (sanskrit) epic Ramayana it is 'Ramsetu' and according to Islamic ancient literature or myth it is Adam's Bridge. In reality it is a 30 mile (48 km) long, liner chain of islands (consisting of 103 sand bars) part of which are under water and others partly or completely submerged under the sea water. In satellite image (or picture from high above) it looks like a broken bridge. According to Hindu or Muslim mythology this is known as Ramsetu or Adam's Bridge.

Why it is still shrouded in mystery

Hearing this mythology many questions were raised by rational people. Was it built by Lord Rama or by his Vanara Sena (ape men army) with the instructions from Nala (son of God Viswakarma)? Or, was it built by the first human son of the God or Allah, the Adam? Was it a structure made by the ancient human? Or is it a naturally formed geomorphic feature?

Modern scientists, specially geologists have explained the natural origin of this so called 'Ram Setu' or 'Adam's Bridge' for long period of time. Though scientists explained the cause of formation of this geomorphic feature several time that this linear sand bars are the product of natural sedimentary process. Fanatics, specially hindutva brigade vehemently emphasized that this so called 'bridge' had been built by the Lord Rama.

This propaganda got strengthened when NASA of USA took satellite pictures of this area and **posted it to all** (See the picture in back



cover). Particularly from this time several hindutva websites e.g. Krishna.org started propagating that NASA's picture is a direct proof that Lord Rama have built the bridge. They said "NASA images Discoverd Ancient Bridge between India and Sri Lanka". The website Krishna.org said *"This information may not be of much importance to the archeologists who are interested in exploring the origins of man, but it is sure to open the sprititual gates of the people of the world to have come to know an ancient history linked to the Indian mythology."* Vaishnava News Network & some other US based news services claimed to have found the remains of the bridge built by Rama & his Vanara army as narrated in Ramayana. A two and half minute video tweeted by Science Channel on December 11, 2017 is being widely circulated as fresh evidence to support the theory that a rock formation in Bay of Bengal off the coast of Rameswaram is actually the bridge that Lord Rama and his army built to reach Sri Lanka as described in the Ramayana. 'Science Channel' is an American television network owned by Discovery Communications, and the video in questions is a promo for an upcoming episode of a series titled 'What on Earth' that seeks to explain inexplicable-looking images of the planet captured by satellites.

Another hindutva website (<http://www.patheos.com>) said on 1st August 2007,

“Adam’s Bridge (Ram Setu) is a Man-made structure : Top Indian Geologist!” In this website Dr. Vadrinarayanan, a retired geologist of Geological Survey of India, who was also former coordinator of the survey division of the National Institute of Ocean Technology, Ministry of Earth Science, in Chennai gave an interview. In that interview Dr. Vadrinarayanan said *“It is not a natural formation ... either between 5,800 to 5,400 years ago or (some time since) 4000 years ago, somebody appeared to have brought all the boulders & dumped them there.”*

After the statement of a Central Government’s Earth Science department ex-officer, hindutva brigade’s view got strengthened & said that birth of Lord Rama & the time span that senior geologist said are going to match. So it is proved that the story written in Ramayana is true. Therefore all the stories written in the Indian Hindu mythology are the ancient history of India.

The main aim of this propaganda of the fanatics is to sustain blind faith among the people which is political. In 1998, the then central government took a project known as “Sethusamudram shipping canal project” (SSCP). This multi-million dollar project aims to create a ship channel across the Palk Strait by dredging the shallow ocean floor near Dhanuskodi. The project envisages the dredging of the shallow ocean region in the south western Bay of Bengal to create an artificial 167 km. long, 300 metre wide & 12 metre deep channel for (10,000-12,000 gross tonnage) ships across the island formations called Adam’s Bridge or Ram Sethu. The rationale for the project is that such a channel would avoid circumnavigation of Sri Lanka (of an additional distance of over 400 km or 30 hours of shipping time) in the voyage between the east & west coast of India.[Fig.] In the British era (1860-61) between the Palk Strait and Mannar Bay construction of a channel was proposed. Due to pressure of fanatics the proposal was not implemented although attempt was made five times.

At last in 1998, during the prime ministership of Atal Behari Vajpayee this project was accepted. But from within the NDA led government, objection was raised. In opposition to that project they said that the channel will destroy the Ram setu, which will hit the religious sentiments of millions of hindu people. So, movement started in the name of restoration of tradition of Lord Rama “preserve Ram’s heritage”. In 2005, during the prime ministership of Dr. Monmohan Singh’s UPA-1 government work of the project first started. With the begining of the work, in the name of restoration of the tradition of Lord Rama, ‘rambhakt’ people (the Vishwa Hindu Parishad, Hindu Munnai etc.) started their movement. Hindutva leader Subramaniam Swamy and Ramgopalon filed petitions in the Madras high Court. In their petition they said that according to epic Ramayana it is a heritage architecture made by the ancient people and it is related to millions of peoples religious emotions; so it should not be broken. The project should be cancelled. Various so called environmentalists organisation in opposition to this project said that the construction of the SSCP will impact the area’s ecology and marine wealth, potential loss of thorium deposits in the area and enhanced risk of damage due to tsunamis. So these environmentalists indirectly helped the fanatics & their idea. At this juncture Supreme court instructed the government of India to file an affidavit.

Two senior officer of Indian archeological department (ASI) submitted an affidavit. In their affidavit they said that mythological texts such as Ramayana “cannot be said to be historical record to incontrovertibly prove the existence of the characters, or the occurrence of events depicted therein,” was perhaps unnecessary and unwarranted for arguing that Ram setu is not a man-made structure as contended by the petitioners, but the statement itself can not be faulted given the scientific evidence. In their affidavit the officers boldly said there is no scientific proof that the

Ram Setu is man-made. ASI officers further stated “In the light of the scientific study conducted, the said formation can not, therefore be said to be a man-made structure. The same is merely a sand & coral formation, which can not be said to be historical, archeological of artistic interest or importance ... [and] the question of constructing Adam’s Bridge as an ancient monument [as demanded by the petitioners] & declaring it as a protected monument [under the Ancient Monuments Archeological Sites & Remains Act, 1958] does not arise.”

But to enhance blind faith of the people and to enhance the religious sentiments the Government inexplicably suspended the said two officers. By doing such the Government seriously undermines the autonomy of a scientific agency like the ASI and the concept of tackling important national issues through a science-based approach. Not only that, by suspending the said two officers the then Law Minister Mr. Hansraj Varadwaj of Central Government (UPA) said “As Himalaya is Himalaya, Ganga is Ganga, Lord Rama is Lord Rama, Lord Rama’s existence is not waiting for evidence.”

On the other hand, the then chief minister of Tamilnadu, DMK leader Karunanidhi, according to their party policy demanded the implementation of the SSCP. The reason behind this decision is that DMK demands for the excellence & resurrection of the ancient dravidian race, opposes aggression of Aryan race and opposes Ramayana and other hindu mythology. Hindutva fanatics then declared the death penalty of the DMK leader & declared prizes for it. So, during August-September period of 2007 all over India including Tamilnadu a riotic situation arose. Recent video tweet of American Science channel on December 11, 2017 again created a similar situation.

Mythology behind Ram Setu or Adam’s Bridge

Hindutva forces demand that as said in the

Ramayana, in the Treta Yuga (they say that started from 21, 65000 years before and ended in 8,69,000 years before) nearly 17,50,000 years ago Lord Rama reached Rameswaram coast to rescue Sita from the clutch of Lanka raj Ravana. He then called the sea to be quite as he crosses the sea. But sea did not oblige. Lord Rama got angry & threatened to dry it. At that time god of ocean sent Nala, son of the Lord Viswakarma. Mythological architect Nala, with the help of Vanara Sena (army) in only five days constructed the Ram Setu. The Lord Rama wrote his name as ‘Sriram’ on the stones and those stones got floated on the water & thus with those floated stones Ram Setu was constructed. Lord Rama with his younger brother Laxmana and vanara sena reached Lanka through that setu & fought with Ravana. Rakshashraj (demon king) Ravana lost the war & died in the hand of Lord Rama. Lord Rama won the war & rescued Sita. Hindutva fanatics also claims that, that was the first time when any human reached SriLanka through that Ramsetu.

According to some Islamic literature, the first son of Allah, Adam, used the bridge to reach Adam’s Peak in SriLanka where he stood in repentance for 1,000 years. The Palk Strait & the Mannar Bay were the foot prints of Adam. The western world first encountered it in “historical works in the 9th century” by Ibn Khordadbeh in his book of Roads & kingdoms (c. 850), referring to it is Set Bandhai of “Bridge of the Sea”. Later Alberuni described it. The earliest map that call this area by the name of Adam’s Bridge was prepared by a British cartographer in 1804.

Scientific explanation of Ramsetu or Adam’s Bridge

Ramsetu or Adam’s Bridge is a chain of limestone shoals between Pambam island also known as Rameswaram island, off the south-eastern coast of Tamilnadu, India & Mannar island of the north-western coast of SriLanka. The so called bridge is 30 miles (48 km) long and separates the Gulf of

Mannar (south west) from the Palk Strait (north east). Some of the sand banks (made up of calcareous sand) are dry and the sea in the area is very shallow, being 1 to 10 metres (3 to 30 ft) deep at places, which hinders navigation. During British period a ferry service linked Dhanushkodi in India and Talaimanner in Sri Lanka was operational. That service was part of the Indo-Ceylon Railway service. One could buy a railway ticket from Chennai (the then Madras) to Colombo, whereby people travelled by rail from Chennai to Pambam island, ferry to Talaimannar, and then travel by rail to Colombo. In 1964, a cyclone completely destroyed Dhanushkodi, as a train was about to enter the station. The tracks & the pier were heavily damaged along the shores of Mannar Bay and Palk Strait. Dhanushkodi was not rebuilt and the train then finished its journey at Rameswaram. There was a small ferry service from there to Talaimannar, but it was suspended around 1982 because of political clash in this area (Tamil nationalist movement).

In the north of the so called bridge, in the Palk Strait, there are waves in the sea & as there is a mantle plume below this area there are some areas where the temperature of the sea water is between 60°-70°C. Because of this condition over the sand bars of this area coral reefs do not mature to its optimum.

On the otherhand in the south of the so called bridge, in the Mannar Bay, sea is tranquil & the temperature of the sea water is low & thus on the sand bars there is a formation of coral reefs. Both ribbon & atoll reefs are common.

Geologically the so called Ram Setu or Adam's Bridge is called **shoal**, where within the very shallow sea there are small to large, chains of long sand bars. Some bars are above the sea water & some are submerged under water, some are partly submerged. These sand bars of islands are made up of conglomerate, sandstone, calcareous sandstone (clastic limestone) & siltstone. These sand

bars are formed by river & ocean current or wave bearing sediments & these are mostly long & thin in nature.

The rocks of the floor of Palk Strait and the Mannar Bay are made up of Miocene to Pleistocene (23.03 million years to 0.011 million years) limestones. Below this limestone (limestone, calcareous sandstone, conglomerate & siltstone) precambrian metamorphic rocks of Indian & SriLankan shield (continental crust) are present. Sediment deposition of these sand bars depend on source of the sediments, character of the basin (where sediments are deposited) & their tectonic condition, ocean currents, reaction & counter reaction of the waves to the coast & the basement etc. These sand bars may range in size (length) from few metre to few kilometres. When these bars get very large (length) in size, (and generally these are developed parallel to the coast lines) those are called barrier islands because they make a barrier for the sea wave in the coastline. In the north American sea coast these are eminent features. On these bars coral reefs are generally formed. In the so called Ramsetu's south, on the Mannar Bay such coral reefs are found on the bars. But as the temperature of the sea water is high (60°-70°C) & there are high waves, in the Palk Strait such coral reefs are rare. Due to the development of such sand bars lagoons may form in between main coast & the barrier islands. As because of this sand bars there are no wave action in the Mannar Bay & the sea is very quite in Rameswaram & other areas. Although in the epic Ramayana it is said that because of Lord Rama's whip the sea became calm & quite. Due to a different type of natural condition special types of ecosystems developed here.

Other types of depositional sand bars are as follows :

Tombolo – derived from the latin word tumulus, meaning mound as is a deposition land form in which an island is attached to the main

land by a narrow piece of land.

Isthmus – is a narrow piece of land connecting two larger areas across an expanse of water by which they are otherwise separated. Because of this formation Palk Strait developed.

Spit – A spit or sandspit is a deposition bar or beach land form off coasts or lake shores. It developed in places where re-entrance occurs, such as at a cove's headlands, by the process of longshore drift by longshore currents. The drift occurs due to waves meeting the beach at an oblique angle, moving sediment down the beach in zigzag pattern. This is complemented by longshore currents, which further transport sediment through the water alongside the beach. These currents are caused by the same waves that cause the drift. When ocean current get a zero velocity formation of spit stop.

These are the variation of Shoal, Tombolo, Isthmus or Spit like depositional land forms. All these land forms develop in almost all types of sea coast in various sizes & shapes.

Throughout the world, or in Australia, Hong Kong, Baltic sea, Canada, Ireland, Jamaica, Germany, Ghana, Newzealand, Ukrain, Great Britain, USA etc. there are 50 such shoal and other depositional sand bars similar to so called 'Ramsetu'. Their shapes, geological history, origin are very similar to the said 'Ramsetu'. Greece, Mexico, Chili, Great Britain and the connecting land between North America & South America i.e. Panama is an example of Isthmus. Actually the whole of Panama mainland is an example of Isthmus. In Australia, Yemen, NewZealand, USA, England, Hong Kong, France Tombolo's are common.

According to geoscientists Ramsetu or Adam's Bridge is a **shoal**, made up of calcareous sandstone & conglomerate. Formation of coral reefs on the sand bars in various places made it harder. Professor Jayantha Narlikar et al, Madurai Kamran University calculated the age of Ramsetu

and said that the approximate age of this chain of sand bar is 1 lakh 70 thousand years. Sea of this area became shallower from Pleistocene (from 25,58000 to 11,700 years) onwards. Sediments from India's south eastern coast & Sri Lanka's western coasts by ocean currents were deposited here and made the ocean floor more & more shallow & formed numerous sand bars. For this reason the so called Ramsetu or Adam's Bridge is known as shoal.

GSI carried out a special programme called "Project Rameswaram" between December 2002 and March 2003, which according to the GSI's news letter of September 2003 annexed in the government counter affidavit, included : (i) reconnaissance survey (ii) drilling the Dhanushkodi Foreland (in the eastern projection of the Rameswaram island); (iii) offshore surveys involving depth measurements; (iv) seabed samples & side scan sonar image of the sea-bed; (v) drilling in one of the islands within the Exclusive Economic Zone (which is about 10 km from the Dhanushkodi tip); and (iv) radiocarbon (or C-14) dating & thermoluminescence (TL) dating of samples.

Four boreholes, roughly 4 km apart, were drilled to collect subsurface sediments / rock samples to generate geological data towards determining the geological history of Dhanushkodi Foreland & Adam's Bridge / Ramsetu.

GSI's conclusions based on geological investigations of its marine wing are as follows :

There are no indication or evidence of man-made structures in the present day seabed or in the sub-surface level between Dhanuskodi tip and Adam's Bridge islands. Age data of corals indicate that Rameswaram island has evolved since 125,000 years ago.

A series of various natural coastal processes such as sea level positions in the historical past, wind-born activity, neotectonic movements, wave action etc. have led to the evolution of the coastal

areas around Mandapam, Rameswaram and Adam's Bridge / Ramsetu, which has led to the formation of beach rocks, coral growth, vast stretches of coastal dunes, series of islands (or Ramsetu) and subsidence of the erstwhile Dhanushkodi township.

Palaeogeographic studies suggest that the sea level in the region has oscillated significantly over historical time scales exposing the seabed between India & Sri Lanka periodically. Around 6,000-7,000 years ago the sea level was 17m below the present level, resulting in partial exposures of the seabed. About 10,000 years ago, sea level may have been even 60m below. Radiocarbon dating suggests that during the last glacial maxima (about 20,260 years ago) when the sea level is at its minimum the level may have been as low as 118m. The domain between Rameswaram & Talaimannar may have thus been exposed sometime between 18,000 and 7,000 years ago. Since then sea level has been rising gradually with minor periodic fluctuation.

Analysis of samples from drilling of boreholes between Dhanushkodi and the third island of Ramsetu suggests that there were three sedimentation cycles dominated by clay, limestone & sandstone. The growth of the Dhanushkodi sand spit itself is a feature of coastal processes and shoreline emergence and its orientation seems to be along the dissipation of wave energy patterns of the Palk Bay and the Gulf of Mannar. The Dhanushkodi sand spit and the 5 islands of the so called Ramsetu changes their shape & size owing to monsoon activity.

The Marine & Water Resources Group of SAC/ISRO also carried out space based investigations, using satellite remote sensing imagery in 2003 to establish if Ramsetu is a man-made or coralline in nature using Indian Remote Sensing Satellite (IRS) data. Ocean Colour Monitor data of the satellite IRS-P4 of April 18, 2002 and LISS-III camera Data of IRS-ID of May 6 and March 21, 2000, were used. The authors concluded that

Adam's Bridge is not man made but comprises 103 small patch reefs lying in a linear pattern with reef crest (flattened, emergent-especially during low tides or nearly emergent segment of a reef), sand clays (accumulations of loose coral sands & beach rock) and intermittent deep channels.

The linearity of the setu was interpreted to be due to the old shoreline implying that the two land-masses of India & Sri Lanka were once connected from where coral reefs evolved. The investigation showed that the orientation & size of the sand clays have changed during 1990-2000 & again 2000-2005, thus indicating their dynamic nature.

According to V. Ram Mohan of the Centre of Natural Hazard & Disaster Studies of the university of Madras, island chains, including sea mounts are frequent in the ocean & could be the result of various geological processes. He argues that the possibility of formation of shoals in the shallow continental shelf as barrier bars (sand bars that may have formed during the period of high water level following sand deposition but remain exposed during the low mean sea level) appears to be the most plausible explanation for the evolution of Rameswaram & Adam's Bridge.

According to S. Ramchandran, vice chancellor of University of Madras, this information may have been initiated when the sea level was 125 metre below the present level, around 18,000 years ago and was building up when the sea level continued to rise. The continuous sand deposition and the natural process of sedimentation have led to the formation of a chain of barrier islands, which are very dynamic, and this is not unique to Adam's Bridge. The formation of barrier islands, which are common in the Atlantic coast, probably began around 25,000 years ago, he says.

Based on available data, N. Ramanujam, head of the department of Geology of V. O. Chidambaram College, Tuticorin, has attempted to reconstruct the geological evolution of the re-

gion & its significant features. According to him, block faulting, subsidence and formation of elongated depressions with ridge separation are the characteristic imprints of the early geological history that are recorded in the Palk Bay & the Gulf of Mannar. He pointed out the similar characteristics of Precambrian basement rocks of India & Sri Lanka. He also pointed out, that Indian plate separated from East and West Gondwanaland about 150 million to 70 million years ago. The northward migration of the Indian plate and its collision with the Eurasian plate and the transfer of stress in the northern converging zone towards the weaker triangular crustal end & the lateral forces enhanced the plume activity (mantle upwelling) at the southern peninsular side. The Caverry basin, he argues, has thus been formed by the downwarding of the crust and the block faulting of the basement over millennia, resulting in the formation of several elongated depressions separated by ridges.

These ridges became centres of coral reef growth, resulting in atoll-like formations, which in turn acted as “sand trappers” attracting peculiar sandy deposits called salient formation in the region. What was originally a paleosea between Mandapam and Rameswaram thus became a sandy deposits extending about 40 km in the E-W direction. This altered the shoreline in the Mandapam-Rameswaram region & acted as an offshore obstruction wall for the littoral currents which transported sediments from the NE & SW directions and directed then towards the E and SE. The diversion of the ocean currents contributed to the accretion of deposits from both the Dhanushkodi spit and the Talaimannar spit resulting in the formation of sandy barrier islands, which forms Adam’s Bridge or Ramsetu.

Anthropological evidences suggest that during last ice age in Pleistocene epoch ice caps may have been deposited on the barrier islands and through that bridge migration of early hominids &

vertebrates from India to Sri Lanka took place.

In the similar time frame an ice land bridge was also formed between Indian subcontinent & Africa. Through that bridge Zirraff, Zebra, Rhino etc. mamals had migrated to Africa from Himalayan region because of cold wave. At the end of that ice age the bridge disappeared, thus those animal never came back to Indian subcontinent.

It has been mentioned that Indian & Sri Lankan people regularly use this bridge from early days. Upto 1982 a ferry service was there to travel from Dhanuskodi to Talaimannar. To restrict the movement of Tamil nationalist from then on the ferry service was stopped. Majority South Indian & Sri Lankan people are not Rambhakt (follower of the Lord Rama) & so they do not consider the so called Ramsetu as a holy place.

Answer to pseudoscientific propaganda

For a long period of time fanatics have used fictions to bind people in dark prison. But with the advancement of rational ideas & discoveries of science, people questioned all these baseless fictions. So in the era of science, to mesmerise the people, the fanatics mix the unscientific & scientific ideas together and produce pseudoscientific ideas. So, with the help of the science & scientific thinking we have to rip open their pseudoscientific mask.

Now, one by one we should answer all the pseudoscientific propaganda –

(1) Religiousists say that the so called Ramsetu had been built by the floating stones on which “Sriram” was written. According to science, stone floating on water is generally not found. According to the geologists only a volcanic rock named ‘pumice’, which has numerous vesicles can float on water for a certain period of time. When its vesicles get filled with water, they sink.

Now, the question arises, is the Ramsetu made up of pumice? No it is made up of calcareous sandstone (Limestone) & conglomerate. On the

coast of Rameswaram or nearby there was no volcano for long geological period of time and pumice is never found in this area.

(2) Hindutva forces said that the Ramsetu had been built in the Treta Yuga (from within 2.165 to 0.869 million years & specifically 1.7 million years ago) with the help of boulders & trunks. But geological investigations and radiometric dating suggests that the rocks of the so called Ramsetu have been formed in around 0.17 million years ago. Another thing is that, there is no record of trunk or leaf fossils on those sand bars or so called Ramsetu.

(3) In Hindutva website Krishna.org, it has been campaigned that the NASA's satellite image prove that the Ramsetu is man made. But that campaign is totally baseless. NASA official Mark Hess had then stated "Remote sensing image or photographs from orbit can not provide direct information about the origin or age of a chain of islands, and certainly can not determine whether humans were involved in producing any of the patterns seen." Hess further stated that NASA had been taking pictures of these sand bars for years. Its images had never resulted in any scientific discovery in that area. "The images reproduced on websites may well be ours but their interpretation is certainly not ours."

