



The Armageddon

Don't tell me you haven't seen it. How many times? Oh, not even once in your lifetime? Okay! If it's not one of the Seven Wonders of the world – the Taj Mahal – then you must have visited the Dilwara Temple in Mount Abu?

Now you know what these architectural marvels are made of? No? Then let me tell you. All these ancient beauties are built on what is called the famous “Makrana Marble” of India. From the Aravalli hills, the gateway to north-western India, meandering through Gujarat, Rajasthan, Delhi, and Haryana, spanning a 700-km range. A range of 2.5 billion years, older than even the Himalayas.

Apart from marble, the Aravalli hills are a goldmine of many other ores such as granite, quartzite, bauxite, limestone, as well as Copper, Lead, Zinc, Silver, Tungsten, and above all, rare earths, which are all symbols of modern life in India.

Industries quarrying these materials earn their stinky profits by selling within and outside the country. Skyscrapers reaching dizzying heights in the rich states of India bear testimony to the heavy usage of these metalliferous and industrial minerals.

So far, so good. But what and why is the need to bring the Aravalli range to the fore? In the parlance of journalism, there is a common adage: you can hit the headlines either by your good deeds or your bad deeds. Well, Aravalli has now become the cynosure of all eyes for reasons best known to all concerned.

Of late, yes, again in India, we have long been hearing the coinages, “media trial,” and “judicial activism.” As far as the first one is concerned, today's media, television channels in particular, are hyperactive. No doubt should be harboured about this because they are always chasing what they call TRP, the rating yardstick. Who decides and how it is done is anybody's guess. Forget it.

The bigger question is, why is there a growing proclivity to fall back upon the judiciary, the highest tenet of democracy, to decide on issues of local and national importance? As such, our courts, from the district to the apex level, are overburdened with litigation. Why would they have to raise their eyebrows and would have to intervene when contentious matters could be settled and decided upon at the administration level or even by elected representatives?

Did I say anything wrong or strike the wrong chord?

Many people think that the greatest tragedy of the common Indian life is the infiltration of politics in every step we take. In keeping with this tradition, the scenic Aravalli has been dragged to the court of law. Why? Is it because of political interests meddling with the centuries-old protector of the Northwest, with its rich greenery, deep aquifers and unlimited reservoir of minerals?

Experts say there should be no doubt about this. The Aravalli have become a glaring example of the “politicians-miners nexus.” Structurally, the topsoil of the hills has started eroding since the last millennium and the degradation has been compounded by mining, mostly illegal, not for the metals but mostly for the industrial minerals, resulting in massive deforestation. Raindrops falling on the hilltop are being washed away without recharging the underbelly aquifers. The net effect is the loss of natural resources of an unbelievable quantum.

Probably, it now seems, the Aravalli would not have hogged the limelight had north India not been affected. Apart from geographical concerns, the hills have become an environmental issue. The region has been protected for so long from further desertification by the flying sand grains from the Thar in Rajasthan, especially in the arid summer months. Otherwise, the already extreme climate of the area, mostly in Rajasthan, Delhi and Haryana, would have gone to the dogs.

Unfortunately, with alarm bells ringing from a failure to stop illegal mining, the Supreme Court had to intervene twice, first last November and again at the beginning of this year, though it could have been easily settled at the political and administrative level, but for the contumacious miners. Is it desirable for this issue, in particular?

When questions were raised again after the first judgment, the highest court had to step in with a verdict that a new committee would review the issue afresh. The Indian experience, by and large, has so far been that if you want to kill an issue, appoint a committee. Many of the reports of different committees, both at the central and state levels, have never seen the light of day. For the time being, the issue has been hanging fire. How long? Nobody knows. Will the report have the same fate and be hidden again in the contours or crevices of the Aravalli?

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The Aravalli Mountains: Ancient Guardians Under Modern Threat

Saikat Kumar Basu

The Aravalli mountain range, among the oldest fold mountains in the world, stretches across Rajasthan, Haryana, Delhi and Gujarat, forming a critical ecological backbone of north-western India. For centuries, the Aravallis have acted as a natural barrier against desertification, a vital groundwater recharge zone, a climate regulator, and a refuge for diverse flora and fauna. However, from the current Indian perspective, this ancient landscape is facing unprecedented challenges driven largely by human activities. One of the most pressing threats is rampant legal and illegal mining, which has severely degraded hill

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Environmental Importance And Biodiversity Of The Aravalli Hills

Swati Nandi Chakrabarti

The Aravalli Range, stretching - 670 km across northwestern India, is one of the world's oldest fold mountain belts, composed mainly of Precambrian granite and gneiss. Its deeply weathered crystalline rocks form porous soils and aquifers that influence regional hydrology and climate. Geologically, the eroded Aravalli massif acts as an ancient highland that modulates atmospheric dynamics. By intercepting prevailing westerly winds from the Thar Desert and generating localized low-pressure zones during summer, the Aravallis draw moisture laden monsoon air inland. As moist air impinges on the ridge, it

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Why Again?

Prasanta K. Bose



The tagline on his WhatsApp status says, “A geologist is always a geologist.” He has held this belief since he got admitted to the earth sciences department at the Presidency College (now Presidency University) in the late sixties. Coincidentally, he began studying the structural geology of the Aravalli hills, mostly in

Dungarpur and Udaipur in south Rajasthan, where one of the tips of the 700 km-long range lies. Ultimately, that became the fodder of his cannon when he returned to teaching at his alma mater, and that too for more than a quarter of a century.

Though he has the dubious distinction of having undergone a double bypass surgery, the Aravalli hills still beckon him. Will he respond to the calls? Well, that's a million-dollar question. But, certainly not alone. Earlier, during field trips, his students used to accompany him, but this time, it will certainly be his wife, an ebullient art historian and also a hill enthusiast, with a repaired broken leg.

When we started deliberating on who to choose for our interview column, especially with the Aravalli Hills in focus, everybody agreed: who else to turn to but Prof. Ananda Chakrabarty? A simple ping helped fix the schedule. One of his unassailable qualities is that he does not mince words when he speaks. Of course, his profound knowledge gives him confidence.

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Aravalli Endangered, But How?

Debdut Ghoshthakur

'A Living Natural System vs. A Hunting Ground for Political Profit and Business'

The Aravalli range is one of the world's oldest geological formations. It is not just a natural landscape; it is a living ecological infrastructure for northwestern India. This mountain range is too important from an environmental point of view touching Gujarat, Rajasthan, Haryana and Delhi. Ecologically, it provides crucial services like groundwater recharge, dust storm mitigation, biodiversity conservation, and regional climate regulation.

It is said that the Aravalli was born approximately in the Proterozoic era, about 1500 to 2500 million years ago, in the very initial phase of Earth's creation. A mountain range, which we know as the Aravalli, rose breaking through the soil, taking on the responsibility of protecting India's northwestern frontier.

It is also an integral part of the water cycle, biodiversity, climate, and human life. Its role in water retention, desertification prevention, air purification, and biodiversity conservation is scientifically established.

But, when the state defines the Aravalli in the language

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SUSTAINABLE DEVELOPMENT GOALS

Guest Editors:
Prof. Kaushik Banerjee
Dr. Paramita Bhattacharyya
Dr. Sudipta Adhikary

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...Aravalli Endangered, But How?

defines the Aravalli in the language of meters and height, nature itself becomes a political question and a contestant. In a capital-dependent democracy, the Aravalli range is simultaneously a hunting ground for political profit and business, where the inter-relationship between the state, capital, and the law becomes clearly visible.

As a result sustainability of this ecological wonder was under scanner of different organizations and courts. Back in 1996, the Supreme court of India had directed that whatever is a 'forest' according to the dictionary definition must be protected, regardless of what government records show. Thus, environmental regulations were applicable to all Aravalli areas—including old notified areas, small hillocks, slopes, mounds, and biodiversity zones. But the soul of this giant ecosystem have been hurt now.

It may be recalled that In 2024, the Supreme Court directed the formation of a Uniform Definition Committee and instructed it to create a single, uniform definition. Because till then the different states i.e. Rajasthan, Haryana, Delhi & Gujarat had different definitions. So again the Supreme Court of India came into action. In 2009, The court imposed a complete ban on mining in a 600 sq km area across Rajasthan and Haryana and raised questions about what exactly constitutes the 'Aravalli hills'.

In 2018, the Supreme Court again expressed strong dismay over the disappearance of 31 hills or hillocks in Rajasthan's Aravalli region and ordered the stoppage of illegal mining within 48 hours.

Finally after 20 years, on 20 November 20, 2025, the recommendation of 2004 came into action. A judgement delivered by a bench comprising of former Chief Justice B.R. Gavai, and other two judges of Supreme Court of India accepted the recommendations of a committee led by the Union Ministry of Environment, Forest and Climate Change (MoEFCC).

This judgement established a new uniform legal definition for the Aravalli range, The apex court stated that the Aravalli Hills or Range would legally be considered only as those landforms, which are at an elevation of 100 meters or more above the local land level. The court also ordered that new mining approvals would remain suspended until a scientific, effective and Sustainable Mining Plan is prepared.

But the ruling was not accepted in all corners. Some questions were raised. What suddenly happened was something that necessitated a legal definition to protect the essential characteristics of the hills in the case of the Aravalli?

How do legal definitions affect or determine the scope of environmental protection? What can be the consequences when the state's laws align with developmental or extractive interests? Can statutory law mitigate the existing power imbalance between capital and environment? According to a group of international environment activists, 'the court was too cautious about protecting the environment, but it is not omnipotent. As long as legal language does not question capitalist development, it remains limited.'

Leaving nature protection solely to the courts ultimately leads to falling into the trap of definitions. Because the court is not outside the state; it operates within the framework of class relations'.

An environmental activist commented, "While playing a positive role in environmental protection, by retaining the term 'Sustainable Development', the court kept the legitimacy of development unquestioned, and did not build resistance against capital itself, but rather 'showed a weak resistance' against capital's 'excess disorder', acting as a 'safety valve' within the framework of popular reaction'."

Environmental Importance...

it ascends and cools, producing orographically enhanced rainfall over adjacent plains. This process helps distribute monsoonal precipitation more uniformly across Rajasthan, Haryana and western Uttar Pradesh.

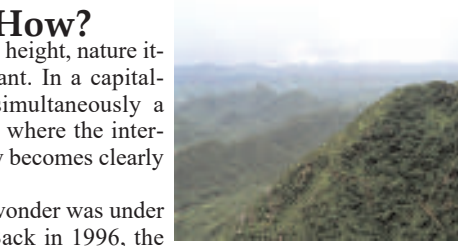
Likewise, the hills' continuous ridges act as a barrier against desertification, slowing the eastward spread of the Thar's dust-laden dry winds and reducing dust storms and aridification in the Gangetic plains.

