

VIGYAN PRASAR

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11 DECEMBER

INTERNATIONAL MOUNTAIN DAY

CLIMATE CHANGE AND
WEED MANAGEMENT

THE UNESCO INTERNATIONAL
DAY OF LIGHT AND
'TRUST-SCIENCE' PLEDGE

SINGING IS SCIENCE TOO!
SEEING PHYSICS IN ACTION

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MY WORD

NAKUL PARASHAR

The World This Year**AN EVENTFUL**

year it was. Had begun on a positive note. At that point in time, it seemed that the wrath of COVID-19 was about to be over. Things started to get normal. Interstate and international borders began to open. Travel that was held back for more than a year started to resume. While all of this started getting into vogue, scientists made efforts to develop the vaccine with better efficacy. Covaxin, Covishield, Sputnik, Pfizer, Moderna, and whatnot, a fully effective vaccine for COVID-19, became the buzzword. This return to normal, as we all know, was short-lived. Another deadly wave hit us in mid-April, and the world witnessed the brakes being applied on the return-to-normal once again. Well, concerted and timely action by various ministries minimised the damage. Kudos to the world's largest vaccination drive. Our proud nation bounced back to lead by example in this war against the COVID-19. Amidst all this, there came up yet another challenge. A significant section of the population had begun to desist the vaccination. This is where science communication, popularisation, and extension (SCoPE) played the most crucial role. It became imperative for every science communicator to reach out to every citizen and create the required awareness. It was essential to clear any confusion and misinformation that was harbouring the minds of our citizens against the vaccination. While we invoked the science communicators to come forward and use every possible media to reach out to the masses, we at Vigyan Prasar continued to do our bit. Through print, our team continued to produce a fortnightly collection of the latest S&T efforts made all around our country to fight the menace of COVID-19. On the electronic side, the nation's leading complete science & technology OTT channel, IndiaScience continued to produce short-and medium-timed films making all of us aware on why a vaccine is so important in our fight against COVID-19. All good, yet

something was still lacking somewhere—enhanced efficiency of communication that could have been possible if more and more Indian languages were brought in.

Oh yes! That is why we realised the importance of communicating science in Indian languages. We stepped up our efforts to add more Indian languages to the fold. The year 2021 thus saw Assamese, Kashmiri, Maithili, Marathi, and Telugu getting added to our existing list of SCoPE-in-Indian Languages of Urdu, Bangla, Tamil, and Kannada. Continuing with our endeavour to cover the entire nation, our discussions with probable partners in Gujarati, Nepali, Malayalam, Odia, Punjabi, Konkani, and Dogri began. In this direction, the 20 October 2021, day-long conclave held at Delhi shall always be remembered. A galaxy of well-known science communicators from Kashmir to Kanyakumari and Kachh to Kamrup had come together to discuss what has been done and what needs to be done to reach the last person in the last queue quickly, and of course much effectively. After all, what better could it be if it's in their mother tongue!

This year also saw the commencement of the 75th Year of India's Independence Celebrations. Science's undeniable importance in the Indian Independence hogged the limelight—stories that were age-old, interesting, and they existed yet never told to the masses so far. They are here now, and much more is being dug out and told as History of Indian Science reveals so much.

While these celebrations are on, centenary celebrations of several scientists get underway this year... the list seems to be getting longer than I could think of.

Let's then usher into a new year happily and with a promise that we'll stay focused by being safe, healthy, and happy. Seasons' greetings to you all.

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COVER STORY I

KANCHAN PURI AND RITESH JOSHI

11 DECEMBER

INTERNATIONAL MOUNTAIN DAY

Mountains, the ‘natural jewels’, are home to 15% of the world’s population and host about half of the world’s biodiversity hotspots. Mountains around the world are water towers providing between 60-80% of fresh water globally. Sustainable Development Goal 15, target four is dedicated to the conservation of mountains’ biodiversity in consideration of its global relevance.

COVER STORY I

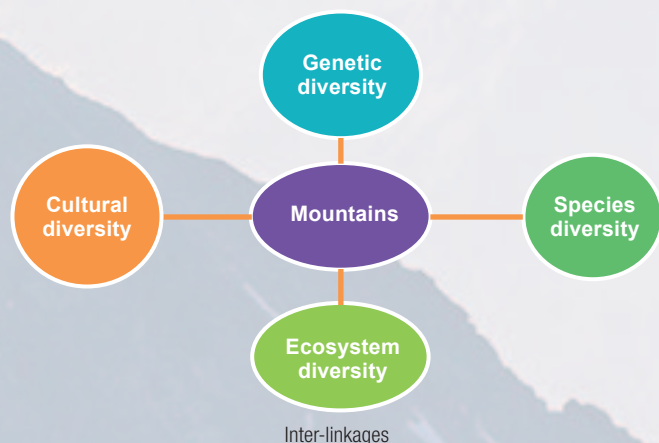
Forty-five per cent of all biosphere reserves in UNESCO's Man and the Biosphere programme are in mountain areas. The International Mountain Day is celebrated each year on 11 December. The UN General Assembly declared 2002 the UN International Year of Mountains, and on this occasion, it designated 11 December, from 2003 onwards, as International Mountain Day (IMD). The day has its roots in the adoption of Chapter 13 of Agenda 21, titled 'Managing Fragile Ecosystems: Sustainable Mountain Development'. The Food and Agriculture Organization of the UN (FAO) coordinates the annual celebration of the Day to foster greater awareness of mountain issues. This day aims to educate the public on issue of concern related to mountains and mobilize resources to address the issue. When the tourism sector has been affected by COVID-19, mountain tourism and its impact on natural resources and livelihoods have become even more important. **“Sustainable Mountain Tourism”** is the theme of this year's International Mountain Day.

