

## Hand In Hand

When Mike Gold, a former NASA official, said, "Chandrayaan III's success is a victory of Indian innovation, human capital and the capabilities that will take India further," it was no exaggeration. Believe it or not, India's two successive astral missions, a lunar and a solar within a short span of time, have made it clear that the giant spacecraft have behind their back a combined toil of at least five hundred scientists at the ISRO and thousands of their counterparts in what is known as startups.

It was not a single stroke of serendipity. Google has released an astounding figure of 55,000 aerospace companies in the MSME sector that had spent sleepless nights for the success of the moon mission. Besides, the NASA and the European Space Agency (ESA) extended their helping hands. This is a unique camaraderie that goes well with India's slogan for the international summit that India had hosted recently.

In fact, this bonhomie should be there if India is to excel in space industry. Scientists claim that only two per cent of the space economy has been fruitfully utilized so far. A country of 140 million cannot afford luxury in its space experiments. The lunar mission's ₹ 615 crore budget when compared with NASA's or with the just failed moon mission of the Russian space agency seems to be a penury and behoove of that.

The Indian march of science exemplified by the two quick missions is not the story of a single day. Chandrayaan I was mooted at least twenty years efore though it came into fruition after eight years. However, it could not do much except for collecting observational data. The second Chandrayaan mission, of course, had met with some success. There would have been much more had not there have been a crash-landing on the lunar surface.

The story would have been complete if there had been no pin pricking by certain quarters that this is a victory of science with technology playing a meagre roll. This is something ludicrous as all technologies have a strong back-up of

science. Science and technology are complementary to each other. Every nut and bolt fitted into the satellite launch vehicle is the product of a joint exercise. One is meaningless without the other.

Now that the initial euphoria has settled down to some extent with a hope of Pragnan's resurrection after a fortnight ISRO scientists are recounting their rough and tumble after the tragic failure of the Chandrayaan II mission. It was a sort of Phoenician venture and they had to learn from their failures after several trials and tribulations, sampling and simulations. There had been errors and deviations from the path followed but that could not deter their determination. The goal is loftier which will mean more of piercing into the sky with limited capabilities and no ostentations because India is not competing with others.

Preliminary results have indicated that the lunar surface may contain water as well as huge mineral reserves. The race for the space is somewhat indicative of the fact that even private space explorers are also interested in laying their hands on these untapped resources like Hydrogen from water in abundance that could meet the needs for alternative energy since non-fossil fuels will face exhaustion in the not-too-distant future. Will Indian policy makers be irresponsible to that because space missions require appropriate funding? The question is being raised because apprehension is lurking in the minds of scientists that several institutions are being wound up presently.

On the lighter side, another race is seen in India simultaneously with the speed of the spacecraft. The Mumbai film industry, one of the largest in the world, is now approaching producers with hot cake scripts of making films with the Chandrayaan mission as the theme. Already fifteen scripts are under consideration and the number is said to be swelling. Hindustan ki Shaan Chandrayaan is one such title, reveals a popular daily's supplement. Any question?

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## The Saha Saga

### Meghnad Saha, A Multi-faceted Life Devaprasanna Sinha

One may start with another write-up on Meghnad Saha (MNS) with the facts available on him, his family, his varied interests, his commitments, his being a great scientist and also a nationalist, his linkages with associations, his publications etc.

A plethora of literature in the form of books and articles exist in various media on each of the aspects with greater information posted and updated from time to time. While we understand a lot of information have been uploaded, much remains to be reiterated to remember him, particularly on his 130th birthday (born on 6 October 1893) this year, this brief note, deliberately reduced, is to present a glimpse of some of the facts that we should know about him, besides, to remember a few, Saha Institute of Nuclear Physics, Indian

Science News Association. We have hitherto started talking about MNS in many fora, particularly, about his initial career, with the names of several classmates like Satyendra Nath Bose, Nikhil Ranjan Sen, Jnan Chandra Ghosh, Jnanendra Nath Mukherjee and others, who happened to be great scientists in different disciplines. We should not forget his strong bondage and high respect for two great teachers Acharya Jagadish Chandra Bose and Acharya Prafulla Chandra Ray. We have read the writings of several scientists and other historians all over the world who collaborated with MNS in many scientific and other developmental projects, both at the research level and national development. MNS stood second at the undergraduate examination in 1913 with Mathematics

## The Saha Saga The Scientist Who Stood For Science Communication Sabyasachi Chatterjee

Right from the beginning, science movements were implemented through the efforts of some notable individuals. Renowned practising scientists were also attached to this movement. Among them Meghnad Saha (1893-1956) deserves special mention. Apart from his scientific papers, Meghnad Saha wrote some excellent popular scientific write-ups, both in English and in the vernacular. His articles, other than scientific papers were of varied subjects like astronomy and astrophysics, spectroscopy, nuclear physics (including cosmic rays and nuclear energy). These articles were mainly published in the Science and Culture. He himself was its editor. One article was published in the Statesman. His Bangla articles were published in the contemporary popular

Meghnad Saha had a scientific mind. He firmly believed that 'man can mould his own destiny'. He was of the opinion that science and technology were the tools by which man can and has achieved so much. Saha had a definite opinion regarding the relationship between modern science and Hindu religion. A debate took place on this subject between Meghnad Saha and Anilbaran Roy. Saha started this debate when he delivered a lecture entitled a new philosophy of life at Shantiniketan on 13 November 1938. The original lecture was in Bangla. An English version was published in the Viswa Bharati News.

In that debate, Saha mainly concentrated on intolerance in religion and the lower status of the working class (i.e.,

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### A pre-Independence issue of Science and Culture during the tenure of Dr. Meghnad Saha when he was the Editor of the prestigious journal

vernacular periodicals like Prabasi, Bharatbarsa, Masik Basumati, Nabya Bharat, Anandabazar Patrika (puja number), and Yugabani etc. The subjects of those articles were also varied, starting from the biography of the scientists (i.e.-Albert Einstein, Niels Bohr, Aston, Volta, Satyandra Nath Bose) to astronomy (i.e. Total Solar Eclipse of Norway), application of science (i.e. physics in medicine) etc.

He showed his concern for the children by writing articles for them. His articles were written mainly on the request of Jogendranath Gupta for his edited children magazine, the Shishu Bharati. At that time, Saha resided in Allahabad from where this Shishu Bharati was published. These articles were written between 1930 and 1940. Saha wrote on the subjects like astronomy, mechanics, geographical discoveries, new inventions in science and technology.

craftsman, artists, builders etc.) in the traditional social hierarchy. He correctly pointed out that there has been no connection between the hands and the brain of Hindu society. That was the reason behind the lack of innovativeness in the techniques of production for thousands of years. Saha pointed out that the caste system was the basis of India's downfall because it separated the hand from the brain by idealizing speculative thinking at the cost of physical labour. The infallibility of the Vedas was another myth he was out to destroy. Saha rightly said that 'our adherence to superstitions about the sneeze or the clacking of the lizard and faith in the Panjika signify the debility of the national character. He successfully differentiated astrology from astronomy. So, this debate revealed the scientific mind of Saha.

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(1916). From left to right: back row - M. N. Saha and J. C. Ghosh. Centre row - R. K. Das, Acharya Prafulla Chandra Ray and D. N. Sen. Front row - H. Sarkar and P. Sarkar (This photograph is provided by Saha Institute of Nuclear Physics, Calcutta, India) (Pramod V. Naik, Meghnad Saha, His Life in Science and Politics, Springer, 2017)

## 1>... A Multi-faceted Life

as the Honours subject and again stood second at the postgraduate level in 1915 in Mixed Mathematics. His classmate Satyendra Nath Bose (SNB) stood first in both the examinations, while another great scientist Nikhil Ranjan Sen (NRS) stood third in the undergraduate examination in 1913, but did not appear in 1915 in the postgraduate examination, stood first in 1916, served as Ghose Professor of Applied Mathematics of Calcutta University till his retirement. He was the founder Treasurer of the Indian Science News Association, which MNS founded as Secretary with Sir Prafulla Chandra Ray as Founder Chairman in 1934.

MNS's many laurels came as firsts, amongst his classmates in the subsequent periods. Both MNS and SNB were looking for jobs and the offer came from Sir Asutosh Mookerjee, Vice Chancellor of University of Calcutta to join in the newly-started postgraduate classes of Physics and Applied Mathematics of the University College of Science at Rajabazar. Besides teaching on different topics, they translated, at the age of 24, from German to English, a monograph/collection of papers entitled "The Principle of Relativity" authored by



In front of the magnet of the cyclotron at the Institute of Nuclear Physics (1948–1949). From left to right: Front row – Dr. A. P. Patro, Dr. B. D. Nagchaudhari, Mr. B. M. Banerjee (only part of his face is visible) and Prof. M. N. Saha (This photograph is provided by the Saha Institute of Nuclear Physics, Calcutta, India.) (Pramod V. Naik, Meghnad Saha, *His Life in Science and Politics*, Springer, 2017)

Albert Einstein and Hermann Minkowski. This was published by the Calcutta University in 1924 with a historical introduction by Professor Prasanta Chandra Mahalanobis, the then Professor of Physics at the Presidency College.

MNS was awarded the D.Sc. degree on the basis of his several research publications in Physics in 1920 and also became the Premchand Roychand Scholar (PRS) in 1920 and his dissertation was "Harvard Classification of Stellar Spectra". He went abroad and worked in many laboratories under many great scientists at that time and that was a long story. He returned to India and joined as the Khaira Professor of Physics at Calcutta University in 1923, did not stay long, went to Allahabad University and built up a school of research with better and equipped facilities and worked there for 14 years from 1923-1938.