(4) The Sangh Parivar's claim that the first inhabitants in Sri Lanka dated back to 1.75 million years is clearly bogus & patently unscientific. Human evolution studies have unequivocally established that modern humans (*Homo sapiens sapiens*) came into existence maximum only about 3,00,000 years ago. Further, humans arrived in the Indian subcontinent not before 100,000 years ago. Clearly the age of Treta Yuga (1.7 million years ago), when Lord Rama is supposed to have reigned, belongs to mythology and so would be the other characters & events in the Ramayana, including Ramsetu.

(5) For the propaganda of pseudoscience, the

tenant scientist that hindutva fanatics forged together Dr. Vadrinarayan said, "It is not a natural formation ... either between 5800 to 5400 years ago or (some times since) 4000 years ago, somebody appeared to have brought all the boulders & dumped them there." Report of GSI said opposit to this. Borehole data of GSI could not find any boulder but Dr. Vadrinarayanan found it. Where does he find this? Where are the sample collected by him (if collected) & the research data? Where did he published his research work? There is no answer to all these questions. But while telling wink stories Dr. Vadrinarayanan did not mention the so called Treta Yuga or 1.75 million years. He refers to the initial human civilization period of time ie. 5800-5400 years. In their propaganda the hindutva's tenant "Top Indian Geologist" does not refer the 'Treta Yuga'. Did the hindutva change their stand of Lord Rama's birth & his creation of Ramsetu during Treta Yuga or 1.7 million years ago? Is Rama not the god of the Treta Yuga? In the article published by these fanatics "Historicity of the era of Lord Rama" with their 'planetarium gold' software, with the then position of stars etc. they calculated the age of Lord Rama as 10th January 5114 BC or 7132 years before. According to their astrological calculation Lord Rama killed demon king Ravana 7094 years before. So, if we accept this pseudoscience then Lord Rama must built the Ramsetu 7094 years ago. Let the hindutva force decide the time of Lord Rama's birth first!

(6) A two & a half minute video tweeted by science channel on December 11, 2017 being widely circulated as fresh evidence to support the hindutva propaganda. In the said video it says "what makes the image especially intriguing is that the rocks are in area in the sea mentioned in an ancient Hindu poem, a poem that also refers to a magic bridge."

The video contains short one line comments from there "experts". Alan Lester, a lecturer in

Geological Sciences at the University of Colorado Boulder, who talks about the story of Lord Rama building sea bridge to reach Sri Lanka; Erin Argyilan, an associate professor in the Geosciences Department of Indiana University Northwest; and Chelsea Rose, a “historical archeologist” who is an “adjunct faculty member” at Southern Oregon University.

The video essentially makes two claims – (i) the rocks at the site “predate” the surrounding sand. “Scientific analysis reveals the rocks are 7000 years old but are sitting over the top of sand that is only 4000 years old” it says. (ii) that the rocks do not belong to there & have been brought from somewhere else, possibly by a human agency.

These claims are not, however, made by any of the three “experts”. They are part of the commentary in the video. An unidentified individual says these are “stones that have been brought from a far and set on top of the sandbar island chains.”

However, none of the several Indian Oceanographers & Geologists the The Indian Express, a daily English newspaper spoke to, were aware of any new published material in any peer-reviewed journal that would support these assertions. Several of them had seen the video and they said it raised more questions than answers. “The claims in this video do not merit a discussion until the evidence or source is revealed.” Dr. Rajiv Nigam, an acclaimed marine geologist who retired from the Goa-based National Institute of Oceanography said to Indian Express.

However, like Dr. Nigam, Prof Rajendran, too said it was difficult to believe any claim in the absence of dating methodology & other information. “The claim about rocks having been transported from somewhere else ... It need not necessarily be due to human intervention.” Prof Rajendran said “It is possible that rocks were transported by cyclones, which are pretty frequent

in that area. But we need to have more information & it is not there in this video” he said to The Indian Express.

The Indian Express had contacted Argyilan & Rose to know more about claims. Only Argyilan had responded. In an e-mail she said that she had “not performed primary scientific research related to Ramsetu” and that she had been asked to comment “only on the satellite photograph” presented in the programme. “My specific comments in the piece addresses only the visual clues related to presence of a carbonate shoal-bright, light blue waters in a carbonate environment indicative of shallow waters between India & Sri Lanka” Argyilan said.

“I am mindful that only scientists working directly with the geologic, archaeological and geochronologic data should be considered ‘experts’ on the site. That, science should be evaluated through rigorous peer review. It was my perception that the science covered in ‘What On Earth’ (programme) is presented to stimulate interest & conversation, but not to arrive at definitive conclusions about the science ... I do not believe that show strive to reach a definitive conclusion on the science, instead they aim to present the science in an intriguing way.” Argyilan wrote in her e-mail to the Indian Express.

This is the difference between science & pseudoscience. The readers should decide what is what?

But the video tweeted by Science Channel gave a new weapon to the hindutva force. In the parliament & in the political arena they use this video against the opposition. The opposition along with the left parties failed to answer because all are in the same boat.

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Bigyan Manashko, West Bengal

Programme

[Concise version of programme of Bigyan Manashko, West Bengal,
adopted in the first Conference, September 2013]

Foreword:

Science is the knowledge of the causes, laws and history of the origin, existence, development-gradual change, and transformation etc. of matter.

The knowledge pertaining to the earth and other planets of our solar system, orbiting in space comes under cosmology. The naturalistic and historical knowledge pertaining to the Earth with all its matter which includes the plant world, animal world and the human world, is divided into various science discipline like Physics, Chemistry, Geology, Biology, Botany, Anthropology, Ethnology, Psychiatry, Social Science, Ecology etc. Mathematics (dealing with numbers, quantity, zero, space) is an indispensable part of Science.

Science and its various branches came into being as a result of the tireless efforts of scientists to unravel the mysteries of the unknown and the knowledge derived from the research and explorations. The devotees of science are, truly speaking, the scientists of society.

The progress of knowledge and science is intrinsically linked with the progress of mankind. When man set off on the path to progress he stopped relying merely on what nature provided him for survival; instead, with the help of his own intrinsic physical and mental labour, he devised tools for procuring food, fashioning clothes and building shelters: for example, devising weapons for hunting animals, birds and fish, shaping tools for farming and tilling, spinning threads from tree bark to be woven into clothes, crafting tools for building shelters from broken stones. This, in turn, gave rise to technology and technological development. Technology was the precursor to science. Had the telescope not been invented it wouldn't have been possible for man to discover the laws governing the movements of planets and stars in space.

Technology is the mechanical means by which ideas oriented to achievement of material goals is applied. Knowledge (ideas) about matter is elevated into scientific theory-science only when their correctness is proved through application or practice. Between ideas (theory) and practice, practice is primary; as correct scientific knowledge is arrived at through experiences gathered from repeated practice, and new theories are formulated from application of this scientific knowledge. Application techniques (Technology) and science are inseparably linked; hence technology is an indispensable part of science.

Science and technology are creations of mankind and an index of the continual development of society. This development owes its origin to the practical results borne out of the indomitable desire to use nature and natural environment to fulfil man's needs. Man was dependent upon nature before he became aware of the laws of nature. Once he began to know the laws, he has been deploying them to achieve his desired goals. The history of human progress acts as an eye opener-reveals truth makes man scientifically conscious. Therefore, it's proper that certain things concerning the history of Human progress be mentioned. The prehistoric age lasted for an estimated sixty thousand years. At this stage mankind attained and developed technological knowledge.

Due to the absence of any written narrative documenting the history of thousands of years since the emergence of mankind from the animal world, this period is characterized as the Prehistoric Age. The historical Age began with the invention of scripts.

It was only in the Nineteenth Century that research in the true sense began to gain knowledge

about prehistoric human society. Notable among the researchers were Swiss jurist and historian Johann Jacob Bacofen, Scottish jurist and historian John Fergusson McLennan and US anthropologist and archaeologist Lewis Henry Morgan. Friedrich Engels wrote the book, 'The origin of Family, Private property and State' based on their research findings about the then society and its development.

During the prehistoric period, early man living in his primeval homeland was completely dependent on nature for sustenance and existence. Later while wandering along river banks and sea coasts in search of food he discovered new food, devised new tools for gathering food and building shelter and acquired tool making skills. At this phase he began transitioning from nomadic life to permanent settled existence through activities like digging out roots and stems, shaping stone weapons for hunting and fishing, making bows and arrows, making fire by rubbing wooden sticks or striking stones together, building shelters using wood, bamboo or even stone blocks, weaving clothes using tree fibre, taming animals and birds, shaping wooden and iron ploughs for tilling etc.

Different languages belonging to different ethnic groups developed. Though it would take him a while before he invented alphabets and script, Man learned to paint during this period. The paintings of animals on cave walls are a case in point. But no instances of emergence of knowledge concerning the laws of nature could be found at this phase. What posed an obstacle to the dawning of this knowledge in their consciousness was the planting of the supernatural idea in their minds that the visible world of space (heaven) was the original home of man, by clan leaders or chiefs. This supernatural power governs everything and is all powerful. Hence, it is one's duty to worship this power as god. Thus the practice of worshipping imaginary beings as gods and goddesses of an imaginary heaven began. Singing and dancing along with worship and sacrifices to appease gods is part of every religious festival. Apart from that in ancient times different clans belonging to particular tribes were identified by different animals; hunting these

animals was banned and they were worshipped as divinities. For instance, in Morgan's writings we find that the Seneca clans of the Iroquoian tribe were symbolized by wolf, bear, turtle, deer, heron and eagle. Droughts, floods, natural storms, blizzards, famines were considered manifestations of the wrath of god and appeasing him through sacrifices would be prescribed. Magic emerged as charm or incantation performed by sages endowed with supernatural abilities, to serve one's interests by appeasing supernatural powers (gods and goddesses). Thus magic came into being. In essence, the origin of religion lay in man's dependence on natural forces and his helplessness in the face of these forces. Veneration of earth, sun, fire and rain gods, stemming from the indispensability of nature's contributions-soil, sunshine, fire, rain etc. in sustaining life and in agricultural production, was widespread (and is still prevalent).

In the past human society was based on clan or tribal units, matriarchal and communistic. In the beginning tribes and clans were constituted by people related matrilineally. This was so as in the early days promiscuous sexual relationship was the norm in society. As paternity of children could not be determined, lineage would be determined matrilineally, according to the mother's right.

Hence women occupied a position of high honour and respect on account of being mothers of the next generation. Thus matriarchal societies came into being. Clans were akin to families. The members, irrespective of gender, took part in food gathering collectively and dined together. This is why primitive society has been characterized as communistic.

During the transition from wild state to the so called civilized society, population grew and clans broke up into newer clans and sub clans. Joint families split into nuclear husband-wife families. Economic changes kept happening. Animal husbandry and agriculture replaced hunting and fishing.

Copper and tin were smelted and used, production and use of bronze, an alloy of these two metals became prevalent. Tools became developed,

weapons of war were made. Battles between clans over right to forest tracts and land began. War-prisoners were turned into slaves. Sometimes all the members of a defeated clan were enslaved. The ever increasing demand for labour power in animal rearing and agriculture was fulfilled by these prisoners of war turned slaves. Thus the Slave-owning system came into existence. Initially, division of labour was based upon natural traits, i.e. division of labour between man and woman. The tasks of men were gathering food and taking part in warfare, women were required to do home-making, prepare food and weave clothes. Division of property ownership arose from this broad division. Men came to own animal wealth, agricultural products, household articles and utensils were owned by women. Collectively produced and used articles – habitations, gardens and boats – were owned collectively. Gradually the clans engaged in agriculture and animal rearing became separated from other clans. Social division of labour thus came about in a big way. Once animal resources and agricultural products became surplus, exchange of surplus products or barter between different clans began. Through such social division of labour and barter the dominance of men began both within and outside households; concomitantly dominance of women as well as matriarchal society began to wane and patriarchal society emerged. Along with this society divided into two classes – slave owners and slaves, exploiters and exploited came into existence. State began to be formed.

The abolition of mother rights, establishment of paternal rights and transition from the custom of joint families into that of singular husband-wife families entrenched and perpetuated the hegemony of men. Ancient matrilineal clans began to disintegrate and unitary families consolidated themselves into a force, endangering clan life. The annulment of mother rights and subjecting women to the servitude of men by tying them up to household duties was a historic defeat for women, the impact of which can still be felt. Patriarchal societies first appeared in the fertile banks of Egypt's Nile, Iraq's Tigris and Euphrates, China's Hwang Ho and Yangtze Kiang and India's Indus and Ganga. This society has been termed as the first

organized civilized society. In these regions small principalities were formed, the commanders of armies of religious guides and landlords were anointed as rulers or kings. In order to keep the subjects loyal and subservient to kings in perpetuity, the religious guides exploited the already entrenched idea among the people that the king of the mortal world is the representative of the omnipotent god of gods of the heavens. Therefore the king's commands should be reverentially accepted as the commands of the all-powerful god. In certain countries the ruler of the supernatural world is propagated as Zeus, in others as Sun god. In some countries including India, the sun is publicized as the ruler of gods. In many countries including Sumer, India and Peru kings have been mentioned to belong to solar dynasties in ancient annals. In Egypt and the middle East the leaders of Jewish tribes, Abraham and Moses successively declared Jehovah as god in human form and claimed they were his representatives. Thus monotheism gained currency. After the establishment of Christianity and Islam, monotheism became prevalent almost all over the world.

The Iron Age or the so called civilized age appeared in the latter half of the age of Barbarism. During this age technological advancement continued unabated in parallel with economic crises and warfare. Philosophy and philosophical rationalism developed alongside. Philosophy emerged from the urge to not accept conventional notions uncritically and judge matters pertaining to nature, religion, state and state policies, discrimination between man and woman, slave owning system from an ethical point of view. Those who were involved in ethical analysis were philosophers. Those philosophers who tried to ascertain whether prevalent ideas were right or wrong without exploring their roots and who employed only rational means are called rationalists and such endeavours are called rationalistic ones. On the other hand, science and scientific doctrines originated from the urge to investigate the sources of conventional ideas and to determine what's correct and what is not in order to learn the laws of nature.

The spread of philosophical rationalism raised questions about the supernatural stories; evoked curiosity about the movements of planetary bodies and stars; their characteristics and trajectories began to be unravelled. Sensing danger, the spiritual guides set upon opposing philosophical rationalism and resorted to coercing the rationalists using state power. But the people, illumined by the beacon of knowledge continued to pursue rationalist philosophy. Consequently rationalism was strengthened. In order to thwart it Christian institutions (churches) infiltrated the educational arena; they began to establish schools, colleges, universities and revamp curricula, giving pre-eminence to supernaturalism and religion.

Commenting on this phenomenon, the historian Hugh Thomas wrote that the objective behind founding Universities was to drive rationalism to a corner. (An Unfinished History of the World). It's noteworthy that, the rationalist philosophers never propagated any doctrine challenging supernaturalism and theology. But there remains a strong likelihood of the inception of loss of faith in religion and spiritual guides, in the event of revelation of truth; hence in accordance to the development of human consciousness and political changes, the spiritual guides and state heads adopted the policy of perpetuating faith in religion by reforming it. In order to perpetuate religion, adaptation of state and religion in sync with the evolution of society and politics is indispensable for the ruling classes. Hence it has been observed that, the rationalist philosophers, raised questions and pointed discrepancies on politics, the rights of the king, church rights and privileges. But they resolved these questions and discrepancies in their own ways as well. As a result, even though conflicts arose between the king-state and church and breakaway sects like Protestant and Lutheran were formed defying the hegemony of the Christian religious head – the Pope, eventually religion has been kept alive through effecting adaptive changes of state and religion and establishment of religion's dominance by according monarchical status to the Pope. Similar things happened with other religions as well.

It should be mentioned that, what lay behind the reformation of old religious doctrines and establishment of new ones was the inception of a new production system within the womb of the old one, the onset of faithlessness in the prevalent system among working people and the proliferation of philosophical doctrines based on rationality among the educated section, which, in turn, was opposed by the ruling classes. The emergence of the doctrine of Jesus Christ in the backdrop of the decline of slave owning system within the Roman Empire and the revolt of the masses is a case in point. Islam appeared in the scene as a fall out of the conflict between the idolatrous slave owning ruling classes and the emergent upholders of mercantile capital. As people belonging to that era had boundless faith in supernaturalism, therefore the champions of the new production system engaged in conflict with the defenders of the old one either by creating new religious doctrines or reforming traditional ones. Finally, the upholders of the old system would arrive at a compromise with the proponents of the new system and stay in power or share power. For instance, on one hand the Roman ruling class crucified Jesus (circa 3rd April, 29 CE), emperor Nero, belonging to this ruling class, slaughtered Christians cruelly and indiscriminately (64 CE) and on the other emperor Constantine, from the same ruling class, legalized and legitimized Christianity (313 CE) and became a preacher of this religion, having converted to Christianity (326 CE). The ruling classes of the Arab world became apostles of this religion after converting to it. The Indian emperor Ashoka embraced Buddhism, which provided doctrinal support to mercantile capital, in order to expand his empire; he expanded his empire along with his missionary campaigns.

In man's material life, development of production and productive forces enhances his intelligence correspondingly; which, in turn, leaves its imprint on arts and science as it does on the economic and political spheres. ('All sciences are historical, except Natural Science' because it's man who has conceived and discovered social science along with human society as well as all scientific discoveries). In material life the production system

systematizes social, political and intellectual life processes. On the other hand the unity of opposites and mutual antagonistic contradictions create conflicts, which, in turn, generate social and political developments; arts and science also undergo development. Hence it's evident in the history of mankind that in material life, along with unity of opposites and mutual antagonistic contradictions, intellectual life processes also developed. Consequently, the urge to learn the laws of nature was created, and this urge gave rise to Rationalism and Rationalist Philosophy on one hand and on the other pioneering individuals of society became involved in scientific discoveries.

Science is devoid of class bias, but whenever science posed a threat to the vested interests of the ruling classes, whose rule was based on prevalent religious belief and exploitative economy, the ruling classes got down to opposing science. They didn't even hesitate to imprison and execute the truth-revealing philosophers and scientists. Galileo, Socrates and Bruno are prime examples of this phenomenon. But, having failed to deny the shining truth of science, they have endeavoured to entrench their class rule by packaging science in religious wrappings and thus conserving people's faith in religion. On the other hand, developments in technology, development in different branches and disciplines of science as well as new scientific discoveries to improve the means of production of material life have continued unabated. Secondly, with the transformation in production processes, the new production system has come into conflict with the old one, which has manifested itself in the conflicts between the standard bearers of the old system and the new. These conflicts enhance new systems, on which, new societies are founded. If we carefully examine the history of transformative phases of slave society to feudal society and its successive transformative phase into capitalist society, we realise this truth and the causes of societal development. We also realise that specific social systems are shaped by specific production systems. When metamorphosis of a particular society begins, the struggle to develop the new system immediately ensues. No production system

is everlasting. Transformations of production systems have taken place to fulfil the material needs of the overwhelming majority of the human population. In this era, the transformation of the production system of the prevalent capitalist system has marked the beginning of the ascent to a new society.

... ..

The overwhelming majority of humanity (working people engaged in production) cannot enjoy the benefits of this progress over the ages.

In prehistoric times communally organized working people contributed to and collectively appropriated the fruits of technological development, domestication of wild animals, selection of different plants for cultivation, conservation of seeds etc. But the scenario changed once this system disintegrated and society split into working masses and their parasites, into exploited and exploiting classes, and with the emergence of slavery. The parasitical slave owners appropriated the products of the labour of the working people. They made the working people work in exchange for just about enough food to stay alive. This tradition continued during the prevalence of feudalism (Serf System) and continues in the Capitalist System (wage slavery). This creates the coexistence of prosperity and destitution in society.

Due to immense progress in scientific discoveries and technological innovation during Capitalism, the extent of affluence among the owners of capital and impoverishment among the wage-slave working people have increased manifold.

Today, we witness on one hand, contention between capitalists for augmentation of their capital, rivalry for becoming top-level capitalists, and wailing among the working people for food, clothing, habitations, medical care and earnings.

In today's world, the rate of food production has increased considerably, but food keeps rotting in warehouses on account of lack of demand in the market. According to a UNO report about 20 billion tonnes of food grains rot in the warehouses every year. Yet according to capitalist stalwarts,

40% of the global population are suffering from malnutrition on account of food scarcity. The industrial commodity scenario is the same. Such a state of affairs in capitalist economy is called the crisis of over production. Hence, efforts are being made to tide over the crisis by reducing production. But reducing production leads to retrenchment of the work force engaged in production, impoverishment of the working people, and rise in unemployment.

State of the art technology and medicines are being used in the arena of medical science, consequent to phenomenal development in this field. But these remain beyond the reach of low income group individuals and the majority of the working masses.

There has been considerable progress in educational sphere, but the overwhelming majority of the children belonging to families of toilers are being deprived of access to education after learning how to read and write.

The same scenario prevails when it comes to housing, high rise buildings are being erected using advanced technology on one hand, on the other, and the majority of the working population and a section of the middle class are denied of proper housing. In every country a spurt in the number of people living in pavements is being witnessed.

The upholders of capitalism hold the crisis of over production responsible for all the crises and in the same breath put the blame for it on over population. But none of these attributions is correct; for the phenomenon of over production manifests itself when production exceeds the needs of the population. In point of fact, at present, production is not in excess of the needs of the population. In the parlance of capitalism, production in excess of the purchasing capacity of the masses and in excess of the needs of the wealthy is characterized as the crisis of over production. Demands are created in the market according to purchasing capacity; one's demand is determined by one's purchasing capacity or power. Purchasing power in capitalism is based on one's earnings; the demands for various commodities are dictated by positions occupied in the material world.

The wages received by the huge numbers of working people engaged in industry and agriculture is less than what's required for subsistence. Hence, due to lack of purchasing power, it's impossible for them to buy necessary industrial and agricultural commodities. For them the very source of having demands for anything more than thick rice, coarse clothes, barely passable education, medical care and housing is simply not there.

This is the general global scenario. The situation obtaining in an industrially backward country like India is even more brutal. The proponents of capitalism maintain, 'population rise engenders the crisis', but this assertion is incorrect. The origin of this absurd idea is the theory proposed by Malthus that production increases in arithmetic proportion, while population rises in geometric proportion. This gives rise to the crisis. When he brought forth this theory, production was still higher than demand determined by purchasing capacity. Human population has increased manifold compared to that period, yet production surpasses the demand generated by it. Due to the use of modern technology, developed seeds, fertilizers and developed irrigation methods, production rises geometrically while population rises in arithmetic proportion; so much so that due to birth control measures adopted by some countries the rate of population increase has dropped to zero. It has been mentioned earlier that food grains are decomposing both in warehouses and in the open air (due to lack of warehouses).

Secondly, the huge store of food and other resources discovered under the oceans is waiting to be utilized. Even if the population increases much further; there won't be any scarcity of food. On addition the planets of the Cosmos are becoming accessible to Mankind.

Therefore, the crisis within the Capitalist system is artificial in nature. i.e. a function of the system of wage slavery of the Capitalist class.