THEMES OF THE PAST YEARS

YEAR	THEMES
2003	Mountains, Source of Freshwater
2004	Peace: Key to Sustainable Mountain Development
2005	Sustainable Tourism for Poverty Alleviation in Mountain Areas
2006	Managing Mountain Biodiversity for Better Lives
2007	Facing Change: Climate Change in Mountain Areas
2008	Food Security In Mountains
2009	Disaster Risk Management in Mountains
2010	Mountain Minorities And Indigenous Peoples
2011	Mountain forests, roots to our future
2012	Celebrating Mountain Life
2013	Mountains-Key to a Sustainable Future
2014	Mountain Farming
2015	Promoting Mountain Products For Better Livelihoods
2016	Mountain Cultures: Celebrating Diversity And Strengthening Identity
2017	Mountains Under Pressure: Climate, Hunger, Migration
2018	#Mountains matter
2019	Mountains Matter for Youth
2020	Mountain Biodiversity

MOUNTAIN RANGES AROUND THE WORLD

CONTINENT	MOUNTAIN RANGE
Asia	Himalayas
Africa	Atlas
Europe	Alps
Antarctica	TransAntarctic
North America	Rockies
South America	Andes
Australia	Great Dividing Range



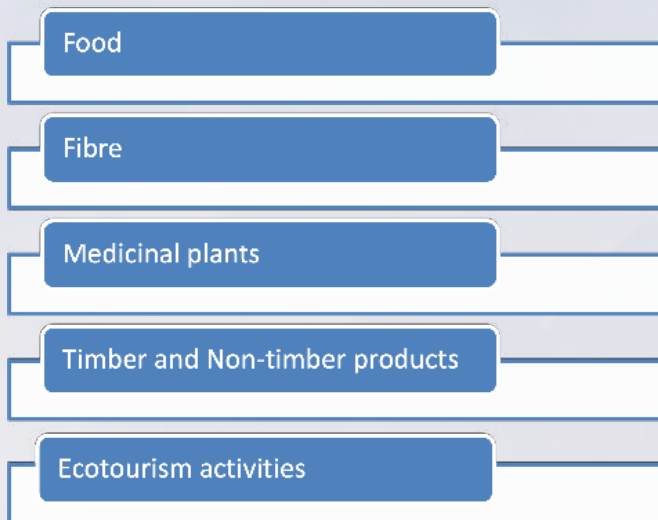
INDIA'S PERSPECTIVE

The Himalaya, diversified mountain system both in terms of biological and physical attributes, is considered a life-support system for millions of people of India. With geographical coverage of over 0.53 million km² area, the Indian Himalayan Region (IHR) constitutes nearly 17% of country's geographical area. IHR is globally recognized as one of the biodiversity hotspots (known for its sensitive ecosystem), representing tropical, sub-tropical, temperate, subalpine vegetation and alpine forest types. It holds a special position due to its unique culture, tradition, and value systems. The cultural practices and ancient traditions in IHR have sustained the biodiversity for generations. Literature reveals the services provided by



Babbler

the mighty Himalayas sustain life much beyond its physical boundaries. It acts as climate regulator and requires conservation and development interventions in sustainable manner. IHR covers 11 Himalayan States/UTs fully, i.e., Arunachal Pradesh, Himachal Pradesh, Ladakh, Jammu & Kashmir, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura and Uttarakhand; and 2 states partially, i.e., hill districts of Assam and West Bengal.

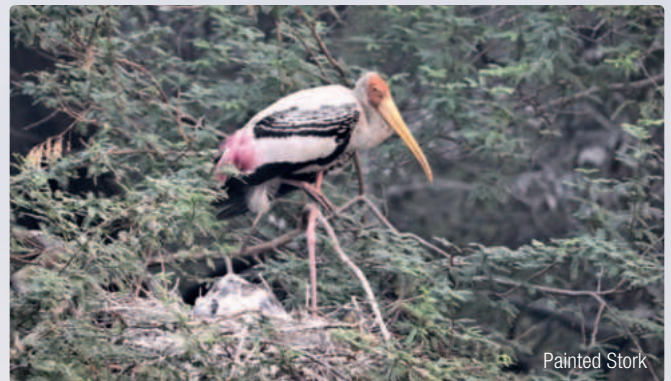
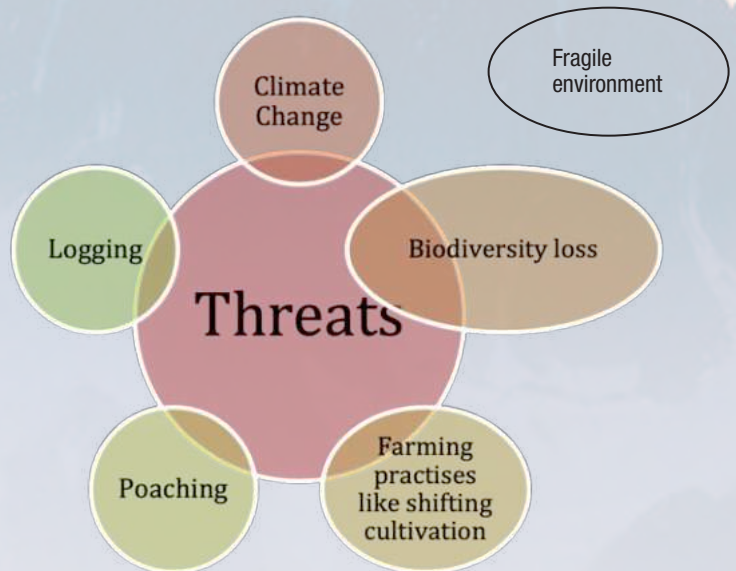