He came back to his alma mater, joined now as a Palit Professor of Physics and Head of the Department of Physics and worked till his death on 16 February 1956. He was instrumental in introducing changes in syllabi, particularly in Nuclear Physics. He became the Fellow of the Royal Society in 1927 at a very young age. He became the Sectional President of Physics Section of the Indian Science Congress Association in 1925. As the General President of the 21st Session of Association in 1934, his address was on "Fundamental Cosmological Problems".

He formed the National Academy of Sciences at Allahabad in 1935, after the UP Academy of Sciences, being the First President. He founded Indian Physical Society in 1934. He was the founder

member of Indian National Science Academy formed in 1935. He was also the Director of Indian Association for the Cultivation of Science and was associated with CGCRI. He founded the Institute of Nuclear Physics in 1943.

As a scientist, MNS will be best remembered for his ionization equation. Ionization or thermal ionization deals with the state of an element to the temperature and pressure. He was the first to attempt developing a consistent theory of spectral sequence of stars. In fact, his equation is one of the basic tools for interpreting the spectra of stars which analyses to find the actual temperatures. He first wanted a long paper but had to reduce its size and published comparatively a small note on selective radiation pressure and problem of solar atmosphere, both in *Astrophysical Journal* and in the *University journal* in 1919/1920.

Many scientists opined that this was the beginning of the study and research worldwide in this direction. His name was nominated more than once, by Prof S K Mitra and others, for Nobel Prize in Physics, but the Committee remarked that the work was astrophysics not related to physics. We know a number of studies and researches were made thereafter and one cannot deny the implications/significances of his research in different emerging

interdisciplinary fields. Even today we are talking about the possible findings of those studies in the Space Mission made by ISRO for journey of Aditya-L1 round the Sun for study of the Solar atmosphere, inter alia, the physics of partially ionized plasma.

MNS wrote many papers, books and articles of general interest. He was the Editor of *Science and Culture* from 1935 till his death. To mention one, he along with B N Srivastava wrote a seminal textbook on heat which was a text book at many universities at the undergraduate classes. He has been involved actively in Cyclotron, River Valley projects, particularly Damodar Valley, then in Calendar Reforms Committee and other societal applications like rehabilitation.

He organized and participated in many national programmes both in pre-Independence period at different levels. In the post-independence period, the first Indian Scientist as a Member of Parliament in 1952, MNS debated on many issues and worked on many diverse and emerging areas not restricted to physics. His research papers, articles, addresses and speeches as a scientist, an educationist, a Parliamentarian on diverse topics, both in Bengali and English, have been compiled and published by a large number of scientists, his students and science communicators. We can pay homage only to him by reading those materials and understanding the relevance of his visions and messages suitably in our modern India.

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## Chandrayaan III Mission

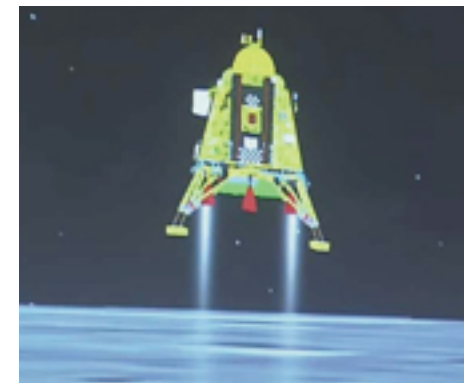
### Scientists from Bengal Lend Hands

Amar Nath Bhadra

We are elated that ISRO has successfully executed their mission to the moon on 23rd of August making the first achievement of its kind. I strongly believe that it is indeed a testimony to the progress of science and technology conducted by ISRO. It has generated worldwide attention for the audacious ambition and pioneering spirit and I will focus on the attention that at least 25 scientists from West Bengal are involved in this great project and it was a grand success in the space technology program.

While it may be mentioned here that the Luna second mission has failed earlier due to technical fault, our Chandrayan three mission has achieved success due to the team effort of scientists and engineers' collective action and dedication as well as

sprit.



Science Communicator

## The Saha Saga

### Saha And His National Calendar

Malabika Sengupta

In 1947, a new nation named India was born after two-hundred years of torture, turmoil and oppression from British Government. A new era began. The free citizens of the new nation dreamt of a prosperous and developed country. With a ray of hope in their eyes, they were looking forward towards the new Government formed in New Delhi. The nation rebuilt itself with its' new projects and policies and took a shape of a well-constructed economy during the 50s and 60s. Dr. Meghnad Saha was one of the pioneers of the decision makers who constructed the pillars of modern India. Besides his innovative work for river management, railway reconstruction, irrigation research, scientific researches, his biggest contribution is in providing a scientific National Calendar of India.

It was the need of the hour. At the time of independence, numerous calendars were followed in different regions of the country. The British Government introduced the Gregorian Calendar which was used for official purposes. But Hindus, Buddhists, Jains followed either the Hindu calendar [Panchang] or the Buddha Nirvana calendar, or even the old Mahavira Nirvana Calendar. While Muslims followed the Hijri calendar, Parsees were followers of the Parsee calendar.

Against this confusing backdrop, the Calendar Reforms Committee was formed under the Chairmanship of one of the finest astrophysicists, Dr. Meghnad Saha, in 1952. It was formed under the aegis of CSIR. Everybody understood the importance of having a uniform national calendar.

According to Dr. Saha, "The calendar is an indispensable requisite of modern civilized life." He always believed that astronomy was the mother of all sciences. An incorrect calendar is an astronomical problem. So, he wanted to prepare an accurate calendar based on a scientific study which would be uniformly adopted throughout the country.

The team under Dr. Saha's guidance first had gone through and did extensive research work on thirty different calendars collected from different parts of the

country. All the calendars had different local dates based on local sentiments, rituals and religions. It was really a challenging task for the committee to integrate multicultural contents from various calendars of the nation.

Dr. Saha found that traditional Panchangs were based on rules of Surya Siddhanta astronomical treatise that measured length of the year as 365.258756 days. But he observed that the actual length of the year is 365.242196 days. He found errors in Gregorian and Hijri calendars also.

After three years of hard work, in 1955, the committee finally submitted the most scientifically accurate National Calendar to the Government of India. It was a Saka Calendar having 365 days and Chaitra as the first month of the year. Dates of the newly-formed calendar has a permanent correspondence with dates of the Gregorian Calendar, with 1st Chaitra falling on 22nd March and in leap years on 21st March.

However, for the following official purposes, the Gregorian Calendar is used

1. Gazette of India.
2. News Broadcast by All India Radio
3. Calendars issued by the Government of India.
4. Government Communications addressed to the public.

The Saka Calendar is a solar calendar and is 78 years behind the Gregorian Calendar.

The important recommendations of the Committee were:

1. The Saka Era should be used in the unified National Calendar.
2. The year should start from the day following the Vernal Equinox [occurs about march 21] day.
3. A normal year would consist of 365 days while the leap year would have 366 days. After adding 78 to the Saka era, if the sum is divisible by 4, then it is a leap year.
4. Chaitra should be the first month of the year, From Chaitra to Bhadra each month would have 31 days and the rest to have 30 days.

The months included in the list are: Chaitra, Vaisakha, Jyestha, Aashaadha, Sravana, Bhadra, Asvin, Kartika, Margashirsha, Pausa, Magha, Phalgun. The names were derived from the older Hindu Lunisolar calendar. Days derived from seven classical planets, Raivata, Somvara, Mangalvara, Budhavara, Brhaspativara, Sukravara, Sanivara with Ravivara as the first day and Sanivara as the last day of the week.

The Government of India started using the Indian National Calendar from 22nd March, 1957 [1st Chaitra, 1897]. But by that time, the brain behind this work, Dr. Saha left for his heavenly abode. The lone fighter and the dedicated patriot gifted India an important calendar which is being used forever. By making this calendar, he unified the whole country in a very unique way. He himself believed that "the National Calendar will prove not only a boon but also a great unifying factor in our country."

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## History of the Calendar

in Different Countries Through the Ages

M.N. Saha  
and  
N.C. Lahiri



COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH  
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1992

*The Saha Saga***Pioneer of Indian Cyclotron**

Debabrata Sur

We are celebrating the 130th birth anniversary of Dr. Meghnad Saha on October 6, who was known as one of the greatest astrophysicists at his time, better known for his Saha Ionization Equation, which is a basic tool for interpreting the spectral classes of stars to their actual temperatures. Prof. Jayant Narlikar considered this equation as one of the ten topmost achievements of 20th century Indian science and could be considered in the Nobel Prize class.

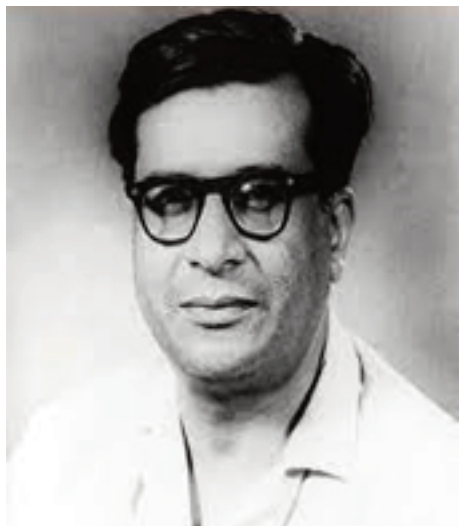
Now we are going to talk about another great scientist in nuclear physics in India and for building the nation's first cyclotron at the University of Calcutta (CU). He is none other than Dr. Basanti Dulal Nagchaudhuri (popularly known as BDN). While he was doing Masters at Allahabad University, he met Dr. Meghnad Saha and became very close and joined his research group immediately. In July 1938, when Saha moved to the Rajabazar Science College, BDN also moved with him. Through encouragement from Saha, BDN came in contact with Ernest

Lawrence and with the latter's support, he moved to University of California, Berkley at the end of 1938 to work on his doctorate in Nuclear Physics. He completed the work in 1941 and returned to India.