Having witnessed the juxtaposition of prosperity and abject poverty and pennilessness in capitalist society, great and wise individuals like Saint Simon felt the need to establish a communistic social system based on justice. But societies are formed according to the social systems; not on the basis

of justice or injustice. A production system is independent of human will, and this system undergoes changes according to the requirements of material production, once again, independently of will. Hence, at that time, a communistic system based on justice, as desired by wise men like Saint Simon, remained confined to desire (imagination). On the other hand, the moment the transformation of capitalist production system began, independently, stemming from production crisis, i.e. production based on individual proprietorship on the basis of collective ownership of many owners (ownership of shares in joint-stock companies by share owners) began, the socialisation of production and labour began. Within this system, with production becoming the norm, the objective, material condition for production based on social ownership was created; taking note of this Karl Marx propounded the doctrine of scientific socialism.

The apologists of Capitalism couldn't counter this doctrine. But as the socialisation of the means of production paves the way to the abolition of the capitalist class, they continued individual distribution of the fruits of production (of social income). Consequently, on one hand the contradiction between social production and individual distribution intensified social contradictions; on the other the crisis of over-production kept reappearing as the general crisis of capitalism. This has been manifested in the bloody conflicts among global organizations of the capitalists over markets, for securing hegemony over the production sectors, and in the struggles of the working class and the larger oppressed masses against the capitalist class. The triumph of the working masses in this war will bring the means of production within the grasp of society, and establish socialist society based upon socialist production system. Social science teaches us this lesson.

Emerging from the prehistoric primitive communistic society, society based on slavery, gradually transitioned into a society based on capitalism. These transitions and the laws of social development have contributed to the development of this social science.

Following and practising science, while avoiding and ignoring this particular branch, is meaningless.

This is so because man devised the instruments of production out of the necessity to produce in material life and has made scientific inventions and discoveries, prompted by the need to develop the concerned instruments and means. He created logic (philosophy), physics, biology, physiology in order to improve his material life; developed logic in order to liberate material world from the delusion of supernaturalism. Therefore social science lies at the root of all other sciences. Secondly, if the various branches of science engage themselves in the service of a small section of society, instead of serving the broader humanity, then science ceases to have any significance for the overwhelming majority. Hence the majority remain ignorant about science; they do not develop a scientific frame of mind. Therefore, it's often seen that the scientific inventions, discoveries and innovations that the masses either are incapable of using or which have no usefulness for them do not evince any interest among them. Capitalism regards scientific discoveries, inventions and innovations as profit-earning commodities and employs them to secure maximum profit. This is the reason why the larger majority of mankind, which not only includes the low-earning working masses, but also the common people belonging to other professions, cannot access these commodities. So they show little interest about these. It's particularly evident in the spheres of health care and education.

Therefore, in order to deploy science in the service of mankind, people with a scientific bent of mind should treat the present transitional phase of the human race (towards socialism) as a manifestation of the development of historical laws of the earlier phases, uphold it as the causal factor behind the development of the different branches of science and champion the truth that it's possible to deploy science in the service of all sections of mankind only in a socialist society. Scientists, like Einstein and JBS Haldane, true to their name, have performed this task. The relevant question is, despite extensive publicizing of scientific discoveries and inventions, despite a large number

of people having direct and indirect experiences of discoveries and inventions that are related to their lives (in agricultural and industrial fields, in the medical field for instance), despite the illusory nature of the so called unworldly events being exposed, despite having observed duping techniques (exposed repeatedly and consistently in full public view by campaigners with a scientific bent of mind), why do supernaturalism and various superstitions still hold sway in peoples' minds? The answer lies, firstly in familial and conventional social indoctrinations, in religious ritualistic practices and institutional education; secondly in institutionally educated people (which includes research scholars, doctors and novelists who have received education in science) reposing their faith in, and propagating supernaturalism and supernatural phenomena; thirdly, in patronization of religion and religious institutions by state leaders, captains and political parties; fourthly, glorification of religion by different media like radio, TV, jatra and drama; fifthly uncertainty and despair in material life.

Borne out of uncertainty and helplessness among them, the tendency to wear amulets, the 9 gemstones (Navaratna) along with related plant roots and stems among the middle class and even the upper class has increased markedly compared to earlier times.

A noteworthy historical feature is: Supernaturalism and theology being bred by ignorance, the pioneers of the Human race ventured forth to uncover the truth; resultantly they succeeded in unravelling the laws of nature, the laws pertaining to the origin and development of life and living organisms, the laws governing all matter and the primary cause behind the creation of the universe. Despite theological beliefs and superstitions stemming from it, man, in order to survive, has been induced not to remain dependent on nature but to engage in production by taming nature and has ushered in epoch making processes by continually bringing about changes in the production process.

What lies at the root of the development of the class society that came into being after the

emergence of Human kind is class struggle—the struggle to develop the new production system that comes into being within the old decadent production system; the struggle waged between the class who is in favour of ensuring the unimpeded onward flow of progress and the class who is in favour of impeding its passage by perpetuating the old decadent stream. So far the classes favouring continuance of the unimpeded flow of progress have been victorious.

In point of fact, human innovative ability has stemmed from engaging in the struggle for production, by taming nature, one of the examples of which is technology; the long and short of it, however, is that science reflects truth.

It's also a fact that, in circumstances when, the struggles of tormented people against discrimination, oppression; crises etc. are directed in coordination with the historical knowledge of human progress, supernaturalism and superstitions dissipate from the minds of the struggling masses. This is so as, there is no place for despondency in such struggles; these struggles, illumined by the hope-beacon of accomplishing one's mission by dint of one's inherent strength, march along crushing into dust all obstacles with the help of science and technology. The struggling masses thus develop a scientific bent of mind. In this era, the goal of all oppressed masses and all progressive people belonging to all classes and strata is: engaging in the fight to eradicate the system which is the repository of prevalent discrimination, exploitation-torment etc.; waging the struggle to develop the new production system that germinated and is ascendant within the prevailing system. Such struggles create a social system where the fruits of production could be handed back to society. In such a system unemployment becomes a thing of the past; discrimination and exploitation cease to exist. It ceases the resources of science from the clutches of the minority along with other resources and turns them into social resources. In such a system, sowing and nurturing scientific knowledge in the minds of the new generation becomes the objective of education so that they could attain complete victory over nature by perpetuating social

development, thereby making it possible for mankind to achieve true freedom.

Thus, the programme and tasks of an organization geared to the propagation of science is derived from the lessons we have learned from history studied insofar.

The aims and objectives of this programme

- Making people scientifically aware by analysing supernaturalism, theism, the doctrine of incarnations, fatalism and all the superstitions that emanate from these from a scientific outlook.

- Upholding the need for launching movements aimed at removing obstacles in the way of making the contributions of science accessible to the masses, by putting an end to the stranglehold of minorities on the contributions that are relevant to the material life of the masses.

- Providing encouragement to evaluate everything related to material existence from a materialist philosophical and scientific outlook.

The Programme

1.1. In order to achieve the abovementioned objective, the need of the hour is to make the masses conscious about the reason behind the perpetuation of supernaturalism, superstitions etc. and upholding the need to mobilize movements to uproot these.

1.2. In spite of scientists uncovering truth wrapped in falsehood in the forms of supernaturalism, mysticism, the cult of incarnations etc., despite witnessing the contributions of science in agriculture, education, healthcare etc., supernaturalism and superstitions linger among the masses due to the general observance of traditional familial and social rituals, state patronization of religion, religious myths, fables and that of religious authorities, propaganda in favour of related falsehood through attractive writings in school texts right from kindergarten, as well as propaganda vended by eminent intellectuals and teachers of science, etc.

Hence, it's incumbent to raise demands for cessation of state sponsorship of religion, for barring state leaders from openly patronizing religion and

religious guides, for removing (expurgating) attractive writings on supernaturalism, theology and founders of religions.

1.3. To uphold the idea of separation of religion from state by debunking the perverted notion of secularism; this is so because at present what is meant by a secular state is one which treats all religions alike and patronizes them all. Acceptance of this idea is tantamount to accepting the validity of theology and supernaturalism.

1.4. Re-propagating texts refuting religion and theology written by eminent bourgeois and socialist intellectuals from 19th C onwards or publishing and publicizing new writings with quotes from those texts. Exposing those who oppose materialist philosophy, in spite of having refuted religion and theology.

2.1. Refuting religious falsehood by bringing to the fore the historical events highlighting the forward march of materialist rationalist philosophy from the European Renaissance in 16th C onwards, overcoming the opposition of theology and theocrats.

2.2. Showcasing before the masses the ideas and discoveries of the individuals and events who/that made original contributions to the development of science and mankind like Rene Descartes (1596-1626), Isaac Newton, Industrial revolution, French revolution, Hegel, Darwin, Pasteur, Saint Simon, Robert Owen, Karl Marx, Engels etc.

3.1. Exposing the essence of State and religion by bringing to the fore historical events illustrating the integral relation between clan leaders (kings) and religion and the historical reasons behind the emergence of various religious ideas.

3.2. Exposing the strategy adopted by priests of obscuring the material and worldly life of Jesus and resorting to miracle-making tricks in order to perpetuate supernaturalism. Investigating the mystery behind the tricks performed by theocrats and exposing them publicly.

3.3. To expose, on the basis of facts, the truth that the roots of blind beliefs and superstitions lie embedded within the existing system based on class exploitation and propagating it through speeches, literature, plays etc.

3.4. Exposing prophesy, augury, palmistry and the trickery of astrologists who deceive people by asserting that planets and stars influence human life as well as opposing state patronization of astrologers.

4.1. To demonstrate the fact that the discoveries and inventions useful in material life remain inaccessible to the masses due to prevalent commodity economy, through elucidation of capitalist economy.

4.2. To reveal in public the intrinsic connection between commodity economy and the efforts of environmentalists to publicize the negative aspects of global warming, nuclear power etc.(sometimes groundlessly).To expound clearly the natural causes of global warming and highlighting the scientific endeavours to bring the unnatural causes under the sway of natural causes.

4.3. To support the deployment of nuclear power to satisfy social needs, on condition that tight security measures will be ensured and to demand banning of deployment of nuclear weapons for mass destruction.

4.4. Opposing deployment of scientific inventions and discoveries in mass coercive activities and their misuse.

4.5. To oppose scientific research in the interest of commodity economy and the complete domination of the research fields by monopoly capitalist companies, engaging in movements demanding takeover of the research fields by the state, and granting opportunity to scientists to conduct independent and unrestricted research.

5.1. Demanding deployment of related scientific innovations for dredging rivers and lakes that have been silted up, and supply of purified drinking water and water for irrigation.

5.2. Demanding scientific education and health infrastructure for everyone.

6.1. In the existing capitalist society, human beings are divided on the basis of class and not on the basis of religion and caste-creed. They are split into two classes-the class of the owners of the means of production and the working class engaged directly in production on the basis of wage-labour. The intermediate class is the petit bourgeois

class comprising the intellectuals engaged in various services (administrative, educational, medical etc.). Apart from that the huge number of working people engaged in the unorganized sector belongs to the working class in the larger sense. People subscribing to various religious beliefs and belonging to various castes and sub castes (the so called upper and lower castes) are part of the aforementioned classes.

To elucidate this truth with the help of economic facts, delineating the historical origins of the classes and explain the political motive behind artificial split on the basis of religion and caste.

6.2. To oppose the culture that aids and supports religion, casteism as well as feudal and capitalist economy and to work in favour of and uphold the culture that aids and supports the ascending progressive economy.

6.3. To highlight the historical roots and class basis of discrimination in rights between men and women in patriarchal society and depriving women of their right to property, and explaining the reason behind point by point gender equality in working class families (both engaging in production on wage basis, the earning ability of both and their participation in class struggles, etc.).

7.1. Through the ages, struggle of the masses for material progress has been the principal source of scientific discoveries, inventions and innovations; conversely, these discoveries and innovations have encouraged people to wage struggles for a society free from exploitation and discrimination; science and such struggles are integrally linked. Mass movements with a scientific outlook infuse a scientific frame of mind in the masses.

7.2. Therefore, the organization 'Bigyan Manashko' will strive to perform its commenced tasks by linking itself intimately with mass movements; i.e., will continue to perform the tasks it has undertaken by uniting with mass organizations that hold the same reasoning and viewpoints.

8. 'Bigyan Manashko' would endeavour to mobilize issue based movements with platforms that share its views and will strive to build joint platforms on the basis of an identical programme. ■

Misinterpretation of Heisenberg's Uncertainty Principle is the other name of Fatalism

The year 1803 is considered to be the most remarkable milestone for the development of particle physics. In that year Sir John Dalton had published the famous “Dalton’s Atomic Theory”. Most of the postulates proposed by Sir Dalton had been proven wrong by the scientists in the following years of development of science. Still the said theory is a compulsory part of academic syllabus for the science-students. This is because, without learning the development of theories nobody can clearly apprehend the route of development of science. Until and unless the natural incidents are not been justified and verified by scientific experiments, this development would be ceased. The theory which seems to be true today, may be proved wrong tomorrow. This is a very common natural trend in the field of scientific research. Nothing in this universe is static

In one of the postulates of his atomic theory Sir Dalton stated that ‘atom is indivisible’ i.e., it cannot be fragmented into smaller parts. It took about 94 years for this idea to be rectified. It was in the year of 1897 when scientist J.J. Thompson fragmented atom and proved the existence of negatively charged particle ‘electron’ inside the atom by his famous ‘Cathod Ray Experiment’. Afterwards, scientists discovered the existence of proton, positively charged particle and neutron, uncharged particle inside the atom. In the year of 1911, scientist Rutherford, by his famous ‘Gold-leaf Experiment’, proved that atom has two distinct parts – nuclear and extra-nuclear part. Nucleus, the heart of the atom containing proton and neutron, is static and in the extra-nuclear part there is electron which is dynamic. In 1913, scientist Neils Bohr, experimenting on Hydrogen, the simplest atom, showed that the sole electron of the hydrogen atom is rotating with a huge speed around the nucleus along a definite path called orbit. He mathematically calculated the radius of the orbit, speed and the energy of the rotating electron. All of these

collectively are known as ‘Bohr’s Postulates’. According to this postulates the speed of the electron at the first orbit of hydrogen atom is about 2180 Km per hour. It means that the electron may reach from Kolkata to Pakistan in one second. This calculation was entirely mathematical and the atomic model proposed by Neils Bohr was based on ‘Planck’s Quantum Theory’.

It was in the year of 1900, in the month of October scientist Max Planck made a revolution in the world of physics. He proved that the thermal energy emitted by a hot black body is in form of particle. These particles were named as ‘Quanta’ by Planck. The characteristics of these quanta (sl. Quantum) cannot be explained by Classical Mechanics. Hence a new branch of mechanics i.e., Quantum Mechanics was born. Afterwards, several stalwart scientists e.g. Albert Einstein, de Broglie, Heisenberg, Schrodinger, Paul Dirac etc. contributed their effort for advancement of this field.

In 1924, scientist de Broglie stated that, every moving particle has two nature – particle nature and wave nature. Bohr didn’t consider this dual character while working with moving electrons. Broglie stated that, Bohr considered only the particle nature of electron and totally ignored the wave nature. This was one of the important defect of Bohr’s theory. De Broglie showed that starting from the tiny electron to the large planet, every moving object has dual nature. But, this duality is almost negligible for a large moving particle. In 1927 two scientists Davisson and Germer performed diffraction experiment on the electrons and proved wave nature of moving electrons and established scientific basis of de Broglie’s theory of duality.

Mysteries were started prevailing over the mind of the scientists. What is the actual location of electrons inside an atom? How does it shape? It was really a hide and seek between nature and science. In the same year of 1927 Scientist Warner Heisenberg presented the theory which is famous

as the 'Heisenberg's Uncertainty Principle' in the history of science. Heisenberg stated that speed of an electron is so high and its mass is so small, its position cannot be known with absolute accuracy or certainty. If anybody wants to determine the position of an electron with absolute certainty, then its speed will become uncertain and vice versa. Therefore, the certainty of speed and position of an electron are inversely related and a mathematical relationship of the two uncertainties was also represented by him. Though theoretically uncertainty principle is applicable for both small and large particle, for the large particles has only negligible impact. Even for a moving tennis ball this theory has negligible effect. From the very beginning a section of intellectuals of the society made it ridiculously simplified in understanding the theory. Scientists' world from that period was divided into two groups. One of the groups thinks that movement of all the moving objects in this universe is uncertain; their future is also unpredictable, uncertain. It means not only inside the atom but also on any object in this universe, this principle can be applied. It cannot be taken under mathematical discipline. This consequence invariably will lead someone to the fanaticism. This fanatic idea tells that 'every incident of the universe is governed by the will of the Almighty God'. The certain outcome of the erroneous application of the uncertainty theory is fatalism. Coming out of the field of particle physics, many of them dare to apply the theory in the field of economics, psychology and anthropology even in the field of social science. In their view, society is dynamic but its future is uncertain, the future form of society cannot be predicted i.e. uncertain. It is an irresponsible approach of the theory in a wrong field in a wrong way. In an atom, the speed, position and the amount of energy of an electron are govern by centrifugal force, electrostatic force etc. and the resultant effect of the forces determine the amount of energy released or absorbed by the atom. The development of the society on the other hand is governed by the production relation, contradiction among the classes

of the existing society and the development of the class struggle. The laws, associated with the development of the society are a science – a fundamental science. Therefore, effort to apply the theory in the field of economics, psychology, anthropology, sociology etc is an absolute stupidity. These activities do not support scientific materialism; on the contrary, it admits fanaticism.

Once, poet Alexander Pope, while expressing the contribution of Issac Newton in science told, "Nature and Nature's Laws lay hid in night. God said, 'Let Newton be!' and all was light". Science does not support such fanatic Ideas. Science never think 'all was light', never believe that all the Laws and the rules of the nature has been discovered.

Many scientists of that period considered the uncertainty principle as an important step of continuous development of science. Once Albert Einstein felt irritated amidst the storm of the debates on the theory and told Heisenberg, 'your God is not playing dices'. However, with the development of quantum theory, spectrology etc. scientists have been gathering considerable knowledge on electron.

In the determination of the position and speed of planets and satellites, the words 'probability', 'uncertainty' are no more applicable because those can be calculated accurately. Unprecedented development of space science shows that science is rapidly eliminating the uncertainties of nature. Application of electronics, development of computer, discovery of Higgs-Boson particle in the recent time proves that science has already eliminated many of the uncertainties at the sub-atomic and sub-nuclear level.

The present capitalist system can only provide uncertainty for the common people of the society. Capitalist economic system has no clue to solve its inherent crisis. Destruction of capitalist economic system can only provide certainty to the people. Capitalism cannot hide this truth no more. Misinterpretation of uncertainty principle goes with the interest of capitalism. As long as capitalism will last, fanaticism fatalism will last – misinterpretation of science will also last. ■

Is Global Warming a Result Of Human Activity?

The word “Global Warming” has undoubtedly been the most popular terminology over the past four decades all around the world. At the same time it has been the most controversial terminology during the same period of time as well. Since, it has been claimed by a group of environmentalist that Global Warming is anthropogenic i.e., caused due to human activity, the matter caused a storm of discussions among the scientists initially and afterwards, spread among the people with scientific bent of mind all over the world. The controlling authority of the global economic system has dubbed Global Warming as the “burning problem” of the earth in the near future. They predicted by the year 2035, all the glaciers deposited at the Himalayan range are going to melt due to global warming and as a result of that 20% of the area of Bangladesh will be under water. They cited the example of ‘Ghoramarah’, a delta island at the mouth of the river Ganga and tried to show how the area of the island gradually diminishes due to rise of sea-water level. To make people conscious about this ‘burning problem’ they introduced ‘Environmental Studies’, EVS as compulsory subject into the curriculum from University level down to the primary level of the education system. The main content of the syllabus under EVS endeavours to establish their prediction that due to deforestation, industrialization, use of fossils fuels etc., gases like Carbon dioxide (CO_2), Methane (CH_4), Nitric oxide (NO), Chlorofluorocarbon (CFC) etc. are increasingly mixing into the atmosphere resulting in a rapid increase of the concentrations of such gases. As the above mentioned gases produce Greenhouse Effect, those play a vital role in Global warming. It has been warned that if the emission of greenhouse gases goes on increasing, the average temperature of the atmosphere will go up to such an extent that the glaciers deposited

on the mountains and polar region will melt. As a result of that, the rivers will be overflowing, sea water level will rise, sea-surface area will increase, land area on the earth surface will be diminished- there will be a huge loss of natural resources including human resource. Some environmentalists and NGOs believe that deviation from nature dependent human activity is the main cause of global warming. IPCC (Inter Governmental Panel for Climate Change), a scientific advisory organization of UNO, have been promoting the concept, since its foundation in 1988.

But the fact is that, there is very little scientific research on the rate of melting of about nine thousand glaciers on Himalayan range. It’s true that the rivers originating from Himalayan belt is fed by the melting-water from the glaciers. But no abnormal rate of melting of glaciers has been ascertained scientifically and the same is true for the abnormal rise of sea water level. A Government organization of Bangladesh has informed that the land area of Bangladesh is increasing by 23 sq.km. every year. Nayachar Island, adjacent to Ghoramarah Island has increased its land area remarkably over the last decade. Again, the phenomenon of Global cooling (decrease in average temperature) during 1940-1970 and abnormal snow-fall in Europe and North America during the winter in the last five years and many others have forced the logical minded people to ponder over the actual reason behind Global Warming. Even the scientists all over the world are deeply divided on this issue.

To resolve the confusion over this issue we have to find the answers to some basic question :

- **What is the source of heat in the heat cycle of Earth?**

- How and what amount of heat energy reaches the Earth from the source of heat?
- Change in relative distance between source of heat (sun) and recipient of heat (earth)?
- What is greenhouse effect?

Earth was a barren planet when it was formed from solar nebula about 4.56 billion years ago. Initially, in the **Hadean** era, the Earth became hotter and hotter due to three reasons.

1. As the different parts of the primeval earth became more and more compact, as a result, the gravitational potential energy was converted to thermal energy.

2. The radioactive substance e.g. Uranium (U), Thorium (Th), radioPotassium (K^{40}), Rubidium (Rb) produced an enormous amount of heat energy due to radioactive disintegration. It was the main source of heat of the earth at the time.

3. Meteorites or shooting stars played a role in increasing the earth's surface temperature.

The increase of surface temperature was the main feature of the earth. Earth's temperature had reached the melting point of iron at one time. It took a very long time for the earth's main components to be arranged in an order on the basis of their mass, specific gravity and chemical properties. For example, heavy metals like iron, nickel has been deposited at the core of the earth and the lighter elements like oxygen, silicon, aluminium, potassium, sodium, magnesium had of the heavy metal like Uranium (U), Thorium (Th) had been deposited at the crust and mantle due to greater chemical affinity towards oxygen and silicon.