Satellite temperature analyses indicate areas near the Aravallis are up to 2-3 °C cooler in summer than the surrounding desert, reflecting the range's role in moderating heatwaves and stabilizing regional temperature extremes. The Aravalli landscape supports high biodiversity across its dry deciduous and thorn scrub ecosystems. Its vegetation is dominated by xerophytic tree species (Acacia spp., Prosopis, Salvadora, Anogeissus, etc.) and shrubs adapted to low rainfall. These forests and grasslands provide habitat for hundreds of wildlife species. Large carnivores such as the common leopard (*Panthera pardus*), grey wolf (*Canis lupus*), golden jackal (*Canis aureus*) and striped hyena (*Hyaena hyaena*) are documented in the Aravalli thorn-scrub ecoregion. Herbivores like the nilgai or blue bull (*Boselaphus tragocamelus*), blackbuck (*Antelope cervicapra*), chinkara or Indian gazelle (*Gazella bennettii*), sloth bear (*Melursus ursinus*) and four-horned antelope (*Tetracerus quadricornis*) also occur, reflecting a relatively intact trophic web. Avifauna is especially rich. Over 200-300 species of birds have been recorded in the Aravalli region, ranging from dryland specialists to migratory species.

Notably, globally threatened grassland birds, the Great Indian Bustard (*Ardeotis nigripes*) and Lesser Florican (*Sypheotides indicus*) inhabit areas in and around the Aravallis. Recent botanical surveys have even discovered previously unknown endemic plants (e.g. *Portulaca bharat*, a succulent, new to science) growing in isolated Aravalli habitats. In summary, the Aravalli Hills serve as a biodiversity refuge and corridor, linking the forests and grasslands of Gujarat to those of the Himalayas and sheltering endemic and threatened species across its length.

Hydrology and Desertification Control Hydrologically, the Aravalli terrain plays a critical role in groundwater recharge. The ancient crystalline rocks of the range are heavily fractured and weathered, creating natural conduits for rainwater infiltration. Monsoon rains percolate rapidly through these permeable layers, replenishing aquifers that supply drinking and irrigation water in Rajasthan, Haryana and Delhi.

Empirical estimates indicate that one hectare of Aravalli landscape can recharge on the order



of two million liters of groundwater annually. This renewable aquifer recharge is vital in a semi-arid region where surface flows are intermittent. Moreover, the hills sustain baseflows: numerous springs and seasonal streams (e.g. the Sahibi River) owe their persistence to gradual release of stored rainwater from Aravalli aquifers even after the monsoon has passed.

By elevating the local water table and maintaining humidity, the Aravallis help prevent large-scale desertification. Their forests and soil cover conserve moisture and organic matter, reducing wind erosion and the advance of sand into agricultural zones.

Ecosystem Services of the Aravalli Forests The wooded and vegetated lands of the Aravallis provide multiple ecosystem services of climatic and societal benefit. Forest canopies intercept rainfall, enhance soil infiltration, and reduce surface runoff and erosion. The trees release water vapor through transpiration, helping to preserve atmospheric humidity and promote localized precipitation. In the densely populated NCR (Delhi-Haryana) region, Aravalli woodlands act as "green lungs." They trap airborne particulates and carbon, thereby mitigating air pollution and sequestering greenhouse gases. The vegetative cover also moderates extreme heat: by shading and evaporative cooling, the range moderates day-time maximums and buffers night-time lows. These combined processes confer climate stability and reduce drought risk in northwestern India.

In addition, the Aravalli landscapes supply goods (fodder, fuelwood, medicinal plants) and services (pollination, recreation, cultural values) to rural communities. By minimizing soil degradation, the hills help retain nutrients and moisture in adjacent farmlands, thus supporting agricultural resilience during erratic monsoons. In short, the Aravalli Mountains are a critical ecological backbone for the Indian subcontinent. Their ancient geology and distinct topography endow them with a unique ability to regulate monsoon patterns, capture groundwater, and anchor biodiversity.

The combined effect of the Aravallis' physical barrier, vegetation, and hydrogeology is to stabilize the regional climate moderating temperature extremes, enhancing rainfall distribution, and guarding against desert encroachment. This integrated suite of environmental functions underscores why the Aravalli Hills remain indispensable for the ecological and climatic balance of northwest India.

Environmentalist & Principal,
Asansol Girl's College

A group of activists said in a national daily that, nearly 90 percent of the Aravalli range area in Rajasthan—which is primarily composed of hills lower than 100 meters—will no longer be considered part of the protected mountain range. According to a reliable source of information, out of about 1.6 lakh hillocks in the state, only 1,048 hills have been able to meet this 100-meter criterion.

Environmental activists blame the resources of the Aravalli for all this confusion. The Aravalli, rich in natural resources, becomes a mineral treasury and land possibility for capital, a source of development and revenue for the state.

But for the local people, the Aravalli is the foundation of water, land, and life, their sole means of survival. In the conventional narrative of environmental movements, the state is presented as a mediator for environmental protection.

But analyzing the state's role in the Aravalli case reveals that the state has effectively functioned as a supportive structure for capital.

An article published in a national daily evaluated the resources of the Aravalli.

- i. Marble, especially from the Makrana (Rajasthan) region, which is extremely fine-grained, durable, and bright. The Taj Mahal is made of Makrana marble, as are Rajasthan's forts and havelis, Dilwara temple, Mount Abu, statue carving work, Rajput and Mughal architecture.
- ii. Limestone, rich in calcium carbonate, a key ingredient for cement and lime.
- iii. Quartzite, extremely hard and erosion-resistant, important for road and railway construction.
- iv. Granite, heavy and long-lasting, used in building construction and monuments and granite slabs continues to showcase in luxurious kitchens etc. Granites are also used extensively for highway and bridge foundations and as railway ballast.

v. The main ingredient of cement industries is limestone. Many cement plants in North and West India depend on the Aravalli.

vi. Minerals like Copper, Zinc, Lead, and small amounts of Iron are found. Now come to the reality. To keep pace with modern lifestyle, the demand for marble and granite in village and home construction is steadily increasing. Increased demand means more profit. As heavy industry declines, sole target now is the service sectors and unrestrained control over the country's water, forests, and mines.

Environmentalists say, if the Aravalli did not stand in the middle, the western desert would have engulfed the eastern side long ago. This is why the Aravalli is called India's 'Great Green Wall'. It also silently protects North India from the dust storms of the Thar Desert. But in return, the naked economic interests of profit-seeking people focused on it and treasures are being stolen. Environmentalists, citizen movements, and politicians are saying the new definition could weaken the ecological balance. Most small landforms may fall outside legal protection.

Villagers and environmental activists in Rajasthan and Haryana have begun symbolic fasts and protests against this Supreme Court ruling. Their demand is that the entire 692 km long Aravalli must be declared a 'Protected Environment Zone'.

According to some environmentalists, the Supreme Court's rulings regarding the Aravalli mountain range can be considered a milestone in the history of Indian environmental jurisprudence. The Supreme Court wants to protect the hills, but it cannot question the development system in which breaking the hills is inevitable.

What a contradiction!

Member Organising Committee, ISNA

Why Again?

The first shot he fires during our tete-a-tete is that the Aravalli hills have become a "big power-big money nexus." A folded mountain range of over 2.5 billion years, even older than the Himalayas, the mountain's deformation began in the last century because of "illegal mining" with impunity.

The range criss-crosses the four north-western states of Gujarat, Rajasthan, Delhi and Haryana, all in the developed category. "But the development juggernaut should not roll down on the people at large." The catchword should be "sustainable development," he asserts. In fact, geology cannot be separated from environmental issues. The consequence of "deliberate ignorance" and simultaneous flouting of rules in the hills is the erosion of the topsoil, large-scale deforestation, and desertification by the Thar. This has benefited the unauthorized miners who do not require high altitudes. The Aravalli is a storehouse of several metals, such as copper, Zinc, Silver, and industrial minerals like granite, quartzite, and marble, used as building materials. Moreover, Prof. Chakrabarty says, mining metals needs a huge investment. As a result, there has been a flurry of illegal mining of industrial materials in this region, taking a toll on the environment since the last millennium.

In the no-holds-barred interview, Prof. Chakrabarty makes it clear that the Aravalli would not have hit the headlines had it not been in north India, the citadel of power. In Haryana alone, between 2000 and 2016, more than 30 per cent of the forest cover was wiped out. On the other hand, erosion of the topsoil after continuous blasting has resulted in "fractured rocks," preventing the recharge of aquifers in the area. Rainwater in the elevated zones is simply washed away. The local flora and fauna have also been disturbed.

The veteran academic has his students spread throughout the world. Himself a globe-trotter once, he is apprised of the environmental skirmishes now by them. Naturally, he has a soft

corner for environmentalists and NGOs that fight for the protection of biodiversity. Organizations like "Aravalli Bachao Citizens' Movement" or "We are Aravalli" have been up in arms against this degradation over the years, which has forced the government to alter its view that hillocks of 100 metres or below should not be considered a part of this historic range. Finally, the Supreme Court was moved, and the Aravalli, which had drawn myriads of geologists from India and abroad, has now become a global attention.

On November 25 last year, a case challenging this was filed, and the apex court initially okayed it. However, a public outcry led it to rescind the earlier judgment and issue a stay order early this year. That meant a total stop in sanctioning mining leases until expert opinion is sought. The expert committee, as of now, has bureaucrats and industrialists among its members. It now remains to be seen what happens when the committee submits its report. The professor bursts into laughter when he recalls the saying, "Should you want to kill an idea, appoint a committee."

