Prof. C. S. Deshpande Memorial Lecture

Origin of Life in the Universe
Is there intelligent life elsewhere in the Universe?

By
Padma Bhushan Dr. Shashikumar Madhusudan Chitre
Mathematician and Astrophysicist

Mumbai, 21 April 2018

Padma Bhushan Dr. Chitre delivering Prof. C. S. Deshpande Memorial Lecture

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Opening Remarks by

Dr. V.N. Gupchup
Educationalist &
Member of Governing Board, Vidyalankar Institute of Technology.

I join the chairperson in welcoming Dr. Shashikumar Chitre and all of you to this third lecture of the Prof. C. S. Deshpande Memorial Lecture Series. We have just seen a documentary showing in brief, Prof. Deshpande's achievements as a student and later as the Founder of the 'Vidyalankar'. A brilliant student in his college days, never letting the FIRST RANK slip out of his grip in the University examinations as well as the National Competitive examinations, one can call him a veritable genius. A scholar of his capability would normally be engaged in Research activities, (he did a stint at the Tata Institute of Fundamental Research), or high level engineering design which he tried with the Indian Railways. Yet he gave up those avenues and got himself immersed in the field of teaching engineering students with particular emphasis on his first love, the subject of Mathematics.

Thus was born the Institute of 'Vidyalankar', initially a modest effort in 1960, only to grow and expand into a huge complex consisting of excellent Coaching classes for a variety of competitive examinations, an Engineering College, a Polytechnic and a School of Information Technology. In the city of Mumbai and in many other places in Maharashtra the name “Vidyalankar' is synonymous with quality education. While three programs at VIT are accredited by the National Board of Accreditation and are permanently affiliated to the University of Mumbai, all the programs of the Vidyalankar Polytechnic are accredited by NBA. The School of Information Technology is accredited by NAAC. This is indeed a testimony of Prof. Deshpande's commitment to his task of educating young minds.

One can never overemphasise the need to keep in mind the Founder's Vision. Hence the Vidyalankar Dnyanapeeth Trust and the Deshpande family wished to carry out some activity to perpetuate his memory. There can be no better activity other than organizing a MEMORIAL LECTURE SERIES – a public lecture delivered on or near Prof. Deshpande's birth

day, 19th May, every year. This year we are organizing the lecture on 21st April 2018. The plan is to invite eminent speakers from within the country or outside to deliver this lecture on varied topics. These would include Education, Science and Technology, Finance, Socio-economic issues, National Development etc. It is hoped that these lectures would provide an opportunity to friends, colleagues and well wishers of late Prof. Deshpande and Vidyalankar to remember the Founder with affection and reverence. They will also inspire the younger generation to believe in pursuit of excellence and higher achievements.

The Inaugural lecture in this Series was delivered by Dr Narendra Jadhav, former member of the Planning Commission and now a member of the Rajya Sabha. Dr Jadhav spoke on the subject "Making Indian Higher & Technical Education Globally Relevant." To deliver the second lecture we had amongst us a renowned scholar, an engineer, and an economist, Padmabhushan Dr. Kirit Parikh. He spoke on the subject of "LOW CARBON STRATEGY FOR INCLUSIVE GROWTH".

Today the Third lecture in the series will be delivered by a renowned Mathematician and Astrophysicist Padmabhushan Dr. Shshikumar Chitre. He will speak on the subject of "ORIGIN OF LIFE IN THE UNIVERSE". Let me introduce Dr. Kumar Chitre briefly. After graduating from the Elphinstone College in 1956 in Mathematics Dr Chitre proceeded to the Cambridge University in England. A receipient of the Duke of Edinburgh Scholarship, he obtained a second Bachelor's degree from Peterhouse College in 1959 and then a Master's degree. Thereafter with the Gulbenkian Research studentship he moved to Churchill College and obtained a PhD from the Department of Applied Mathematics and Theoretical Physics of Cambridge in 1963. During this period, he was a close colleague of the illustrious scientists Steven Hawkins and Jayant Naralikar. Dr Chitre commenced his academic career as a Lecturer at the University of Leeds and then as a Fellow at CALTECH (California Institute of Technology) in USA.