As radioactive decay decreases with geological time, earth's surface temperature also decreased rapidly and the crust solidified. When the earth's crust became cold enough, the lithospheric plate started moving due to the convectional current of the molten fluid under the lithosphere (crust and upper mantle). At the time

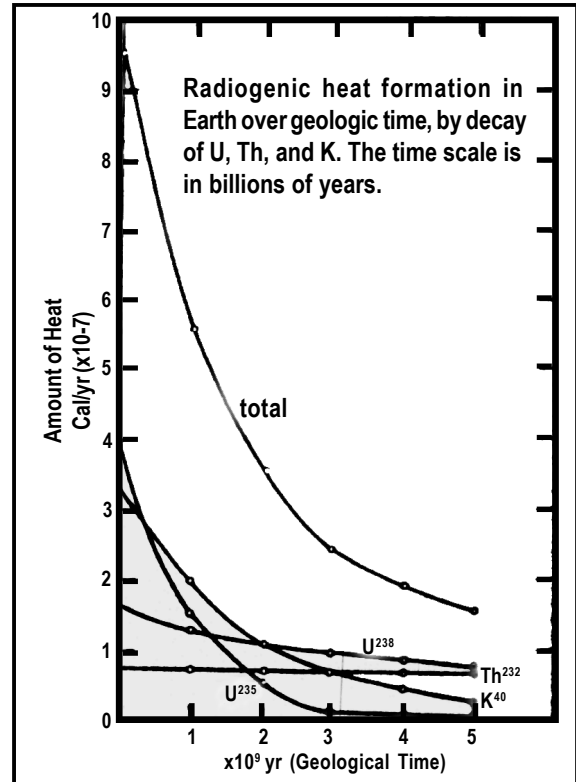


Fig 1 : Shows the graph of radioactive emission against geological time.

when radioactive emission gradually came down to a minimum level, the Sun became the main source of energy of the earth's atmosphere and the crust. For this reason, there is no evidence of glacial age before Proterozoic era (2500-570 million years). Thenceforth, the Sun became the main source of energy in the earth's energy cycle.

Sun and Sun spot

Sun, being a mixture of gases, has no well-defined surface. It consists of three main layers. These are photosphere, chromosphere and core, from surface towards the centre as shown in Fig-2.

a) Photosphere : It is the most illuminated and the deepest layer of the sun. The layer consists of burning gases of an average thickness of 300

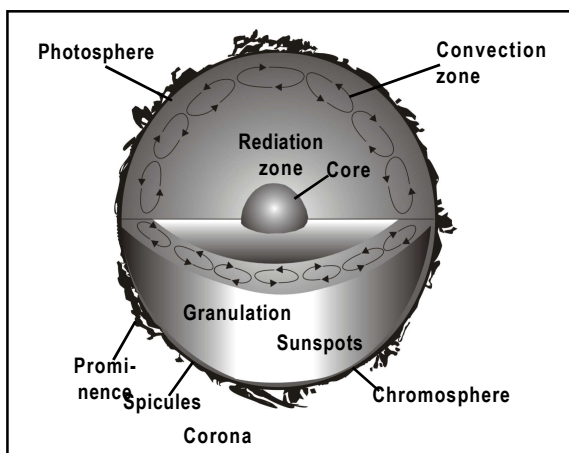


Fig 2 : From surface towards the centre – photosphere, chromosphere and core of the Sun

km. the layer is absolutely uneven and composed of innumerable small bright parts called Granules which have an average diameter of 1000 km. The hot gases from the inner part of the layer spread over the outer surface which eventually become cool and enter the inner part. As a result of it a convectional current is generated. The gaseous composition of photosphere is 90% Hydrogen and 10% Helium. The average temperature of this layer is about 6000K- which determines the amount of thermal energy of the radiation and wavelength of the emission.

b) Chromosphere : the layer of thin burning gases next to photosphere is known as chromosphere. This layer is irregular and the temperature rise from 6000°C to about 20,000°C. The pressure of these gases in this layer is very high and particles have an enormous kinetic energy which explains why these particles have a tendency to be isolated from the sun. This phenomenon is known as solar storm.

c) Core : the centre of the sun is the core. The temperature of this region is about 1,50,000°C and the density is about 150,000 kg/m³ which is 10 times the density of lead. The gases in this state exist in plasma state. Due to the high

temperature and the density of the core region, Nuclear Fusion reactions (proton-proton chain reaction) take place where initially four hydrogen nuclei combine to form one Helium atom. The mass of the Helium atom thus formed is slightly less than the total mass of the four Hydrogen nuclei. If the mass defect be Δm , then according to the Einstein's mass-energy equivalence equation [$E=mc^2$], it can be explained that the energy corresponding to the mass defect due to Nuclear Fusion reaction is coming out from the Sun. Due to the generation of huge amount of thermal energy at the centre, the atoms no longer can remain stable. The electrons become free and move more randomly. The energy conversion per unit time (power) of fusion in the core changes with distance from solar centre. When the rate of this reaction increases, the core becomes hotter and expands. Due to expansion the distance from the solar centre increases which again decreases the rate of fusion reaction; as a result the core contracts to its original volume. Thus a self-correcting equilibrium is maintained.

d) Sun spot : Sometimes, black spots are observed on the outer surface of the sun. The temperature of spots is about 1500°C less than their surroundings at the chromospheric layer. In ancient times, astronomers believed those black spots to be the clouds between the earth and the sun. Th Galileo, was the first scientist to state that the black spots are not clouds but characteristics of the sun. The life span of these sun spots ranges from few weeks to few months. Many of the spots are formed at a cycle of eleven years. Number of sun spots increases gradually to a maximum number of 100 or above and again the number gradually reduces to zero. The scientists has confirmed the eleven years cycle by an observation during 200 years. By the month of April in the year of 2000 the number of sun spots had reached to about 120, which were only 10 in May, 1995. Around Sept, 1989 about 150

sun spots were seen. In seventeenth century, during the reign of Aurangzeb, the sun spots were vanished. During that period no sun spots were observed for half a century. But no evidence of global warming was recorded on the contrary Europe experienced a severe cold wave and remarkable fall of average temperature had been recorded during that period. The phenomenon proves the sun spots are not the sole factors behind Global warming or global cooling. Had it been so global average temperature would have been increased but if not sun spots then what are the actual reason behind global warming- that will be discussed in the later part of the article. In the year 2001 a sizeable no. of spots were noticed on the surface of the sun which gradually diminished and in the year 2008 the sun became almost spotless. Scientists expected gradual rise of the number of spots during 2010 and 2011 but it did not happen. According to the astronomist, the extremely heated gases when come out from the sun and spread over the entire surface, becomes cool and again enter into the sun. Sometimes, in some of the areas on the surface, this cycle stops. As a result the gases in those areas cannot spread over the surface, the temperature as well as brightness of those areas become lower than the surrounding. Therefore these areas appear black and from the earth they look like small spots. Now, why does spot in those areas?

It has been discussed earlier that due to the excessive temperature the sun, the gases cannot remain in atomic state. The subatomic particles (protons and electrons) move freely after being detached from the atoms. As the flow of charged particle is the reason behind the formation of electrical and magnetic field, under the influence of magnetic energy convectional current of the gases is stopped. The change in the power of the magnetic field on the solar system is different. The areas where the magnetic field is very powerful, convectional current of the gases in the

areas are stopped. Sun spots are seen in those areas. Scientists have got direct evidences of these incidents. Sun spots are always noticed in pair on the solar surface.

The charged particle like electron has a property to flow along the lines of force of magnet. Scientific research on this subject revealed recently that the electrons coming out from the sun flow along the lines of force of the solar surface and emit ultraviolet rays. Photographs, taken from space shuttle, confirmed the existence of magnetic field in the sun spots. Under the influence of magnetic field, 200 years of cycle of sun spots had been proved. Astronomists believe that solar radiation increases by 10% per 100 million years.

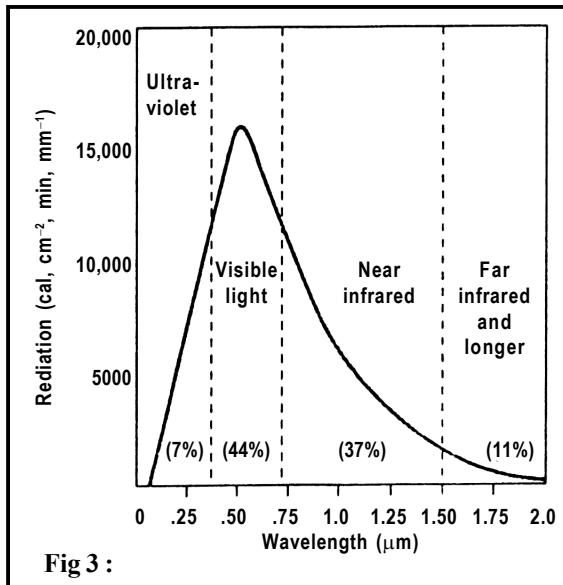
With the variation of the numbers of sun spots, solar radiation also varies. Though these variations is very small, its result is not small. As a result of this small warming and cooling takes place on the earth. Moreover, under the influence of these incidents, the outer surface of the Earth's atmosphere is contracted due to cooling. As a consequences, the artificial satellites change their orbit due to the increase of the frictional force with the atmosphere.

How and what amount of solar heat reaches the Earth?

Any matter above absolute temperature (0K, -273°C) radiates energy in form of electromagnetic waves. The velocity of this emission is equal to the velocity of light. The radiated energy travels one place to another in form of wave. The nature of those wave (wavelength, amplitude, frequency) depends on the temperature of the source. [Fig-3]

With the help of Stephen-Boltzmann law, the radiation can be calculated.

$F = \sigma T^4$ [F = flux density of the radiation, T= temperature of the surface of the source in Kelvin scale, σ = Stephen-Boltzmann constant = $5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$]



Average surface temperature of the sun is 6000K and that of the Earth is 288K. Therefore, surface temperature of the sun is more than 20 times that of the earth.

$$F_e = \sigma T_e^4$$

$$\text{And, } F_s = \sigma T_s^4$$

$$> \sigma (20T_e)^4 \text{ [As } T_s > 20T_e]$$

$$> 160000 \sigma T_e^4$$

$$F_s > 160000 F_e$$

Where F_e = Flux density of Earth's radiation

F_s = Flux density of Sun's radiation

T_e = Surface temperature of earth in Kelvin scale

T_s = Surface temperature of the Sun in Kelvin scale

Therefore the radiation energy per square meter area of the sun is more than 160000 times that of Earth. Sun being self-radiating, it radiates electromagnetic wave whose wavelength ranges from 10^5 meters to 10^4 meters.

According to Wien's Law $\lambda_{\max} = 2897/T$, it can be explained that more will be the temperature of the energy radiating body, less will be the wavelength of the radiating energy.

$$\therefore \lambda_s = \frac{2897}{6000} \quad \& \quad \lambda_e = \frac{2897}{288}$$

$$= 0.48 \mu m \quad \& \quad = 10 \mu m$$

where λ_s = wavelength of the radiation of the sun
 λ_e = wavelength of the radiation of the earth

In reality, most of the wavelengths of the radiating energy from the sun vary between 0.4 μm to 0.7 μm .

Besides this the laws regarding the relation between radiation and absorption of energy are

i) $C = \lambda \cdot f$ [where λ = wavelength, C = velocity of light i.e., 3×10^8 m/s, f = frequency]

According to this law shorter will be the wavelength of the radiation, more will be the frequency.

ii) $F = \epsilon \sigma T^4$ [where $\epsilon < 1$]

According to this law black bodies are the best radiator.

iii) $e_\lambda = E_\lambda \cdot a_\lambda$ [where e_λ = radiating power, a_λ = absorbing power, E_λ = radiating power of a ideal blackbody at that temperature and for that wavelength of radiation.]

According to this law, it can be said that a good absorber is a good radiator.

iv) $E = h\nu$ [where E = radiation energy, ν = frequency of the radiation, h = Planck's constant]

From this law it can be stated that radiation energy and frequency of radiation are directly proportional.

Most of the space between the Sun and the earth is vacuum. The solar radiation reaches the earth's atmosphere by radiation. The earth receives only 1/200,000,000 fraction of the total energy radiated by the Sun. Average distance between the sun and the earth is about 149.5 million kilometre. It has been calculated that the solar energy that falls perpendicularly on the outer surface of the earth's atmosphere is 1367 W/m² (i.e., 1.97 Joule/cm²/minute). This is known as solar constant. When the solar radiation enters the earth's atmosphere, four phenomena are

manifested : a)reflection, b)scattering, c)absorption and d)transmission.

a) Reflection : A considerable amount of the solar energy is reflected back to the space by the earth's atmosphere and the earth's surface. Depending on the nature and the thickness of the reflector, the amount of energy reflected may vary from 40% to 90%. The radiation energy reflected by the water bodies on the earth's surface depends on the angle of incidence as well as on the glossiness of the water surface. White cloud and the mountain peaks covered by white snow reflect about 75% of the radiation energy. Land and water surface, atmosphere (including cloud) reflect about 30% of the solar radiation. This phenomenon is known as **Planetary Albedo**. Reflected solar radiation has no role in the heat cycle of the earth.

b) Scattering : In this process solar emission is diverted from its path by the particles and gas molecules of the atmosphere. This phenomenon is termed as scattering. This was discovered by a British Scientist Lord Rayleigh. The extent and direction of scattering depends on the ratio of radius and the wavelength of the radiation of the particles.

The amount of scattering is inversely proportional with the fourth power of the wavelength of the radiation.

$$(Scattering) \propto \frac{1}{(wavelength)^4}$$

$$\theta \propto \frac{1}{\lambda^4}$$

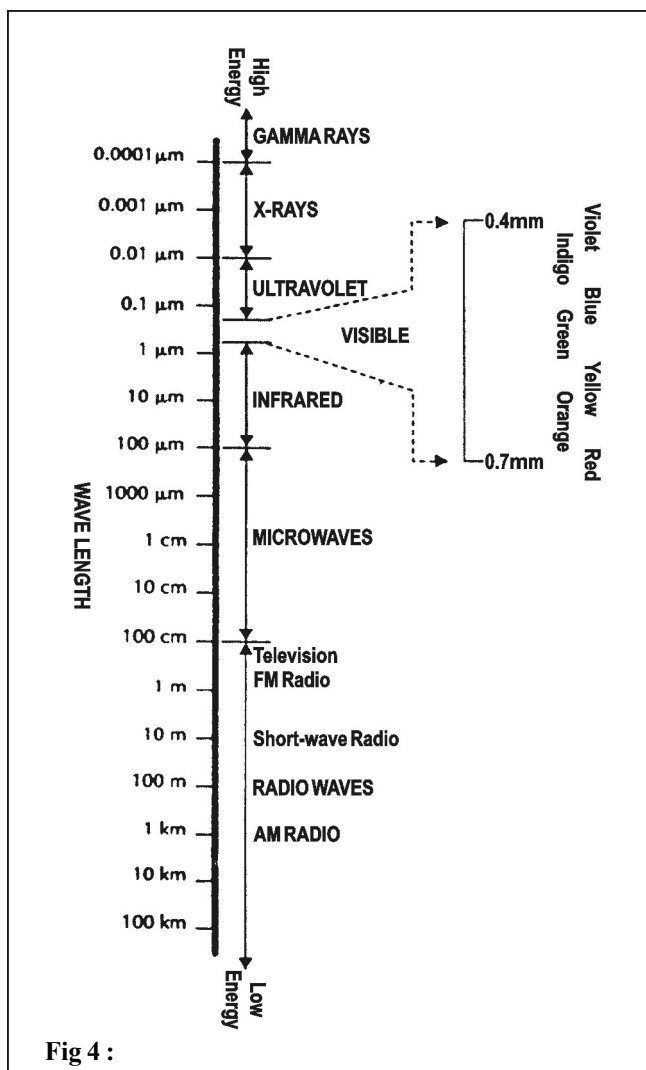
From this mathematical relation it can be said that the radiation of small wavelength is scattered more efficiently than that of higher wavelength. It's pertinent to mention here that the sky looks blue due to the scattering of radiation. After entering the atmosphere the visible region of the solar radiation is scattered into radiation of smaller wavelength by the gas particles.

Violet colour of light is almost absorbed or scattered at the outer layer of atmosphere. As the blue colour is scattered in the lower layer of earth, the sky looks blue. After scattering a portion of solar radiation reaches the earth's surface. In overcast conditions it reaches indirectly through sky radiation. The portion of radiation, that bounces back to space due to scattering at the outermost layer of the atmosphere, plays no role in the warming of the earth's surface.

c) Absorption : The process by which the incident radiation is absorbed and converted to other forms of energy is known as absorption. Mostly the absorbed radiation is converted to perceivable heat resulting rise in temperature of the matters absorbing it. The gas molecules, cloud, fog, smoke and dust particles suspended into the atmosphere, absorb a portion of solar radiation. The rate of absorption of different particles is different and they absorb different frequencies of electromagnetic radiation. For example ozone(O_3) absorb ultra violet region of radiation(smaller wavelength or higher frequency). Wavelength of most of the solar radiations are within $0.5\mu m$. Nitrogen(N_2) is not a good absorber of this radiation. Most of the absorption takes place in the ionosphere of the earth atmosphere.

Water vapours absorb infra-red radiation. As the gases in the atmosphere are not good absorbers of electromagnetic radiation of visible range, it easily reaches the earth's layer. Most of the solar radiation is in the visible range are showing in the Fig. 4.

d) Transmission : Besides reflection, scattering and absorption, solar radiation reaches the earth surface through atmosphere, by transmission also. Transmission depends on the atmospheric condition and distance traversed by solar radiation through atmosphere. Distance traversed by radiation is called path length or optical air mass. Path length is taken to be one at a place where the sun ray fall perpendicular to



the horizontal surface of the earth. Path length increases with the increase in angle of elevation.

Relative position of the Sun and the Earth

The relative position of the Earth with respect to the Sun depends on :

- a) The change in earth's orbit around the sun
- b) Tilt of earth's orbit
- c) Tilt of earth's axis [fig 5 and 6]
- a) The earth makes its revolution around the sun along an elliptical orbit, with the sun at the

focus of the orbit. This elliptical orbit path is ever changing. The eccentricity of the elliptical orbit changes periodically. Periodicity of this transformation is about 1, 00,000 years.

We know that the eccentricity of the elliptical orbit is less than 1.

This may be expressed by the equation

$$e = \sqrt{1 - \frac{b^2}{a^2}} \text{ when } e < 1 \text{ and } a > b$$

[2a=length of major axis, 2b=length of minor axis]

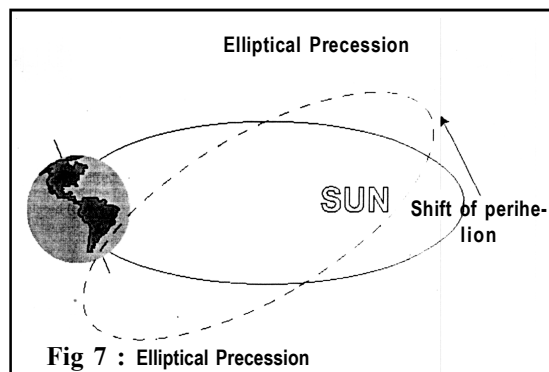
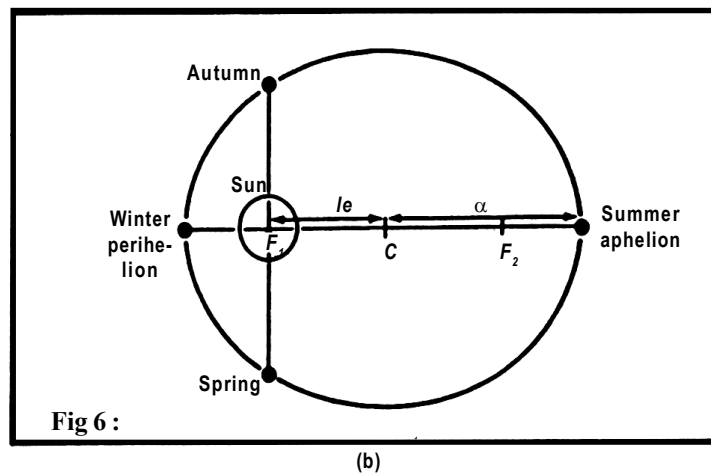
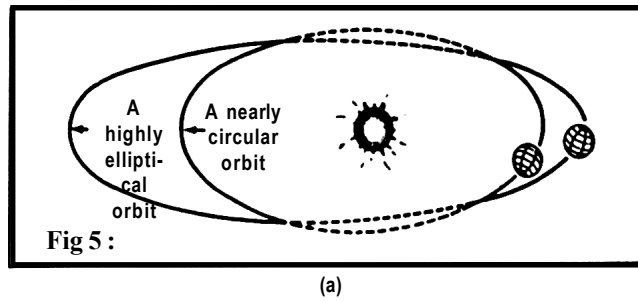
When b^2/a^2 increases, the value of e decreases, it means value of b is increasing to a or value of a is decreasing to b . For earth's elliptical orbit $0.0607 \geq e \geq 0.005$ at present $e_E = 0.0167$.

The most important reason behind the occurrence of ice age, is the change in the value of e_E . The lesser the e , the lesser will be the distance between the sun and the earth and vice versa. When the distance between the sun and the earth is maximum, a very little amount of radiation of the small wavelength reaches the Earth.

b) The plane of the elliptical orbit of earth around the sun tilts periodically. The time period of this tilting is about 70,000 years. For this reason the elliptical plane is

not two dimensional. This phenomenon is a resultant of gravitational attraction among the nearby celestial bodies e.g. the sun, moon, other planets and stars etc. Due to this phenomenon, there is a change in Perihelion, that is why it is also called perihelion precession.(Fig-7)

c) Precession is a change in the orientation of the rotational axis of a rotating body. In astronomy, axial precession is a gravity-induced, slow and continuous change in the orientation of an astronomical body's rotational axis. Presently, the



Changes in earth's orbit around the sun : (a) Over time, the orbit changes from elliptical to almost circular (fig.5); (b) Eccentricity of the orbit . The Sun is one focus (F_1) of the elliptical orbit (fig.6). The distance from the center (c) to aphelion or perihelion is given by half the major axis α . The distance from C to F_1 is linear eccentricity (le) which is used to determined eccentricity (e), which is given by $e = le/\alpha$.

revolutionary plane of the earth exists at an angle of 66.5° with the rotational axis. Therefore, the angle between the rotational axis and the normal on this plane is $23.5^\circ [90^\circ - 66.5^\circ = 23.5^\circ]$. This is called obliquity angle. The value of this angle is not constant. Its value ranges from 22° to 25° in a simple harmonic motion, with a time period of 41000 years. As a result, the locus of the terminal point of rotational axis changes and at a three dimensional frame two enormous cones are formed at the two sides of the axis. Time period of this phenomenon is about 26,000 years. This time is known as Great year or platonic year. When the obliquity angle is zero(0), then light and day become approximately of equal length all over the earth, this is known as equinox.[Fig.8]

But why does the obliquity angle of the Earth changes

This happens mainly due to gravitational attraction of sun, moon and the other celestial bodies. As all the celestial bodies in the universe are moving, their relative positions are also everchanging. Therefore, the gravitational attraction of these bodies(including sun and moon) on the earth keeps changing, as we all know that the gravitational force is inversely proportional to the square of the distance between any two celestial bodies in this universe. Though this force acts perpendicularly on the axis of the earth, it acts parallel with the plane of rotation of end point of rotational axis. Shape of the earth is not uniform; it is flattened at the pole and bulges at the equator. This shape is known as oblate spheroid. The equatorial diameter (12,756 km) is about 43 km larger than the polar diameter(12,713 km). Due to the axial tilt of the earth, half of the equatorial bulged portion faces the sun while the other half remains turned away. As the gravitational force is inversely proportional to the square of the distance, the part of the earth closer to the Sun experiences greater gravitational force than the rear portion. Due to the different forces acting at

both ends of the equatorial axis, a torque is generated on the earth. The axis of the torque is roughly perpendicular on the rotational axis of the earth; as a result precession of the rotational axis takes place.