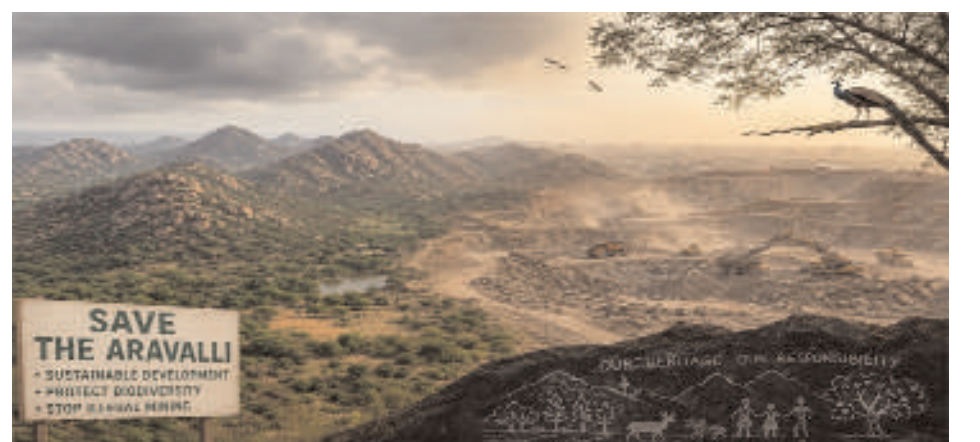
Why does he think so? "Look, we are in Kolkata. Have you forgotten how many people died in a recent incident of illegal construction in the East Kolkata Wetlands (EKW)? That mishap happened only because of the money power that buttered the palms of our politicians. What has happened since then, do you know?" he fumes. Lest the conversation become more serious, if not debatable, we had to cut it short. His dinner bell was also tingling following medical advice. I thanked him and bade goodbye at the end as the rule demands.

Did I miss anything? I was wondering, as a scribe should, while coming back. I realized my gravest mistake. I completely forgot his other introduction.

He is my closest pal, maybe, of the last 70 years!

Prasanta K. Bose
Editor

Scientifica Communica & Bigyan Kahan



Sir Asutosh Mookerjee
A Towering Jewel Of British India
Sudhendu Mandal

India has produced a good number of remarkable personalities having great visionaries, who have done extraordinary service to the nation. These people can be categorized as jewels for their commitment, devotion, respective attitude and work.

They have played immense role as leading thinkers in the late nineteenth and twentieth century to help shape the present India, fought hard for its freedom from the British rule through their original thinking, ideas, talent and set independent India on the right path and glory. These people are the real role models for the young generation to know about them to have the moral boost for their future line of activities.

India is home to a rich history of language, culture and science with 22 official languages, which nurtures presently about 1.4 billion people. Today's India is because of the contribution of some of these remarkable and great personalities, born in a particular decade (1861-1870) from different areas of British India. Their contributions are praiseworthy in various spheres of life having great significance to modern Indian Society. These persons have played a significant role in our history, culture, literature, freedom struggle, medicine, engineering, science and technology. I am now presenting one such great important personality i.e. Sir Asutosh Mookerjee - A Towering Jewel of British India, and about his contribution in the global context.

Asutosh Mookerjee (29.06.1864 - 25.05.1924): A man of great integrity, high self-respect, courage and towering administrative ability, became the first student having a dual degree (M.Sc. in Mathematics and M.Sc. in Physics) from the University of Calcutta. He was a prolific Bengali educator, jurist, barrister and mathematician. He was the second Indian Vice-Chancellor of the University of Calcutta for four consecutive two-year terms (1906-14) and a fifth two-year term (1921-23) Sir Asutosh, the then Vice-Chancellor of the University of Calcutta could find out a galaxy of Indian scientists, who showed their talents and made immense contributions towards the development of a global profile of Indian science. The nation is always grateful to Sir Asutosh for initiating modern science education in India.

Rabindranath Tagore had a very good bonding with Sir Asutosh regard-



ing the academic development of our country. He had a wide and diverse interest in science. The development of post-graduate teaching and research in science and technology at the University of Calcutta opened a door for Indians to learn science.

Several research institutes like the Indian Association for the Cultivation of Science in Calcutta (in 1876), Tata Institute (1908), now known as the Indian Institute of Science in Bangalore and the Bose Institute (1917) in Calcutta are the landmarks in the development of science, but none can reach that level before independence, as compared to the developments initiated by Sir Asutosh at the University of Calcutta. He played a key role in inducting C.V. Raman, P.C. Ray and S. Radhakrishnan at the University of Calcutta.

He was honoured by the Companion of the Order of the Star of India (CSI) in June, 1909, and knighted in December, 1911. He founded the Calcutta Mathematical Society in 1908, and served as its president from 1908 to 1923. He was also the president of the inaugural session of the Indian Science Congress in Calcutta in 1914. Sir Asutosh completed his Bachelor of Law degree in 1888, and received an L.L.D. in 1897, and became the Tagore Professor of Law of the University of Calcutta. Finally he was appointed as Puisne judge of the High Court and subsequently elevated as the acting Chief Justice of the Calcutta High Court.

Sir Asutosh was elected as a Fellow of the Royal Astronomical Society (FRAS, 1885), Royal Society of Edinburgh (FRSE, 1886), Physical Society of London (FPSL, 1887), Edinburgh Mathematical Society (FEMS, 1888), and also of the American Mathematical Society (FAMS, 1890).

Editor-in-Chief, Science and Culture, ISNA and former Director, National Library

Shrinivas R. Kulkarni

RAS Award For World Renowned Astronomer
Manas Chakrabarty

Professor Shrinivas Kulkarni, a globally acclaimed Indian-American astronomer, has been awarded the prestigious 2026 Gold Medal by the Royal Astronomical Society (RAS), London for his "sustained, innovative and ground-breaking contributions to multi-wavelength transient astrophysics," a field that focuses on studying short-lived and rapidly changing cosmic phenomena.

This two-century-old award places Kulkarni in the rank of iconic scientists such as Arthur Eddington, Albert Einstein, Edwyn Hubble, Subrahmanyan Chandrasekhar, Fred Hoyle, Stephen Hawking, Vera Rubin and Jocelyn Bell Burnell. The medal features an image of the 40-foot telescope constructed by Sir William Herschel, the first president of the RAS.

Born in 1956 in Kurundwar, Maharashtra in a family of medical professionals, Shrinivas R. Kulkarni got his M.S. degree in Physics in 1978 from the I.I.T. Delhi and his Ph.D. degree in Astronomy in 1983 from the University of California, Berkeley, USA.

He joined Caltech in 1985 as a Radio Astronomer and has been working there ever since on variable and transient astronomical objects. Since

2017, he has been the George Ellery Hale Professor of Astronomy and Planetary Science at Caltech, and simultaneously the Director of Caltech Optical Observatories during 2006-18.

While pursuing doctoral research under the supervision of Donald Backer, he discovered in 1982 the first ever millisecond pulsar - PSR B1937+21. It is an ultra-fast rotating (more than 600 times/sec) neutron star. He used two wide-field sky astronomical survey instruments, viz. Palomar Transient Factory or PTF (working since 2009), and Zwicky Transient Facility or ZTF (since 2018) for the discovery. Noticeably, Kulkarni was also involved in the planning and operation of both these instruments. He discovered in 1994 a cool brown dwarf - GL229B - a new class of objects weighing in between gas-giant planets (like Jupiter) and small main-sequence stars. It was confirmed in 1995 by the Hubble Space Telescope. Teaming up with others, Kulkarni also

demonstrated that soft gamma-ray repeaters are neutron stars. In 1997, his team also confirmed that gamma-ray bursts originated from extragalactic sources - a significant breakthrough in astrophysics.

Kulkarni switched his focus of research every three to five years. Over time he wandered from the study of Galactic interstellar, millisecond pulsars, pulsars in globular clusters, brown dwarfs, soft gamma-ray repeaters, gamma-ray bursts and cosmic explosions. He also developed new techniques, novel instruments, and methodologies. His research outcome by 2015 resulted in 63 Nature Letters, 7 Science Letters and 479 refereed scientific articles.

Professor Kulkarni expectedly received



many international awards, including the Shaw Prize in Astronomy in 2024, and previously the Alan T Waterman Award from the US National Science Foundation, and the Dan David Prize. He is a member of several leading scientific academies, including the US National Academy of Sciences and the Royal Society of London.

He loves music, and is a fan of Salsa, Qawali, Latin Jazz, and music from Mali successively. He is also known to be a great student of macro-finance, especially financial meltdowns. He loves rabbits since, he says, they best reflect his personality.

Another interesting fact about him is that he is a brother of the well-known author Sudha Muthy, the wife of Narayana Murthy, who is the founder of Infosys, the sparkling star in the galaxy of Indian IT world.

(This article is published as a tribute to S. R. Kulkarni)
Member,
Organizing Committee,
ISNA

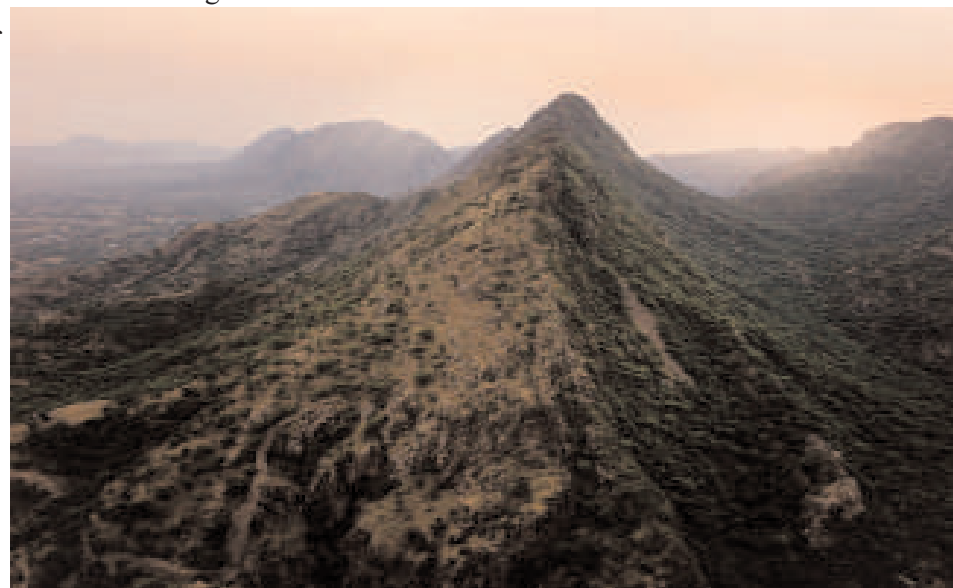
The Aravalli Mountains:

structures, forests and aquifers. As everyone knows, quarrying disrupts natural drainage patterns, accelerates soil erosion, and irreversibly damages groundwater systems. However, despite judicial interventions, enforcement gaps continue to allow extraction in ecologically sensitive zones. Equally alarming is an unchecked urbanization and infrastructure expansion, especially around the National Capital Region, Gurugram, Faridabad and Jaipur. Large tracts of forested Aravalli land have been diverted for real estate, highways and industrial development, fragmenting habitats and reducing green cover. This has intensified air pollution, heat stress and water scarcity in adjoining urban areas. A critical institutional challenge lies in policy and legal ambiguities. Narrow definitions of what constitutes the Aravalli hills — often based solely on elevation — risk excluding vast ecologically functional areas from protection. Such regulatory loopholes weaken conservation efforts and open pathways for further exploitation. The degradation of the Aravallis has also intensified water stress and climate vulnerability. As key recharge zones for aquifers in an already water-scarce region, their destruction directly affects groundwater availability, increases drought risk, and exacerbates extreme heat conditions. Additionally, biodiversity loss and rising human-wildlife conflict reflect shrinking habitats and disrupted ecological corridors. The Way Forward (sub-head/bold) Protecting the Aravalli Mountains demands a holistic and

future-oriented approach. A clear, science-based legal definition that recognizes ecological functions — not just altitude — must be adopted uniformly. Zero tolerance for illegal mining, supported by satellite monitoring, strict penalties and institutional accountability, is essential. Urban planning must integrate eco-sensitive zoning, green buffers and wildlife corridors, treating the Aravallis as a climate infrastructure rather than vacant land. Large-scale ecological restoration using native species, revival of traditional water-harvesting systems, and prevention of invasive plantations can help rebuild degraded landscapes. Crucially, local communities should be central to conservation efforts, with livelihood opportunities linked to restoration, eco-tourism and sustainable resource management. Finally, the Aravallis must be embedded within India's climate adaptation and water-security strategies, recognizing their role in safeguarding ecological and human well-being. The

survival of the Aravalli Mountains is inseparable from India's environmental security. Protecting this ancient range is not merely about conserving hills — it is about ensuring water availability, climate resilience, biodiversity conservation and sustainable development for generations to come.-----

Member, Organizing Committee, ISNA



Climate Change The Impending Catastrophes Anwar Saeed

Life on planet Earth is at least 3.8 billion years old! It started in the oceans as microscopic organisms. Through evolution, it has now reached the super complex and intelligent level of a human being, leading to its present levels of advanced civilization, science, art and culture! All Life (animal and plant) depends upon the delicate balance of nature – it's temperature, atmospheric gases, water and



soil content. Homo sapiens appeared on our planet approximately 3 lakh years ago – alongside other hominid relatives – only when the natural conditions for sophisticated intelligent life were just “right.” Civilization, and it's recorded history, is just about 10,000 years old! Let's consider here, only just one vital natural parameter for the survival of all Life – and especially of human life. That is, the temperature of the Earth's atmosphere! For thousands of years, the planet's average temperature stayed very stable around 14°C ad up to 1760 AD (beginning of the Industrial Age).

This is when humanity started burning fossil fuels (oil, gas and coal) to power its industries, cities and homes! This started the irreversible process of digging up vast tracks of virgin agricultural land, forests, mountains and deserts. Besides adding CO2 to the Earth's atmosphere, this “quantum leap” of civilization has by now raised the temperature permanently of our atmosphere by 1.6°C at least!

The atmospheric CO2 in the Agricultural age was around 280 ppm. It's gone up to 430 ppm now, and rising fast! More of this gas has caused the atmosphere to trap more solar radiation.

This has started the process of global warming! By 2030-35 AD, the average

global temp. could rise by another 0.4°C. Earth will then be 2°C hotter, compared to the Agricultural Age! And most of this extra heat will be initially absorbed by the oceans. This will further upset the balance of Life here, as oceans contain 50-80% of all Life forms, though most still unexplored/undiscovered. Earth's climate is now changing permanently. As the planet gets “warmer”(with little hope, in the foreseeable future, of reduction in our use of fossil fuels), the incidents of extreme weather, species extinction, sea level rise, pollution, pandemics and mental health problems - will all rise fast! The polar ice, that contains almost 80% of Earth's fresh water, will melt – raising not only the sea level by almost 200 feet, but we also lose the most precious natural resource to Life – drinking water!

Climate change is, by far, the most important concern of mankind today! If the global temperature goes beyond 3°C plus, the planet could start moving in the direction of becoming “uninhabitable” to humans. The usual patterns of rainfall, winter/summer, agriculture, soil fertility etc. will all be seriously disrupted. Besides causing huge changes in our life, humanity will be plagued with more wars, migration of human populations, hunger, fresh water shortage and new diseases. Already, the mass extinction of species has started.

So, is there any hope in this most dystopian situation? We have just 10-15 years left, in which to make huge changes in the way we live, work, eat, use energy and reproduce our species! We have to give up fossil fuels as early as possible, use nuclear power from fusion, and renewables - to sustain our civilization! There is no other way!

We have to innovate changes in the way we live, and even think - with support from Quantum Physics and Artificial Intelligence – which will ensure our survival. Climate Change is the single most important issue of our civilization today!

Unfortunately, the levels of ignorance and apathy are not going away fast enough! For the first time in history, entire mankind has to unite and act urgently and unanimously! If the almost imminent calamities of climate change in our near future does not unite us all, then nothing else can!!

**Science Journalist
and Writer**

Shinrin-Yoku Anindita Mukerji

The history of forest bathing, or Shinrin-Yoku, dates back to the 1980's in Japan. The Japanese government introduced this practice to promote public health and well-being, as people were experiencing high stress due to rapid urbanization and technological advancements. The idea was to encourage people to spend time in forests, breathing in phytoncides and immersing themselves in nature to reduce stress and boost immunity. Forest Bathing means spending calm, quiet time in nature, to relax mind and body. It involves slowly walking or sitting in the forest and enjoying the natural surroundings. The aim is to slow down, breathe deeply, and feel calm and relaxed. Japan's forest agency, part of the Ministry of Agriculture, Forestry and Fisheries, coined the term "Shinrin-Yoku" and launched a national campaign to promote forest bathing. Since then, forest bathing has gained popularity worldwide, with many countries adopting this practice as a natural way to improve mental and physical health. Research has also led to

certified forest therapy programs, like those offered by the Association of Nature and Forest Therapy in the US. According to Dr. Aresh Kumar Lahiri, Environmentalist and United Nations expert in Forestry,



"Forest bathing or Shinrin-yoku reduces stress, boosts immunity, and improves mental clarity. Immersing yourself in nature lowers cortisol levels, heart rate, and blood pressure. Phytoncides from trees en-

hance mood and cognitive function." Dr. Lahiri advises, "To try forest bathing, find a quiet spot in nature, turn off your mobile, focus on your surroundings, take slow breaths. Listen to the chirping of birds, smell the soil, touch the bark. You can do this for as less as 20 minutes to several hours. Forest bathing reduces stress, boosts immunity, and improves clarity. Give it a try and experience the calm." This practice is more than just a health trend – it's a way to reconnect with nature and ourselves. By slowing down and engaging our senses, we can quieten our minds, spark creativity, and gain a fresh perspective. Regular forest bathing can also foster a sense of community and connection with the environment. As you unwind, you might discover new appreciation for nature's beauty and rhythms, inspiring positive lifestyle changes. So, take a break from the chaos and immerse yourself in nature.

**Director (Environment)
Rotary Club, Akurdi, Pune**

Kitchen, The Wellspring Of Immunity

Ritika Bandyopadhyay

Almost 50,000 to 500,000 species of botanicals are present on Earth. However, relatively few plants (1-10%) are consumed in the diet by both animals and humans. Hippocrates, the father of medicine, spoke of 300 to 400 of them as healing plants. Pedanius Dioscorides (a Greek physician and botanist) inscribed De Materia Medica, a catalogue of medicinal herbs, which became the model for the modern dispensary. The use of different plant extractions in medical science is a very ancient practice, as in Sumerian and Egyptian civilisations, the names of many medicinal plants and their properties were mentioned. Some important plant-derived compounds like flavonoids, alkaloids, saponins, lignins, and tannins have antimicrobial properties. Sometimes, the important crude plant extracts like atropine, emetine, hesperidin, salicin, quinine, etc., are directly used as drugs. Allium sativum (garlic), Azadirachta indica (neem), Ocimum sanctum (tulsi), Origanum vulgare (oregano), Curcuma longa (turmeric), Zingiber officinale (ginger), Phyllanthus emblica (amla), Phaseolus vulgaris (rajma), Camellia sinensis (tea), and Amaranthus tricolor (lal sag), etc., are some examples of the most common medicinal plants that are easily available in our kitchen.

Many common vegetables, like those mostly present in our daily diet, such as garlic, red pepper, fenugreek, and turmeric has antimicrobial and anticancer properties. In some studies, it was also proven that Allium sativum (garlic) has some antiviral properties. There are almost 18 compounds present in garlic oil that have some antiviral properties. Among them, Lepitin can play a significant role in the prevention of SARS-CoV-2 virus infection. Almost 30 compounds of Ferula asafoetida (hing) can inhibit the binding between SARS-CoV-2 and the human ACE2 receptor. It was reported that Glycyrrhizin (GR) extracted from the roots of Glycyrrhiza glabra or jasthi madhu has multiple properties, such as anti-ulcer, cytotoxic, anti-tumour, anti-allergic, anti-carcinogenic, antioxidant, anti-inflammatory, antiviral, and eczema, which act similarly

to Chloroquine phosphate, Hydroxychloroquine-sulfate, Remdesivir, and Favipiravir. Plants like Punica granatum (anar in Hindi, dalim in Bengali), Santalum album or sandalwood and Glycyrrhiza glabra are able to play the role of Remdesivir, Favipiravir. By taking the role of Lopinavir/Ritonavir, Curcuma longa or turmeric can inhibit the activity of 3-CL protease of coronavirus. Zingiber officinale or ginger can stimulate the release of TNF- α via macrophage activation. For all these beneficial activities of plants, the Ministry of AYUSH, Government of India has recommended Nilavembu kudineer (NVK), a multiherbal formulation consisting of A. paniculate or kalmegh, Z. officinale or ginger, S. album or sandalwood, along with other herbs against COVID-19.

The roots and bark part of Aleurites moluccana, or Indian walnut, a conventional Hawaiian medicine for Herpes viral infections, also has significant anti-HIV action. Betulinic acid and its derivatives from Betula utilis (bhojpatra in India) can significantly inhibit the viral entry and a special enzyme, protease. Catechin and essential oil compounds, from Cocos nucifera or coconut palm, α -Mangostine, a xanthone, from Garcinia mangostana or mangosteen, xanthones and mangiferone from Mangifera indica or mango, also has multiple antiviral activity, including anti-HIV properties.