In 1967 he returned to India to join the prestigious Tata Institute of Fundamental Research in Mumbai and continued his research activity till 2001. His research is directed and focussed on Solar Physics, astrophysics and gravitational lensing. He has carried out extensive research on Sun's magnetic activity cycle, the solar dynamo theory, and the role of Neutrals in the solar atmosphere. Currently Dr Chitre is the Academic Chairperson and Professor Emeritus of the Centre for Excellence in Basic Sciences and

INSA Honorary Scientist at the University of Mumbai. He has also been the Raja Ramanna Fellow at the University of Mumbai.

Dr Chitre has been honoured by Fellowships of several prestigious scientific institutions, which include Max Planck Institute of Extraterrestrial Physics, Indian National Science Academy, National Academy of Sciences in India, Royal Astronomical Society, International Astronomical Union etc. He has been a Visiting Professor at many a renowned University like the Cambridge University, Princeton University, University of Amsterdam, University of Columbia, etc. He has been associated with the Godard Space Flight Centre, NASA, National Academy of Sciences, USA, Institute of Astronomy, Cambridge, and Physical Research Laboratory at Ahmedabad. His research publications have appeared in distinguished scientific journals. As a recognition of his outstanding achievements Dr Chitre was awarded PADMA BHUSHAN by the Government of India in 2012.

Ladies and Gentlemen, let me once again welcome Dr Shashikumar Chitre and invite him to deliver his lecture. THANK YOU.

Origin of Life in the Universe - Is there intelligent life elsewhere in the Universe?

Padma Bhushan Dr. Shashikumar Madhusudan Chitre
- Mathematician and Astrophysicist

It is an honour to be invited to deliver the C. S. Deshpande Memorial Lecture. I have been a teacher all my life; even at the age of 82, I still continue to teach. I believe I get inspiration from interacting with young minds, and as long as my physical strength permits, I will continue teaching. Rashmi Deshpande, Vishwas Deshpande, Milind Tadvalkar, all of you have been very kind in inviting me to come here; I am happy to see my friends sitting here!

Instead of saying 'Origin of Life in the Universe', I choose to address the question 'Is there intelligent life elsewhere in the universe?' So, with this, let me launch into my talk which I have been delivering for a number of years now. I was educated at institutes where I was under the influence of people who had done enormous amount of work in this area and I was triggered by their enthusiasm. As a student of mathematics, in the third-year, I attended lecture courses from inspiring teachers on general relativity, the physics behind gravitational properties of stars, and that is what motivated me to venture into this area. Before that I went to an observatory and that's where I learned what astronomy is. Many people have asked me what attracted me to astronomy and my answer to this is that I didn't have a clue, except that I found myself as a vacation student working at an observatory, and normally what happens is, inspiring teachers encourage your interest.

The earlier question on whether there is intelligent life elsewhere in the universe has been posed since the ancient Greek times. There have been many debates on whether there is life elsewhere. What you imagine, in a large field of maize, is that not only one stock grows. So the assumptions were, there are many worlds. The question is: are they inhabited the way we imagine them to be? Has intelligence developed on those sites? You must not forget that the theological influence was very strong in the medieval times and religious concepts did not permit one to think of or propagate the idea that there are other worlds. Why was that so? It was because if there are other worlds they will need a saviour and that idea is in

direct conflict with the concept of our uniqueness and our saviour's incarnation. For theological reasons people rejected the idea that there could be other worlds and there could be intelligent beings occupying such sites beyond our Earth.

On Earth itself you see biodiversity: from a little ant or a termite, to a huge animal like the elephant. You have such a spectrum of life and spectrum of intelligence too, so why is it that such phenomena must not occur elsewhere in the universe? So, they could figure on a philosophical ground that the cosmos is infinite and there is the plenitude principal that talks of plurality of worlds. What can exist here on Earth can exists elsewhere too. But then came the doubters who said that we don't have any evidence of extra-terrestrial beings, so they do not exist. The absence of evidence does not mean evidence of absence. Maybe we need to be optimistic that there are other worlds. In the 4th century it was said, to consider Earth as the only world is as absurd as to consider that in a field only one grain will grow! With this view I will now develop my theme.