BDN's research focused on nuclear isomers, induced radioactivity, Cherenkov radiation and nonthermal plasma. During his stay at Berkley, he had worked with the pioneers of cyclotron. Before returning to India in 1941, with support from Saha (who was eager to build an indigenous cyclotron here) and funding from Tatas, BDN had arranged for shipments of parts for a cyclotron magnet to CU. However, the ship carrying the second consignment of parts for the cyclotron was sunk by the Japanese bombing.

The team under the leadership of Saha and later under BDN took on the task of building the remaining parts themselves at various Howrah lathe workshops. Problems with the vacuum pumps continued to afflict the project. The demountable oscillators also proved difficult to build. It was an uphill task for the whole team of scientists with limited resources. In 1954, after a visit from Emilio Segrè (from Berkley Radiation Lab) to the CU lab, that the cyclotron started to function. BDN is thus credited with building the first cyclotron in India. The original instrument is now placed at Saha Inst. of Nuclear Physics, Salt Lake. Padma Vibhushan BDN passed away on June 25, 2006. It was under his headship at DRDO that the Smiling Buddha nuclear test was successfully carried away in May, 1974.

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**B. B. Ray – A Pillar Of ISNA**

Manas Chakrabarty

The citadel of ISNA rests on its pillars, one of whom is Professor Bidhu Bhushan Ray (or B.B. Ray), dubbed as 'an unsung hero of Indian science'. A pioneer in X-ray research in India, B.B. Ray was the first Indian physicist to work with the Nobel Laureate Niels Bohr in Copenhagen, Denmark. In 1935, he became a founder Secretary of ISNA, an Editor of Science and Culture, Khaira Professor of Physics in the University of Calcutta, and a Fellow of what is now known as the Indian National Science Academy.

B.B. Ray (July 1, 1894 – July 29, 1944) B.B. Ray was born on the July 1, 1894 in Khadarpara, now in Bangladesh. Having worked on meteorological optics under the guidance of C.V. Raman he received his D. Sc. Degree in 1922 from the University of Calcutta where he was a Lecturer in Physics since 1921. With T.N. Palit Foreign Scholarship, he went abroad to work on X-ray spectroscopy with two Nobel Laureates in physics. He did experimental work with Professor Manne Siegbahn in Uppsala, Sweden for about six months and theoretical work with Niels Bohr in Copenhagen, Denmark for a year and a half since September, 1924.

In 1927-1928, he set up an X-ray research laboratory in Calcutta University and worked also on meteorology for about a decade and a half and published papers in leading journals like Nature, Zeitschrift für Physik, Phil. Mag. (London), etc. B.B. Ray is reported (Nature, 1930) to have observed additional spectral lines in scattered X-rays, analogous to Raman spectra, but physicists in Europe and USA were unable to reproduce the results. It led to a deep-seated controversy. Despite Ray's subsequent rebuttal (Nature, September 13, 1930),



followed by experimental support from Meghnad Saha's group at the Allahabad University, the controversy continued until Arnold Sommerfeld confirmed (1937) Ray's observations, thereby settling the issue. B.B. Ray once again went to Europe in 1934. In Germany, he met W. K. Heisenberg, a pioneer in quantum mechanics, and Netaji Subhash Chandra Bose.

In his late stage of life, Ray was suffering from malaria and beriberi. On July 29, 1944, he breathed his last in Calcutta. After the premature death of B.B. Ray, his X-ray laboratory was taken up by S.N. Bose. This article is a tribute to Professor B.B. Ray from ISNA.

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Nothing is rocketing science in our life but for some people rocket science is life. Dr. Anita Sengupta, "an Explorer by heart and an engineer by training" as her website declares, is one of such kinds. She is the mastermind behind developing multiple indigenous technologies and systems to enable NASA's Space exploration to Mars, Asteroids and Deep Space.

Born in Glasgow, Scotland and immigrated to New York, USA with her Bengali father and British mother at the age of three, she has been living in California for the past 15 years. When she was six, the character of Spock in the "Star Trek" series and the "Doctor Who" original series on American National Television made her wonder about the concept of alien worlds and civilizations. Later, she admitted that it was the trigger point to be a space explorer and running after her dream she reached the prestigious Viterbi School of Engineering at the University of Southern California to obtain a dual graduation degree in Aerospace and Mechanical Engineering. She also completed her Master's Degree and PhD in Aerospace Engineering from the same University.

During her Master's Degree, she decided to break all the barriers beyond the sky and leaped into her professional career at the Boeing Space and Communications as the Test Engineer for the X37 Vapor Ingestion Experiments and later as the Cognizant Engineer for the Xenon Ion Engines of the Hughes 702 spacecraft program. During this time, she also worked on the cryogenic propulsion system for the Delta IV launch vehicle, microgravity flight tests for the X37 vehicle and Commercial Communication Satellites (XM Radio Satellite) Ion Propulsion system. Following her success in these projects soon she got hired by the Jet Propulsion Laboratory, a federally funded research & development center managed for NASA by Caltech, to work on the DS1/Dawn ion propulsion system which eventually awarded her with the Doctorate Degree in 2005.

Dr. Sengupta's doctoral research focused on the development of the ion engines that powered NASA's Dawn spacecraft, launched in 2006, to reach Vesta and Ceres in the main asteroid belt of our solar system. Dawn discovered that Ceres was an

**Anita Sengupta, The Explorer Engineer**

Abhijit Roy &amp; Sayari Biswas

ocean world where water and ammonia reacted with silicate rocks. She served as the Task Manager for the Extended Life Test (ELT) of the DS1 Flight Spare Ion Thruster under this project which resulted in AIAA best paper award. Ion engines generate thrust by accelerating a plasma (charged gas molecules of superheated matter) either by Coulomb's Force or Lorentz Force. The main challenge in using them is that being low thrust devices they are mostly operated over many thousands of hours to provide the needed energy transfer to obtain the desired orbital trajectory, which she aimed to overcome. The Dawn Mission was the first NASA Space mission to orbit two destinations breaking several records along the way between 2007 and 2018. It made record breaking use of solar electric propulsion which propelled the spacecraft at 25,700 mph.

On 5th August, 2012 NASA successfully landed the Curiosity rover on Mars using the supersonic parachute system designed and developed by Dr. Sengupta and her team. And it successfully conquered those seven minutes of terror. Borrowing words from herself, "Leading the parachute development will always be a highlight of my career as it taught me that nothing is impossible and the sky is not the limit but only the top of the atmosphere." It took over 5 years to design and test the system to ensure it would

be strong enough to withstand an aerodynamic load of over 65,000 pounds (280.12 kN) on a device that only weighs 100 lbs. (43.36 kg). At 70 feet in diameter, it was the largest parachute opening at the highest speed (twice the speed of sound) ever

on Mars. The hardest part of Mars landing is that scientists and engineers can never actually test the system end to end here on Earth as the atmosphere and composition of Mars is totally different. During the Viking Lander mission in 1960s and 70s it was observed that, at speeds greater than 1.5 times the speed of sound on Mars, parachutes tend to inflate and collapse reducing their ability to effectively slow down falling payloads and, in some cases, resulting in failure of the parachute. Sengupta and her colleagues discovered that the turbulent wake from the falling entry capsule would modify the bow shock and pressure distribution in front of the parachute, causing the collapsing or deflating cycle. They designed a parachute that was strong enough to survive flight through the Martian atmosphere.

Dr. Anita Sengupta is one who loves to embrace the engineering extremes, from the design of a probe for scorching-hot Venus to leading the experiments at the universe's coldest place, The Cold Atom Laboratory (CAL) on board at the international space station (ISS) which is a billion times chillier than the vacuum of space. "At these incredibly cold temperatures, atoms do something unusual – they move together in unison, like a wave," she, the CAL Project Manager and Mission Manager, says. "This can

give us insight into the quantum realm and explain strange properties, like superfluidity and superconductivity." These clouds of atoms at super cool temperatures are known as the Bose-Einstein condensates which have been a point of keen interest for scientists for years now. It is not that they have not been attempted for studies on Earth, but here they're affected by the pull of gravity and earth's magnetic field, where at ISS microgravity allows them to persist longer. At ISS, up to 20-second-long interaction times and temperatures as low as 1 pico-kelvin are achievable. The laser-cooling quantum



## Soap From Plastic Waste Amit Krishna De

It is well known that a huge amount of plastic waste is causing damage not only to the environment but also to health of human, plants and animals. The alternative ways for reducing plastic waste through recycling and reusing are restricted to several brands of plastic only. Around one tenth of the plastic waste is recycled. Rest of the plastic wastes are used as landfills or transformed into low quality raw materials for building and construction purposes, packing materials, trash bags, traffic cones, bottles for household cleaners, mats and rugs, etc. The need for plastic free environment is pursuing scientists for years to search for alternate measures for transforming the plastic waste into useful raw materials. In this endeavour recently scientists have been able to transform plastic waste into little bars of soap.

Recently a group of scientists have been successful in transforming the plastics wastes into surfactant as reported in Science of Aug 10, 2023. Surfactants are required as the key

ingredients in manufacturing dozens of products including lubricants, ski wax, detergents and soaps. Surfactants and the two most used kinds of plastic, polyethylene and polypropylene, are made of molecular chains of carbon atoms. But surfactants' chains are far shorter than those of plastics and are capped with groups of water-attracting atoms.

To turn plastic into surfactants, Liu and colleagues from Department of Chemistry, Virginia Tech, Blacksburg, USA developed a special reactor that carefully heats and condenses plastic into a wax with short carbon chains. By capping the wax's chains with groups of oxygen atoms and treating them with an alkaline solution, the researchers turned the wax into surfactant. Combining the surfactant with a bit of dye and fragrance produced tiny bars of soap.