According to several reports, Andrographolide and other derivatives, isolated from Andrographis paniculata or kalmegh, aqueous extract of Moringa oleifera or drumstick tree in a specific concentration, can inhibit the growth of herpes simplex type 1 and type 2. Due to the presence of flavonoid compounds such as Beta-amyrin, aqueous extract of Moringa oleifera can decrease or inhibit the yield of HSV-1 by inhibiting viral DNA replication. This plant extract has antiviral properties because of the presence of phenolic compounds such as ferruginol, which show their antiviral properties by inhibiting lipid peroxidation, replication of either RNA or DNA viruses, disabling the viral lipidic envelope and interfering with viral compounds required for adsorption and cell entry.

Microbiologist, former student, ISNA

Emergence Of New Technology

Science Institutes Changing Names

Devaprasanna Sinha

I was tempted to write some brief lines of text about algebraic geometry and geometric algebra, with their similarities and differences. Though many of us know the two basic subjects, much more information was made available in regard to interdisciplinary nature and/or amalgamation of various other topics in our study, research and application in many places.

I do find some basic subjects lose their generality, foundational or basic concepts, nature or understanding etc., for obvious reasons. The purpose of newer and newer specializations with more emphasis on the differences have become imperative. Two or more subjects with their positions in names take different seats and priorities, not only for assisting others, but also with the existence of separate or evolving disciplines or more specializations. The inclusion of new classes defined with all other properties and uses, with multiple interpretations coexist.

Gone are the days using similar terms or clarifications, as we did read and had heard the words like Physical Chemistry and Chemical Physics, or Mathematical Physics or Physico-Mathematics. A few decades back it started with Mathematical Biology and Biomathematics. It is natural to see the usage of more terms with reversible qualifiers that augur well for the expansion of the subjects in their own rights, depending on the content, emphasis and purpose. The first one gets less importance compared to the second, according to the rules of making two words into one in these contexts.

One uses the terms almost frequently the two words in emerging technology. There is more use of ‘engineering science,’ rather than ‘scientific engineering’. That the two words - Science and Engineering - are separate and different in identified respects are well-known. The usage of the term ‘engineering science’ is so overarching that institutions of the name of erstwhile renowned engineering college, Bengal

Engineering College, which underwent many names and places since its inception in 1856, had to change to Indian Institute of Engineering Science and Technology, Shibpur in 2014 after some changes in names and status.

The rationale for changing the same has been to provide more scientific principles to solve more complex and advanced problems in engineering, thereby creating new knowledge, apart from building with the assistance of other interdisciplinary areas.

There are other institutes already in vogue like IITs, the oldest being IIT Kharagpur, and many government and private institutes, that have joined the fray, remained skeptical

towards renaming the names of colleges or institutes, but widening the scope of curricula at all levels, even to the extent of inclusion of law and management.

To mention just two other institutes of global and historical importance, the Indian Statistical Institute (ISI), Kolkata and the Indian Institute of Science (IISc), Bengaluru, however, have not changed their names in spite of their diversification in a large number of academic pursuits in several interdisciplinary newer areas in learning and research, explored, and hitherto unexplored. Much could have been written like introduction of the word ‘technology’ and their prevalence in the names of laboratories and even ministries, presumably with different connotations and legacies.

The above lines of text are written to ponder on different issues that might be of interest and instance in this direction, either at the research level or at the general science communication level.

Authors or communicators then can find and highlight several approaches to try out, clearing concepts and understanding of topics and subjects with derived names of different emerging subjects and institutions.

Member, Council, ISNA



Child Science



Amazing Science Institutes of Kolkata

Arnab Kumar Banerjee

One sunny morning in Kolkata, a curious child named Somdeb looked at the sky and wondered, "How do scientists discover new things?" His grandfather smiled and said, "Come, let me tell you the story of Kolkata's great science houses." Long ago, in 1876, a kind doctor named Mahendra Lal Sircar dreamed of teaching science to Indians. He built a special place called the Indian Association for the Cultivation of Science (IACS).

Many years later, a brilliant scientist, C. V. Raman, worked there and discovered a magical secret of light, called the Raman Effect in 1928. This discovery made India proud and he won a Nobel Prize. Today, the IACS continues research in physics, chemistry, and materials science. As Somdeb walked further, he reached the Bose Institute. It was started in 1917 by Acharya Jagadish Chandra Bose, who loved plants like friends. He showed the world that plants can feel and respond, just like living beings. Scientists at Bose Institute still explore nature, life, and the environment. Bose Institute was one of the first interdisciplinary research centres in the world. Today, scientists here study biology,



physics, environment, and new technologies.

Not far away, stood the Indian Statistical Institute (ISI), founded in 1931 by Prasanta Chandra Mahalanobis, the man who loved numbers. He believed numbers could help a country grow. ISI helped the Indian government in making economic plans after independence.

Scientists here use mathematics, statistics, and computers to solve real-life problems—from weather to population planning.

Somdeb then looked up at the stars and learned about the Saha Institute of Nuclear Physics (SINP). It was started in 1943 by Meghnad Saha, who wanted to understand stars, atoms, and the universe.

Scientists here study both the smallest particles and the largest galaxies.

Next came the Indian Institute of Chemical Biology (IICB). It began in 1935 to help people stay healthy. Scientists here study diseases, medicines, and the human body. Their work helps doctors fight illnesses and save lives.

Finally, Somdeb visited the Central Glass and Ceramic Research Institute (CGCRI), started in 1950. He was surprised to learn that everyday things like glass bottles, tiles, and even solar panels are made better through research done here.

As the sun set, Somdeb smiled and thought, "Science is everywhere!" His Grandfather said, "Yes, and one day, you might become a scientist too." Kolkata's science institutes are not just buildings—they are homes of dreams, discoveries, and curiosity.

Joint Editor,
Scientifica Communica & Bigyan Kahan

Rogue Planets

Beware, They Are Blinking At You!

Debabrata Sur

In the vast expanse of the universe, there exist mysterious worlds that defy the conventional norms of planetary formation. These are rogue planets, celestial bodies that wander aimlessly through the galaxy, not attached to any star gravitationally or any planetary system.

Imagine a planet, similar in size to Jupiter or Earth, drifting through the darkness of space, its surface a frozen, lifeless expanse. Without the warmth of a nearby star, these planets are thought to be extremely cold, making it unlikely for life to exist.

Rogue planets are thought to form in two ways : either they are born within a planetary system and later ejected due to gravitational disturbances, or they form independently through the gravitational collapse of gas clouds. The latter scenario is particularly intriguing, as it suggests that these planets may have their own unique formation pathways, separate from traditional planet-formation process.

These lonely wanderers are notoriously difficult to detect, but astronomers have developed innovative methods to spot them. By using microlensing techniques (invented by Takahiro Sumi of Osaka University of Japan in 2011) and direct imaging, scientists have discovered a handful of rogue planets, and the number is expected to grow with upcoming surveys.

The study of rogue planets offers a fascinating glimpse into the formation



and evolution of planetary systems. By understanding how these planets come to be, scientists can gain insights into the complex dynamics of star formation and the early days of our own solar system.

However, the possibility of life existing on these isolated worlds, although slim, cannot be ruled out entirely. Some scientists propose that rogue planets could potentially harbour life in subsurface oceans, warmed by internal heat or tidal forces.

As we gaze up the night sky, we might be looking at a rogue planet, its faint light a whisper from a world that is both familiar and yet, utterly alien. The first of this type of planets was first discovered by the UK team Lucas and Roche in the Orion Nebula in the year 2000 by direct imaging. Microlensing techniques gave the first light in 2017. It is estimated that there are two Jupiter-mass rogue planets for every star in our Milky Way. The study of rogue planets has just begun, and we can expect to be surprised by the secrets they reveal about the universe and our place within it.

Member,
Organizing Committee, ISNA

I just finished my internship from a diversified manufacturing and FMCG-support company, at Haridwar. Haridwar, the place people come to cleanse their souls. I went there to taint mine with some ink, solvent, and a bit of sorrow.

People thought I had to be extremely lucky to get a high-end corporate internship. In reality, I was clad daily in a pair of safety boots, a helmet, and the permanent expression of a person questioning their life choices.

My project was centered on a gravure printing press, which looks nice and clean until you see one up close. A gravure printer is a fast and silent assassin. It is built to run without error, but when it does, it becomes hostile.

The first day the engineer said, "This machine runs 400 meters a minute." I nodded like that meant something to me. I thought to myself, "If I have to deal with a problem, the waste will outrun my heart rate."

Textbooks describe gravure printing as uniform and flawless. I call it managed chaos with a lot of solvent. The best part? I was an engineering intern and my main task was to avoid touching anything.

So, most of my testing prepared me to operate machines. The industry taught me to keep a safe distance, like a plant that provides emotional support. I carried a notebook with me at all times. I jotted down things like: Cylinder spin: turning, Ink: current, Sound: intense. Once, I wrote "the machine seems upset today", because, at that point, I was as spot on with my tech analysis as I would ever be. The gravure press was like that moody, emotionally unstable kid. When the old engineers were there, it was like the perfect student — good density, perfect registration. When they left, it was like: Strap. Run naked in public. Dots missing. It was like the machine saying "Oh, look, interns. Let me embarrass you all, in

An Intern Speaks: Spiritual Exploration Of An Industrial Trauma

Sneha Debnath

front of the whole place."

At one point, ink density changed out slightly. Maybe. As in only what an expert or person of great ability would notice. At some point ink density did vary slightly. By a small degree, which is noticeable only to experts or those with special skills. The operator saw it right away. I looked at the print for five straight minutes and saw nothing. That day I noted: Experience includes inherent amplification.

I put out my take on the issue: "Could the issue be that the viscosity has changed due to solvent evaporation, sir?". We all agreed to that.

The operator did it without taking any readings and sorted it out. Science left the discussion. Tuning in the doctor blade was also a tough go. Raise the pressure a bit? Ink is running over. Reduce by some degree? Ink goes out

as my confidence does in interviews. The machine required "micron level precision". My hands shook in tiny intense fear.

Safety training was excellent.

Outfit yourself in PPE. No breaks. Full personal protective gear. In five minutes, the noise from the machine was so great you could not hear the warning. Only feel it emotionally.

Lunch breaks were a joke. We spoke of the degree of coat thickness at dinner which had no bearing on the issue at hand. Gravure is reliability. The cafeteria is for growth. In my project report, I was intense.

I clarified:
* Impinged rollers
* Capillary action
* Impression roller's pressure
* Techniques for removal of the moisture

I peaked academically. Then the question arose: "What goes on if every parameter is spot on, but the print is still wrong?" "Silence."