The plenitude of habitation depends on what we do in this rocky planet that is circling around the Sun. We have a solar system with a Sun that is bubbling away, constantly throwing highly energetic particles into space in the form of flares or mass ejections which are directed by a magnetic shield which protects us. And then there are other planetary bodies such as Mercury, Venus, Mars, Jupiter, Saturn, Uranus, Pluto, asteroids and comets. Unfortunately, our international astronomic unions downgraded Pluto. I was present when they decided to remove Pluto from the list. I must tell you, sometimes democratic principles go counter to wisdom, because this decision was made as it was argued that many bodies similar to Pluto exist, so why consider Pluto as a planet? Not all of us voted; around 2000 people voted and Pluto was suddenly downgraded!

We are aware that there is intellectual life here so there must be another variation of civilisation elsewhere. Some places might be in their Stone Age, some maybe 50 years ahead of us, in fact some maybe several million years ahead of us. Now as intelligent beings we would not be able to get in contact with those in the Stone Age, but it is necessary to not downgrade civilisations. We need to establish contact with those civilisations that are millions of years ahead of us, who might not be interested in our nondescript existence. In fact, imagine how long it took for us to reach a digital and technical stage of existence. 200 years? 300 years? That is nothing in comparison to billions of light years across

galaxies. Let's start with our solar system and then we move beyond.

Man and man's machines were sent to the Moon in 1969. We didn't find any inhabitants there. And Moon, as we know, cannot sustain any form of life we know. In fact, Apollo 11, whose purpose was exactly this, recently discovered a thin sheet of ice. This is a sign of water. Now what is there to be alarmed about? How is this a suspicious sign? Any living organism survives in something basic, for example for humans it could be water. Most of life is water-based and carbon-based, and chances are there could be others as well. So, life needs a basis to sustain and assumptions are constantly made based on elements discovered.

Mars was a fascinating object in the beginning of the 19th century. Percival, the astronomer, thought he saw canals, the Martian canals, and spoke of the frozen ice-caps. It was later understood that there are no ice-caps on Mars. There is frozen carbon dioxide. Network of canals, not water, but frozen carbon dioxide, intense atmospheric pressure is exerted on Mars; in fact, it is 100 times of what is there on planet Earth. So, water will evaporate. Martian atmosphere is mainly composed of water vapor and carbon dioxide, slight oxygen and no traces of nitrogen. The Viking machines did not find evidence of organic life. In fact, the probe says that if it had explored deeper or tried to find something more there might have been more to be discovered.

Venus is a fascinating planet in the evening sky, sometimes referred to as morning star or evening star. It is covered with a mass of clouds. The surface of the planet is close to 900 degrees and the atmospheric pressure is close to 100 times our atmospheric pressure. Dante's titular Inferno is what Venus is exactly. Though you can say it cannot sustain life, you cannot forgo the possibility of microorganisms existing.

Jupiter's atmosphere is like a “Hanging Zoo”. It is a vast chemical laboratory containing a mixture of elements like methane, ammonia and water vapor from which primitive forms of life probably arose on ancient Earth. There is something called extremophile also known as archaea which could probably exist. Ancient Earth might have resembled Jupiter. They could be precursors of complex microorganisms. Miller and Urey produced organic compounds (amino acids) from a mixture by bombarding it with UV discharges. It doesn't indicate cellular life but can possibly lead to biological life. Interestingly, traces of oxygen were detected on Calisto, one of the moons of Jupiter. Jupiter's moon “Europa” shows evidence of 100-mile deep oceans containing thrice the amount of

water on Earth. All these are conjectures, because we don't know for sure. Probes have been sent which have given us clues. Jupiter has also attracted several comets which have their own molecular composition. These comets crashed onto Jupiter's surface and there must have been settlement of mixed molecular composition on Jupiter. Why do we assume that life started on planet Earth? It could have been transported from other bodies. Crashes must have led to deposition of molecular compositions that might have then led to the beginning of life. So, this questions the idea that life began in Darwin's warm little pond. It is not easy to get ammonia and methane together, both of which are necessary for life.