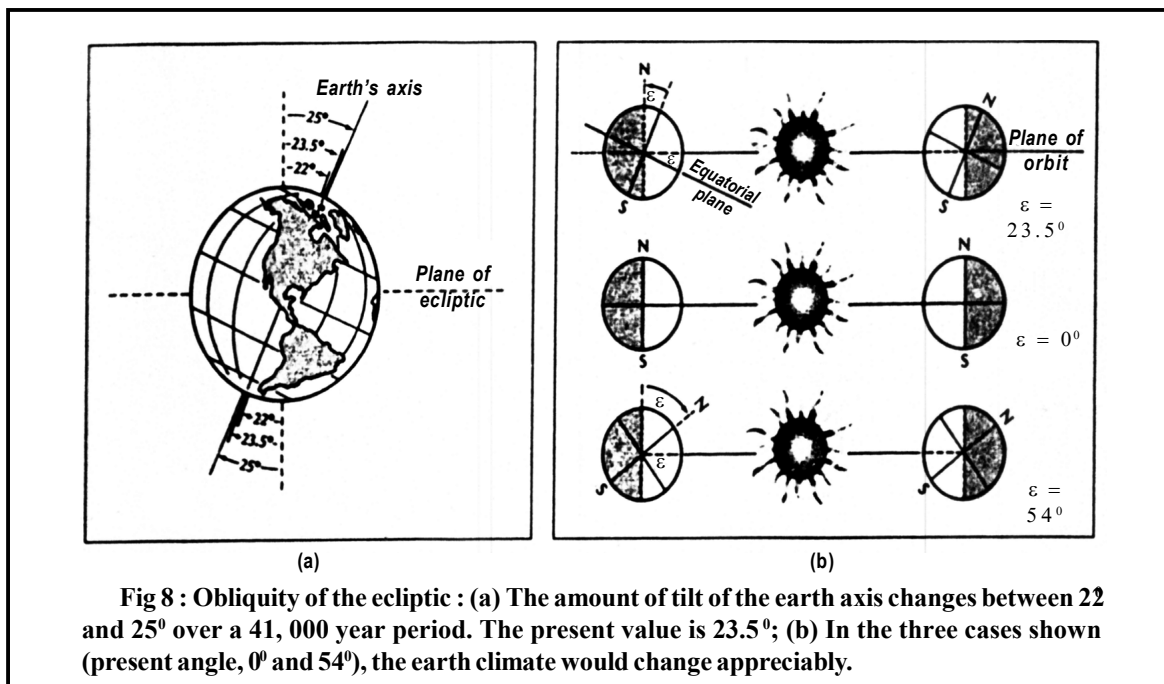
Since average torque is perpendicular to the direction of tilt of the rotational axis, torque has no effect on the tilt of the rotational axis. Due to the change in the relative position of the Sun and the Moon, gravitational forces acting on the earth alter which in turn alters the tilt of the rotational axis as well as rate of change in precession.

As discussed earlier, currently the tilt of the earth's axis of rotation is 23.5° . Increase of this value has a great impact on the cycle of season on the earth. When axial tilt is less, then the sun shines almost equally in the summer as well as in the winter. Again, due to this axial tilt and precession, there is a remarkable change in the absorption of solar energy at equatorial and polar region. Axial tilt and precession result no change in the position of pole and the line of equator on the earth. But in respect to the solar system, the position of the pole and the line of equator change.

The resulting effect of the axial tilt, precession, orbital eccentricity, obliquity and the tilt and precession of the earth's orbit, and their effect on the receiving of solar energy by the earth, collectively is known as **Milankovitch Cycle**. This has been named after Serbian Geophysicist and astronomer **Milutin Milankovitch** who proposed the theory in 1920.

How the thermal equilibrium of the earth's heat cycle is maintained?

The portion of the solar energy, which ultimately reaches the atmosphere, is circulated inside the atmosphere by radiation, evaporation (including transpiration) conduction and convection. Only a portion of the energy, radiated by the earth's surface, bounces back to space and the rest remains inside the atmosphere to create 'green house effect'.



Absorption and rejection of heat, separately and collectively maintain equilibrium. This is known as THERMAL EQUILIBRIUM. This equilibrium is dynamic and complicated. The amount of energy received by the earth depends on

a) The amount of energy radiated by the sun, and

b) The relative position of the sun and the earth.

As discussed earlier, the amount of energy radiated by the sun is dependent on the sun spots. The average solar energy received by the earth annually, is almost same for a phase of relative position of the sun and the earth, but it is not constant.

The heat energy received by the earth's surface is transported to the atmosphere by means of convection and evaporation of water to water vapor. Only a few centimeters of atmospheric layer, adjacent to the earth's surface, receives this energy by conduction. The atmosphere is a mixture of gases and is a bad conductor of heat. So heat energy from lower to the upper layer is

transported by means of convectional current. The heat absorbed by the open surface of the water bodies on the earth's surface, increases the kinetic energy of the water molecules. But only that amount of water which succeeds in overcoming the potential barrier, evaporates into water vapor and is released into the atmosphere. Plants also release water vapour to the atmosphere by means of transpiration. This water vapour when condensed to form water droplets, release heat energy into the atmosphere.

In January, 1977, a calculation by Kitt Peak National Observatory showed a fall of surface temperature of the sun by 11°C during a span of one year. Computerized calculation showed that there will be a small ice age if solar radiation reduces by 1 – 2% and a big ice age may occur due to a reduction of solar radiation by 5%. So far the highest recorded temperature on the earth is 58°C in Al Aziziya of Libia in 1922, whereas the lowest recorded temperature is being - 89°C measured at Antarctica in the year of 1983.

GREEN HOUSE EFFECT

Green house is a special type of glass house used for the growth of germinated seeds or saplings in the cold countries. The glass used for this purpose allows the radiation of small wave length to enter the house but does not allow the longer wave length of radiation to get out of it. Therefore temperature inside the house increases.

The surface temperature of the sun (6000 K) is much higher than that of the earth (288 K). For this reason, wave length of the radiated energy from the sun is less than that of the earth. The wave length of the radiated energy from the earth may be up to 10 μm which is about 20 times greater than that of the sun. The gases, carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbon (CFC), nitric oxide (NO), water vapour (H_2O) present in the atmosphere produce green house effect. It means that the solar radiation with smaller wave length that reaches the earth's surface cannot penetrate the atmosphere to get back to space. Thus greenhouse effect of the atmosphere is a natural phenomenon. Water cycle is an essential part of the heat cycle in the earth's atmosphere. Carbon dioxide (CO_2) is released into the atmosphere due to respiration of plants and animals. CO_2 is also released due to the burning of fossil fuels in industries and transports. Methane (CH_4) is produced by the decomposition of dead plants and animals.

Professor and Meteorologist Richard S Lindzen and his co-workers of MIT stated that 'IPCC scientists had exaggerated the role of CO_2 and CH_4 behind global warming. The extent of global warming will remain 98% even in the absence of those gases. This is because water vapour plays the most important role in global warming.'

CARBON DIOXIDE – THE GREEN HOUSE GAS

It has also been stated by some environmentologists that global warming is an

obvious result of the development of industries which produces greenhouse gas like CO_2 . But the reality is that amount of CO_2 in atmosphere has been increasing gradually since long before the starting of using fossil fuels (since last 18000 years). Ice core data of Antarctica of Vostok of former USSR shows that the concentration of CO_2 has increased with the increase of atmospheric temperature. [Fig-9]. But during the last 800 years increase of the concentration of CO_2 is lagging behind the increase of temperature. Incidentally, at present the amount of CO_2 and temperature of the atmosphere is very close to that of the inter-glacial era about 140,000 – 120,000 years back. In earth science that interglacial era is known as Eemian Interglacial Period which lasted for 20,000 years.

At present only 0.28% of the greenhouse gases has been formed due to human activity. The rest of the 99.72% has been formed naturally. From different sources every year 186 billion ton of carbon are converting to carbon dioxide and mixing in the atmosphere. Out of these only 6 billion ton is being generated due to human activity. According to the geological evidences, during the Cretaceous age our planet had experienced a global warming due to greenhouse effect when average temperature rose to a level higher than the present global warming. During that period sea water rose to the highest level. It was long before the appearance of humans on this earth. This incident proves that global warming is not a result of human activity i.e. global warming is not anthropogenic. In comparison to the previous ages CO_2 concentration in the present atmosphere is remarkably low.

CO_2 is an important component of metabolism of living system. It is neither a pollutant nor a poisonous gas. In absence of CO_2 photosynthesis of green plants would have been ceased.

CO_2 is a colorless, odorless and tasteless gas. The CO_2 gas which is released into the

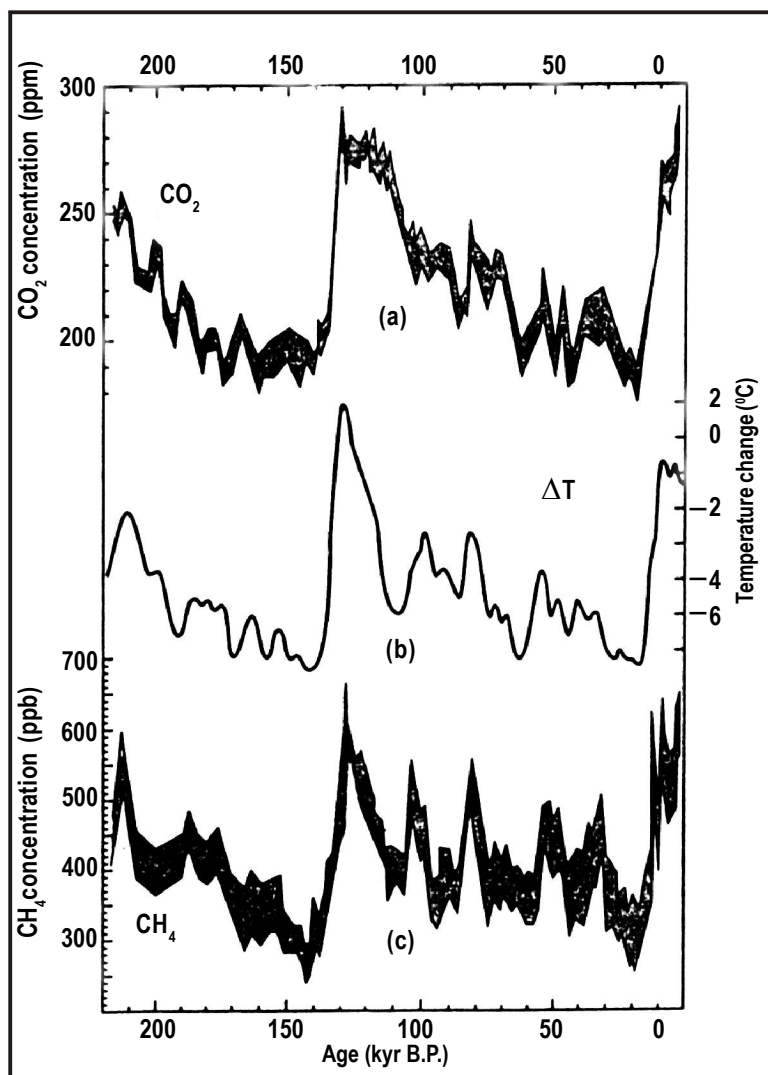


Fig 9 : The trend of atmospheric carbon dioxide (CO_2), methane (CH_4), and temperature as recorded in the Vostok, Antarctica, ice core. The atmospheric temperature at Vostok is plotted as a deviation from present-day mean temperature (ΔT_{atm}). The different line widths represent the ranges in estimates (from Kump L. R., Kasting J. F. and Crane R. G., *The Earth System*, © 1999, Prentice Hall, Upper Saddle River, N.J.).

atmosphere without remaining static, is circulated through the carbon cycle. If in a certain region concentration of CO_2 increases, the partial pressure of CO_2 in that region will be increased

and a portion of it will be dissolved in the available water bodies in that region.

Sometimes, people feel suffocating in a closed chamber, which is not due to the increase of CO_2 -

concentration but it is due to decrease in O_2 -concentration. If concentration O_2 is increased somehow, the rate of respiration will increase. Growth of plants and animals will be inhibited in pure oxygen breathing; aging process will also be accelerated.

Some environmentologist and media are serving unscientific theories, wrong and insufficient statistics linking greenhouse problem with global warming. The only motive behind this unscrupulous activity is to generate markets for antipollution commodities, air conditioner machine, alternate fuels etc.

As the educated and conscious people of the society are neither defending nor trying to establish the truth scientifically, common people are confused by the illogical and recurrent campaign of the promoters who are hell bent on proving the lie – ‘global warming is anthropogenic’.

ICE-AGE OR GLACIAL-AGE

Since the birth of the earth till today, the surface temperature of the earth has never been steady. The average temperature of the earth is ever changing. The Geological era during which the average temperature of the atmosphere as well as of the earth's surface remain very low for an enormous period of time, is known as **ICE AGE** or **GLACIAL AGE**. During this period, glaciers are formed in the Continental regions, Polar Regions and at the Mountain tops. Ice age is a natural system. During a big ice-age, very cold and comparatively warmer periods are also observed. Very cold periods are called glacial periods whereas comparatively warmer periods are known as Interglacial Periods. From geological point of view, glacial age is to be considered as the period when glaciers are found in both the Hemispheres. According to the geological definition last ice age started from Pleistocene age. Presently the earth is passing through an Interglacial period because, in both the hemisphere

of the earth, glaciers still exist e.g. in Greenland, Antarctica and at the Himalayan tops. During this present ice age, the lowest temperature was achieved 20260 years ago, when most of the Northern America and Eurasia were covered by ice. [Fig-10]

So far the earth has experienced five major ice ages. The average temperature of the non-glacial periods was very high, even the high mountains were hot and iceless.

The first glacial age on the earth appeared about 2400-2100 million years ago i.e. in the **Huronian age**. Geological evidences revealed the existence of thousand kilometers of glaciers which were extended from St. Mary, Sudbury up to the North-Eastern part of Huron Lake in North America. The other regions like Merquette, Michigan in North America and several parts of Western Australia were also covered with ice during the Huronian glaciations.

The next ice age appeared on the earth was **Cryogenian Ice Age**, which appeared before 850-630 million years ago. During that glaciations the whole planet even the equatorial region were covered by glaciers. After that ice age the globe became warm. Due to those deglaciations, sea level rose and the earth became favourable for existence and survival of animal kingdom, new form of unicellular organism appeared. Those animal kingdom is known as Ediacaran Fauna. After that period about 600-570 million years ago an abundance of life was observed. This is known as Cambrian Explosion.

The next Ice Age was Andese-Sahara Ice Age. Its duration was short and appeared before 460-430 million years ago i.e., from the end of Ordovician age to Sirulian age.

After that Karoo glacial appeared about 350-260 million years ago i.e., from the middle of Carboniferous age to the early of Permian age. The Geological evidences in favour of that glacial say that Australia, South America, Africa and Indian

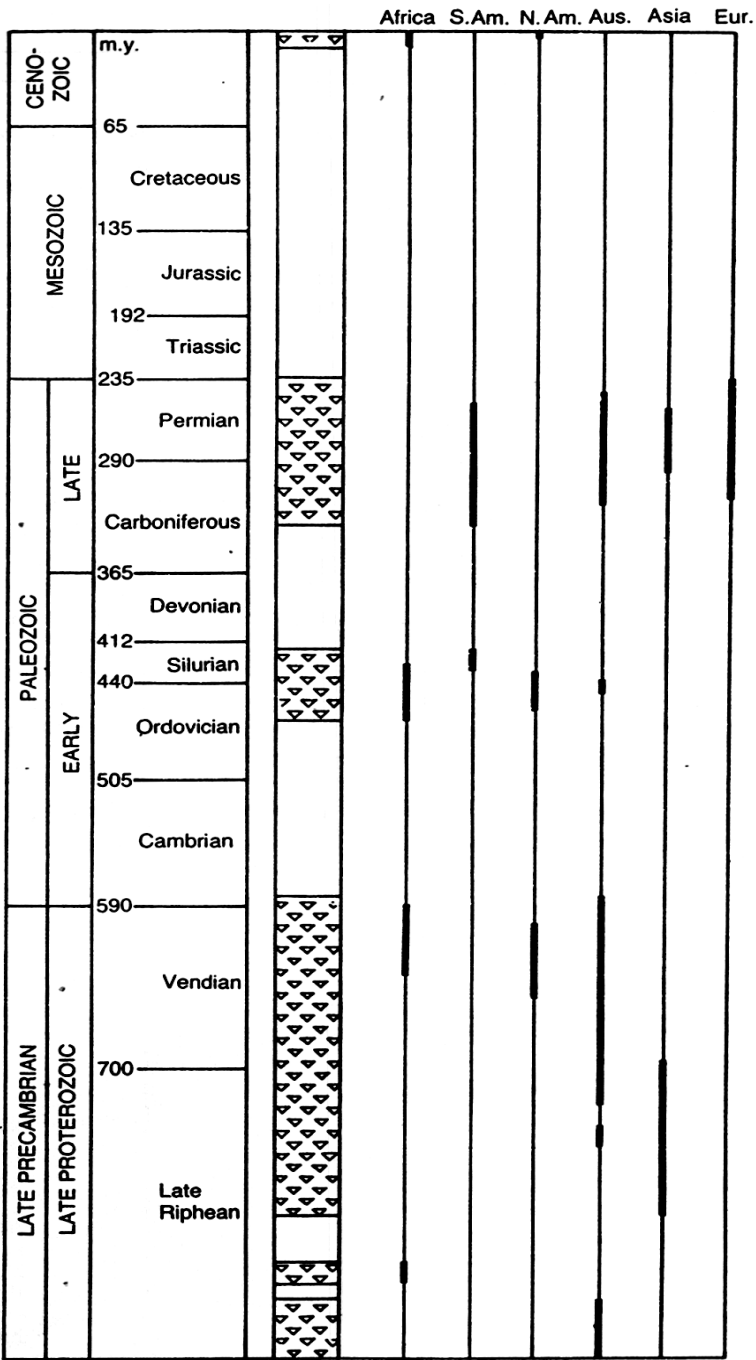


Fig-10 : Figure shows the history of the main ice ages(including Interglacial 'periods) appears so far on the earth.

Continent i.e., the old supercontinent Gondwana Land were largely affected during that ice age. Lots of evidences in favour of this ice age are available under the coal layer of Damodar valley.

After the end of that ice age, the Earth became warm again, sea level rose and new living species were appeared. Plenty of continental plants appeared which were the sources of Gondwana coal.

The last ice age on the earth begun about 2.5 million years ago i.e., at the end of Pliocene age and continuing till the present age. This ice age is called **Pleistocene Glaciations**. In this ice age within a certain intervals many small glaciations and interglaciations are observed.

In North America the following glacial and interglacial periods were observed.

- **Post Glacial**
- **Wisconsin glacial**
- **Sangamon interglacial**
- ↑ ● **Illimial glacial**
- **Yarmouth interglacial**
- **Kansan glacial**
- **Aftonian interglacial**
- **Nebraskan glacial**

In this way four main glacial periods may be split into several glacial and interglacial periods. Before the last small glacial Wisconsin, appearance of two very small glacial Riss and Wurm were important. This Pleistocene glaciations had left its strong evidences in Europe, Antarctica, a part of Asia and Australian continent. The last small glaciations was Wisconsin which is known as Weichsel in North Europe. During Pleistocene glaciations Himalayan Mountains, the whole Northern and central India were covered with ice. Hundreds of species of mammals and vertebrates were found at the foot of the mountains (Tarai region). The evolution of human ancestors into modern humans took place during this age. During that period Shiwalik Mountain

were formed by the sediments of the foot of the Himalayan Range.

During this phase, central Asia and African continent were connected by glaciers. Many vertebrates and non-vertebrates became extinct due to intolerably low atmospheric temperature. Many mammals inhabitants e.g., Giraffe, zebra, tiger, lion, deer, leopard etc. of Himalayan and Siwalik range migrated to the comparatively warmer regions of African continent through middle Asia to survive themselves from cold atmosphere. Afterwards, when temperature reduced due to the melting of glacier, sea reappeared and the two continents Asia and Africa again disconnected. As a result the migrated animals could not return to their previous habitat.

[Fig.11 shows the variation of the volume and size of glaciers with variation of atmospheric temperature in Northern America and Europe in Wisconsin glacial age. (Lemon: page-433 fig-15.22)]

The above research has proved strongly that warming and cooling of the earth appeared alternately and these incidents are natural. The root cause behind it had been discussed earlier.

But, are there any evidences in favour of the fact that global warming and cooling of the earth's atmosphere appeared alternately? Now, let's discuss the geological evidences behind the occurrences of glacial age on the earth.

There are three evidences in this regard.