The operator answered: "Machine ko kuch der ke liye samay dete hain." Sure! Please provide the text you would like me to paraphrase.

The machine is emotionally stuck. Right on. At the conclusion of the internship: My clothes smelled of solvent. I've got great respect for operators. My ego got wonderfully smashed. Irony is, people say it like this, "Oh, printing engineering? So, you just press print?"

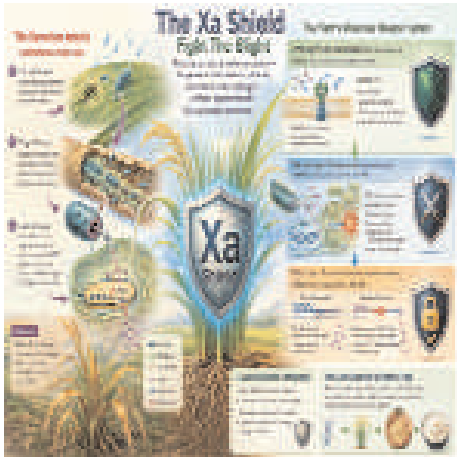
Yes. Just press print. On a 400 m/min gravure with engraved cylinders, volatile solvents, invisible tolerances, and pure faith, while standing in Haridwar, praying the machine doesn't want to teach you yet another lesson.

B.E. Student,
Printing Engineering, Jadavpur University



The Xa Shield
Fight The Blight

Subhendu Deb Chatterjee



Imagine a tiny bacterial thief breaking into a rice plant, hacking its genetic system, and forcing it to surrender its own food supply until the plant slowly wastes away. This is Bacterial Blight (BB) — one of the most devastating diseases of rice — caused by *Xanthomonas oryzae* (Xoo). During severe outbreaks, the disease can destroy up to 80% of the yield, threatening farmers' livelihoods and food security in rice-growing regions. For decades, rice and this pathogen have been locked in a molecular arms race. Hidden within the genomes of wild and heirloom rice, however, scientists discovered a powerful natural defence system — a built-in biological security network collectively known as Xa genes.

How the Bacterium Hijacks the Plant During rain, bacterial cells spread through splashing water and slip into leaves via natural openings called stomata and move to Xylem vessels. Inside the Xylem, the bacteria multiply rapidly and secrete a sticky substance known as Exopolysaccharide (EPS). This viscous slime clogs vascular tissues like debris blocking a household drain, cutting off the water flow and creating an internal drought.

Yet physiological blockage is only part of the attack. Xoo then deploys its most sophisticated weapon. Using a needle-like secretion system, the bacterium injects proteins called TAL (Transcription Activator-Like) effectors into plant cells. Acting like expert hackers, these proteins travel to the nucleus and reprogram plant genes. Their main targets are the rice SWEET genes, which encode sugar transporters. Once activated, these genes force the plant to export sugars into the apoplast and xylem — essentially feeding the invading bacteria. The plant is now no longer merely infected; it is manipulated into nourishing its attacker. As nutrients drain and water movement collapses, infected tissues wilt, turn brown (necrosis), and eventually die. The Plant's Molecular Weapon System Unlike animals, plants lack mobile immune cells; their immunity is encoded directly in genes. In rice, resistance against Xoo is governed by a family known as Xa genes, with more than 45 members identified so far. Some are dominant (Xa) and others recessive (xa), together developing a multilayered defence strategy that detects invasion, mounts counterattacks, and ultimately starves the pathogen.

First layer: Early surveillance Dominant genes such as Xa21, Xa4, etc., function as molecular sentinels on the cell surface. They encode receptor-like kinases embedded in the plasma membrane. When Xoo enters the leaf, it releases bacterial molecules called pathogen-associated molecular patterns (PAMPs). These receptors instantly recognize the signal and trigger

phosphorylation signalling cascades that activate PAMP-Triggered Immunity (PTI) — including bursts of reactive oxygen species, calcium signalling waves, activation of defence genes, and reinforcement of cell walls through callose deposition. The aim is rapid containment, slowing bacterial spread before serious damage occurs.

In everyday terms, these genes function like an early warning radar, detecting an approaching threat.

Second layer: Counterattack through executor genes Xoo attempts to bypass PTI by injecting TAL effectors. A second defence layer, constituted by certain genes like Xa23, Xa27, etc called executor genes, turns this strategy against the pathogen itself. When TAL effectors bind specific DNA sequences in these genes, they unintentionally activate them. The resulting proteins trigger a hypersensitive response (HR) — rapid, localized programmed cell death around the infection site. Deprived of living tissue, bacterial growth halts. In effect, the pathogen activates its own defeat, like a burglar unknowingly triggering a hidden alarm.

This highly specific defence is known as Effector-Triggered Immunity (ETI). Third layer: Starving the invader The final strategy, governed by recessive genes such as xa13, xa25, xa41, and xa5, is more subtle. Instead of detecting or killing the pathogen, these genes remove what bacteria need most — food.

Successful infection depends on activating SWEET genes that export sugars for bacterial nutrition. In resistant plants, small mutations in promoter regions prevent TAL effectors from binding. The SWEET transporters remain inactive, sugars are not released, and the pathogen faces starvation. Disease development slows dramatically because the bacteria lack energy to multiply. This resistance relies on resource denial rather than direct confrontation.

A Layered Defence Architecture Together, these mechanisms form an elegant defence system:

- Xa21/Xa4/Xa3/Xa26/Xa38 etc provide early surveillance and slow invasion.
- Xa23/Xa27/Xa10/Xa7 etc launch localized counterattacks when effectors are detected.
- xa13/xa25/xa41/xa5 etc quietly block nutrient supply to pathogen limiting its survival.

This multilayered protection acts as a biological shield built through evolution itself. From Gene Discovery to Farmer's Field Understanding Xa genes revolutionized rice breeding. Using marker-assisted pyramiding, breeders combined multiple resistance genes to create durable protection against Bacterial Blight while preserving grain quality and yield. Recently released improved varieties serve as examples of this strategy: Improved Samba Mahsuri (Xa21, xa13, xa5) puts back disease-prone Samba Mahsuri, while Pusa Basmati-1886 (xa13, Xa21) displaces susceptible Basmati-6, DRR Dhan 53 (Xa21, xa13, xa5 and Xa 38) substitutes vulnerable high yielders. Farmers retain productivity, export quality, and grain excellence while gaining strong disease resistance. The story of Xa genes reminds us that even against deadly microbial adversaries, evolution has already written powerful solutions into plant DNA. Modern science has simply learned how to read, combine, and deploy them — transforming rice from a vulnerable host into a crop armed with its own molecular shield.

Former Director of Agriculture, Government of West Bengal

Teleportation:
From Imagination To Possibility

Debaprasad Ghoshdastidar

Teleportation is the idea of moving an object or a person from one place to another instantly without moving through the space in between. The concept appears in science fiction, movies, and video games where characters simply disappear from one place and reappear somewhere else.

Long before science fiction existed, many cultures had stories of instant travel. In Indian mythology sages like Narada as well as Gods could travel instantly from one place to another. Greek mythology described God's movement across the world within moments. These were, however, supernatural ideas, not scientific.

The word teleportation was first used by the American writer Charles Fort in 1931. Soon after, teleportation became a favourite theme in HG Wells writings - Star Trek - etc. It was imagined long before Edward Page Mitchell (1852 - 1927), an American journalist and one of the earliest and most innovative science fiction writers, had published a good number of stories anonymously in the "New York Sun" paper between the 1870's and early 1900's. But he had never thought of publishing these stories in a book form. In 1973, these almost forgotten stories were rediscovered and published in a collection entitled, "The Crystal Man," edited by one Moskowitz. Out of the many science fiction stories published by Mitchell, the most significant one was - The man without a body - of 1877. It was a landmark story on teleportation fiction. A scientist attempts to teleport himself using a device that vanishes matter. His body disappears but his head reintegrates at the destination. This story predates HG Wells' teleportation imagery by 20 years. Edward Page Mitchell is considered to be one of the founding figures of early science fiction.

Question is, "is teleportation a fantasy?" Modern physics, especially Quantum Mechanics, reveals surprising facts that make certain types of transportation possible today, although in a different way from fiction Today's scientific approach to teleportation (Bold/italic/subheading) Teleportation is often imagined as instantly moving a person from one place to another as in Star Trek. Modern science cannot teleport people or objects from one place to another but it can teleport information at the Quantum level. This form of teleportation is real, already proven, and is improving every year. The scientific name of this process is Quantum Teleportation.

The principle of Quantum Teleportation is to transfer the exact state (the information) of a particle from one place to another without moving the particle itself. Today we have been able to teleport Quantum States of photons (light particles), atoms and ions, and Quantum signals over long distances (hundreds of kilometres).

Recent achievements are given below: a) China (2017- 2020) -- teleported Quantum information between earth and a satellite (1200 km away)

b) US and Europe (2020 - 2024) -- demonstrated teleportation in Quantum networks forming the basis of a future Quantum internet

c) scientific achievement during 2023 to 2025:

- 1) stable teleportation between different types of Quantum systems (photons --> atoms),
- 2) improved teleportation using Quantum repeaters and faster entanglement distribution. Quantum teleportation is now being used in Quantum computing, Quantum internet prototype and Ultra secure communication. Probable scientific reasons of inability of humans teleportation are illustrated here:
- 1) scanning every atom: a human body contains about 10 to the power of 28 number of atoms. Scanning each atom with Quantum accuracy is impossible still today
- 2) storing an unimaginable number of data: one



person's atomic structure = 10 to the power of 28 Quantum States = 10 to the power of 9 gigabytes (Universe scale data). No computer on earth can handle such large volume of data

3) no cloning theorem: Quantum physics forbids making a perfect copy of the Quantum state. Human teleportation would require copying of entire structure, which is illegal and against Quantum mechanics

4) energy problem: dis-assembling and reassembling a human body, atom by atom, requires more energy than nuclear fusion.

Therefore, it is evident, teleporting humans is scientifically impossible today, and the situation may continue, unless physics can discover new laws.

Even though human teleportation is impossible today, researchers are still trying for Quantum teleportation in meaningful ways. For example,

- 1) teleporting multi particle system
 - 2) teleporting small molecules
 - 3) teleporting Quantum states across different platforms
- Let us wait and see.

Former Scientist, Department of Agriculture, Government of West Bengal

Delhi, which has been formally serving as the country's capital since 1931, today is facing a deep crisis which is of pivotal importance. The city every year experiences unhealthy AQI levels, which by every passing year is growing worse.