So now we have Saturn with a ring around it and then Titan, the icy mysterious moon of Saturn. Then we have Uranus, Neptune and Pluto. So, let's come to the birth and death of the stars. Stars and planets are born out of gradual compression of tenuous interstellar material made of gas and dust and our own galaxy contains hundreds of billions of stars. Some gravitation triggered the condensation of the dust which led to a huge explosion that sent shock waves and it compressed to form galaxies with billions of stars. This is all in the theoretical domain, but that is what seems to happen. Now the astronomers attempted to find the calculation behind the formation. The interesting phenomenon that takes place is the death of the star which gives rise to the next generation of stars. Stars go from birth to death to rebirth.

Going back to the epoch of the big bang, in the first three minutes itself, Mother Universe was able to cook for us hydrogen, helium, tritium, deuterium, lithium all the way up till beryllium, carbon, nitrogen, magnesium and all other elements which are vital for life processes and the birth of a star. Where does platinum come from? Stars are born out of gases and dust. The center is a shining orb and the debris that is left around, due to the angular momentum, keeps circling around under the influence of the gravitational pull of the center, just like the Sun. We still don't know how the solar system was formed. Our galaxy is circling around as are several groups of galaxies. Clusters of galaxies en masse and that is what we understand is the observable limit of the universe. And here we are a speck of dust as a planet, circling around the Sun. I was able to speculate and imagine the architecture of this solar system. Only the conscious observers who are watching the universe give rise to the existence of the universe at large.

We do not know how the solar system was formed; we do have theories.

The current dogma is that our solar system came into existence because an explosive event took place. Just about a million years prior to the formation of our solar system, two things have happened. The explosion gave rise to a strong shock wave which went out and pressed against a nebula that condensed to form the planetary system. This was the earlier condition of stars which exploded. Thus, the elements were formed, and those elements were mixed with the solar nebula and that's how we made it. Otherwise where do you think the calcium in our bones, the iron in our blood came from? It came from the ashes of the earlier generation of stars, so stars had to die to give existence to elements necessary for life. So that is the basic thought process that concludes that our solar system came into existence after a massive explosive event which you call the supernova explosion.

We started looking for extra–solar formations of planets in our solar system. For instance, let us consider the Trappist-1 system around a dwarf star. There are seven planets which encircle the star; they take 1 or 2 days to circle the dwarf star. They are present somewhere around the orbit of Mercury. Is that a good Sun-Earth system? That is the question. What makes a good Sun-Earth system? If it's too hot water will evaporate; if it is too cold, water will freeze. So, we are looking for a Goldilocks Zone which refers to the habitable zone around a star where the temperature is just right - not too hot and not too cold for liquid water to exist on a planet. Congenial conditions should be created by the parent star. The orbit should be reasonably circular but if the orbit is highly elliptical, you will have ice age and a very warm phase depending on the distance of the planet from the parent star. Is it possible for congenial conditions to exist elsewhere? That is what the search is all about.

It all depends on the evolution of the star and how it develops. First hydrogen bursts and creates helium. Sometimes helium bursts to create carbon dioxide. In some stars, carbon dioxide bursts to create magnesium, potassium, sulphur, all essential elements for life. Some more dramatic stars create metals. The helium core and a hydrogen shell - the first puts pressure on the tenuous envelope and it blows away like a smokescreen. The neutron star has a rough dimension which may not even cover Bombay. It is about 10 km and the density is very high and it spins very rapidly i.e. around a thousand times a second. Imagine what kind of a spin that is! Stars have masses. Even the iron nickel core is not able to stabilize or bear the weight of the gravitational pull. Gravity takes over and completely crushes the central object and the star retrieves to what we call

a black hole, so that is the formation of the black hole, and that's what Stephen Hawking had worked on. How a star dies depends largely on its initial mass but there are other parameters like where the stars are located, the rotation of the magnetic field, but the controlling parameter is the mass, and different morphologies arise because of that.