Plastic waste contains different types of thrown away plastic materials. The advantage of producing surfactant from plastic waste is that it can be made from polypropylene, which is a very common ingredient in most of the plastic materials. Hence, there is no question of segregating the different types of plastic for making this kind of surfactant. Because of this process can be easily used to make soap, which will be very much cost effective and also have minimum impact on the environment. It is expected that such type of soap will become very popular in the market in near future.



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## Avatar Partha Pratim Lahiri

### Introduction:

Social networking and mobile devices are now synonymous. However, such electronic participation in social networking is mostly by utilising voice and text. Video communication is generally avoided due to band width and tariff issues. Hence the users are satisfied with downloaded or stored video content.

5G technology promises for device-to-device or machine-to-machine communication when both can turn on their videos. However, 'modicum of privacy' poses problem, if one of the conversant is averse to disclose his/her identity.

The one of the viable solutions to this problem is to replace the communicator by an abstract visual representation, called 'Avatar'.

### Demand from Avatar:

1. How 'Avatar' can be produced and utilised in mobile communication?
2. Does Avatar thus created technologically, in case of mobile communication, carry enough improvement to fulfil outcome?
3. What kind is psychologically and emotionally best suited for the

connected communicators maintaining visual camouflage?

### In search of solution:

To resolve above problems, large bodies at different corners of the globe are continuously researching. However, most of the researches are confined to computer-based medium using large display screen with high resolution output. But there lies much difference if a low-resolution screen like that of a mobile screen with small display that reproduces an action, say some facial expression, which may not be exactly reproduced on a mobile screen, as produced on a high-resolution computer screen.

Mobile communication mostly depends on 'affective elements' in case of social media communication, however, focus has been shifted to last oriented communication among collaborating group members. Major challenge lies in to replace nonverbal human-to-human communication to visual display to utilise the small space of a mobile screen.

### Hypothetical Solution:

1. Higher realism Avatar associated with greater copresence and satisfaction with communication.
2. Three-dimension study of avatar realism of social and psychological copresence and social Richness

### Conclusion:

Several groups are carrying research on the above aspects having useful breakthrough in order to produce more realistic 'Avatars' with improved social copresence to match large screen 'Avatars' along with rendering style and body details which are also two dimensions for virtual Avatars.

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## Higgs Boson, The Particle That Gives Us Mass Anirban De

Popularly known as the 'God particle', the Higgs boson is an elementary particle that is thought to give mass to other particles except neutrinos. This subatomic particle is named after the living legend Peter Ware Higgs (b.1929), a British theoretical physicist who had predicted the existence of this particle in 1964 and was awarded the 2013 Nobel Prize in Physics after the successful detection of this particle in 2012. The discovery of the Higgs boson on 4 July 2012 at CERN, Geneva, was a major breakthrough in physics that confirmed the existence of the Higgs field, i.e., the field of energy which gives rise to the Higgs boson.

Interestingly, the name 'boson' refers to a class of fundamental particles obeying the Bose-Einstein statistics, developed by the Indian physicist Satyendra Nath Bose (1894-1974) in conjunction with the eminent physicist Albert Einstein (1879-1955). Some other bosons (or bosonic particles) are photons, gluons and mesons.

How does the Higgs boson give mass to other subatomic particles (e.g., electrons, protons, neutrons, positrons, mesons)? Let us think of it like a crowd of people in a room. When everyone is moving around freely, it is easy for them to move past each other. But if someone stops and starts talking to others, they create a 'crowd' that slows everyone down and makes it harder to move.

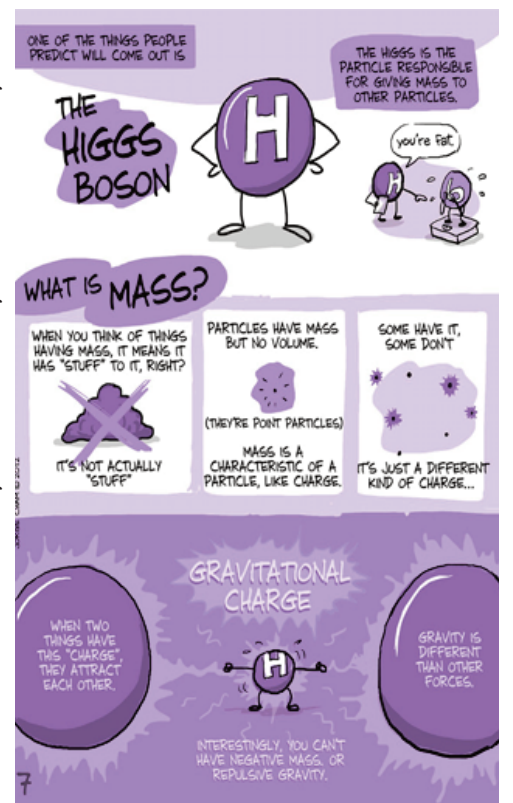
Similarly, the Higgs boson creates a 'crowd' in the universe that slows down the particles that try to move through it, thereby providing them with mass. In other words, when particles interact with the Higgs field, they experience a resistance, or 'drag', which slows them down, similar to the way a swimmer experiences more resistance when moving through water than through air. This resistance is what gives particles their mass. Without the Higgs boson, all particles would move at the speed of light and there would be no atoms or matter as we know it.

Remember that the Higgs field and the gravitational field are not the same thing. What is the Higgs field then? This is a field of energy that permeates all of space and is responsible for giving particles their masses. The gravitational field, on the other hand, is a field that describes the curvature of spacetime caused by the presence of mass and energy. In other words, the gravitational field determines how objects with mass or energy interact with each other and with the fabric of space and time. While both fields play important roles in our understanding of the universe, they are fundamentally different concepts with different properties and effects.

Does the Higgs boson itself have a mass? Yes, it has. In fact, the discovery of the Higgs boson was achieved by using the Large Hadron Collider (LHC) to create collisions between protons and study the debris produced in those collisions. The Higgs boson was detected as a specific pattern of particles produced by these collisions that could only be explained by the presence of a particle with a mass of around 125 GeV/c<sup>2</sup>, where c is the speed of light in vacuum. This mass is much larger than most other elementary particles, which typically have masses measured in mega-electronvolts/c<sup>2</sup> or kilo-electronvolts/c<sup>2</sup>. The mass of the Higgs boson is a crucial parameter in the Standard Model of particle physics, which describes the behaviour of subatomic particles and their interactions with each other.

In the Standard Model of particle physics, the Higgs boson is responsible for giving mass to other particles. The mechanism by which this occurs is called the Higgs mechanism, and it involves the interaction between the Higgs field and other particles. According to the Standard Model, all particles in the universe are thought to interact with the Higgs field to varying degrees. Some particles, such as the photon, do not interact with the Higgs field at all and therefore have zero mass. Other particles, such as the W and Z bosons, interact with the Higgs field more strongly and therefore have nonzero masses.

Is one Higgs boson responsible for the mass of another Higgs boson? Not really. In the Standard Model, the Higgs boson is thought to be responsible for giving mass to other particles, but a Higgs boson does not get its own mass from another Higgs boson. The mass of the Higgs boson is thought to arise from interactions between the Higgs field and the Higgs boson itself. This may seem circular or self-referential, but it is a fundamental aspect of the Higgs mechanism. The Higgs field spreads through all of space, and the Higgs boson is thought to arise from fluctuations, or 'ripples', in the Higgs field. As the Higgs boson moves through the Higgs field, it experiences a resistance, or 'drag', which slows it down, giving it mass. Thus, what gives the Higgs boson its own mass is such interactions between the Higgs field and the Higgs boson. In short, the Higgs boson does not get its mass from another Higgs boson, but rather from its own interactions with the Higgs field. The Higgs boson itself is thought to arise from fluctuations in the Higgs field, and it interacts with other particles through the Higgs mechanism to give them mass. In a sense, the Higgs boson is a manifestation of the Higgs field, and its mass is a reflection of the strength of the interactions between the Higgs field and other particles.



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## Drink More Water? Minakshi De

A 35-year old woman named Ashley Summers died due to water toxicity in US' Indiana. Water toxicity, also known as water intoxication occurs, when someone consumes too much water in a short span. The condition arises when kidneys struggle to handle an influx of water, leading to imbalance of electrolytes. It can decrease sodium levels, which could result in brain swelling. This can overwhelm the kidneys' ability to eliminate the surplus water, leading to a dangerous dilution of electrolytes, particularly sodium.

Symptoms may include nausea, headache, cramps and in severe cases seizures, brain swelling and sometimes even death. Maintaining a balanced fluid

intake is essential to prevent water toxicity and keeping overall in good condition. Medical reports say kidneys can only remove 0.8 to 1.0 litres of water per hour and a very high intake can upset the body's electrolytic balance. The authors of the study report that hyponatremia symptoms



can develop if a person drinks 3-4 litres of water in a short period, though they do not give a specific time estimate.