Before proceeding further, we must understand the concept of AQI. AQI or Air Quality Index is a color-coded numerical tool used by governments worldwide to communicate daily air pollution levels and their associated health risks to the public. The AQI helps us to assess the level of pollution in the air and the current condition and the future forecast of the air quality.

As the pollution levels rise, so does the AQI levels and its increase is associated with disastrous health risks. To understand AQI more efficiently we must understand the various colour codes and its levels. The following AQI categories are set according to the CPCB guidelines and are followed in India:

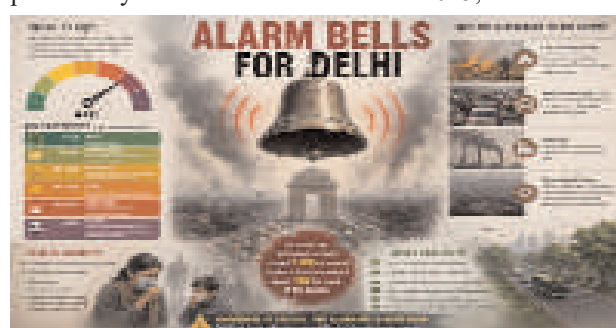
- Good (0-50): Minimal impact.
- Satisfactory (51-100): Minor breathing discomfort to sensitive people.
- Moderate (101-200): Breathing discomfort to people with lungs/heart issues.
- Poor (201-300): Breathing discomfort to most people on prolonged exposure.
- Very Poor (301-400): Respiratory illness on prolonged

Alarm Bells For Delhi

Mouktik Sengupta

exposure. • Severe (>400): Affects healthy people and seriously impacts those with existing diseases.

Now why we are talking about Delhi? Every year the capital consistently experiences air quality more than 400 which is causing disastrous effects to the people living there. In 2026, Delhi's air quality index (AQI) readings on certain private and international trackers exceeded 1,000, particularly in October and December 2025, while the



overall AQI levels of the city remained over 450 consistently. Now the question that bothers everybody is why Delhi remains so polluted every year? The answer lies in both geographical and human causes. Farmers in neighbouring Haryana and Punjab burn crop stubble after harvest in months of October and November, and this smoke fires drifts to Delhi worsening the condition.

Vehicular emission accounts up to 23% of the air pollution contribution, pumping pollutants like carbon monoxide, nitrogen oxides and sulphur dioxide and other greenhouse gases. Various industries operate in and around Delhi which adds to the hazard.

Geographically, Delhi sits in a basin like topography that traps pollutants and during winter, temperature inversions create a lid that prevents pollutants from dispersing upwards. Also, low wind speeds results in accumulation of pollution.

Poor AQI levels poses significant health risks, causing coughing, and breathing difficulties, alongside long-term risks such as cardiovascular disease, lung cancer, and premature death. The awareness is crucial as the country's capital cannot afford to have such poor AQI which projects a bad image of us and cripples the growth of the country. The alarm bells have rung.

38th Science Journalism Course (Advanced), ISNA

Chemistry For Human Development

ISNA Stalwarts Lead International Summit

By Our Special Correspondent

“Chemistry for human development.” This was the theme of the three-day international conference, organized by Professor Asima Chatterjee Foundation, Kolkata (PACFK), in conjunction with the University of Calcutta, Biswa Bangla Biswa Bidyalaya, and the Sister Nivedita University from January 10, within the hallowed precincts of the Rashbehari Siksha Prangan.

Incidentally, though the Indian Science News Association (ISNA), founded by Acharya Prafulla Chandra Ray, the father of Indian chemistry, inside the Rajabazar Science College almost a century ago, did not collaborate directly, many of the ISNA stalwarts, all chemistry wizards, were actively involved in the 4th such summit. They presented papers, chaired sessions, and spoke on issues in the presence of nearly 300 delegates from India and abroad.

It was at this very science college premises where Prof. Chatterjee did her Master's and Doctoral degrees and then worked as a faculty member for several decades. The conference was sponsored, among others, by the Swami Vivekananda University and the Royal Society of Chemistry.

The inaugural function began with a Tagore song that set the stage for one of the most prestigious gatherings of scientists in chemistry and related fields annually in India. Floral tributes were offered to the portrait of Prof. Chatterjee.

Prof. Avijit Banerji, Conference Chair, welcomed the participants. Prof. Sanku Ghosh, Vice-Chancellor of Sister Nivedita University, hoped that the increasing use of AI in scientific research would open up new vistas of research in Chemistry and Biochemistry. Prof. Nikhil Guchhait, Head of the Department of Chemistry, University of Calcutta, and Prof. Asutosh Das, Registrar, Biswa Bangla Biswa Bidyalaya and Prof. Dilip Kumar Maiti, Convener of the Conference, spoke on The objectives



behind the conference.

The lectures were presented in three parallel sessions - at the Chemistry Department, Meghnad Saha Bhavan, and the N R Sen auditorium. About 100 plenary and invited lectures were delivered. Renowned scientists exchanged their views and discussed a wide range of contemporary research areas, such as: Chemistry of Natural Products – isolation, characterisation and synthesis; Medicinal Chemistry and Drug Development; Medicinal Aspects of Natural Products; Cancer treatment by synthetic polycyclic molecules and ATRA; Traditional Medicine integrated with modern practice; different strategies for Organic Synthesis; Photochemical synthesis; Catalysis in organic synthesis using iridium, silver, palladium, gold, cobalt, nickel; Application of green tools in organic synthesis; Advanced Biochemistry; Computational Chemistry – Molecular

docking; Chemical processes in industries for pharmaceuticals and agrochemicals; Innovative Organic Materials.

Several renowned scientists attended from abroad, including Prof. Stephen Hashmi, Prof. S. Das from Germany; Prof. Y. Kuninobu, Prof. K. Nozaki, Prof. M. Tarada, Prof. F. Kakiuchi, Prof. Y. Nishihara and Prof. L. Illies from Japan; Prof. B. Arndtsen (Canada); Prof. B. Banik (Saudi Arabia) and Prof. Arun Ghosh (USA).

Oral paper presentations by young scientists took place in a fourth auditorium. Nearly 40 posters were displayed. The academic discussions did not stop at the sessions – these spilt over into the breaks, where the participants animatedly discussed their research problems and plans. Many new contacts were made, and older connections were resumed.

The conference provided a confluence between academia and industry. A panel discussion was arranged where scientific personnel from both fields participated. The session discussed the possibilities and advantages of industry and academia collaborations. It also enlightened young participants about the future career aspects

in industries. Altogether 10 Prof Asima Chatterjee Awards were given to eminent scientists from academia and industry.

Prizes for the best oral and poster presentations were awarded on the evening of the 11th by Prof. Dilip Maiti. These Awards were instituted by the Royal Society of Chemistry and Wiley Publications.

The valedictory session included addresses by foreign and Indian delegates. Prof. Avijit Banerji and Prof. Dilip Maiti concluded the technical sessions by summing up the proceedings. Thereafter, participants bade adieu to each other, looking forward to the ICCHD2027 in January next year.

ISNA Ties Up With 'Radio Kolkata'

By Our Special Correspondent

The Indian Science News Association (ISNA) organized an excellent event on the occasion of the formal Launch of 'Radio Kolkata' and ISNA tie-up, and the release of ISNA Bengali e-paper, 'Bigyan Kahon' as part of The XXXVIII Training Programme on Science Communication and Media Practice 2025-26 (TPSCMP) on December 11 at the prestigious N.R. Sen auditorium, located in Rashbehari Siksha Prangan, Rajabazar (University of Calcutta).

Introduction of the theme - "International Mountain Day" - was illustriously delivered by Dr. Swati Nandi Chakraborty, Member, Organizing Committee, TPSCMP. "Unless we are concerned of the environment, the consequence will be disastrous," she reminded all, while speaking on the theme.

The introduction of the guests was provided by Shri Prasanta Kumar Bose, Chairman (TPSCMP) and Vice-President, ISNA. He emphasized on the rich heritage of ISNA, on the importance of Radio Kolkata, and the significance of the tie-up.

Next, Dr. Amit Krishna De, Convener, Organizing Committee, TPSCMP and Honorary Secretary, ISNA welcomed the guests and highlighted upon the significance of the august gathering. He also provided details about the ISNA e-newsletters for the audience. Dr. De touched on the importance of efficient science communication through variable approaches like puppetry.

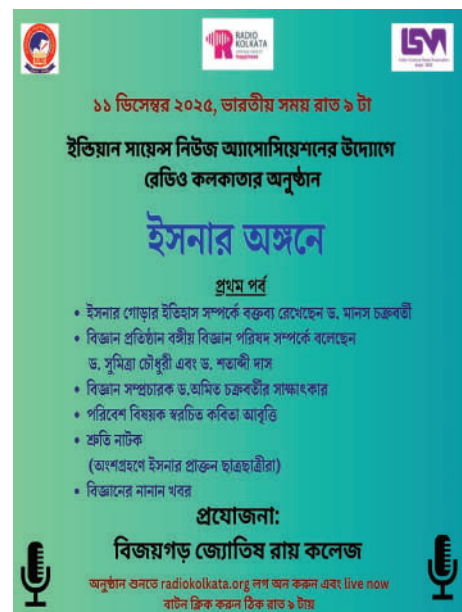
Prof. Manas Chakrabarty, Member, Organizing Committee, TPSCMP entertained the audience with a beautiful presentation about the history and evolution of ISNA, and about its' glorious heritage. Dr. (Mrs.) Sima Mukhopadhyay, Member, Organizing Committee, TPSCMP, focusing meticulously on the "Radio Kolkata" and ISNA tie-up, explained why this has been a significant achievement for both organizations. She also spoke on the journey of this collaborative initiative, and on various challenges and obstacles on the way to make this happen.

Mr. Bikas Das, veteran photojournalist, Associated Press (AP), Eastern India, serving as the Guest of Honour, deliberated on the challenges and opportunities of journalism in India, and extended his best wishes to both organizations for venturing into this great innovative collaboration.

This was followed by the formal launch of the 'Radio Kolkata' and ISNA tie-up, and release of the ISNA Bengali e-paper 'Bigyan Kahon', (Volume 4 & Issue 2) jointly by Dr. Bikas Chakraborty, President, ISNA, and Dr. Rajyasri Neogy (Principal, Vijaygarh Jyotish Ray College).