Initially when the universe was launched with the Big Bang, the density decreased and then it cooled. When it came down to 12-degree kelvin, the universe was full of protons, electrons and neutrons. It kept on cooling and expanding, elements started to appear. Hydrogen appeared first, then helium and so on. That's what this is -neutron plus proton. The only nuclear species which were produced during the epoch of the Big Bang are helium 3, helium 4. All the other elements we are made up of - carbon, nitrogen, oxygen that are essential for life are from stars, so it is right to say we are star children, star dust is what we are based on and stars had to die to give rise to us. We should be grateful to the earlier generation of stars which made up all the elements essential for life.

The birth of our Sun resulted in the aftermath of the spectacular supernova explosion, close to the site of proto solar nebula, a million years ago. Before the Sun condensed out of the gas cloud, because of the trigger, the shock wave that came from the supernova pressed the cloud. The cloud became denser and then little lobules formed and eventually one of them went on to become the Sun. There are other stars that are also nearby. So the connection between the death and birth of stars and the evolution of atoms, is associated with the evolution of stars because stars evolved and manufactured the elements and the atoms which are essential and vital for life. These stars had to die for us to create carbon, nitrogen, oxygen, calcium, iron. George Wall, the biologist, said that we living beings are the late outgrowth of the metabolism of the galaxy, so these are the elements of origin. The history of a star is a contraction as it evolves in the nuclear matter and the temperature keeps rising from million degrees to 100 million degrees to a billion degrees. Likewise the density goes up; the central density of the Sun is 100 g/cc and the temperature is 10 million degrees. Hydrogen gets converted into helium under this high temperature and then gravity takes over, you see gravity is always beating to crush the stars. Gravity is a source of all energy; the universe exists because of gravity. Helium starts burning, carbon dioxide comes forth and then other elements magnesium, silicon, and eventually iron and nickel. So this is my theory. Born out of the ashes of stars, elements such as hydrogen, deuterium, beryllium, lithium, nickel, all of these are

manufactured in the first three minutes. The carbon oxygen core becomes a white dwarf and the hydrogen shell and this shell blows to become the planetary nebula. The amazing thing is that Chandrashekar depends on the physical constants such as Planck's constant, the speed of life, the force of gravitation and the mass of proton. I always wonder why we designate the masses of stars in solar masses. You will notice Chandrashekar's limiting math depended on only physical constants.

Likewise, the neutron star is a limiting mass about the same order. Why do we need it? I've spent 30 years over the limiting mass of the neutron star. The search for a black hole depicts the knowledge of the white dwarf and the limiting mass of the neutron star. Blackholes can't be seen but we infer that they exist. So, we aren't that naïve.

At least thousands of stars are known to have a planetary system. When I was doing my thesis work 50 years ago, astrophysics and cosmology were driven by theoreticians and now it is technology. Earlier Galileo enabled us to see through optical windows, after World War II the radar discovery made radio astronomy, followed by infra-red, microwave, UV, X ray and gamma ray and now we are at gravitational wave astronomy. Technology is driven and I must admit that we theoreticians have been left behind, but we will catch up. Unless there is an Einstein or a Stephen Hawking giving you an idea of what to look for, what would you look for?

If we have looked at the universe through all the windows, then what is there left to be done, and does astronomy have any future? As long as technology is driving astronomy, it will survive. Every time we feel we have come to an end, like the time we felt we had come to the end of physics, Mother Nature acquaints us with something new. She is under no obligation to reveal all her secrets in this era of 2018, and she has enough secrets up her sleeves! We did not know of the existence of dark energy or dark matter until 30 years ago. We will discover that only 5% of matter is what we are made of, what the stars are made up of, and 95% is made of dark matter, dark energy.