Significance of Himalayas in IHR

CHALLENGES

Due to the on-going climate change-related phenomena, mountains face various challenges like ecosystem degradation, loss of livelihoods, migration etc. It is important to understand the environmental process affecting this ecosystem in order to restore the balance in the region. Researchers have revealed

that with climate change, rising temperatures and reduction in rainfall temporal spread, and a marked decline in winter rain; the problem of dying springs is being increasingly felt across the IHR. The Himalaya remains fragile and prone to natural disasters, such as earthquakes, landslides, and flash floods. Incidences such as in Leh in 2010, Kedarnath in 2013, and Nepal and neighbouring parts of India in 2015 are some recent examples of such disasters. Also, the vulnerability of this mountain chain towards human-induced disturbances is now well established. Moreover, these disasters exacerbate the hardships of the people living in the region. Sustainable approaches to development are therefore particularly important in mountain regions. To respond to the global challenges and threats, holistic, participatory, and integrated approaches are required.



Painted Stork

CONSERVATION EFFORTS

The Himalaya requires conservation and development interventions in sustainable manner. Ministry of Environment, Forest and Climate Change (MoEF&CC) attaches highest priority to protect the unique and highly fragile Himalayan ecosystem. The National Mission on Himalayan Studies (NMHS), which is a Central Sector (Grant-in-aid) Scheme was launched in year 2015-16. The scheme targets to

OTHER MOUNTAIN RANGES IN INDIA

1. Aravalli Range: This is the “oldest” mountain range of the country (youngest being the Himalayas) and is part of the Peninsular India. It extends from North India from Delhi and passing through southern Haryana, through to Western India across the states of Rajasthan and ending in Gujarat. Aravalli translates to 'line of peaks', and spans a total length of 800 km forming the important Eco-region of the country. Generally speaking, the forests in northern Aravalli have more xerophytic characteristics in comparison to the forests in the southern Aravalli.

2. Karakoram Range: The Karakoram is a large mountain range spanning across the borders of India. It lies to the northwest of Himalayas. It is the second highest mountain range in the world and is part of the complex of ranges including the Pamir Mountains, the Hindu-Kush and the Himalayan mountains. This range has the length of 500 km; K2 being the second highest peak of the world lies in the Karakoram Range.

3. Purvanchal Range: The Purvanchal mountains cover the states of Assam, Arunachal Pradesh, Manipur, Tripura,

Nagaland, Meghalaya, and Mizoram. There are three hills in this mountain range - Patkai-Bum Hill, the Garo-Khasi-Jaintia Hills, and Lushai Hill (Mizo Hill). Khasi Hills is a low mountain formation on the Shillong Plateau in Meghalaya. Forest covers Tropical Evergreen, Tropical Semi-evergreen, Tropical Moist and Dry Deciduous, Grasslands and Savannas, Temperate, and Sub-tropical Pine forests.

4. Satpura Range: This is a range of hills in central India, part of the Deccan plateau. The range's name meaning “Seven Folds” rises in eastern Gujarat running east through the border of Maharashtra and Madhya Pradesh to the east till Chhattisgarh. It forms the watershed between the Narmada and Tapti rivers.

5. Vindhya Range: The Vindhya Range (also known as Vindhychal) is a discontinuous chain of hill ranges and highlands in west-central India. The ranges are covered with tropical dry deciduous forest.

6. Western Ghats: Also known as Sahyadri (Benevolent Mountains),

it is a mountain range of 1,600 km traversing the states of Kerala, Tamil Nadu, Karnataka, Goa, Maharashtra, and Gujarat. This range is internationally recognized as a region of immense global importance for the conservation of biological diversity, besides containing areas of high geological, cultural, and aesthetic values. It is one of the important biodiversity hotspots of India.

7. Eastern Ghats: This range of mountains runs along India's eastern coast from the northern Odisha through Andhra Pradesh to Tamil Nadu in the south passing some parts of Karnataka. It forms several ranges of low hills like the low Sirumalai and Karanthmalai Hills and Kondapalli Hills. The Tirumala Hills are located along the Seshachalam-Velikonda Range of the Eastern Ghats. The forests include dry evergreen, semi-evergreen, southern tropical dry mixed deciduous, dry savannah, southern tropical dry scrub, and southern tropical thorn forests. Indigenous tribes including Savara, Jatapu, Konda Dora, Gadaba, Khond, Manne Dora and mukha Dora reside in these region.

provide much needed focus, through holistic understanding of system's components and their linkages, in addressing the key issues relating to conservation and sustainable management of natural resources in IHR.

The mission supports innovative studies and related knowledge interventions. Its strategy is to focus on enhancing livelihoods of local communities, in line with the National Environment Policy, 2006 of the Government. There are seven Broad Thematic Areas: Water Resource Management; Livelihood Options and Employment Generation; Biodiversity Conservation and Management; Skill Development and Capacity Building; Infrastructure Development; Physical Connectivity; and Handling of Hazardous Substances. The Scheme, in addition, also envisages facilitating knowledge building in IHR Institutions by way of creating various fellowship and academic (national) exchange programmes, promoting education, awareness and outreach programmes and events, developing an online system for monitoring and dissemination of results



Askot landscape Uttarakhand

of the studies (www.moef.nic.in). Furthermore, the NMHS also serve to complement and supplement the outcomes of National Mission on Sustaining Himalayan Ecosystem (NMSHE), anchored by the Department of Science and Technology (DST) under National Action Plan on Climate Change.