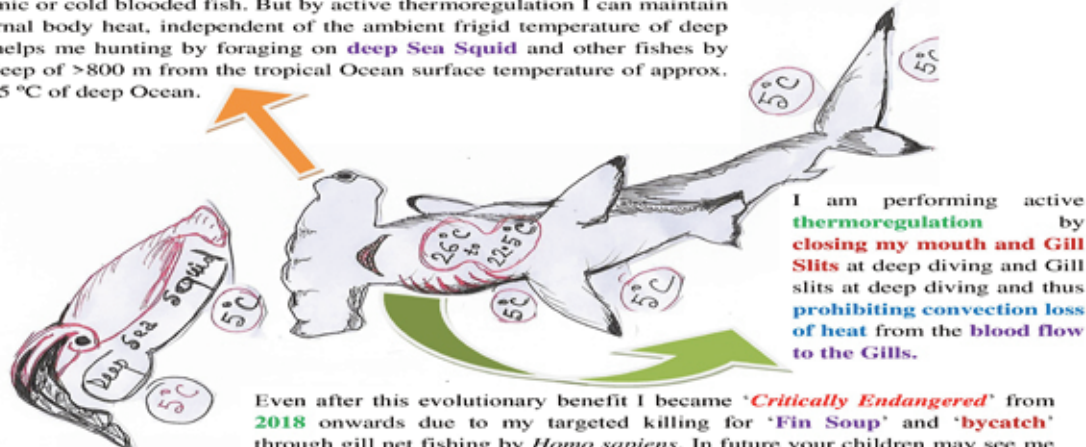
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**Ocean Conservation: plan for the Planet**

My name is **Scalloped Hammerhead Shark** (*Sphyrna lewini*). I am an exothermic or cold blooded fish. But by active thermoregulation I can maintain my internal body heat, independent of the ambient frigid temperature of deep Sea. It helps me hunting by foraging on **deep Sea Squid** and other fishes by diving deep of >800 m from the tropical Ocean surface temperature of approx. 26°C to 5 °C of deep Ocean.



Even after this evolutionary benefit I became '**Critically Endangered**' from 2018 onwards due to my targeted killing for 'Fin Soup' and 'bycatch' through gill net fishing by *Homo sapiens*. In future your children may see me in Museums. I think you will feel sorry to narrate my story of **extinction** to your children.

**SANJIT KUMAR SAHA, WBFS**  
Deputy Conservator of Forests, Personnel  
Directorate of Forests, Government of West  
Bengal

Sanjit Kumar Saha

**Petite Devine**

Urbi Roy

You born with droplets of faith,  
You peep with dribbles of hope,  
You smile with sprinkle of peace,  
And spread love all above.

You grow up with splash of joy,  
You scatter the wave of charms,  
You live for the world to let them live -  
You soak all the distress, grief and harms.

You are unaware of your destiny, oh poor Tree, the fairy of God!  
All your favours go to vein with a stroke of cruel axe,  
But you shower mercy upon the fiend, the fierce human.  
And revive again as a Phoenix!!

Student, ISNA

Mandala is a Sanskrit word that loosely translates to mean 'circle' or 'center'. Mandala art is a form of artistic expression characterized by the creation of intricate, often symmetrical, and circular designs. Artist and math Professor Fernanda Bonafini began making mandalas just for the joy of it. This art has a rich history and can be found in various cultures and spiritual traditions worldwide, including Hinduism, Buddhism, Native American traditions, and more. In their most basic form, mandalas are circles contained within a square and arranged into sections that are all organized around a single, central point. They're typically produced on paper or cloth, drawn on a surface with threads, fashioned in bronze, or built in stone. While extraordinary as a standalone work of art, mandalas hold symbolic and meditative meaning beyond their vibrant appearance.

**Purpose of Mandala:**

A mandala is a symbol of the universe in its ideal form, and its creation signifies the transformation of a universe of suffering into one of joy. It can also be used as an aid to meditation, helping the meditator to envision how to achieve the perfect self.

**Here are some key aspects and uses of Mandala Art:**

**Spiritual and Symbolic Meaning:** Mandalas are often used as spiritual symbols and tools for meditation and mindfulness. In Hindu and Buddhist traditions, they represent the universe, unity, and the balance of opposites. Mandalas are believed to help individuals focus their thoughts, find inner peace, and connect with the spiritual world.

**Geometric Patterns:** Mandalas are characterized by geometric patterns that can include circles, squares, triangles, and other shapes. These patterns are meticulously drawn or painted to create a sense of symmetry and harmony.

**Color Therapy:** Mandala art often incorporates a wide range of colors. Different colors can have different meanings and effects on emotions and mood. Color therapy is sometimes used in conjunction with mandala creation to promote healing and self-awareness.

**Creative Expression:** Creating mandalas can be a form of creative expression and self-discovery. Many people use mandalas as a form of art therapy, allowing them to explore their feelings, thoughts, and inner selves through the act of designing and coloring mandalas.

**Healing and Relaxation:**

Engaging in the process of creating or coloring mandalas can be a relaxing and therapeutic practice. It can help reduce stress, anxiety, and promote a sense of calm and well-being.

**Art Forms:** Mandalas can be created using various artistic mediums, including drawing, painting, digital art, and even sand art. They can be found in different cultures and art forms, such as Tibetan sand mandalas and stained-glass windows in Gothic cathedrals. Cultural Variations: Mandalas can vary greatly in their designs and meanings depending on the culture and tradition they are associated with. For example, Tibetan mandalas often feature intricate depictions of deities, while Native American mandalas may incorporate symbols from their cultural heritage.

**Contemporary Art:** In addition to their traditional and spiritual uses, mandalas have also found a place in contemporary art. Many contemporary artists create mandala-inspired works that incorporate modern elements and themes.

**Mandala Art**

Sneha Debnath

Whether used for spiritual purposes, creative expression, or relaxation, mandala art continues to be a meaningful and versatile form of artistic expression that has transcended cultural boundaries and has a lasting appeal to people seeking balance and inner harmony.

**Role of Art in Science:**

Art enables scientists to represent abstract ideas in a tangible form. Scientific diagrams and representations are vital to understanding convoluted chemical mechanisms and technologies.

**Mandala Art in Science:**

Carl J. Jung, Swiss psychiatrist introduced to the West the practice of creating mandalas for self-expression, discovery, and healing. In Jung's daily practice of creating mandalas, he discovered that the shapes, colors, and symbols reflected his mental, emotional, and spiritual well-being at the time that he created them. Reflecting on these mandala drawings, Jung concluded that our subconscious and conscious selves are always seeking balance. He observed that through creating mandalas, it helped to soothe patients experiencing chaotic psychological states. Jung also identified universal patterns and archetypes that reoccurred in his mandalas.

Mandalas are Macrocosm and Microcosm. They are galaxies, planets and stars. They are the patterns found in nature. They are a labyrinth that represents our inner journey or symbols for the energy portals in the human body known as the Chakras.

i. Circular diagrams are often used in phylogenetics, especially for the graphical representation of phylogenetic relationships. Evolutionary trees often encompass numerous species that are conveniently shown on a circular tree, with images of the species shown on the periphery of a tree. Such diagrams have been called phylogenetic mandalas.

ii. Body Mandalas, also referred to as 'internal body mandalas, are based on the physical human body, the nervous system, veins, arteries, spine and principal joints of the body. All of these grouped physical parts of the body are visualized (imagined) to be major and minor deities.

**Importance of Mandala Art:**

The brilliant psychoanalyst Carl Jung believed that the

mandala represents the Self and that drawing a mandala gives a person a sacred space to meet that Self. He considered making mandalas an effective form of art therapy, helping to calm and comfort people struggling with mental health issues.

**Therapeutic Effect:** Mandala coloring books and apps are the most powerful healers. Coloring might help to lessen negative thoughts and unpleasant feelings. Mandalas have specific capabilities that help to reduce anxiety and stress. The sacred circles of a mandala have a magical healing ability that can be rejuvenating.

**Mandala About the Drawn Art:** Mandala art inspired by the desire of Lord Krishna can be a beautiful and meaningful expression of devotion in Hinduism. Lord Krishna, one of the most revered deities in Hinduism, is often depicted in various poses and stories from Hindu mythology. His desires and actions are a central theme in many of these stories.

**Central Depiction:** In the center of my mandala, I have depicted an image or symbol that represents Lord Krishna. He is often shown as a young, blue-skinned deity playing the flute, standing with a cow, or in a divine dance pose. So, I chose an image of Peacock Feather (located in his crown), symbolizing his connection to nature and the beauty of creation.

**Radiating Devotional Symbols:** Around the central image of Lord Krishna, create radiating patterns and symbols that symbolize the devotee's deep love and devotion.

**Offerings and Symbols of Bhakti:** Include symbols of devotion and offerings that devotees commonly use in Krishna worship, such as a conch shell, a lamp, a peacock feather fan, or a garland of flowers. These symbols represent the devotee's dedication to worship and service.

**Color Palette:** Used a vibrant color palette that is commonly associated with Lord Krishna, such as shades of blue, green, and yellow. These colors are often used in depictions of Lord Krishna.

**Intricate Patterns:** Incorporate intricate patterns and designs around the central image and symbols. Mandalas are known for their geometric and symmetrical patterns, so I created a visually appealing arrangement of shapes and lines.

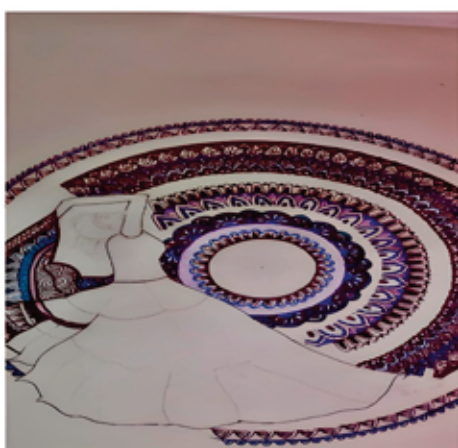
**Mantras or Chants:** If you wish to add a spiritual dimension to your mandala, you can incorporate Sanskrit mantras or chants related to Lord Krishna's desires or his divine qualities. Mantras like "Hare Krishna" can be written in the mandala.

**Personal Expression:** Mandala art can also express anyone's personal interpretation of Lord Krishna's desires. Think about the specific aspect of his desire that resonates with others, whether it's his yearning for spiritual connection, love, or his role as a divine guide, and incorporate symbols or elements that reflect that.

.....Creating a mandala art piece that represents a devotee's devotion to Lord Krishna is a heartfelt and spiritual process. It allows you to express your love and connection to the divine in a visually meaningful way. As you work on your mandala, allow your devotion to flow through your art, making it a deeply personal and meditative experience. As you get more experienced and add complexity to your patterns, keep in mind Madra's advice to beginners: "Always remember the three Ps: practice, patience, and perseverance".