So here we are in our habitable zone Earth and its two neighbouring planets Mars and Venus - the Goldilocks Zone - neither too hot, nor too cold. In this habitable zone you see traces of water and you see life flourishing on this planet Earth. Should we then look for other sites? Yes, we should look for congenial conditions for habitation. For example, if the Earth would have been much heavier, our height would have been tiny. Next, the size, location and the long term stability of the parent star

matters; if the Sun would have been wildly fluctuating in its radiation, life would have not been stable here. There are far too many coincidences which then make me think - are we a coincidental universe? Even with the slightest change in gravity, life on Earth would have been different. The electronic charge would have been of different value, life on Earth would have been different. All these considerations make you go back to the atrophic principle; for example the existence of water on this planet at the exact temperature of boiling and freezing. However there are extremophiles. Microorganisms seem to survive the most uncongenial environments. So why should you consider the temperature between freezing and boiling to be just right? Don't forget, it takes millions of years for life to develop to the form we now know. Humans also have evolved over a certain time period to develop to the present form. Why should we assume there is one universe, our universe? There could be multiple universes; there might be a desert beyond our observable universe. Maybe the gravitational constant may have a different value in that universe, maybe people must develop in a different way with a different electron charge. So, we have not really reached the frontier of knowledge, we may have reached the frontier of ignorance. All that we are doing is, we are pushing the frontier of ignorance. The very fact that I am aware of my ignorance shows that I have thought through the problem!

Multiple galaxies have gone beyond the cluster of galaxies. The gravitational pull of the cluster galaxy pushes the background galaxy beyond so how do we study all of cosmology if we limit ourselves to counting stars?

How do I convince you and answer this question - what is life? Maybe what is on that planet, and in an inanimate world, is essentially the same hydrogen helium carbon dioxide water molecules. And these elements are universally present. If anybody looks with an astronomical telescope, you'll see formaldehyde and water molecules hydrogen and cyanide. Why are they so cosmically abundant, is the question. Life must be existent but maybe we might not have made enough efforts to access it.

So, these are the issues to think about. On this planet there is an extensive biodiversity of various sizes and shapes, involved in complex life processes, engaged with the living and physical environment around it. The environment plays a big role, especially genetics, as all living beings are surrounded by carbon dioxide, hydrogen, water etc. So, we are all used to living in a carbon-based chemical environment. How do you know

there is no environment or life that is ammonia based or silicon based? So, it is our tunnel vision that makes it difficult for us to find answers. The answer to this is also difficult. So, we have made a huge leap from primordial organic soup to membrane moderated self-replicating DNA based structures. All that we know is that chemical evolution on the basis of carbon dioxide, hydrogen and silicon eventually lead to biological evolution. What we need to know is where did it come from?

Origin of life, if you are a believer in the divine ideas of life, maybe it is an intelligent design understood as a divine intervention. The aim of chemical evolution, the primordial organic soup is perhaps to create life. Maybe this came from asteroids and comets crashing onto Earth - we discussed how asteroids crashed onto Jupiter and what it has led to. Or maybe some other civilization or process planted the biomolecules. Maybe some intelligent life is watching us and wanted to awaken us. Or we haven't made the right mental effort to learn of their presence. Only those universes exist which are conscious of their own presence.

How did it come about all together? In fact, getting ammonia, methane and water vapour all together must have come together in small proportions, but by what design did they come together? What do we make of Darwin's design? Maybe it is the survival of biomolecules to evolve into higher forms of life.

The number of intelligent civilizations in our own universe, the number of stars in our own galaxies; we'll have to factor in the date of all the stars perhaps. We begin to find exoplanets. We have to factor planets with hospitable conditions for life, conditions for evolution of intelligent life to evolve and exist. As we had the first generation of stars that manufactured hydrogen, helium and the likes, and that generation of stars had to live and die and deliver those elements for us to begin life. Then there is an extravagant time scale for intelligent life on Earth. So, who am I?