Dr. Arnab Kumar Banerjee, Joint Editor, 'Bigyan Kahon' and Member, Organizing Committee, (TPSCMP), and Founder of 'Radio Kolkata' provided an in-depth commentary on this unique radio program's structure, detailed contents, the process of work and on how it has been accomplished.

He also spoke on the varied contents of the ISNA Bengali e-paper, 'Bigyan Kahon,' and



mentioned about the various articles published along with author's name. He invited the entire team of ISNA-Radio Kolkata tie-up to the dais, to honour and recognize their support and sincere efforts in making this event successful.

A brief recording of the first episode of "ISNAR ANGANE" was played for the audience amidst great appreciation and enthusiasm.

Chief Guest, Dr. Rajyasri Neogy, Principal, Vijaygarh Jyotish Ray College, and the hosting organization for the internet radio station, 'Radio Kolkata,' explained her journey as an academic, touching on the challenges in current higher education scenario. She highlighted upon the importance of the collaboration and the need to move forward, in spite of the challenges and obstacles. Dr. Neogy also shared her valuable research experiences as an economist on the various aspects of sustainable development and about her work on fishing communities of Digha, East Midnapore. She emphasized on environmental advocacy and dedicated ground work that are absolutely necessary to educate and awaken various vulnerable communities about alternative and sustainable livelihoods.

Prof. Bikas Kumar Chakrabarti, President, ISNA, and former Director, Saha Institute of Nuclear Physics, Kolkata deliberated on higher education challenges. He pointed out the loopholes, where higher education drives have been impacted and provided valuable suggestions for improving the future landscape of higher education in the state.

The vote of thanks was delivered by Prof. (Mrs.) Julie Banerji, Vice-President, ISNA with a passionate tone that touched everyone in the auditorium. The entire programme was coordinated by Dr. Swati Nandi Chakraborty.

Weaving Stories In Science

ISNA Launches Advanced Programme

Esha Pandit

Indian News Association (ISNA), founded by two visionaries and scientist par excellence, Acharya Prafulla Chandra Roy and Dr. Meghnad Saha, is perhaps the oldest and the most prestigious science communication organization in India. Since its inception in 1935, the organization focused on making science and its researches accessible to the general public and integrate it into our daily lives and cultures.

The organization recently launched the 38th certificate course on advanced training on science communication and media practice for the 2025-2026 session. The inaugural ceremony for this program was conducted online on February 23. Along with other distinguished dignitaries and members, the program was graced by Dr. Sandeep Poddar, Deputy Vice Chancellor (Research and Innovation), Lincoln University College, Malaysia, Sri Santosh Kumar Singh, Editor, Ekdin, a Bengali daily, Prof Bikas K. Chakrabarty, President, ISNA, Prof. Manas Chakrabarty, Vice President (elect), ISNA, Prof. Prabir Kumar Saha, Honorary Treasurer, ISNA, Dr. Amit Krishna Dey, Honorary Secretary, ISNA, and Convener of the training program; and Mr. Prasanna K. Bose, Vice President, ISNA, and Chairman of the training program. The online meeting was attended by current as well as former students and coordinators. The event was emceed by Dr. Esha Pandit and Mrs. Malabika Sengupta, former ISNA students. Prof Bikas K. Chakrabarty started the event by welcoming everyone. He briefly highlighted the importance of science communication in today's world, and how modern digital tools could considerably boost science communication by allowing scientists to engage a larger audience through interactive elements.

Mr Prasanna K. Bose in his address said, "In today's world, it is absolutely important to learn the art of communicating science in a jargon-free manner. It can spread awareness, and at the same time motivate the science communicators to disseminate the significance of original research work in understandable terms."

Prof. Manas Chakrabarty discussed the need of traditional methods in science communication. "Scientific innovations need to reach the most isolated regions of our country. Learning some traditional and regional art forms is crucial to make science relatable for locals from rural areas."

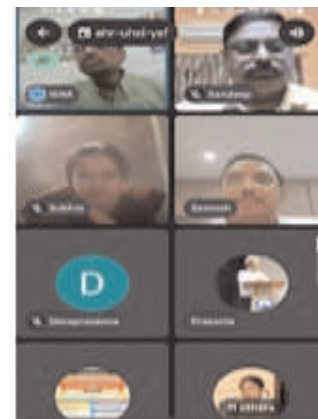
Dr. Amit Krishna Dey, highlighted the key areas that will be discussed in the course, and explained how the mentorship will enrich the experience of the students. The course was formally inaugurated by Dr. Sandeep Poddar. He highlighted the importance of this course mentioning, "This course is unique. Integrated courses like these are still not common in the country or even around the world. This will definitely enrich the students and work as a stepping stone in the world of science communication."

Sri Santosh Kumar Singh shared his experience as a journalist, and explained how science news writing was an integral part of journalism. He briefly discussed how effective science communication influenced the lives of people belonging to different social backgrounds.

"I hope the course will enable the students to explore diverse career options and explore wonderful opportunities," he mentioned. He shared his optimism regarding the future of science communication in India. Additionally, he urged the students to fully engage in the program's lectures and workshops that will be held during the next six weeks of the program.

All the entrant students introduced themselves later during the program. These are students with various specializations and working in various vocations. Nonetheless, this curriculum has united them due to their passion for science communication.

The vote of thanks was given by Prof. Prabir Kumar Saha. In the upcoming weeks of the program, we anticipate several fascinating talks and workshops.



Former Student, ISNA



Science, Society, And The Power Of Trust

Nabina Ray Majumdar

Every year on February 28, India celebrates National Science Day to honour one of the country's greatest scientific milestones — the discovery of the Raman Effect by Sir C.V. Raman in 1928. This landmark achievement earned India global recognition and led to Raman receiving the Nobel Prize in Physics in 1930. To commemorate this event and to promote scientific awareness, the Government of India officially began observing National Science Day in 1986.

Over the decades, National Science Day has evolved beyond a tribute to a single discovery. It has become an occasion to reflect on the role of science in national development and everyday life. From healthcare and agriculture to communication, space research, and technology, science quietly shapes modern society. Yet, in recent times, the relationship between science and the public has faced new challenges — making public trust in science an issue of growing importance.

Trust in science does not mean unquestioning belief. Instead, it is confidence in the scientific process — a process built on evidence, experimentation, verification, and openness to revision. Science advances by asking questions, accepting uncertainty, and correcting itself when new facts emerge. Helping the public understand this nature of science is essential for building long-term trust.

In the age of rapid information flow, misinformation often spreads faster than scientific facts. Complex research is sometimes reduced to misleading headlines, leading to confusion and scepticism. This gap between scientific knowledge and public understanding can weaken trust. National Science Day serves as a reminder that science communication must be clear, honest, and accessible, reaching people beyond classrooms and laboratories.

Education plays a crucial role in this effort. Scientific literacy empowers individuals to think critically, evaluate claims, and make informed decisions. When people

understand how science works, they are less likely to be misled by false narratives. Equally important is inclusivity in science—when diverse voices, including women and underrepresented communities, participate in scientific pursuits, trust in science deepens and broadens.

Public trust is also strengthened when science directly addresses real-world problems. Advances in medicine, environmental protection, disaster management, and sustainable energy demonstrate science's relevance to human well-being. When communities see science improving lives, confidence naturally follows.

National Science Day is not only about celebrating past achievements; it is about shaping the future. As India moves forward in fields such as artificial intelligence, biotechnology, space exploration, and climate research, the cooperation between scientists and society becomes vital. Trust acts as the bridge that allows scientific knowledge to translate into meaningful progress. On this National Science Day, fostering public trust in science is a shared responsibility of scientists, educators, communicators, policymakers, and citizens alike. When science is trusted, it empowers society. When society engages with science, progress becomes inclusive, responsible, and sustainable.

Trust is the bridge between scientific discovery and social good. When that bridge is strong, the future stands firm.



Program Producer, Radio Kolkata & Science Writer

Beauty Is Truth, Truth Beauty: Choose Your Health Over Cosmetics

Sanchalita Bhattacharyya

Cosmetics are materials applied to the face or body to improve appearance. They alter the appearance of the body, promote attractiveness, improve beauty, and cleanse. We use a wide range of cosmetic goods, particularly those for skincare, hair, nails, and perfumes. These items can all include dangerous ingredients that are very bad for our health. The cosmetic industry is currently employing additional compounds with preservative action, surfactants, fragrances, and stains in the formulation of cosmetic goods. The majority of cosmetic products contain hazardous substances like talc, parabens, mineral oil, triethanolamine, coal tar dye, phthalates, scent, lead, arsenic, nickel, cadmium, and mercury. These compounds enhance the quality, properties, and longevity of cosmetics, but many of them are toxic to humans and present health risks. The severity of these poisons can range from a mild allergic reaction to a fatal intoxication. Dangerous chemicals and metals can enter the body through the inhalation of fragrances, deodorants, nail polish, scented powder, etc., or by the absorption of hazardous compounds from body lotions, moisturizers, cleansers, eye makeup, etc. Oral ingestion of metals and chemicals included in lip balms, glosses, lipsticks, and other cosmetics is another method.

Chemicals are added to cosmetic goods for a variety of reasons. For example, oxybenzone filters UV rays in sunscreen, phthalates improve aroma in fragrances, and PFAS boost waterproofing and durability. Furthermore, under the guise of less common words like chromium, lead acetate, thimerosal, sodium hexametaphosphate, and hydrogenated cottonseed oil, heavy metals including lead, arsenic, mercury, aluminium, zinc, chromium, and iron are frequently found in cosmetic items. Once within the body, these substances can alter

hormones by acting as endocrine disruptors. Numerous issues can result from changes in hormones in the body, such as, Problems with fertility such endometriosis, miscarriage, Disruption of the thyroid, unusual development and growth, Cancer of the breast. Lipstick is the main product that contains lead. The US removed lead from gasoline by 1996 since it is a recognized poison. Exposure to the toxin is known to cause lead poisoning, and elevated blood lead levels are linked to degenerative diseases, high blood pressure, and impaired kidney function.

Mercury is known to be extremely hazardous, impacting the immune system, respiratory system, reproductive system, and brain system. Some skin creams will include traces of it. However, its amounts are restricted in many FDA-regulated cosmetics. Although aluminium is frequently found in deodorants, it is also present in trace levels in almost all foods, water, soil, and the air. High amounts of aluminium exposure have been linked to lung issues as well as bone or brain disorders, although low levels are usually safe.

Covering all these, it is better not to use chemical cosmetic products. Herbal cosmetics can be a safer option. The only problem is that they go beyond the purchasing power of ordinary buyers for exorbitant prices.

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