1) Evidences from sedimentary rocks :

During ice age the continents and the oceans are covered with large glaciers (as seen in Antarctica and North America at present). Due to flow of these glaciers, sedimentation takes place. The size of the sedimentary particles ranges from very small to very large of irregular shape. Small pebbles and large stones or boulders are mixed with mud during sedimentation. The sedimentary rock thus formed is called **Tillite** &

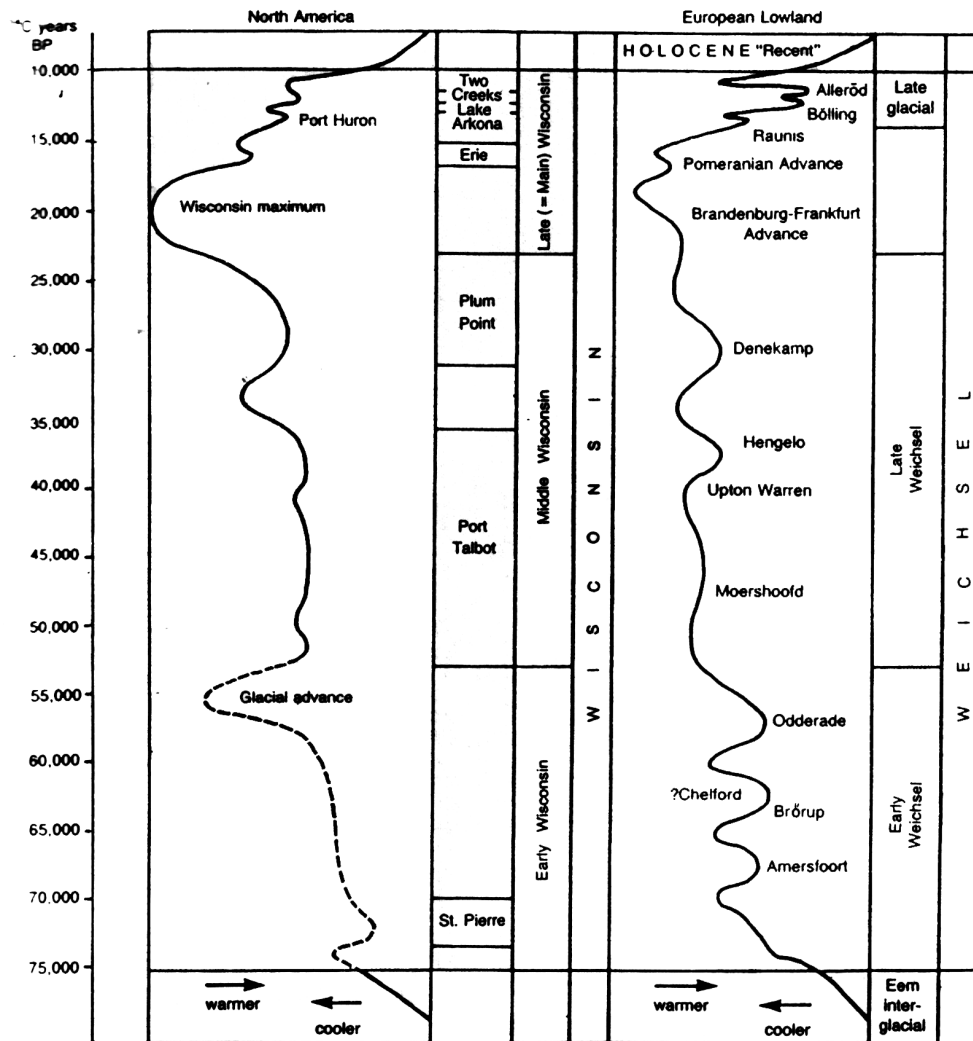


Fig 11 : Above figure shows the variation of the volume and size of glaciers with variation of atmospheric temperature in Northern America and Europe in Wisconsinan glacial age. (Lemon: page-433 fig-15.22)

Tilloid. On the surface of the boulders and pebbles frictional scratches are formed due to friction with ice. These scratched pebbles are found to be distributed irregularly throughout the tillites. The presence of such tillites throughout an enormous area is a strong evidence in favour of the appearance of an ice age. Other than tillites another type of sedimentary rocks **verbs** are also found. Verbs are the sedimentary rocks with

periodic layers of fine particles and mud, which is formed in rivers and lakes fed by ice-melt water. Two such layers are formed every year – one is formed in summer and the other in winter. Presence of such verbs gives an idea on the extent of glaciation. The sedimentary rock formed in ice age can never be of red or brown coloured as the iron particles present in the sedimentary rock get less oxidation due to the lack of moisture in the

atmosphere. On the contrary, the colour of rocks in the ice age is light green. Such tillites, dropstones, green shales have been found at the bottom layer of the Gondwanan sedimentary rock found in valley area of Damodar, Godabari, Mahanadi etc. These rocks were supposed to be formed during the Karoo glacial period.

2) Chemical Evidences :

By determining the ratio of different isotopes of an element in the fossils and sedimentary rock at the time it was formed, we can determine the climatic condition (specially change in temperature). Study of ratio of isotopes of oxygen in this aspect is an effective index.

We know that oxygen atoms have three isotopes – O^{16} (ordinary oxygen atom), O^{17} and O^{18} . Among those O^{17} occurs in a very traceable amount in atmosphere, O^{18} occurs about 0.2%. As the isotopes have different atomic mass, the rate of association and dissociation during chemical reaction take place differently. It has been observed that O^{18} isotope in carbonate compound and CO_2 is associated at the higher rate when reaction takes place at relatively lower temperature. The standard ratio of $\frac{O^{16}}{O^{18}}$ in the carbonate compounds formed in laboratory is compared with the ratio of $\frac{O^{16}}{O^{18}}$ in various sedimentary rocks. If the ratio in a certain carbonate rock or shell of a fossil is lower than the standard value, then it is concluded that the fossil/rock was formed in a cold climate and if the ratio is higher than the standard value then it is clear that the fossil/rock was formed at a warm climate.

Scientist Emiliani made a serious effort to determine the temperature of ancient atmosphere by studying the shell of an oceanic fossil foraminifera (*Globigerina saculifera*). The scientist established the change in temperature in Mexican Bay before 0.8 million years by studying

the ratio of $\frac{O^{16}}{O^{18}}$ of the outer shell of *Globigerina saculifera* obtained in different layers of sedimentary rock. Research revealed that during the last eight hundred thousand years the Mexican bay region have experienced at least nine warming and cooling. Scientists have also proved that during

glacial period $\frac{O^{16}}{O^{18}}$ ratio decreased in the sea water, sea water level was lowered; as a result of this salinity of water has increased. On the other hand the ratio was found to have increased and salinity of sea water decreased during warmer period. [Lemon : Page 413 fig 15.7] Fig. 12

3) Evidences obtained from cyclic extinction and development of different species

It has been proved that with the successive change in Atmosphere temperature, several animals and plants became extinct or exterminated or modified. In glacial ages many species of animals and plants had either been rendered extinct or been exterminated for not being tolerant to cold atmosphere. The figure explains the rate of extinction of animal per genus with the change of temperature. [Fig.13]

According to Milankovich Cycle, global temperature successively become warm and cool at an interval of 100 thousand, 41 thousand and 23 thousand years. This has been proved by scientist Hey (1976) by studying the change in the ratio of oxygen isotopes as discussed earlier. Later scientist Wowe J. J and Walker MJC (1984) reassured the validity of Milankovich Cycle. [Fig. 14] [Lemon : page 415, Fig. 15.8]

However, from the results of the several research, scientists have reached the conclusion that, in the history of the earth, the average atmospheric temperature has changed

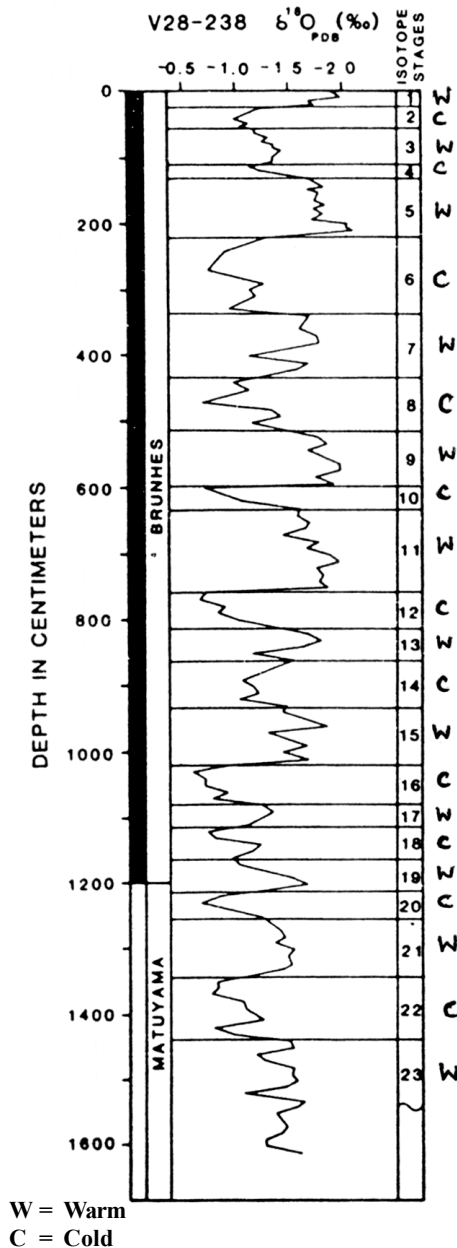


Fig 12

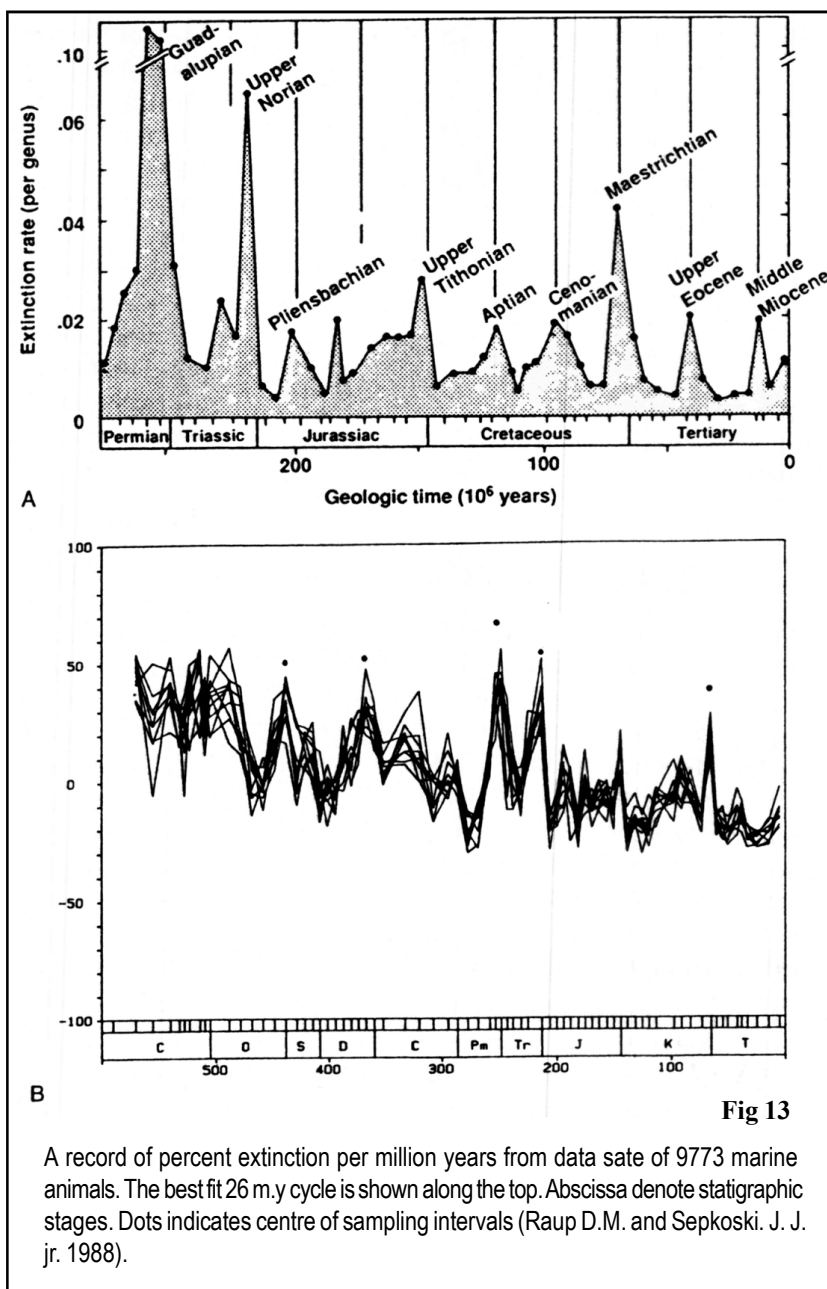
Succession of oxygen isotope stage as determined in deep-sea core V28-238 from the equatorial Pacific (depth scale in cm), with age estimates for stage boundaries. (From Williams, D.F. 1984) Correlation of Pleistocene marine sediments of the Gulf of Mexico and other basins using oxygen isotope stratigraphy, in Healy Williams, N., ed., Principles of Pleistocene stratigraphy applied to the Gulf of Mexico : Boston, Internat. Human Resources Devel. Corp.

successively in rhythmical pattern, as a result of that global warming and global cooling also appeared in the same pattern and will be maintained in the future also. Since last four decades it has been campaigned that global warming is an outcome of combustion of carbon-fuel, but most of them remained mute about the global cooling during the period from 1940-70. However, few have made air pollution responsible for global cooling as lesser amount of solar energy reached the earth's atmosphere during that period. NASA scientist have published report regarding the change of temperature of 48 states of USA during the period from 1880 to 2006. The report says that during the last 226 years USA has experienced a several warming and cooling. [Fig : 15] Scientist Hey, Martinson, Morey etc. has proved that fact that during the long 8 00 thousand years our planet has faced successive global warming and cooling. [Fig: 16]

Positive and negative feedbacks are the most important feature of global temperature and climatic system. Sometimes an incident changes the internal conditions of the climate system in such a way, that the original incident is extended. This phenomenon is known as positive feed back. For example : In glacial age due to the increase of Albedo duration of glacial age increases. That is why duration of glacial age is longer than the warming age. On the other hand if the internal condition of the climatic system alter in such a way, so that the original incident diminishes, then this phenomenon is known as negative feed back. For example, on decrease of the distance between the sun and the earth, glacial age comes to an end.

According to Richard S. Lirdzen negative feedback mostly takes place in nature. But IPCC scientists believe that positive feedback is more prevalent.

The natural phenomena can not be explained properly untill and unless all the laws of the nature



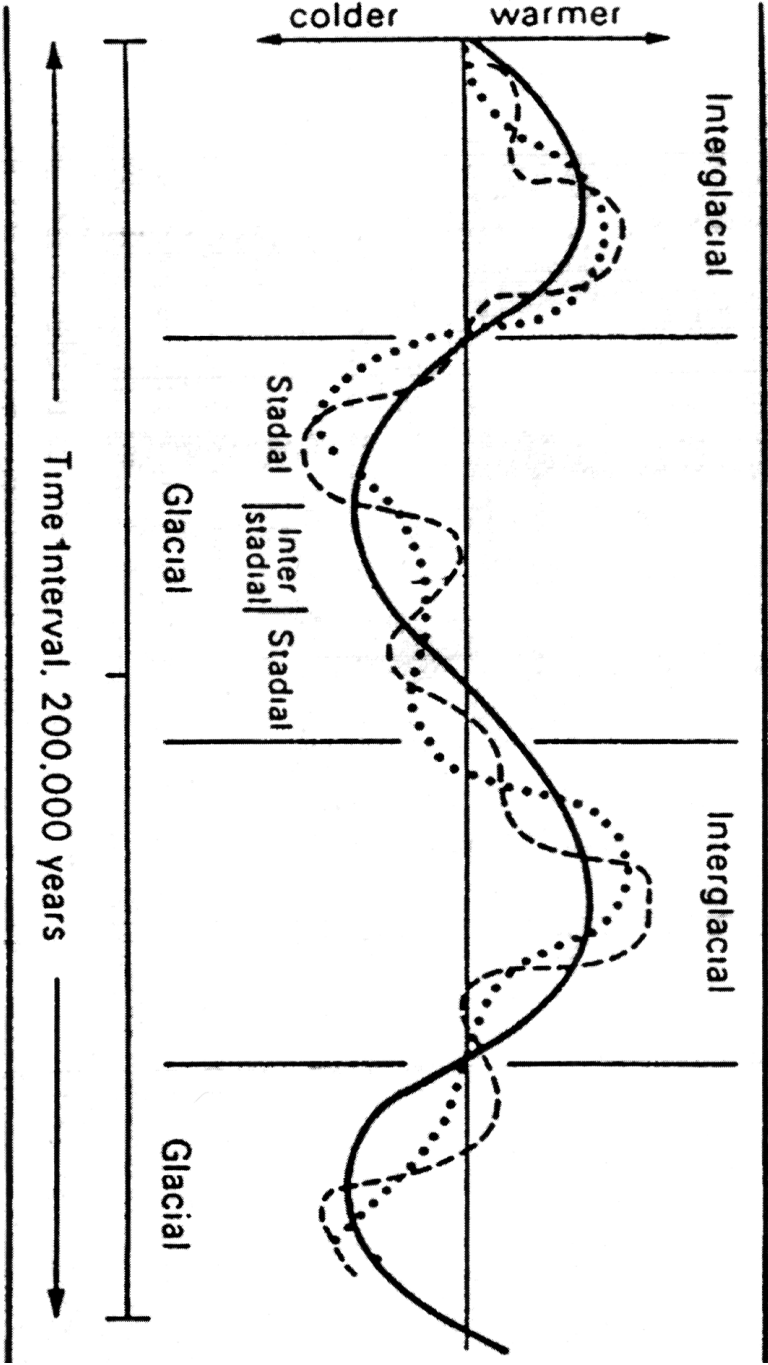


Fig 14

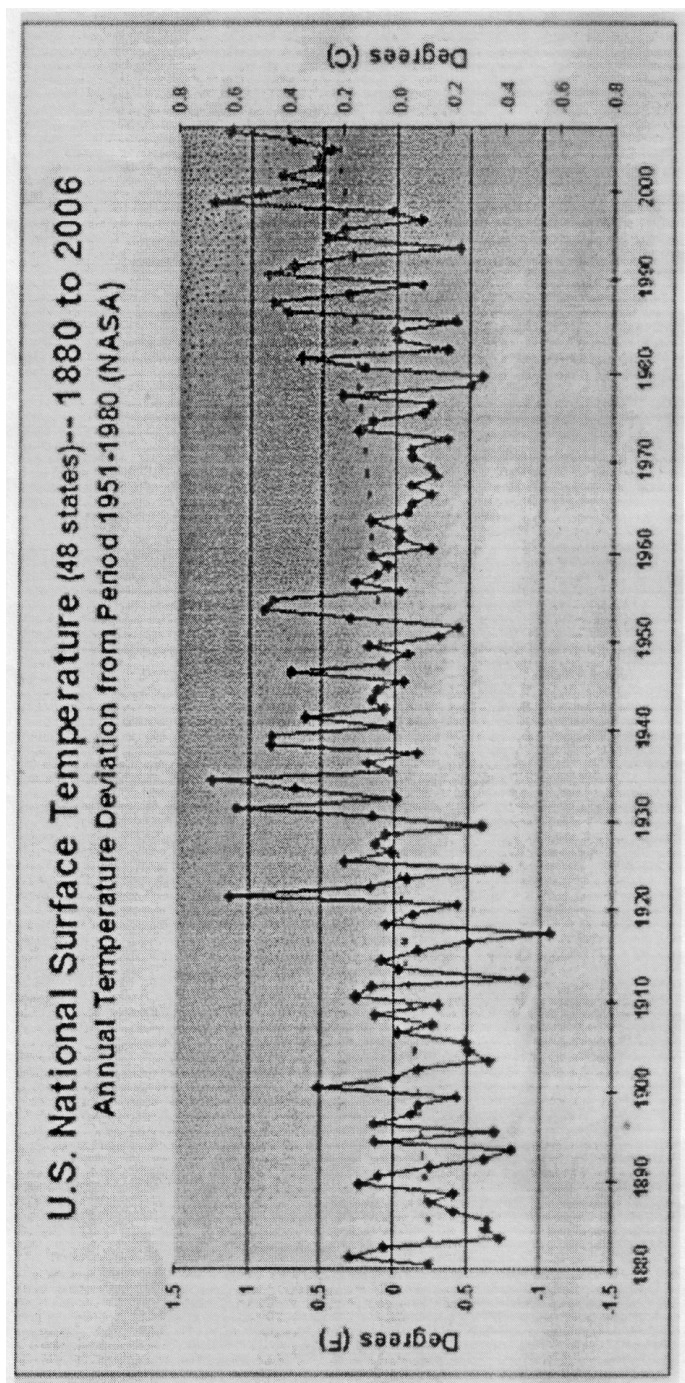


Fig 15

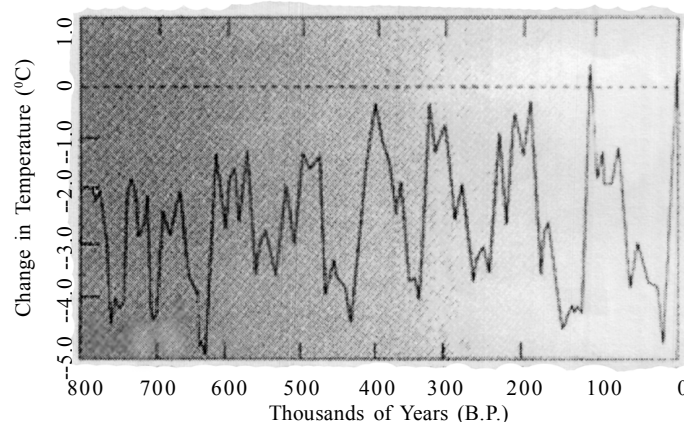


Fig 16

Temperature data inferred from measurements of the ratio of oxygen isotope ratios in fossil plankton that settled to the sea floor, and assumes that changes in global temperature approximately tracks changes in the global ice volume. Based on data from J. Imbrie, J.D.Hays, D.G. Martinson, A. McIntyre, A.C. Mix, J.J. Morley, N.G. Pisias, W.L. Prell, and N.J. Shackleton, in A. Berger, J. Imbrie, J. Hays, G. Kukla, and B. Saltzman, eds., *Milankovitch and Climate*, Dordrecht, Reidel, pp. 296-305, 1984. Courtesy of Thomas Crowley, *Remembrance of Things Past : Greenhouse Lessons from the Geologic Record*

are not discovered. Scientists have studied eight hundred thousand years of history of the nature and found that the global temperature has reached its highest as well as the lowest point in a successive manner. Global warming occurs much faster than global cooling. Due to cosmological reason, several glacial ages have appeared on the earth. But never had it prevailed over the entire globe. Presently, glaciation exists at the polar region of the earth. IPCC has unquestionably held human activities to be solely responsible for global warming and changes in weather. That is why IPCC has termed present global warming as 'Anthropogenic Warming'.

After going through the topics of Milankovich-Cycle, sun-spot, green house gases, plate tectonic evidences and the evidences of ice age will people with a scientific bend of mind still believe that the global warming is 'Anthropogenic'?

Global warming and global cooling have definite causes and factors which are interrelated and take place in cyclic manner. These factors have a resultant effect which determines the occurrence

of warming and cooling of the earth's atmosphere. The graph of atmospheric temperature during the last 800,000 years has never been linear. On the contrary evidences of lots of small warming ages during the long cooling phase and lots of small cooling ages during the long warming phase have been clearly observed in the scientific studies.

Scientists all over the world are quite certain about the fact that global warming is a natural phenomenon. Even the capitalist intellectuals both at the national and international levels are sanguine about this truth.