Who knows one of the signals we send outside will receive a response. The best communication strategy would be to interact with higher forms of life, some advanced communities millions of years in our technical future, a number of them hundreds of years ahead of us. We can assume that some civilizations maybe about the same stage of development as ours, many of them a few hundred years behind us and some primitive societies may be coming out of their Stone Age. Human beings are probably inevitable products of a grand cosmic evolutionary scheme, set into motion with the birth of the universe. We may be members of a much

larger family of living beings some of whom may have unimaginable capabilities.

Societies live only momentarily compared to the age of the universe. We are a living system that maintains continuity. There must be a galactic law that enables communities to spot an emerging civilization such as ours. There might be a galactic library that holds information of countless civilizations. Nevertheless, collectively we provide necessary links between the cosmic past and uncharted future. As human beings our prime responsibility is to nurture the living system that has arisen on this planet and maintain the continuity in transmitting knowledge that we have accumulated, not merely to successive generations of humans but to a much larger brotherhood. We have continuously announced our presence into the cosmos, inviting contact from other civilizations.

The following is a quote from the Rigveda:

In the beginning love arose

Which was the primal germ cell of the mind.

The seers, searching in their hearts with wisdom

Discovered the connection of being with non-being.

Who really knows? Who can presume to tell it?

Whence was it born? Whence issued this creation?

Even the gods came after its emergence

Then who can tell from whence it came to be

That out of which creation has arisen,

Whether it held it firm or it did not

HE who surveys it in highest heaven,

HE surely knows – or maybe HE does not!

Even the Gods came after the Universe came into existence. Maybe one who sits in a higher heaven knows or doesn't. So, who am I to tell you where it all came from, in this universe?

Q.1 Our scriptures have 3 loks akash lok, patal lok and mrityu lok how do you relate with your scientific explanation, and the wisdom of, which you have concluded with the rigved how it is affecting our lives directly?

Ans. It's a question of a philosophical level , metaphysical level, I barely say that the analogy you are carrying too far , the patal lok all that you say are from the puranas, earlier you only had the central earth the moon, the sun and 5 planets because we didn't have the means to observe it at that time but now the view of the universe has changed because we have the means, huge telescopes, satellites, so that way the technology has enlarged the view of the universe . We shouldn't read too much into what our scriptures say but take the message and the essential theme.

Q.2 You spoke about three processes or ways through which the solar system could have been formed. In the third way you said some kind of wave came and hit the nebula and then there was the formation of planets, but how did they form the motion? How did they start revolving around when there was no external force or collision?

Ans. The universe is born with angular momentum, so the angular momentum was carried and the cloud itself is rotating. The cloud is part of the galactic system which itself is rotating and the incoming shock wave just compresses, increases the density, becomes basically gravitationally unstable but it still carries the angular momentum with it. The gravitational energy gets converted into the rotational energy and also the kinetic energy. That's why we have the rotation of various systems and the magnetic field. The basic question that should be asked is where did the rotation and the magnetic field in the universe come from? Was it born with the angular momentum or was it inherited from astrophysical phenomena?

Q. 3. We know A (Adenine) T(Thymine) G(Guanine) C (Cytosine) U (Uracil) as the DNA/ RNA base pairs found in all the living organisms. And from your explanation we learn that it is there in the universe so why can't we conclude that these five are extra-terrestrial in origin?

Ans. Though we know that the amino acids are not terrestrial, the declaration that our origins are indeed a matter of resolving disparity in the case of biological complexity.

Q. 4. Where was the energy that caused the big bang before the explosion? But we also say that energy can neither be destroyed nor be generated but mass can be converted to energy. And energy can again be converted into mass.

Ans. We understand it is energy existing in a vacuum. The time itself came to existence with the big bang so the same time I also alluded that there might be multi-verses, so we don't know why and what limits our observable universe. What comes from our distant sources is instantly accepted and we find it hard to see beyond that. There are other universes.