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## Ozone Depletion Aggravates Skin Cancer

Arnesha Guha

The earth's stratospheric ozone layer plays a critical role in absorbing ultraviolet radiation emitted by the sun. In the last thirty years, it has been discovered that stratospheric ozone is depleting as a result of anthropogenic pollutants.

Concentrations of the greenhouse gases have increased since the Industrial Revolution due to anthropogenic activities. Carbon dioxide, methane, and nitrous oxide concentrations are now more abundant in the earth's atmosphere, this has resulted in massive ozone depletion. Stratospheric ozone depletion leads to an increase in UV-B that reach the earth's surface, where it can disrupt biological processes, damage a number of materials, and cause health hazards.

Exposure to UV radiation has been linked to many human health problems, including skin cancer. The skin is the largest organ of the human body. It is made up of three main layers: the epidermis, dermis and subcutis. Skin cancer happens when skin cells grow and multiply in an uncontrolled, unordered way. Basal cell

carcinoma and squamous cell carcinoma are the most common types of skin cancer and are sometimes called "non-melanoma skin cancer."

Research suggests that globally and especially among the fair-skinned populations, melanoma rates are increasing by 4% to 5% annually. Past research has shown that non-melanoma skin cancer risk increases for every one-degree rise of temperature, suggesting that as the planet continues to warm, there's the possibility that rising temperatures could further drive and amplify the induction of skin cancer cases due to UV radiation over exposure. While human body can repair some of the DNA damage in skin cells, it can't repair all of it. The unrepaired damage builds up over time and triggers mutations that cause skin cells to multiply rapidly which lead to malignant tumours.

Over the last 4 to 5 decades, increased incidences in skin cancer cases have led international health organizations to develop strong sun protection measures. To lower the risk of skin cancer, one should avoid exposing his/her skin to sunlight and other sources of UV radiation for extended periods. Regular skin self-exams are important for people who are at higher risk of skin cancer, such as people with a personal and/or family history of skin cancer.



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## Dark Matter: An Enigma

Arkadip Nandan

For centuries scientists have looked up at the night sky and believed that the luminous matter was all that made up our Universe. This belief has been challenged in the past eight decades based on observations that have indicated that our Universe cannot be in its present configuration without the presence of some unknown type of matter, the dark matter. We have strong indirect evidence for dark matter but it has not been observed directly till date.

The search for dark matter is about more than explaining discrepancies in observation of the Universe which we cannot explain with our present understanding. Dark matter will help us to answer the questions about how the universe formed, and how it will ultimately end. Dark matter is matter in the universe that we cannot see directly because it does not emit light. However, we know dark matter exists because of how its gravity affects other universal bodies, like stars and galaxies.

Dark matter's existence is known from gravitational effects on visible matter and gravitational lensing of background radiation. It was originally hypothesized to account for discrepancies between calculations of the mass of galaxies, clusters of galaxies and the entire universe made through dynamical means (by measuring the speed of the galaxies), and calculations based on the mass of the visible "luminous" matter these objects contain (by measuring the luminosity and hence the mass). The most widely accepted

explanation for these phenomena is that dark matter exists and that it is most probably composed of a new type of particle called the "weakly interacting massive particles" (WIMPs) that interact only through gravity and the weak force.

Alternative explanations have been proposed but there is not yet sufficient experimental evidence to determine which is correct. According to observations, dark matter accounts for 26.8% of the mass-energy content of the observable universe. In comparison, ordinary (baryonic) matter accounts for only 4.9% of the mass-energy content of the observable universe, with the remainder being attributable to dark energy. From these figures, matter accounts for 31.7% of the mass-energy content of the universe and 84.5% of the matter is dark matter.



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## Electrifying Vehicles In India

Sayantn Chakraborty

The electric vehicle (EV) era is undeniably upon us, offering a solution to air pollution with zero tailpipe emissions and a chance to reduce oil imports. India's position as one of the world's largest automobile markets makes its widespread adoption of electric vehicles a potentially transformative moment both nationally and globally. The future of electric vehicles in India is promising, but it requires focused efforts for the market to flourish.

One major obstacle to EV adoption is the relatively higher upfront cost compared to conventional vehicles, limiting affordability and demand. Additionally, the presence of charging infrastructure remains a significant hindrance in achieving widespread acceptance among users. The need to retrain repair professionals or find newly trained workers for EV technology adds to the anxieties of EV owners and drivers, who worry about breakdowns in remote locations without access to help.

Range anxiety, the fear of running out of battery charge while driving, poses another substantial challenge to the widespread adoption of electric vehicles. Battery degradation over time can also lead to a decrease in the driving range.

At present, the range of available electric vehicle models in India is relatively constrained compared to conventional vehicles. To meet the diverse preferences and requirements of consumers, the market demands a broader selection of options, including affordable EVs, in various segments.

Despite these challenges, there are positive signs in the Indian EV landscape.

JMK Research reported impressive sales of 455,733 electric vehicle units in FY2022, and the Ministry of Road Transport and Highways revealed that as of July 2022, 1,334,385 electric vehicles were already on Indian roads. Further growth is expected as central and state governments, along with private sector entities, actively promote EV adoption.

By addressing these challenges and capitalizing on existing opportunities, India can create a greener and more sustainable transportation landscape.



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## India's Space Programmes Lauded

Anwar Saeed

The great astronomer, astrophysicist, environmentalist and visionary Carl Sagan has said "All civilizations become either Spacefaring or extinct." While NASA, and other Space agencies around the world have been doing very well for many decades, now ISRO of India has also picked up this challenge seriously!

With the spectacular success of Chandrayan 3, in soft-landing a spacecraft at the South Pole of the Moon on August 23 of 2023 - India became a major Space exploring nation on Earth.

The future of human species lies in Outer Space! While Earth was its "cradle," its among other planets and stars that it will attain adulthood, wisdom and immortality! As humanity is today facing existential threats like overpopulation, pollution, nuclear war, climate change and biodiversity loss - our priority is giving up fossil fuels and moving out into the Solar system. To explore and colonize other planets, their moons and the asteroids.

In history, India has led the world in philosophy, mathematics and in teaching a reverence for all Life. Now India has to again lead humanity into a new frontier - Deep Space. For that's where our future destiny and survival truly lie. Western powers are in rapid decline! The sword of nuclear war hangs above our heads at all times! Earth is overpopulated and impoverished for natural resources! India can play a vital role at this critical moment! The other planet's, their moons, the countless asteroids and comets - all beckon us with promises of infinite riches. A vast array of new industries will come

into existence - giving employment to hundreds of millions! Today, India has a huge population of young graduates in Science and engineering - all raring to go!

The Moon is just a stone-throw away and merely our First step. But it will help us in going to the other planets; As a low-gravity launch pad for future missions and also for better optical astronomy; To use the natural resources there, to mine the countless asteroids and comets for metals and water.; To research on our Sun and unlock the secrets of fusion energy. To lift our minds and souls into vast and infinite new realms and dimensions! Space exploration will release us from our petty worries and primitive fears. It can truly unite entire humanity into One strong species!

The present Industrial Age is now ready to make the quantum leap into the Space Age! ISRO's success is good for the Space industry as a whole. Let's hope that we do not now lose our way into superstitions, irrationality, religious intolerance or political exploitation. India can be at the forefront in the coming years - of humanity's adventures, not only in Science and new knowledge - but in Space Exploration also!



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## 3 >> ...The Explorer Engineer

After her 16 years long endeavour with NASA, in August 2017, she landed into the private sector of a futuristic transportation system as a senior executive leading the development of an in-vacuum, magnetically levitating, and electrically propelled high-speed transportation system known as the Hyperloop. She was the Senior Vice President and Advisor of Virgin Hyperloop One. In February 2018, the Virgin Group signed an "intent agreement" with the Government of Maharashtra to build a hyperloop transportation system between Mumbai and Pune. Later in August 2019, the government deemed hyperloop a public infrastructure project and approved the Virgin Hyperloop-DP World Consortium as the Original Project Proponent (OPP), recognizing hyperloop technology alongside other more traditional forms of mass transit.

In 2020, Dr. Sengupta founded a green energy technology company, Hydroplane, developing a hydrogen fuel cell power plant for aviation and aerospace applications. As the CEO of Hydroplane Ltd., she is the two-time contract awardee of the USAF Agility Prime Program. As an aviation entrepreneur, Dr. Sengupta is putting her space program skills to develop key energy storage technologies to bring a more cost effective, reliable

and lower carbon footprint urban air mobility solution to planet earth. They are developing a modular Hydrogen Fuel Cell Power Plant for General Aviation, Urban Air Mobility and Vertical Lift platforms. They are also trying



to find ways to work with India on the development of eVTOL (electric vertical take-off & landing) aircraft and aims to make green air travel affordable to everyone. The unique design addresses PEM thermal management, durability, and cost for the aircraft owner/operator. In 2018, the aviation sector CO2 output was 1.04 billion tons with a 4% growth per year since 2010. The impact of switching global air travel to hydrogen power will cause more than 50 billion tons reduction of CO2 by 2050, if the market is fully adapted to this new technology.

Besides, she continues to be a STEM (Science, Technology, Engineering and Mathematics) outreach advocate and a Research Associate Professor of Astronautical Engineering at the University of Southern California (USC) specializing in entry vehicle design, supersonic aerodynamics, in space propulsion, and green transportation technology at the Viterbi School of Engineering. Scientist by profession and an avid commercial pilot, a snowboarder, scuba-diver, sport motorcyclist, mountain bicyclist and runner by passion, Dr. Sengupta believes, "if it was easy, it probably wasn't worth doing and if it seems impossible - all the more reason to try and do it."