To achieve sustainable mountain development, it is essential that all concerned stakeholders are involved and that awareness is raised about mountain ecosystems, prevalent problems, and about ways of addressing them. On this day, therefore, we need to recognize that the beautiful Himalayas are lifeline of India and needs to be protected by adapting integrated approach and proper developed programmes customized to local conditions.

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COVER STORY II



JYOTI MARWAH

REINVENTING POST-COVID-19 AROMA TOURISM DESTINATION: **Mussoorie, A Case Study**



THE INDIAN HIMALAYAN REGION HAS A NUMBER OF popular hill stations such as Mussoorie, Nainital, Dhanaulti, Kullu, Manali, Shimla, Darjeeling and many more across the hilly states and UTs of Uttarakhand, Himachal Pradesh, Jammu and Kashmir, Assam, Meghalaya, Ladakh, and West Bengal which have been a solace for tourists from all over the country as well as abroad. One such hill station is Mussoorie in Uttarakhand. These towns mostly focused on basic model of tourism namely providing stay, food, and basic entertainment to the tourists. Though these were ideal models to expand tourism in post-independence India, they are not offering anything unique to the tourists anymore. There have been decades of build-up problems with tourism in hills including conflicts between

authorities and tourists, traffic jams, and very high footfall as there are more tourists than the carrying capacity of the hill stations (especially Mussoorie). Therefore, there is a need for alternative models for the advancement of tourism.

One such way is to encourage people to reach out to destinations for spiritual/physical/mental wellness and healing and immunity building. More than ever before, people will now value the need for a healthy state of mind and body, which is at peace with one's own body and soul. This becomes more realistic today after COVID-19 when people are looking for its end and regaining health and mental peace.

MUSSOORIE'S HISTORY OF WELLNESS

Historically, Landour Cantonment in Mussoorie, like



other cantonment areas, came into existence primarily as a Convalescent Centre for the ailing British soldiers to recuperate from the tropical diseases, essentially tuberculosis and war-torn Europe. As this gained popularity, more and more civilians also realised the health benefits of Mussoorie and Landour weather, the flora, fauna and the mountain air. Gradually the Government established Evelyn Hall and St. Mary's Hospital in Mussoorie for civilians suffering from tropical diseases. Later, Himalaya Hotel in Mussoorie also served as a sanatorium for civilians who came from the hot plains of India and spent many months to recuperate with the mountain air and regain their impaired health. This applies to all the regions of the state of Uttarakhand and other hill states. Gradually, with the passage of time, the hill resorts degenerated to become a bag-packers' haunt. The heritage value of the hill states and cities were lost in many places. COVID-19 has driven some hard facts to be considered seriously and urgently.

TOURISM IN PRE-AND POST-COVID-19 WORLD

Before we were hit with COVID-19, there were around 378 registered hotels and even more hospitality centres in the form of homestays and B&Bs. The footfall was way beyond the carrying capacity of Mussoorie. Pre-COVID-19, approximately two million tourists used to visit Mussoorie annually, which resulted in over Rs. 1000 crore yearly revenue.

Post-COVID-19, by the end of 2020, things were returning to normal. Hotels reopened and tourism was gaining momentum. But the second wave, which hit the country again in March-April 2021, has shattered the dreams of tourism industry to revive and recover their losses from the previous financial year. Hotels, cafes, restaurants, and shops are closed or in case they are open they are unable to run their business profitably. The footfall and revenue is nil. Many small businesses are on the verge of closing down. People are willing to sell their shops, hotels, and restaurants but the real estate market doesn't seem promising either. This leaves these people with negligible to non-existent income and personal financial crisis.

TWO MILLION TOURISTS ANNUALLY!

Our hills have been the victim of decades of destructive tourism. We have been following the basic model of tourism without giving our hill stations time to repair, reinvent, and reorient. The city was hard pressed for options for tourists to spend time in Mussoorie proactively. There was lack of recreational activities the city could offer the tourists. Tourist season was a stressful time for both tourists and the authorities. The traffic galore, road rage and conflicts marred the very purpose of tourism in the hills. COVID-19 and national lockdown gave us an opportunity to relax, review, rewind, and restructure our tourism model in such a way that it would be a breakthrough for Uttarakhand tourism and give it an edge.

POST-COVID-19 CHALLENGES

It is evident that after COVID-19, tourism might take several months to years to revive and break-even with the condition of



tourism prior to pandemic and lockdown state. This pandemic has taught us the importance of connecting with our roots and nature. Many people want to escape the concrete city life and experience bliss amidst nature. This gives an excellent opportunity to the tourism department to move towards more environment-friendly tourism plan to encourage people to travel for health benefits and connect them with nature. Promoting wellness and aroma tourism may revive tourism in hills and revolutionize tourism for health in Uttarakhand in the long run.

WELLNESS IN THE HILLS

It is an age-old fact that mountain air refreshes one's senses and clears the mind. The air in the hills appears clean and feels good as there are no allergens, compounds, and pollutant in the air in contrast to cities where these particles are known to irritate the pathways and cause shortness of breath and chronic obstructive disorders and other issues and thereby lowering immunity of the body. To combat these issues we often diffuse essential oils like eucalyptus, peppermint, etc.

A study titled "AltitudeOmics: Red Blood Cell Metabolic Adaptation to High Altitude Hypoxia" by Angelo D'Alessandro and his team (2016) explained what happens to the body at high altitudes. Though the concentration of oxygen decreases at higher altitude, the cells are able to retain the oxygen for a longer period of time. This enhances the cell's function and extends its functionality for a longer frame of time.





AIR INFUSED WITH BENEFICIAL SECONDARY METABOLITES

Our hills are rich in flora and fauna. There are innumerable plants and trees that release a number of molecules in the air, such as beneficial secondary metabolites called terpenes, inhalation of which helps promote sleep and supports the respiratory system. Inhalation of lavender and chamomile promotes sleep and eases stress.