The knowledge of the history of earth's environment will help us to comprehend the subject.

The History of Environment

The earth's atmosphere and water bodies were created due to the proper location of the globe in the solar system and then earth's atmosphere has become habitable for fauna and flora. Was the atmosphere the same at the time of its creation as that of the present? The answer

is 'No'. It has been changing continuously since its creation. Since then atmospheric temperature, pressure, composition of the atmospheric gases, sea-water level etc. has been altering and even today these keep changing. As a result of this nature as well as the status of living creatures are also changing.

Presently, the two main constituents of air are nitrogen and oxygen. The other constituents are carbon-di-oxide, hydrogen, water vapour, ozone etc. These gases take part in photolytic reaction mainly at stratospheric or above level.

Primitive atmosphere was formed mainly by these processes :1) From the gases after the creation of earth from Solar Nebula, 2) the extraterrestrial materials e.g.; meteors, comets etc. and 3) gases evolved due to volcanic eruption. From their intensive studies, scientists have come to know that at the preliminary stage i.e. in the Hadean and Archean era, there were methane, ammonia, hydrogen, carbon-monoxide and a little amount of carbon-dioxide, water vapour, hydrogen sulphide and nitrogen in the earth's atmosphere. With the passage of time, the gaseous components of the earth's atmosphere have increased in amount and in numbers.

Initially there was no oxygen in the primitive earth's atmosphere. How oxygen had appeared in the atmosphere? In the atmosphere, oxygen had formed 1) during the light phase of photosynthesis through the photolysis reaction of water molecules, 2) during photolysis of water vapour at the stratosphere of earth's atmosphere, 3) by decomposition of sulphates and carbonate compounds present in the sea-water and earth surface. In the first 2500 million years (approx.) of earth's creation, aerobic plants were absent, therefore the amount of oxygen was dependent on the last two factors.

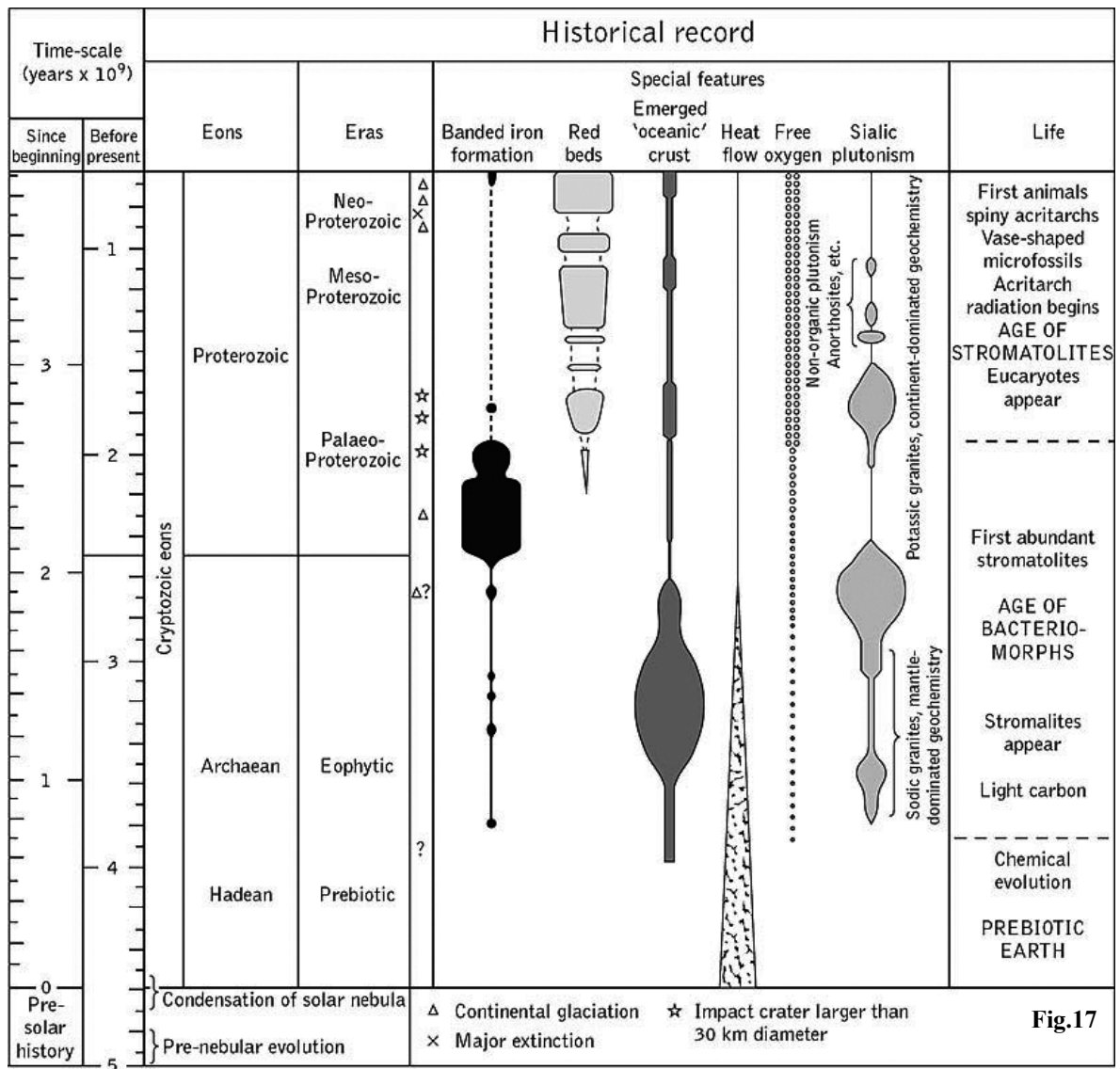
First life on the earth appeared about 3500 million years ago into the sea-water. Although it is not exactly known to the scientist that how

organic compound were formed from inorganic substances, scientists have a strong belief that the essential life materials had been created from the gases present in the then atmosphere and unicellular organism (prokaryotes) had appeared gradually through evolution. Stromatolites (trace fossils) obtained in marine phosphates and carbonates are carrying the evidence that unicellular organisms appeared about 3500 million years back. Evidences of unicellular organism of 2500-1800 million years old have also been found in iron ore. Ancient rocks of our country are also carrying such evidences. First unicellular bacteria had appeared about 1000 million years back.

Let's have a look at the gradual changes in earth's atmosphere, evolution and extinction of several lives during various ages.[Fig.17&18]

The concise history of earth's environment shows that life on earth appeared only when the atmosphere became habitable to the creatures. Aerobic fauna and flora appeared on the earth only after the oxygen level had reached a certain level in the atmosphere. The environment kept on changing even after the life appeared and thereafter lives are being adapted with the changes in the environment. The species which were unable to adapt themselves with the change of environment had got extinct. It is the nature – the environment which actually rules.

The main reason behind the changes of the environment is change in the equation of the balance of energy. The Sun is the ultimate source of energy of the environment. The different regions on the earth have different relative positions with respect to the Sun. Depending on the solar energy that is enters different region on the earth, different food chain relationships are noticed. Energies flow along the food-chain. The life cycles of plants and animals are directly related with bio-geo-chemical cycles. The earth absorbs solar energy and a portion of it is radiated back to the atmosphere. Greenhouse gases entrap a portion of the energy radiated by the earth surface which make the environment habitable for the plants and animals. Scientist stated that had



there been no greenhouse effect, the average atmospheric temperature would have been -18°C which is not favourable for survival of life. Therefore, greenhouse gases have immense importance in maintaining the energy balance of the environment. Biogeochemical cycles maintain the balance among the elements and compounds. If any fact (i.e. earthquake, volcanic eruption, meteoric impact, extraterrestrial events etc.) cause changes of energy in the environment, a new

equation of energy-balance is set up. Thus, the time period, stability of the biogeochemical cycles are also changed.[Fig.19] These changes lead to the changes in the environment due to the change in the balance of element-compound cycle. With the change of the environment, living creatures start adapting. The species those fail to adapt with the change in the environment become incapable of surviving and become extinct. On the other hand, the species that manage to adapt with changing

Era	Period	Epoch	Duration in Millions of Years	Time from Beginning of Period to Present (Millions of Years)	Geologic Conditions	Plant Life	Animal Life
Cenozoic (Age of Mammals)	Quaternary	Recent	0.011	0.011	End of last ice age; climate warmer	Decline of woody plants; rise of herbaceous ones	Age of humans
		Pleistocene	1.9	1.9	Repeated glaciation; 4 ice ages	Great extinction of species	Extinction of great mammals; first human social life
	Tertiary	Pliocene	4	6	Continued rise of mountains of western North America; volcanic activity	Decline of forests; spread of grasslands; flowering plants, monocotyledons developed	Man evolved from humanlike apes; elephants, horses, camels almost like modern species
		Miocene	19	25	Sierra and Cascade mountains formed; volcanic activity in northwest U.S.; climate cooler		Mammals at height of evolution; first humanlike apes
		Oligocene	13	38	Lands lower; climate warmer	Maximum spread of forests; rise of monocotyledons, flowering plants	Archaic mammals extinct; rise of anthropoids; forerunners of most living genera of mammals
		Eocene	16	54	Mountains eroded; no continental seas; climate warmer		Placental mammals diversified and specialized; hoofed mammals and carnivores established
		Paleocene	11	65			Spread of archaic mammals
Mesozoic (Age of Reptiles)	<i>Rocky Mountain Revolution (Little Destruction of Fossils)</i>						
	Cretaceous		70	135	Andes, Alps, Himalayas, Rockies formed late; earlier, inland seas and swamps; chalk, shale deposited	First monocotyledons; first oak and maple forests; gymnosperms declined	Dinosaurs reached peak, became extinct; toothed birds became extinct; first modern birds; archaic mammals common
	Jurassic		46	181	Continents fairly high; shallow seas over some of Europe and western U.S.	Increase of dicotyledons; cycads and conifers common	First toothed birds; dinosaurs larger and specialized; insectivorous marsupials
	Triassic		49	230	Continents exposed, widespread desert conditions, many land deposits	Gymnosperms dominant, declining toward end; extinction of seed ferns	First dinosaurs, pterosaurs and egg-laying mammals; extinction of primitive amphibians
Paleozoic (Age of Ancient Life)	<i>Appalachian Revolution (Some Loss of Fossils)</i>						
	Permian		50	280	Continents rose; Appalachians formed; increasing glaciation and aridity	Decline of lycophytes and horsetails	Many ancient animals died out; mammal-like reptiles, modern insects arose
	Pennsylvanian (Carboniferous)		40	320	Lands at first low; great coal swamps	Great forests of seed ferns and gymnosperms	First reptiles; insects common; spread of ancient amphibians
	Mississippian (Carboniferous)		25	345	Climate warm and humid at first; cooler later as land rose	Lycophytes and horsetails dominant; gymnosperms increasingly widespread	Sea lilies at height; spread of ancient sharks
	Devonian		60	405	Smaller inland seas; land higher, more arid; glaciation	First forests; land plants well established; first gymnosperms	First amphibians; lungfishes, sharks abundant
	Silurian		20	425	Extensive continental seas, lowlands increasingly arid as land rose	First definite evidence of land plants; algae dominant	Marine arachnids dominant; first (wingless) insects; rise of fishes
	Ordovician		75	500	Great submergence of land; warm climates even in Arctic	Land plants probably first appeared; marine algae abundant	First fishes, probably fresh water, corals, trilobites abundant; diversified mollusks
	Cambrian		100	600	Lands low, climate mild; earliest rocks with abundant fossils	Marine algae	Trilobites, brachiopods dominant; most modern phyla established
Proterozoic	<i>Second Great Revolution (Considerable Loss of Fossils)</i>						
			1000	1600	Great sedimentation; volcanic activity later; extensive erosion, repeated glaciations	Primitive aquatic algae and fungi	Various marine protozoa; towards end, mollusks, worms, other marine invertebrates
Archeozoic	<i>First Great Revolution (Considerable Loss of Fossils)</i>						
			2000	3600	Great volcanic activity; some sedimentary deposition; extensive erosion	No recognizable fossils; indirect evidence of living things from deposits of organic material in rock	

*NOTE: Adapted, by permission, from Villee, C. A. Biology, 7th ed. Philadelphia: W. B. Saunders Co.; 1977. © 1977 W. B. Saunders.

Fig.18

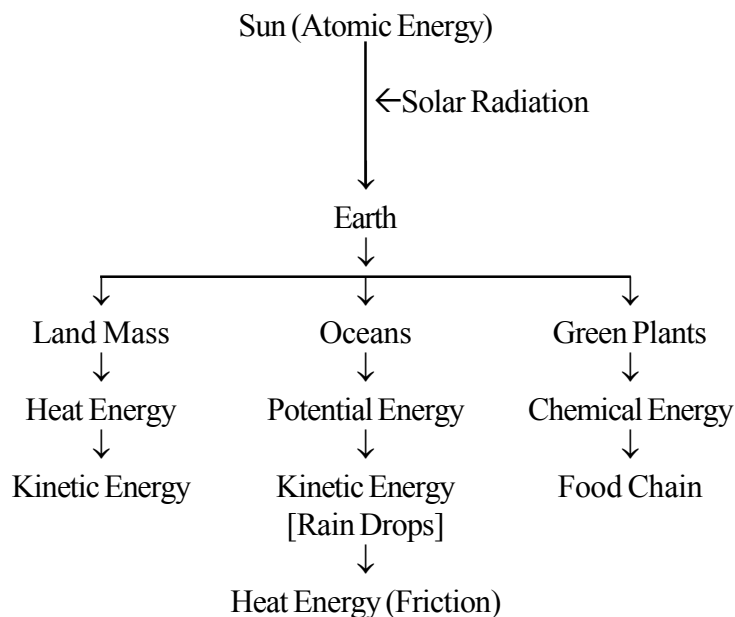


Fig.19

environment, survive. It has been found that rate of extinction of the species during global cooling is remarkably higher.

A report published in 2015 mentioned the appearance of hundreds of new species in Himalayan and Amazon region very recently a research paper of 'elife' magazine published that not 'natural selection' but 'mutation' plays the most important role behind appearance of new species.

Historical studies on climate also support the fact that climate changes with time and on the basis of that biogeological cycles maintain dynamic equilibrium.

Now, the question is, inspite of having these knowledge, why IPCC and a section of environmentologists are stating the global warming as anthropogenic?

The scientists of IPCC are trying to pass off pseudo-science as science. A good section of academicians are induced by the IPCC campaign and many of them have become patron of this unscientific notion. Governmental, non-governmental and private media agencies play an active role in this campaign. Through the education system of all the nations of the world, this notion

of IPCC is being presented to the students in the name of 'Environmental Science'. The scientific analysis against the unscientific view of IPCC is not coming to the fore but it exists among a good number of scientists and to the people with a scientific bent of mind. In order to hide the scientific causes behind the environmental and climatic changes, use of fossil fuels and carbon-di-oxide have been made culprit by IPCC. The scientists against this unscientific notion have made it clear that global warming is a natural phenomenon, a cosmological phenomenon which is supported by geological proof. Water vapour has the maximum greenhouse effect which is generated in a certain phase of water cycle. Carbondioxide Cycle has little or no connection with global warming – because a large amount of excess carbon dioxide generated due to natural activity and human activity is absorbed by marine water. Moreover alteration of atmospheric temperature does not depend on alteration of amount of carbondioxide in the atmosphere, on the contrary, alteration of the amount of carbondioxide in the atmosphere depends on alteration of atmospheric temperature. IPCC also states that carbondioxide emitted due to

anthropogenic cause is responsible for positive feedback of water vapour in the atmosphere. Recently, stooge scientists of IPCC have started saying that marine water is unable to absorb carbondioxide but without any scientific research.

But it is known to all that carbondioxide is a colourless, odorless gas which is released into the atmosphere by various biological activities of living creatures and it has never been poisonous. Carbondioxide is the only source of carbon which is used by the plants in carbon assimilation process (photosynthesis) for preparation of carbohydrate type of foods for animals world.

Why bio-friendly carbon-di-oxide gas has been made a culprit?

All the national and international projects that have been commissioned regarding the climate change and the 'carbon budget' have been commissioned on the basis of an idea where 'cause' and 'result' has been mixed up. The 'cause' has been presented as the 'result' and vice versa. Therefore, all the projects and the schemes prepared afterwards have no scientific basis. This types of campaign have some phylosophical target – which is anti scicence. Materialistic observation shows that not only climate, all the objects of this universe are ever changing. With time everything in the universe changes though dynamic equilibrium. For example, the relative position of all the celestial bodies like planets stars etc are changing. Within an enormous space of time the mass, gravitational force of the celestial bodies changes. Due to continental drifting, the position of the continents of our globe change. Also magnetic field of the earth changes. Study of the history of human civilisation proves that the human society in not static. So nothing is static in the universe. Science is not class dependent but philosophy is class-dependent. That is why, when an imperialist-lobby champions the unscientific

theories behind the 'global warming', the other lobbies instead of exposing the truth behind the climate change, remain mute. The imperialist groups have a common philosophical interest behind this unscientific campaign. Dying imperialist groups have a common class-interest of providing a life support to the capitalism. The present global economy, that has attained the highest monopolistic stage of capitalist development, cannot provide a solution to overcome its inherent crisis of over production. Instead, the crisis is intensifying. This overproduction is in respect of the demand of the market, not in respect of need of the society. Renewable energy cannot be an alternative of fossil fuel in the field of industrial production. This global crisis has forced capitalism to invest more in the non-productive sectors. Use of renewable energy is suitable in non-productive sectors. For the same reason rise of production of atomic energy is not essential to them. For this reason, anti-atomic energy movements of the environmentalist organisations are getting momentum and sometimes succeed in stopping setting up of nuclear power plants.

Though all the laws of the nature have not discovered yet, but it has been discovered and proved that global imperialist system is market dependent. In the class based society, intellectuals are not class independent, instead they defend class-interest. Every cycle of capitalist economy terminates in the market. To create market for new commodities, on one hand, use of the commodity is made mandatory and on the other, by hiding the actual cause, purposeful campaign is organized to form public opinion in order to create new market. For this purpose IPCC and its patrons are branding global warming as, anthropogenic. Who knows if global cooling might not also be used in future to create market of new commodities? ■

THE JOURNEY OF MIGRATORY BIRDS

Our world, “The Earth”, is the only place where life exists. There are about 8.7 million species on the Earth – with 6.5 million species on land and 2.2 million in oceans. Humans (Scientific Name : *Homo sapiens sapiens*) among all 8.7 million species is the only advanced surviving species on the earth. According to the classification of ‘Animal Kingdom’ human beings are ‘Mammals’. The class ‘Mammals’ evolved from a group of reptiles of class ‘Reptilia’, through an ‘Organic Evolution’ – the process by which changes in the ‘Genetic’ composition of population of organisms may or may not occur in response to environmental changes but obviously through ‘Mutation’.

The class ‘Reptilia’ is again divided into another ‘class’ named as ‘Aves’, which is commonly called ‘Birds’. Investigation of historical origin of birds revealed that there is a close relationship between birds and reptiles after the discovery of fossils of the primitive birds, ‘Archaeopteryx’, in the nineteenth century. ‘Archaeopteryx’ is a ‘Missing Link’ between the Reptile (dinosaurs) and the modern birds.

The Modern Birds or Birds are a group of endothermic or warm blooded vertebrates, characterized by feathers, toothless beaked jaws, the laying of hard-shelled eggs, a high metabolic rate, a four chambered heart and a strong yet light weight skeleton. Another word we habitually associate with the name bird, is ‘Flying’.

Here, we are going to discuss about the flying mechanism of the birds which is related to ‘Migration’. Migration is the unique ability of the birds that enables them to traverse large distances, flying over continents and oceans. Once, primitive men led the life of ‘vagabonds’ just like the migratory birds in search of adequate food, learned lessons from each other and evolved with every change in nature through practice and this

developed their brain vastly, enabled them to produce food by their own through cultivation and domestication of wild animals. This evolutionary changes distinguished them from all other animals of animal kingdom and erect themselves as an advanced species ‘Human beings’.

Historically, near about 3000 years ago, migration was recorded by Ancient Greek Authors including Homer and Aristotle. Sometimes, we have seen, high up in the sky a ‘flock of birds’ flying in formation making a soothing rhythmic sound. They fly high above the boundaries and barriers of the countries and the continents, flying restlessly and ruthlessly towards their destination, by conquering the undesirable hindrances of natural calamities in order to survive in the planet ‘earth’.

A report, on 12 December, 2016 based on a new research led by the “American Museum of Natural History” suggested that there are about 18,000 bird species in the world. The birds that look similar to one another, or were thought to interbreed, but are actually different species are long-distance migrants. So, to represent a subject generally we have to understand four basic facts about migration: what, why, where and how?

What is Bird Migration?

The term ‘Migration’ describes periodic large scale movements of population of animals. Bird Migration is a unique characteristic of some specified species of birds which involve regular seasonal movement, often north and south along a flyway, between their ‘breeding ground’ and the ‘wintering ground’. The word ‘Migration’ has come from the Latin word ‘migrare’ which means going from one place to another.

Why do the Birds Migrate and where do they Migrate?

The primary necessity of birds to migrate is the fluctuations in availability of food due to

change in the climatic condition which makes survival extremely difficult, sometimes impossible.. Eventually, the birds bid adieu to their their habitat and wing their way in search of a 'new home' i.e. wintering ground towards the temperate zone of the earth. The birds mainly migrate in the Northern Hemisphere from both Northern and Southern Hemisphere. For birds, migration means 'two-way' journeys – onward journey from home i.e. the breeding ground to the new wintering ground and back journey from the 'new' places to the 'homes', In northern hemisphere, the most common pattern involves flying north in the spring to breed in the temperate or Arctic Summer and returning in the autumn to wintering ground in search of food and habitat, in warmer regions to the south. On the other hand in the southern hemisphere the directions are reversed but there is less land area in the far south to support long distance migration. A record based on the scientific evidence says that over a lifetime of about 25 years, an 'Arctic tern' (*Sterna paradisaea*) can fly a million kilometers, travelling between Arctic breeding grounds and the Antarctic each year, which is nearly three times the distance from the earth to the moon.

Types and patterns of Migration

There are different types and patterns of migration depending upon the nature of migratory birds. The most common pattern involves flying north in the spring to breed and feed their younger one during the longer days of northern summer and returning in the autumn to wintering grounds in warmer regions to the south of the northern hemisphere. It is observed, that within a population, it is common for different ages and sexes to have different patterns of timings and distance. For example, "Female Chaffinches in eastern Fennoscandia migrate earlier in the autumn than males do.