Proprietor, Qualcast India/  
Assistant Professor,  
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## An Ode To Physics By A Special Correspondent



Was July a pre-designed month for Physics? Kolkata's prestigious Birla Industrial and Technological

drama."

But there is no denying of the fact that the epic film has struck a note on its own. The story, the presentation, the metaphors and the sequences have all pointed out how imagination can be mingled with filmization. Critics have already pointed out that the film is a product of prolonged research but interpretively there might be smaller deviations or aberrations. Many feel that it is better to ignore these flipflops in the greater interest of history because the film is a saga of a sequel to the World War.

We at ISNA have also not forgotten physics. By deciding to launch the current issue on his birth anniversary we have made a feeble attempt to honour one of the great astrophysicists of his time, Dr. Meghnad Saha who could easily have been a justified claimant of the prestigious Nobel prize by the dint of his contribution to modern science. Dr. Saha throughout his life has proved that he did not only confine himself to physics alone but also had asserted his role as a nation builder and planner.

At the same time his role in science popularization cannot be forgotten. By joining hands with the doyen of Indian science, Acharya Prafulla Chandra Ray he founded the Indian Science News Association and came forward to publish the heritage journal, Science and Culture, to bring science closer to the doorsteps of the common people. Both were not Nobel laureates but made other Nobel laureates write for the paper that propounded the vignettes of both science and culture with a somewhat emphasis on the Indian aspects. Long live physics!



Museum (BITM) organized a weeklong exhibit on the glorious subject for school children. This is local. But, worldwide, the father of the modern atom bomb, Oppenheimer, had been ruling the roost with his robust biopic smashing all box office records of the recent past and generating a massive explosion on the social media. Are people turning to physics as exemplified by a generous turn out of students at the BITM or the movie as a time

turner? Ask a common man with a rudimentary education. He may name Copernicus, Galileo, Archimedes or even Einstein with a vague idea of what these renaissance giants did or about their influence on modern physics with all ramifications today. That may not be a wonder.

But Oppenheimer of the Manhattan project fame at Los Alamos in the US is turning out to be an enigma. Each and every one, barring a few, after seeing this biopic directed by cerebral filmmaker Christopher Nolan, is euphoric in their eulogy. Overwhelming is the monosyllabic summary of their reaction.

Doubters, no matter who, will always raise their fingers. Some, feeling "disappointed" are of the opinion that history has been "smeared." Some have accused him of chanting the Sanskrit verse wrong after the bomb burst. Some too have pointed out the screenplay is a quagmire. One has fired his salvo straight by saying that Oppenheimer has opened the "gate of death." Many, however, missed his special effects, quite unlike his previous creations, and thus called the film "a court-room

## ISNA students visit Science City Urbi Roy

On July 7 last students of Indian Science News Association (ISNA) went to Science City.

At first, they visited the section 'Science on a Sphere'. There is a spherical projection system of 1.80-meter diameter. Using computers and video projectors, planetary data are displayed on that big sphere which is analogous to a giant animated globe. A slideshow was going on which was showing about the real-time infrared satellite images of Earth and other planets like Jupiter, Mars, and Saturn, providing information on the climate and environment of the planets and their natural satellites, an ocean acidification model, real-time earthquakes, pictures of air and satellite traffic around the space of Earth, images of Earth during the night, climatic and temperature variations, the concentration of chlorophyll content, cloud movements and several others.

Next, the students entered the 3D digital theatre. when only two movies were shown. Starting from under the ocean and ending to Jupiter, it was really an epic voyage. Mainly the whole journey of Voyager 1 and 2 was depicted in the movie. The 3D effect made the whole environment so realistic that it seemed like the students were traveling in space. The graphics along with the voice-over made the session a mesmerizing one.

The 'Time Machine' was basically a 'Motion Stimulator'. It is a box having a seating capacity of 15 persons. Inside the box, a movie was going on and the during that time the box was shaken vigorously with the people inside as if they were having a 'motion-trip'.

They next explored 'A Geological Timeline of Life on Earth' where life from 1200 BC to the Ice Era was depicted through various models. Students boarded a small toy train and entered into the 'Dinosaur age timeline'. Various models of dinosaurs with other reptiles were present there. The voiceover was informing related data respective to each model. The section named 'Science & Technology Heritage of India' was

showing the progress of ancient Indian science and technology through sections on the history of Indian Civilization, town planning, architecture, water technology, technical crafts, maritime activities, coin minting, ancient medicines with medical progress, glass technology, perfumery, earth sciences, musical instruments, agriculture, physics and chemistry related concepts, mathematics, astronomy, metals and metallurgy and many more.

The second part of the visit an interview with the Director of Science City, Dr. Anurag Kumar. around a 30-minute session students asked numerous questions from different aspects related to Science City. Dr. Kumar said that Science City in Kolkata was established in the year 1997 on around 45 acres of land. There are five buildings including a Food Court. This is the biggest infrastructure in entire South Asia. Before 2000, it was under the National Council of Science Museum. After 2000, it was handed over to the State Government. The main purpose of establishing Science City is to communicate science in the society. For this purpose, the cost or entry fee or tickets are kept very low so that people can afford to visit. For school students, tickets have more than 50% concession. In addition, Science City has a great impact on the environment as it was built up on the biggest dumping ground of Kolkata, and changed the overall unhygienic surrounding into a healthy environment. He said the Science City Authority has planned to come up with a new hall for Global Climate Change by next year. Around 1.5 lac students visit Science City yearly. About 1000 schools are registered. The Authority wants to reach more schools in West Bengal. The Authority is having a plan on upgrading the Dynamotion Hall, Butterfly Park, and the Science Park.

Student  
Indian Science News Association (ISNA)  
Kolkata, West Bengal,  
India

## ISNA Celebrates Foundation Day Malabika Sengupta

Indian Science News Association (ISNA) celebrated its Foundation Day on July 12, 2023 in the N.Rajabazar Science College Campus of the University of Calcutta. At the outset, Dr. Amit Krishna De, Honorary Secretary, ISNA introduced all the dignitaries on the dais. The recorded welcome address of Dr K. Muraleedharan, President, ISNA, was presented for the audience. Prof. Manas Chakrabarty, Hony Secretary of ISNA, briefly narrated the genesis of the organization, highlighting on the uninterrupted publication of Science and Culture (the mouthpiece of ISNA), the continuation of a Training Course on Science Communication and Media Practice and on the recent publication of two e-journals - Scientifica Communica (in English) and Bigyan Kahon (in Bengali).

The Chief Guest, Prof. Souvik Bhattacharyya, Principal Academic Advisor, TCG Centres of Research and Education in Science and Technology dwelt on new-age technology - Artificial Intelligence and ChatGPT under the theme - "Dear Data -The Good, the Bad and the Future of GPT". He focussed on the early days and the present status of AI, including Chat GPT, especially on its importance in educational field and research. He suggested that Chat GPT should be

introduced from school to university level for teaching and assignments to students.

Two students Aditri Gupta and Akansha Chatterjee, both from DPS, Ruby Park, the two recipients of Mrinal Kanti Dewanjee 'Students Award on Basic Science Research', then briefly presented their proposals by powerpoint. A cash Prize of Rs. 10,000/- and a framed Certificate from ISNA were then given to each awardee by Professor Souvik Bhattacharyya. Joint Editor Dr. Arnab Banerjee and Assistant Editor Sukalyan Gain of the two e-Papers briefly explained on how they prepared the present issue (vol. 2, issue 2) of Bigyan Kahon which was released officially by Prof. Bhattacharyya. Prof. Dhrubajyoti Chattopadhyay, Vice-President, ISNA and Vice-Chancellor, Sister Nivedita University delivered the concluding speech covering the activities of ISNA, its training programme and the importance of science education and teaching. He stressed on the role of science communicators in the society. Dr. Amit Krishna De, Secretary, ISNA, delivered the vote of thanks.

Student  
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## Science Communication Training Programme Starts Bratati Barik

The Inaugural ceremony of the 36th Training Programme on Science Communication and Media Practice 2023-2024, was held on June 15 by in the University of Calcutta, Rajabazar Campus.



Dr. Amit Krishna De and Dr. T.V. Venkateswaran were the conveners of the programme in which Prof. Manas Chakrabarty, the Honorary Secretary, ISNA and Mr. Prasanta K. Bose, the Chairman of the science communication course of ISNA, were present. Professor Sudhendu Mandal, the editor-in-chief, Science and Culture, presided over the programme which started with the felicitation of the guests. In his welcome address, Mr. Prasanta K. Bose emphasized on the need of building up a scientific temperament and the urgency of propagating scientific knowledge through both digital and non-digital media to the common people. This was followed by an address by the honorary Secretary, Prof. Manas Chakrabarty. The special guest of the day, Dr. Rajarshi Mitra, Associate Professor and Head in the Department of Environmental Science at Vivekananda College, Thakurpukur. shared his invaluable experience about how his life

was changed and directed to the correct destination by the expertise and excellent guidance of the eminent members and co-members of ISNA. He also emphasized on learning to think

logically and then to learn to communicate. He added that only a logical thought can bear fruit of spreading awareness for change. Veteran journalist and public relations expert, Mr. Biswarup Mukherjee, the Guest of Honour, spoke on past glory and present status of ISNA that brought inspiration to the participants and learners present in the programme. Swami Kamalasthanda Maharaj, the Principal of

Ramkrishna Mission Vivekananda Centenary College was the chief guest of the programme said that science communication is a matter of creation that could provide joy. The matters of intellect involved in science communication created awareness through a rhythm that binds all in a sense of empathy and leads to success. Dr. Atanu Pal, Associate Professor of Rheumatology and Nephrology (Institute of Postgraduate Medical Education & Research) delivered the "Third Professor Biswapati Mukherjee Memorial Lecture". emphasizing on the need for further development of the Ayurveda treatment process and the utility of evidence based medical treatment. At the end of his lecture, Dr. Atanu Pal was honoured with the Biswapati Mukherjee Memorial Award by ISNA. The programme ended with a vote of thanks by Prof. Prabir Kumar Saha, Treasurer, ISNA.