Uttarakhand is home to *Rhododendron arboreum* or Burans, oak moss, and silver oak which have medicinal properties and are used as expectorant. In the hills diffusion of pine, juniper berry, rosemary, oregano, thyme, cypress leaf oil, and deodar lowers blood pressure and generates the feeling of wellbeing.

EXPANSION OF MEDICINAL AND AROMATIC PLANTS FOR FRAGRANCE AND FLAVOURS: POST-COVID-19

There is a need to expand cultivation of medicinal and aromatic plants in the hills of Uttarakhand. This can be achieved by providing planting material to cultivator, supporting young and small entrepreneurs, advertising the State as a hub for

aroma tourism and encouraging people to go local and organic.

For high altitude there is a need to promote self-sufficiency in products that were hitherto imported. Most of the souvenirs people bought from hill stations were cheap toys and daily use products which were imported. We know that after COVID-19 these imports will either reduce or completely cease to exist.

This generates a market with a broken supply chain and gives an opportunity to local artisans, cottage industries, and small entrepreneurs to enter the market and provide unique solutions for the demand. It's interesting to learn that today China cultivates and exports more English Chamomile than Europe as they started its cultivation and extraction some 20 years back. We have the resources, ideal climatic conditions, and skilled farmers. With little push and guidance in the right direction, we may start farming aromatic plants and experiment as we did with mint in 1990s.

REVIVAL OF FOREST BATHING

Forests bathing (shinrin-yoku) is a Japanese technique of healing as it has shown proven results in wellbeing by generating wellness and health improvement. By spending time in the forest, you immerse yourself in the overall sensory experience. To an Indian the concept is not new however!

Technology-filled world and the addiction to digital media have created a disconnect with nature and animals, harming health and happiness. Animals restore this connection on farms and with the natural world. Animal-based therapies are effective for wellness and mental health restoration that lowers stress and boosts social skills.

NEED FOR SELF-SUFFICIENCY

This is the time to think right and take the right steps in terms of cultivation, value addition, making end products, as well as capitalising on the market that exists within and outside the country for forest-based goods. One most lucrative option is to build aroma wellness destination which has additional benefits of the mountain air healing.

Post-COVID-19 the world will be faced with a situation wherein import of essential oils from foreign countries maybe stalled; so, it is legitimate to think in terms of becoming self-sufficient in Chamomile, Lavender, Thyme, Rosemary, Oregano, and the likes.

FINDING SOLUTION

This can be luring way to get the hotel industry back to a 50-per cent occupancy by looking at the hills as a wellness destination that can help heal the ailing human mind and body. Treatments with the use of essential oils from these plants, which are very specific to the high altitude and an





asset for the state of Uttarakhand, can play a pivotal role in this resurrection which the society needs urgently.

SCOPE FOR BENEFITS

The scope for this is from creating natural livelihood solutions for the people. This can be achieved by bringing people from all sectors together. This can be done by building a bridge between our land and labs for value addition and thereon to the procedures for making end products for both direct consumers and wellness centres. Thus, this calls for skill development and creating niche job opportunities as well as self-employment.

These products will be unique to Uttarakhand and useful for treating ailments such as stress, anxiety, blood pressure, building immunity, resolving haemoglobin levels or low vitality and much more.

Meditation, yoga, free and mindful mindlessness to connect with nature by promoting long walks in the mountain terrains without any intrusion by automobiles can be a great option as well.

The medicinal and aromatic plants that grow in the hills have many beneficial effects on the human body and mind

due to the environs in which they grow and their medicinal benefits. The essential oils of the plants are highly exotic yet healing in nature.

Our hill towns can be reinvented to offer healing both mentally and physically by promoting Aroma Tourism. Primarily in post-COVID-19 conditions the hospitality sector has to change its functionality to accommodate the changes that arise due to the need for COVID-appropriate behaviour.

It becomes important that the government promotes the hills of Uttarakhand as Centres of Aroma Wellness Tourism.

REGULATED HOSPITALITY SECTOR WITH SUPERVISION

The hospitality industry must adhere strictly to the post-COVID guidelines of maintaining social distancing and re-enforcing cleanliness and hygiene. The hotels must have appropriate ventilation and rooms should be spacy and large.

Government rules must be strictly enforced by disallowing illegitimate and encroachments functioning as hotels. Every structure must be audited for the COVID-19 requirements, and only legitimate hospitality structures with regular inspections should be given licence to host tourists. Further to this, fines need to be imposed on the erring stakeholders in case of failure to abide by the rules.

These will add new dimensions to the livelihood of the local women folk in the rural areas based on the use of healing medicinal and aromatic plants of the State. Development Authorities and District Forest Officers need to work together to use the forest wealth more amicably for the good of all.

Forest fires need to be strictly controlled by laws and regulations with heavy fines being levied on those breaking the rules. Wild-life hospitals need to be set up to assist ailing animals.

It is most imperative to promote cultivation of medicinal and aromatic plants (MAPS) that are beneficial and adaptable to the region and this applies to all parts of the country. Hence a mechanism needs to be put in place to support the following:

Aromatherapy Centre offering treatments with plant extracts of the hills be made a special feature of tourism in the hills.

Authenticate use of MAPS in wellness and wellbeing with sanctioned Clinical Aromatherapy.

Additional processing units including attar making for value addition and packaging of end products for use in wellness and wellbeing need to be increased.

Training programmes need to be introduced in developing fragrance and flavour-based end products to enhance capacity building and skill development of the youth and women.

All wellness centres offering therapies must be centres of rejuvenation with access to green environs and natural surroundings.