Vote of Thanks

Milind Tadvalkar
Director, Vidyalankar Dyanapeeth Trust

Good evening all. Around 15 years back my wife and I attended a programme in the University of Mumbai. Our daughter that time was very small about 2 years old and obviously was with us over there. It was a small gathering on very pleasant evening at the lawns of the University. Dr Vijay Khole who was the Vice Chancellor of the University of Mumbai at that time was addressing and he said I congratulate parents who have brought their kids with them. He added, I'm sure this monument of learning with its enriched academic ambience will definitely prevail upon the young minds for years to come. I have deeply registered this sentence of his in my mind. Acquaintance of good books, expert academicians, scientists and distinguished educational organisations, all help in shaping personalities. Today I see various dignitaries, scholars and illustrious personalities from various organisations like IIT Mumbai, Homi Bhaba National Institute, BARC, Nehru centre, Government officers and principals of colleges and schools here in our auditorium and I believe that the warmth of their presence shall prevail upon all of us at Vidyalankar and will give us confidence in shaping our endeavour in this campus.

Three years back Dr. Gupchup sir suggested organising lectures in the memory of our founder Prof. C.S. Deshpande. I remember him saying that through this activity, we shall be able to invite eminent personalities at our campus and it will eventually lead to our enrichment. I see his words are coming true. Thank you, Sir, for always guiding us on the right path.

I wholeheartedly thank Dr. Chitre for accepting our invitation to deliver this 3rd Professor C.S Deshpande memorial lecture. Obliviously the topic he selected is big. He has worked in the subject for last 50 years and we could allot only one hour for him. But still, Sir, you made it very interesting and as there were many questions we could see that you have definitely inspired all of us at the auditorium.

I thank Mrs. Chitre for her gracious presence for this occasion. My thanks to all dignitaries and friends present here today. On behalf of our Chairperson Rashmi Deshpande, Managing Trustee Vishwas Deshpande, Trustee Avinash Chatorikar and Namrata Deshpande, I once again thank everyone who made this programme successful.

About Prof. C. S. Deshpande (1932-2005)

Endowed with a good academic career, C. S. Deshpande stood FIRST at the Inter Science Exam winning all the University prizes. Then after completing B.E. (Electronics and Telecom.) from the College of Engineering, Pune, he joined the prestigious T.I.F.R. He appeared at the I.E.S. (Indian Engineering Services) Examination and again stood FIRST in this All India examination.

He discovered his intrinsic interest was in the field of teaching and writing Mathematics and in Mathematical Engineering Subjects. This pursuit of his passion and an urge of dedicating himself to sincere academic pursuit led him to establish Vidyalankar. His basic objective was to guide eager young students. He worked at it with a missionary zeal to enhance their worthiness and imbibe nobler values of life in their receptive minds not through empty words alone but through his own example.

About Dr. Shashikumar Chitre

Dr. Shashikumar Chitre graduated from the Elphinstone College in Mumbai in Mathematics and then went to Cambridge University in England for further studies. He did his Ph. D. from the department of Applied Mathematics and Theoretical Physics in 1963. During this period, he was close colleague of Dr. Steven Hawking and Dr. Jayant Naralikar. In 1967, he returned to India to join TIFR in Mumbai. His research is directed and focussed on solar physics, astrophysics and gravitational lensing. He has been a visiting professor at many renowned universities like Cambridge, Princeton, Columbia to name a few. He was awarded Padma Bhushan by Government of India in 2012.

2016 Making Indian Higher and Technical Education Globally Relevant – Dr. Narendra Jadhav – Economist and Writer, Member of Rajyasabha, Government of India.

2017 Low Carbon Strategy for Inclusive Growth – Padma Bhushan Dr. Kirit Parikh, Chairman, Integrated Research and Action for Development, New Delhi.

2018 Origin of Life in the Universe - Is there intelligent life elsewhere in the Universe? – Padma Bhushan Dr. Shashikumar Chitre, Mathematician and Astrophysicist.

August Audience

Interactive session

**Felicitation of Dr. Chitre by
Shri Avinash Chatorikar, Secretary,
Vidyalankar Dnyanapeeth Trust**