Student  
Indian Science News Association (ISNA)  
Kolkata, West Bengal



The origins of life on Earth have been a source of speculation among philosophers, religious thinkers, and scientists for thousands of years. Many human civilizations used rich and complex creation stories and myths to explain the presence of living organisms. Ancient Greek #W20000

Darwin did not know it, but the answer was at hand—although it would not be acknowledged in his lifetime. In the Augustinian monastery at Brunn (now Brno in the Czech Republic), Austrian monk Gregor Mendel experimented with the breeding of garden peas, observing how their traits were passed down through generations. In crossbreeding pea plants to produce different combinations of traits—color, height, smoothness, and other characteristics—Mendel noted that although a given trait might not appear in every generation, the trait did not disappear. Mendel discovered that the expression of traits hinged on whether the traits were dominant or recessive, and on how these dominant and recessive traits combined. He learned that contrary to what most scientists believed at the time, the mixing of traits in sexual reproduction did not result in a random blending. Traits were passed along in discrete units. These units are now known as genes. Mendel performed hundreds of experiments and produced precise statistical models and principles of heredity, now known as Mendel's Laws, showing how dominant and recessive traits are expressed over generations. However, no one appreciated the significance of Mendel's work until after his death. But his work ultimately gave birth to the modern field of genetics.

### Population Genetics and the Modern Synthesis

As the science of genetics advanced during the 1920s and 1930s, several key scientists forged a link between Mendel's laws of inheritance and the theory of natural selection proposed by Darwin and Wallace. British mathematician Sir Ronald Fisher, British geneticist J.B.S. Haldane, and American geneticist Sewall Wright pioneered the field of population genetics. By mathematically analyzing the genetic variation in entire populations, these scientists demonstrated that natural selection, and not just mutation, could result in evolutionary change. This modern view of evolution integrated discoveries and ideas from many different disciplines. In doing so, this view reconciled the many disparate ideas about evolution into the all-encompassing evolutionary science studied today. The modern synthesis was advanced in such books as *Genetics and the Origin of Species*, published in 1937 by Russian-born American geneticist Theodosius Dobzhansky; *Evolution: The Modern Synthesis* (1942) by British biologist Sir Julian Huxley; and *Systematics and the Origin of Species* (1942) by German-born American evolutionary biologist Ernst Mayr. In 1942, American paleontologist George Gaylord Simpson demonstrated from the fossil record that rates and modes of evolution are correlated: New kinds of organisms arise when their ancestors invade a new niche, and evolve rapidly to best exploit the conditions in the new environment. In the late 1940s American botanist G. Ledyard Stebbins showed that plants display evolutionary patterns similar to those of animals, and especially that plant evolution has demonstrated diverse adaptive responses to environmental pressures and opportunities.

In addition, biologists reviewed a broad range of genetic, ecological, and anatomical evidence to show that observation and experimental evidence strongly supported the modern synthesis. The theory has formed the basis of

## Biological Evolution: The Perspectives Of Theory Hemen Biswas

evolutionary science since the 1950s. It has also led to an effort to classify organisms according to their evolutionary history, as well as their physical similarities. Modern scientists use the principles of genetics and molecular biology to study relationships first proposed by Carolus Linnaeus more than 200 years ago.

### New Techniques in Molecular Biology:

In 1953, American biochemist James Watson and British biophysicist Francis Crick described the three-dimensional shape of DNA, the molecule that contains hereditary information in nearly all living organisms. In the following decade, geneticists developed techniques to rapidly compare DNA and proteins from different organisms. In one such procedure, electrophoresis, geneticists evaluate different specimens of DNA or proteins by observing how they behave in the presence of a slight electric charge. Such techniques opened up entirely new ways to study evolution. For the first time geneticists could quantitatively determine, for example, the genetic change that occurs during the formation of new species.

Electrophoresis and other biochemical techniques also demonstrated to geneticists that populations varied extensively at the molecular level. They learned that much of population variation at the molecular or biochemical level has no apparent benefit. In 1968 Japanese geneticist Motoo Kimura proposed that much of the variation at the molecular level results not from the forces of natural selection, but from chance mutations that do not affect an organism's fitness. Not all scientists agree with the neutral gene theory.

### Sociobiology:

In recent decades, another branch of evolutionary theory has appeared, as researchers have explored the possibility that not only physical traits, but behavior itself, might be inherited. Behavioral geneticists have studied how genes influence behavior, and more recently, the role of biology in social behavior has been explored. This field of investigation, known as sociobiology, was inaugurated in 1975 with the publication of the book *Sociobiology: The New Synthesis* by American evolutionary biologist Edward O. Wilson. In this book, Wilson proposed that genes influence much of animal and human behavior, and that these characteristics are also subject to natural selection.

Sociobiologists examine animal behaviors that are called altruistic—that is, unselfish, or demonstrating concern for the welfare of others. When birds feed on the ground, for example, one individual may notice a predator and sound an alarm. In so doing, the bird also calls the predator's attention to itself. What can account for the behavior of such a sentry, who would seem to derive no evolutionary benefit from its unselfish behavior and so seem to defy the laws of natural selection?

### Punctuated Equilibria:

Evolutionary theory has undergone many further refinements in recent years. One such theory challenges the central idea that evolution proceeds by

gradual change. In 1972 American paleontologists Stephen Jay Gould and Niles Eldredge proposed the theory of punctuated equilibria. According to this theory, trends in the fossil record cannot be attributed to gradual transformation within a lineage, but rather result from quick bursts of rapid evolutionary change. Occasionally, when conditions are right, the equilibrium state becomes "punctuated" by one or more speciation events. While these events probably require thousands or tens of thousands of years to establish effective reproductive isolation and distinctive characteristics, this is but an instant in geologic time compared with an average life span of more than ten million years for most fossil species.

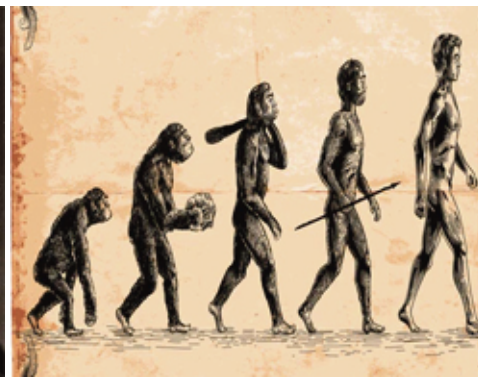
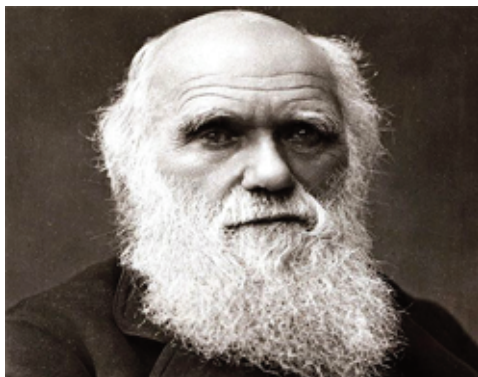
### Role of Extinction:

In the last several decades, scientists have questioned the role of extinction in evolution. Of the millions of species that have existed on this planet, more than 99 percent are extinct. Historically, biologists regarded extinction as a natural outcome of competition between newly evolved, adaptively superior species and their older, more primitive ancestors. Recently, however, paleontologists have discovered that many different, unrelated species living in large ecosystems tend to become extinct at nearly the same time. The cause is always some sort of climate change or catastrophic event that produces conditions too severe for most organisms to endure. Moreover, new species evolve after the wave of extinction removes many of the species that previously occupied a region for millions of years. Thus extinction does not result from evolution, but actually causes it.

Extinction as a cause of evolution rather than the result of it is perhaps best demonstrated in terms of our own ancestors—ancient mammals. During the time of the dinosaurs, mammals constituted only a small percentage of the animals that roamed the planet. The demise of dinosaurs provided an opportunity for mammals to expand their numbers and ultimately to become the dominant land animal. Without the catastrophe that took place 65 million years ago, mammals may have remained in the shadow of the dinosaurs.

Nevertheless, evolutionary theory is still, in some cases, the cause of misconception or misunderstanding. People often misconstrue the phrase 'survival of the fittest.' Some people interpret this to mean that survival is the reward for the strongest, the most vigorous, or the most dominant. In the Darwinian sense, however, fitness does not necessarily mean strength so much as the capacity to adapt successfully. This might mean developing adaptations for more efficiently obtaining food, or escaping predators, or enduring climate change—in short, for thriving in a given set of circumstances. But it bears repeating that organisms do not change their characteristics in direct response to the environment. The key is genetic variation within a population—and the potential for new combinations of traits. Nature will select those individuals that have developed the ideal characteristics with which to flourish in a given environment or niche. These individuals will have the greatest degree of reproductive success, passing their successful traits on to their descendants.

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## Acknowledgement

We are extremely grateful to eminent ENT surgeon, Dr. Pradip Patra, for his spontaneous contribution of a portrait of Dr Meghnad Saha, painted by him, to enrich this issue. The editorial board heartily appreciate this kind gesture.

At the same time we renew our appeal to our writers to keep in mind that the word limit for each contribution is 350 words and not more. Ours is an e-Paper and we feel helpless when we find the word limit is not adhered to despite a good content.

Meanwhile, please get ready with your contribution for our upcoming issue of Bigyan Kahon planned to be launched sometime in December. Please remember the limit is 350 words.

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