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Mountains Under Siege-

Hasan Jawaid Khan

Publisher: **Vigyan Prasara**, New Delhi

Mountains are the ornaments of the Earth. They have great repository of precious metals and minerals, herbs, and huge amount of clean water including numerous other resources on which human race depend on. Mountains share one-fifth of space on the Earth's surface: 54% of Asia, 34% of North America, 25% of Europe, 22% of South America, 17% of Australia, and 3% of Africa. Sociologically, mountains inhibit diverse cultural heritage. They provide a wide range of tourism opportunities and impact our daily life directly or indirectly.

Such towering figures and facts naturally trigger curiosity among people around mountains and its rich ecosystem. The book "Mountain Under Siege" provides a glimpse of necessary information about mountains, their ecosystem, threats, and human efforts for their preservation.

The book initially invokes curiosity about mountains by presenting interesting information and then presents the concerns about protecting their rich treasure in terms of material resources, culture, and social heritage. The book also presents some lesser known facts about mountains, such as their vastness, different kind of resources crucial to the survival of humankind, biodiversity, and ecosystem.

The second chapter has been dedicated to defining mountains and discussing the process of formation of mountains along with related theories.

The chapter also talks on tectonic movements, non-tectonic movements, and their role in mountain formation. A brief account on assessing the age of mountains has also been discussed.

Earth is unique among other planets because of its climate and the favourable conditions for survival of life on it. The third chapter talks on role of mountains in shaping the climate of the Earth and its different parts.

The mountains are highly susceptible to natural hazards. They are the prime sites for natural hazards like earthquakes, volcanic eruptions etc. Chapter four discusses about these hazards and how to prevent them. The author has made special emphasis on discussing the Himalaya.

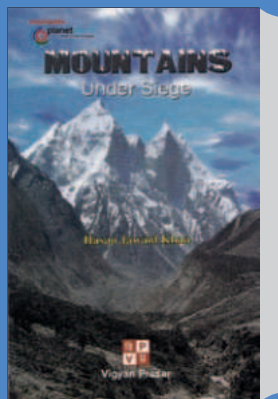
Mountains are not only susceptible to natural hazards but also to uncontrolled human interference to its ecosystem. Flora and fauna of the mountains are under threat due to extensive human activities. In chapter five, the author sensitizes the readers on land use changes, losing forest cover, threatened water security, vanishing biodiversity, extensive mining, effects of global warming and mountain tourism and eroding cultural diversity at mountains.

Chapter six exclusively focuses on the Indian mountains and Himalaya. Several interesting facts about the different prominent peaks of Himalaya and their features have been discussed in details. A short description of the genesis of the Himalaya has also been discussed with the help of interesting

facts. The chapter also presents the concerns regarding the conservation of the Himalaya and its biodiversity and ecosystem.

The concluding chapter details the human efforts to preserve mountains and their diverse ecosystem with special focus on Himalaya. It talks about several conventions, programmes, international projects, forums, agendas and research initiatives. It also talks about the International Centre for Integrated Mountain Development (ICIMOD) which has eight regional member countries of the Hindu Kush-Himalayan area – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan—and the global mountain community. Based in Kathmandu, Nepal, ICIMOD was founded in 1983. It aims to secure a better future for the people and environment of the extended Himalayan region.

The book sensitizes the common public about the basic know-hows on mountains and their rich ecosystem which is at risk now. It should be read by everyone who has interest in mountains and climate change. Issues related to degradation of mountains, especially Himalaya, have been discussed in a language that common public can understand and enjoy. The simple and lucid language grips its readers' attention and helps them to understand complex phenomena easily. The length of the book is such that it can be read during a trip to mountains too!



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VIGYAN PRASAR YEARLY ROUNDUP

Since its inception in 1989, Vigyan Prasar has been carrying out various activities following its mandate of science communication, popularisation and their extension (SCoPE). Along with developing resource materials and communication dissemination of scientific developments and achievements Vigyan Prasar produced authentic information-rich content in various forms during the year 2021 on COVID-19 and related S&T research and development, technology, innovation, etc. Several articles covering the activities and researches of DST, DBT, CSIR, and MoES were published as popular science articles under the ISW portal. Audio-visual and films have been used extensively to propagate scientific temper among common people. Here we present a glimpse of some of the activities.

PROJECT VIGYAN BHASHA

This year saw the metamorphosis of the seed, Project Vigyan Bhasha, a concerted effort for Communication, Popularisation and Extension (SCoPE)-in-Indian Languages, planted in 2019 blooming into a lush sapling. With branches in Urdu, Kashmiri, Dogri, Punjabi, Gujarati, Marathi, Kannada, Tamil, Telugu, Bangla, Assamese, Maithili, Nepali in addition to English and Hindi, the fledging sprout has emerged into the flagship programme of Vigyan Prasar. Assessing the progress made so far, after a one-day conference held at India International Centre, New Delhi, on 20 October 2021, it is clear that challenges are many but with effective processes and a devoted team of science communicators, the project has achieved numerous milestones in a very short period. Soon the activities would be extended to Malayalam, Punjabi, Odia, and Santhali.

PUBLICATIONS

Ten monthly newsletters in Hindi, English, Urdu, Bangla, Assamese, Telugu, Tamil, Kannada, Kashmiri and Maithili were published regularly during the year. More than a dozen books on various topics of SCoPE were published in these languages during this year.