1) Long Distance Migration : This is a well-known and wide spread migration predictably

based on seasonal changes, as birds move between the breeding and the new wintering ground. In this type of migration, the most common pattern of flying of migratory birds is identified, which basically happens in the northern hemisphere due to availability of excessive land and feeding areas for the migrants in the 'new moderate wintering ground. For example, the pink-footed goose migrates from Iceland to Britain and neighbouring countries, whilst the dark-eyed junco migrates subarctic and arctic climates to the contiguous United States. The long distance migration is classified into followings :

a) Seasonal : When the climate conditions forces the birds to leave there 'home' i.e. breeding ground in search of adequate foods and they migrate towards new wintering ground for habitats during a definite period of season, between spring and autumn or wet and dry, then its called seasonal migration.

b) Latitudinal : This migration is between areas of different latitudes from north to south and vice versa. Neotropical Migrants are special types which exhibit this type of migration.

c) Longitudinal : Similar to latitudinal migration, this types of migration is between different longitudes from east to west or west to east.

d) Loop : This migration includes two distinctly different routes to and from breeding grounds, often taking advantages of varied resources at different times of the year. Loop migration is also common with many sea birds and shorebirds as they use seasonal variations in wind patterns to aid their flight.

e) Diurnal : Some large-broad-winged birds migrate in the day time which mainly depends on "Thermal columns" of rising hot air to enable them to fly. [Note : Thermal column is a column of rising hot air in the lower altitudes of earth's atmosphere, a form of atmospheric upward convection current created by the uneven heating of earth's surface from solar radiation.]

f) Nocturnal : This type of migration is participated by the smaller insectivorous birds, migrating a large distance usually at night in a particular region, they land in the morning and may feed for few days before resuming their migration. This short duration between the origin and destination referred this birds are **Passage migrants** – One cost of nocturnal migration is the loss of sleep. Migrants may be able to alter their quality of sleep to compensate for the loss.

g) Nomadic : This type of migration depends on the availability of food and water resources. Nomadic birds tend to stay within the same range but may be completely absent from parts of that range when resources are scarce, but will return when the habitats becomes more suitable.

h) Leap-Frog : An interesting type of migration in which some species migrate a greater distance to skip over a sedentary population, population of same species of bird occupy the suitable wintering ground for habitat, but the individual population do not extensively mix.

i) Reverse : Actually this type of migration is not observed in a particular species of bird but among the young birds those who get confused and actually go in the opposite direction, instead of migrating along the expected route. These last birds end up as vagrants far from their traditional location.

Generally, the long-distance migratory birds have a very tough migration route between breeding and wintering ground. It doesn't follow a straight line, rather it could follow a hooked or arched line with detours around the geographical barriers. For most land-birds, seas, large water bodies or high mountain ranges become the barriers because of the lack of stopover or feeding sites. In reverse, a large area of land without bodies of water that offer feeding sites may also be a barrier to a bird that feeds in coastal waters. So, the birds' migratory journey is rather a tougher one than we imagine. Food is the main motivation

for migration, for some species of bird choose not to migrate if fed throughout the winter.

2) Short-Distance Migration : This type of migration is a response to local weathering condition, however it may not need a timing mechanism.

a) Altitudinal : This type of migration is the movement of mountain dwelling birds from higher elevation to the lower elevation in winter, when harsh weather and deep snowfall may make staying at higher elevation impossible.

3) Some Other types of Migration :

a) Irruptive : Circumstances such as a good breeding season followed by a food source failure the following years lead to irruptions in which large numbers of a species move far beyond the normal range and bring them into an unusual areas, most often in winter.

b) Dispersal : This type of migration includes the '**Juvenile Birds**' i.e. the young birds. In this migration juvenile birds are forced away from their hatching grounds and must seek out their own territories as their parents continue to use the same range.

How Do The Migratory Birds Navigate The Route Of Journey?

The migratory birds travel a long distance in search of adequate food and a new wintering ground. During such labourious journey, birds face many challenges, mainly the abnormality of the weathering condition, which they have to defeat to reach their definite goal. The control of migration, its timings and response are generally controlled and appear to be a primitive trait that is present in migratory species of birds. Before the birds begin to migrate, they exhibit some behavioural activities as well as physiological changes. In **Ethology**, the science of animal behaviour, it describes that the anxious behaviour of the normal migratory birds especially during migration period, display higher activity or **Zugunruhe**. Zugunruhe is a German compound

word consisting of Zug means move, migration and “Unruhe” means anxiety, restlessness. In migratory bird species, the occurrence of “Zugunruhe” is quite a circannual endogenous programmes. This anxious behaviour displayed by migratory bird species was once due to environmental cues or causes (i.e. Shortening of days and falling temperature). But they have generally been adopted by these over year after years and now such a behaviour is genetically transmitted through the species and are displayed even where such environmental causes are absent. **This behavioural attitude is thus not a genetic change but a genetic framework for nearly all migratory bird species which is carried down by whole migratory avian lineages.** The cage-raised birds also display such “migratory restlessness” with no environmental cues and even take a preferential flight direction that corresponds with the migratory direction they would take in nature, changing their preferential direction at roughly the same time their wild conspecifics change course. Hence such an anxious behaviour of the migratory bird species in proved to be genetically controlled.

Now, let's deal with the physiological changes. Before migration, the hormone level in the birds stimulate them to gain body weight. This stimulation of hormonal level leads the birds to a state of voracious feeding and abnormally excessive desire for food, which is termed as **hyperphagia** ‘hyper’ means ‘excessive’ and ‘phagia’ means ‘eating’. Due to excessive feeding, major biomolecules substances get stored in the body. ‘Prolactin’ – a hypothalamic hormone – induces fat deposition in the body because fats have evolved as a major fuel to support bird migration whereas ‘Gonadal Hormones’ play an important role, mainly ‘the testosterone and its metabolism’ in increasing the muscle and bone mass, and even the growth of body feathers thus increasing the total body weight of the birds. So,

this too the behavioural activities and the physiological changes are an **innate biological clock** which change on a daily, seasonal, yearly or other regular cycle in the life-style of the migratory bird species.

Usually, the migratory bird species, take a flight in ‘flock’. A ‘flock’ is a gathering of a group of same species of animals. In our childhood, we were very much accustomed with this ‘collective noun’ ‘a flock of birds’ which is singular, even though there are lots of birds. Therefore, many, if not most, birds migrate in ‘flocks’. For migratory birds, flying in flocks reduces the energy cost required in migration by making correction in the direction of wind or wind drift. [Fig.1, *inside back cover*] For example, Geese in a ‘V-formation’ may conserve 12-20% of the energy they would need to fly alone. The flying in flocks also reduces the risk of predation and unwanted death due to predation. The storage of energy through the accumulation of fat and control of sleep in nocturnal migrants require special physiological adaptations. So, to meet the demands of migration, birds need to alter their metabolism processes. The migratory birds possess longer and pointed wings than the non-migratory birds which helps them to reduce air resistance, thus promoting a easier flight. Due to such long distance flights, the feathers of a bird suffer from wear and tear and require to be moulted. The timing of this moult is usually once a year but sometimes twice – varies with some species moulting prior to moving to their winter grounds and others moulting prior to returning to their breeding ground.

So far, we have a glance about the types, changes and activities of the migratory birds species. But still it is unknown as well as mysterious to us as to how these migratory bird species detect and navigate their migratory path. To unravel this mystery, many research studies have been carried out to understand the biophysical and biochemical mechanisms of the

migratory birds. Many claim that the migratory birds use celestial cues from the sun and stars, some are of the opinion that it probably has a mental map and others say that the migratory birds use the geographical boundaries, landmarks and mountains to discover their migratory path. All such assertions, do not have any strong authentically verified evidence, which could prove the migration mechanism of migratory birds.

After a long period, through prolonged research, it has been confirmed established that the migratory birds use information about the earth's magnetic field to detect their direction and position. This specialized attribute of migration of such a migratory avian lineages is credited to the phenomenon called **Magnetoreception**. Magnetoreception is a sense with the help of which an organism perceives direction, altitude and location by interacting with the earth's magnetic field. The innate biogenic organ that has the ability to interact and detect magnetic field is called the Magnetoreceptor. Therefore, the migratory bird species possess an innate biological sense, acquired from evolution. Analogically, Magnetoreception is a combination of biophysical and biochemical mechanism within the body of the migratory birds where as Magnetoreceptor is equivalent to a magnetic compass needle which must be made up of ferromagnetic or ferrimagnetic minerals and shows the direction of migration by interacting with the earth's magnetic field.

The earth's magnetic field originates from a so-called self-generating **Geodynamo**. [Fig.2, *inside back cover*] Geodynamo is the self-sustaining process responsible for maintaining the earth's magnetic field in which the kinetic energy of convection motion of the earth's liquid core is converted into geomagnetic energy. It is observed experimentally, that the intensity of the geomagnetic field ranges from 68 μT at the magnetic poles to 23 μT around the magnetic

equator. Consequently, the earth's surface experiences an average magnitude of magnetic field about 10–4 tesla which is basically a weak field. So, the magnetoreceptor, present in the body of the migratory birds need to detect very minute variations in both intensity and direction. Moreover the number of magnetoreceptors must be high enough to overcome the signal to noise ratio i.e. a magnetic field can be only perceived when its effects is higher than any background noise of the reception system.

There have been sound experimental evidence that have conclusively demonstrated the presence of Magnetoreceptor i.e. chains of crystal of ferrimagnetic minerals either magnetite (Fe_3O_4), Hematite (Fe_2O_3) or greigite (Fe_3S_4) in migratory birds. Magnetometry, X-Ray fluorescence and atomic force microscopy such numerous techniques are applied to detect the presence of magnetoreceptor on migratory birds body. Mainly, the presence of ferrous and ferric particles in the body of migratory birds are from the type of foods they usually feed. Dried peas and beans, nuts and seeds, legumes and whole grains, red meat as well as shell fish contains good amounts of **iron**. This iron particles thus undergo the chemical reaction with the oxygen or sulphur molecules and hence form oxides of iron or ferric sulphate within the body of the migratory birds. Not only from the food but also from the soil, this ferrimagnetic minerals enter the birds body when they peck the seed grains from the soil as soil is rich in cobalt, iron and nickel. The location of ferrimagnetic minerals is different in different species of migratory birds. Some evidence of the presence of ferrimagnetic in migratory birds have been found. In homing pigeons, a complex array of biogenic magnetic minerals have been found in a part of the beak i.e. six clusters of such minerals have been found – three on each side, coupled to a nerve that responds to change in intensity and direction of magnetic field. In other migratory

birds, magnetite grains were reported in the head particularly in the ethmoid region (the space between the nasal cavity of beak and the brain). This portion of the birds head is innervated by the 'Ophthalmic nerve', nerve that carries sensory informations from face, eye and eye brows to the brain.[Fig.3, *inside back cover*]

Hence, the presence of Magnetoreceptor as ferric magnetic mineral inside the body of migratory birds and its interaction with and detection of earth's magnetic field have almost unraveled the mystery of migratory journey of the birds. Now, let's focus on the mechanism of the Magnetoreception. There are two most acceptable research based principles for explaining the concepts of magnetoreception in birds:

i) Radical Pair Mechanism ii) Resonance Model.

i) Radical Pair Mechanism : The radical pair mechanism can be suggested as a Photochemical Mechanism. A Radical is any atom, molecule or ion that has one or more unpaired valence electron in their outermost orbital. It has been proposed that the primary detector is a specialized ocular (vision-based) photoreceptor that plays host to magnetically sensitive photochemical reactions having radical pairs as **fleeting intermediates**.

The radical pair mechanism is responsive to the **geomagnetic inclination** rather than the **polarity of the geomagnetic field** as the birds maintain their orientation towards the direction of the magnetic field while migrating and don't seem to depend on its intensity. **Magnetic dip** or **Magnetic inclination** is the angle made with the horizontal by the earth's magnetic field lines.[Fig.4, *inside back cover*] The migratory birds species show greater attention towards magnetic inclination which have a tendency to align themselves with lines of magnetic field. Moreover, this avian magnetic orientation is light-dependent. This magnetically sensitive reactions almost

always involves radicals i.e. molecules that have an odd number of electrons and consequently an unpaired electron spin that may be found in one of 2 spin states $\uparrow\downarrow$.

An atom with unpaired electrons are termed as Paramagnetic gets attracted towards the magnetic elements because electrons within the orbital are not stabilized or balanced, thus resulting a net magnetic field whereas an atom with paired electrons are termed as Diamagnetic unable to attract the magnetic elements because electrons within the orbital are uniform and stabilized within the orbital thus resulting in no magnetic fields. The Radical pairs are very much sensitive due to the unpaired electrons, may be present in the ferrimagnetic minerals and hence act as a magnetic compass inside the body of the migratory birds to detect the direction of the external magnetic field. More interestingly the mechanism of radical pair formation depends on the relative orientation between the earth's magnetic field and the radical pairs. A radical pair consists of two radicals derived from biomolecular (one donor and one acceptor) reactions in a biochemical transformation in photoreceptors of migratory birds. This light-dependent magnetoreceptors or photoreceptors are light (photons) sensitive sensory cells distributed around and aligned within the retina of the bird's eye, in the manner of the visual rods and cone cells.

In turn, the magnetoreceptor molecules would be oriented within the receptor cells perhaps by attachment to Cryptochromes a blue-light sensitive photoreceptive proteins found in the retinal neurons of migratory birds during migration period. Cryptochromes are blue-light photoreceptor flavoproteins, first identified in plants in 1993, generated automatically in the retinal neurons in a cyclic order during migration. These flavo proteins get activated on exposure to blue light, have a group of biogenic proteins called Chromophore that induces radical pair formation by photon excitation

through light adsorption which is similar to the photosynthesis reaction. As a result of this birds perceive the magnetic field as an apparent light intensity or colour variation in their visual field. These concept of 'vision-based magnetoreceptor' concluded that the birds can 'see' the magnetic field and align themselves with direction of the geomagnetic field they want to travel where 'Cryptochromes' provides an invisible path of connectivity between the earth's magnetic field and the internal radical pair formation. The whole mechanism of the radical pair and its interaction with the external geomagnetic field through 'Cryptochromes' is a bio chemically adapted genetical framework, which is naturally participated by the migratory bird species in a cyclic order.

iii) Resonance Model : This is a proposed model of magnetoreception in migratory birds which is based on the Resonance principle. Here, resonance means matching or the interaction of two different field resulting in high intensity. This model represents that the magnetoreception takes place in the optic tectum of the brain of migratory bird and acts like a magnetic compass for the bird. The optic tectum is a portion of the bird's brain that receives two distinct spatially separable visual signals from the retina. Actually, the resonance

effects occur during the visual stimulation, when the changed particles oscillate, creates a radical electric field in the optic tectum of the bird's brain which interacts with earth's magnetic field. The resonance becomes more pronounced when both the internal radical electric field and the earth's magnetic fields are perpendicular to each other. The orientation perceived by the migratory birds into their brain is related to the earth's magnetic field depending upon the magnitude of intensities of stimulation in the optic tectum. This mechanism is a proposed research-based model which may or may not have any practical evidence which could prove the mechanism behind the migratory abilities of birds.

Hence, the both research-based principles, The **Radical Pair Mechanism** and The **Resonance Model** have a strong authentic evidence according to the experiments performed in the laboratory over some particular species of cage-raised migratory birds but it is still quite uncertain how far this researched based principles have a correspondence with the practical mechanism of migration of birds. Therefore, to unravel this mysterious migration of bird species, it needs more accurate and scientific evidences both in experimental in accordance with practical world. ■

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সমীক্ষণ

Fig.1



Fig.3

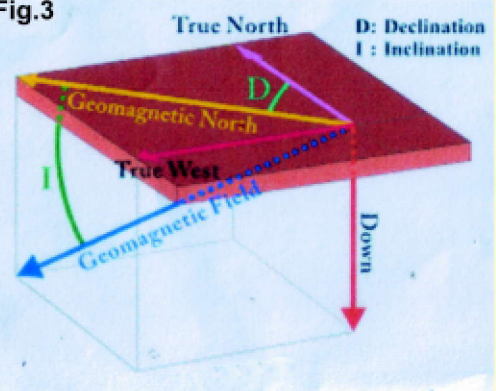


Fig.2

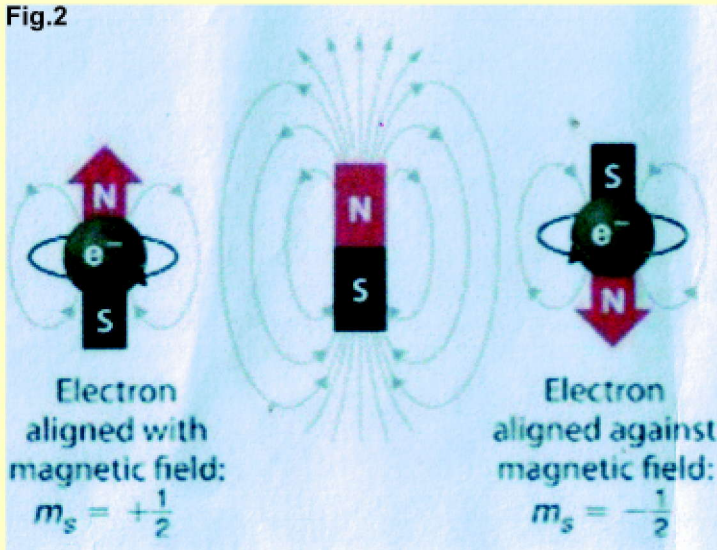
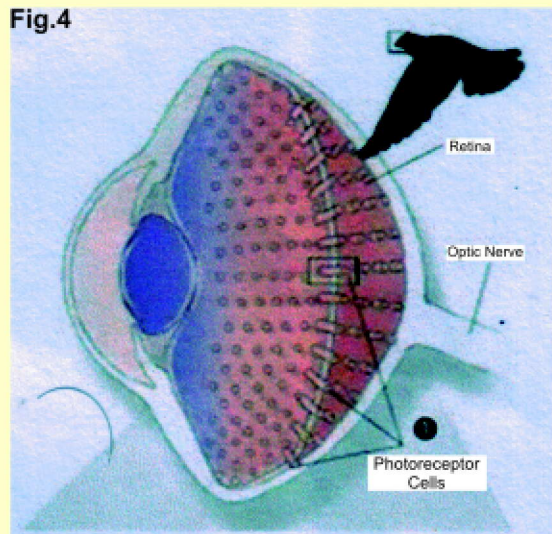
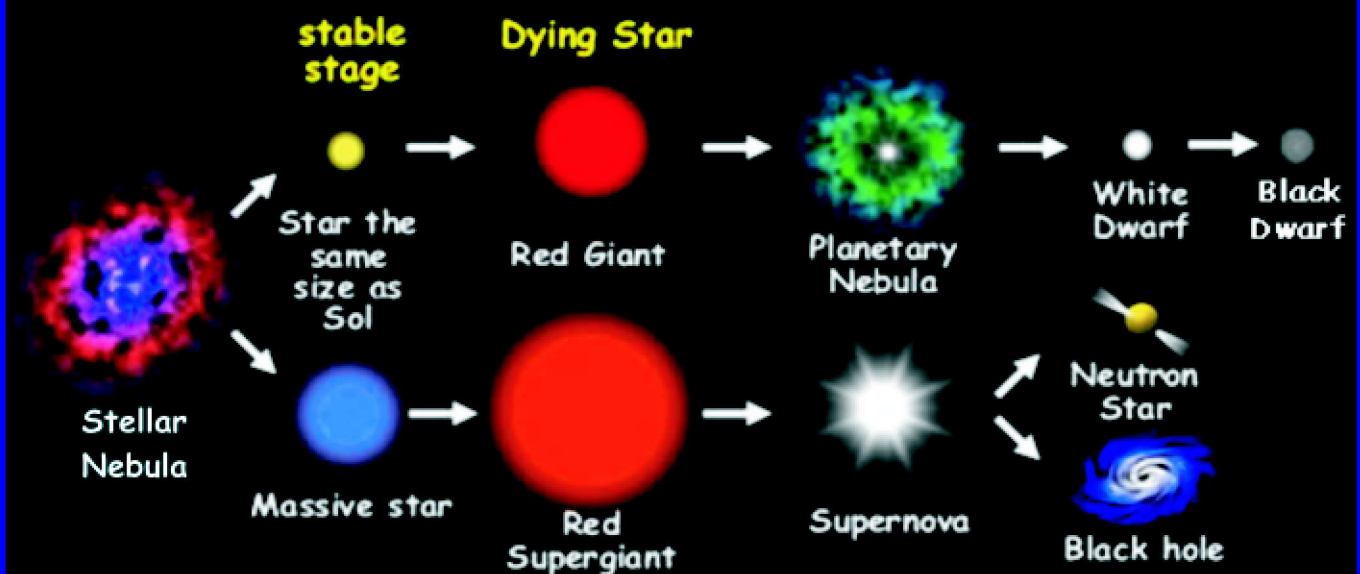
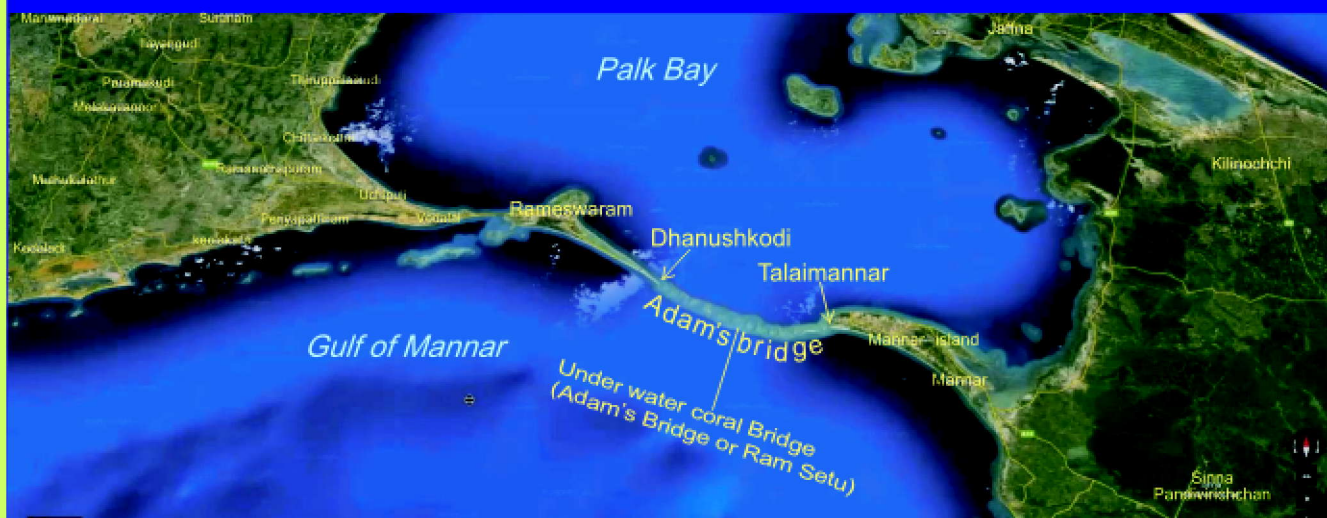


Fig.4



The Lifecycle of a star





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