INDIA SCIENCE, TECHNOLOGY & INNOVATION (ISTI) PORTAL

ISTI Portal (<https://www.indiascienceandtechnology.gov.in/>) is a central repository of content generated in and by the Indian STI ecosystem with a major thrust to reach out to students, researchers, scholars, scientists from India and abroad, as to help them choose fellowships, scholarships, funding, and startup opportunities in India. The Portal hoards 13000 research projects, 4000 technologies & innovations, 7000 organisations working in science ecosystem, 1500 available funding opportunities, and 300 programmes and schemes, along with other similar elements. In 2021, around 2000 new research projects, 700 developed technologies, 110 programmes and schemes were added to ISTI repository.

As the nation celebrates “Azadi Ka Amrit Mahotsav”

marking the 75 years of Independence, ISTI Portal is hosting a year-long programme “Tech-75”, to highlight the impact of science, technology and innovation in creating



social equity, inclusion and aspirations to display the STI capacity at the societal foundation level.

COMMUNICATION ON COVID-19 PANDEMIC

A special COVID-19 newsletter was initiated in April 2020 to disseminate COVID-19 pandemic-related information. Till now, 3600 science stories related to on-going research and their outputs, developed technologies, efforts of various ministries, institutions, industries, organizations, civil societies, on efforts impacting COVID mitigation, and much more have been published. Fifty-five editions of the newsletter have been published so far. <https://vigyanprasar.gov.in/covid19-newsletters/>

GENDER AND TECHNOLOGY COMMUNICATION

The Women Technology Park (WTP) is a technology modulation and training centre to showcase improved technologies for women livelihood. As pandemic struck last year, Vigyan Prasar provided communication resources and trained WTPs to work at regional levels to conduct sensitisation and awareness programmes to help them to develop products and services. WTPs were also trained towards measures to take to enhance the livelihood generation of women at the grassroots level. In 2021, Vigyan Prasar organized online discussions series for technology communication for socio-economic development of grassroots level women on various themes.

Realizing gender gap in education and opportunities in Science, Technology, Engineering, Medicine and Mathematics (STEMM), Vigyan Prasar organized discussion series on topics related to bringing in more women in STEMM education and research under the banner: “Each for Equal” in alignment with Government Programmes & Schemes like GATI, Vigyan Jyoti & KIRAN (DST), Women Transforming India (NITI AAYOG) and other initiatives of Government.

On the occasion of International Women’s Day 2021, a one-day programme was conducted in two sessions. The discussions were towards S&T based entrepreneurship for establishing the new normal in the entrepreneurship ecosystem. On the occasion of the 6th International Day of Women and Girls in Science (11 February) Vigyan Prasar conducted a conversation series with frontline women warriors of COVID Pandemic.

Communicating S&T Initiatives & Achievements of the DST through print, digital and social media platforms. In 2021, Vigyan Prasar generated more than 200 original



science communication content, repurposed and disseminated them through various media platforms, like print, digital, electronic, and social media, for wider dissemination & outreach. Vigyan Prasar also brings out a monthly e-newsletter –‘STRIDES’–highlighting the S&T research development stories along with event, activities, policies.

INDIA SCIENCE: AN EMERGING PLATFORM IN SCIENCE COMMUNICATION, POPULARIZATION AND ITS EXTENSION ACTIVITIES

With the emergence and explosion of digital media, there is a need to make changes in our science popularization activities through conventional channels of communication. India's mammoth internet user base of 500 million is split between 305 million urban Indians and 195 million rural Indians, all of whom need to be reached with authentic science and technology content. And to do so, the internet is fast becoming the most accessible and preferred media for content delivery. With this objective in mind Vigyan Prasar is running India Science, an Internet-based OTT (over the top) channel. This bilingual, 24x7 Science Channel is supported by the National Council of Science and Technology Communication (NCSTC). India Science is accessible on the following platforms: India Science App: Android / iOS App/KaiOS (download from Google play store/Apple store/ Jio Store); India Science YouTube: www.youtube.com/c/indiascience; India Science Facebook: <https://www.facebook.com/indiascience>; India Science Website: www.indiascience.in

The platform now has a science videos repository of more than 2000 videos on different categories like Agriculture and Dairy Farming, Bio-Technology, Health and Medicine, Covid-19 updates, and much more. In its effort to promote science popularization in regional languages, India science has started dubbing of its Hindi and English videos into various regional languages.

ENGAGE WITH SCIENCE

Engage with Science (EWS) programme is an outreach activity of India Science aimed at school students and teachers, to kindle scientific temper and quest for scientific knowledge. This unique initiative is being executed in collaboration with IBM. The initiative drives smart outreach techniques interspersed with virtual incentives as well as a gamification-driven technology platform that incentivizes students for all

activities on the India Science OTT channel. More than 10,000 schools pan India would be onboarded soon to the Engage with Science platform. The Central Board of Secondary Education (CBSE) is also playing a key supporting role in this initiative's success.

Vigyan Prasar organized a quiz contest and short science film competition on the MyGov platform in September 2020 and November 2020 to promote the India Science OTT channel. It has crossed a reach of 200 million, while another 100 million and more are waiting to be tapped as the new JioPhone App of India Science gets mobilized shortly. Harnessing the power of social media, Vigyan Prasar is conducting various campaigns on social media platforms, including Facebook, Instagram, YouTube, Twitter, LinkedIn, Pinterest, etc.

Being a free channel, it can be accessed by every section of society, from an illiterate to a scholarly person, from a nursery kid to a Ph.D. scholar, sitting in any part of the world.

COVID communication and addressing vaccine hesitancy was one of the main themes that VP shouldered during this year. A number of online seminars and talks were organised in various Indian languages to allay the fears and motivate the public to take vaccine.

AMATEUR RADIO



For the past 25 years, Vigyan Prasar is providing technical support and catering to the information needs of students and amateurs engaged in communication using Amateur Radio, commonly

known as ham radio. In order to popularise use of ham radio several online training programmes were organised in collaboration with National Institute of Disaster Management (NIDM), Ministry of Home Affairs, Government of India. A special programme titled Youth Engagement in Early Warning and Dissemination also drew over 100 participants. During the 39th session the **VIPNET Science Club Lecture series** a talk on “**Amateur Radio - Alternative Mode of Community Communication**” was delivered. During the celebration of World Amateur Radio Day on **18 April 2021**, a deliberation on the International Amateur Radio Union (IARU) theme “**Amateur Radio : Home but Never Alone**” was delivered for the **West Bengal Radio Club (WBRC)**.

Activities of Vigyan Prasar Amateur Radio Station discussed at the **Hamfest India 2021**, an Annual Conference of the amateur radio experimenters in India. This was a Pan-India workshop on 20 November by **All India Council for Technical Education (AICTE)** FDP syllabus to establish amateur radio clubs in the engineering colleges all over India was discussed.

The UNESCO International Day of Light and ‘Trust-Science’ Pledge

The United Nations General Assembly, in its 71st plenary meeting held on 20 December 2013, proclaimed the International Year of Light and Light-based Technologies 2015 (IYL 2015), and the responsibility of its implementation was given to UNESCO. The main goal of IYL 2015 was to improve the public understanding about light and light-based technologies in their daily lives and the central role that IYL plays in the development of a future global society. Its opening ceremony was held at the UNESCO Headquarters in Paris (France) on 19-20 January 2015, which was graced by four Nobel Laureates. The IYL 2015 closing ceremony was held in Merida (Mexico) from 4-6 February 2016 in which two Nobel Laureates delivered lectures. During the International Year of Light, more than 13,000 activities were held in 147 countries, reaching an audience of more than 100 million. Among all international years of the United Nations organized, the IYL 2015 has been the most popular and successful. This encouraged the UNESCO to have an International Day of Light (IDL) as a follow-up to the International Year of Light.

The International Day of Light (IDL)

With the great success of IYL 2015, the UNESCO General Conference at its 39th session held on 7 November 2017, adopted a resolution to proclaim the International Day of Light and, on 19 November 2017, it decided to hold IDL every year on May 16—the anniversary of the first successful operation of the laser in 1960 by the physicist and engineer, Theodore H. Maiman. In this connection, it is to note that during the last sixty years,

the laser has transformed our lives completely due to great contribution to healthcare and connecting the world through the Internet. Its importance can be understood from the fact that so far there have been more than 20 Nobel Prizes in laser science. However, the IDL is not confined merely to light science; it covers a variety of subjects, viz., Science (astronomy, biology, chemistry, physics, photonics, etc.), Lighting (design, architecture, cities and energy), Culture (art, music, poetry, history and philosophy), and Development (education, energy, climate change and light pollution).

The IDL has the following major goals:

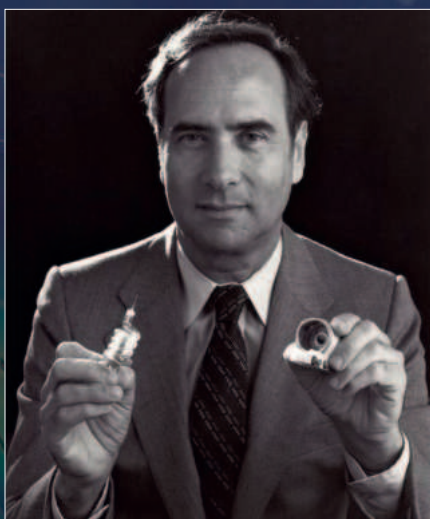
- Improving the general understanding of the masses how light and light-based technologies are helpful in their daily lives.
- Understanding the role of light in the future development of the global society.
- Building worldwide educational capacity through activities targeted on science for young people.
- Addressing issues concerning gender balance, especially in developing countries.
- Highlighting the close link between

light and art and culture, and enhancing the role of optical technology in the preservation of cultural heritage.

- Creating a central information resource for activities and improving international cooperation among learned societies, NGOs, government agencies, educational institutions, and industries.
- Asserting the importance of basic research in the fundamental science of light.
- Highlighting the need for investment in light-based technologies to develop new applications.
- Promoting careers in optics and photonics.
- Emphasizing the importance of lighting technology and the need for access to light and energy infrastructure in sustainable development for improving quality of life in the developing world.
- Raising awareness about limiting energy wastage and developing appropriate technologies and design that result in greater energy efficiency.
- Educate people about minimizing light pollution, which is essential for the preservation of dark skies.

These points cover all the themes of the 2030 Agenda for Sustainable Development. The IDL ‘Logo’ has therefore been designed such that it includes all the 17 colours of the United Nations Sustainable Development Goals (SDGs). Currently, the IDL website has its logo in 36 languages, which includes six United Nations languages, viz., English, French, Spanish, Arabic, Chinese and Russian. It also has logo in four Indian languages - Bangla, Hindi, Tamil and Urdu; Urdu being the latest addition..

The information-rich website of the IDL (<https://www.lightday.org/>) features News, Events, National Nodes, Resources and Press Room, in addition to information on the IDL background, goals, governance, the significance



Theodore H. Maiman

of May 16th for IDL, and important applications of light. Starting from the first International Day of Light, IDL 2018, it is regularly updated for each upcoming IDL.

IDL 2018

The IDL was widely celebrated worldwide, with hands-on activities in schools, festivals, scientific conferences, light-painting installations, open labs, night-sky observations, workshops, competitions, online activities, lectures and more. More than 600 events were held in 87 countries reaching hundreds of thousands of people, and a spectacular afternoon and evening celebration was also held at UNESCO HQ, Paris.

In the Opening Ceremony of IDL 2018, the Flagship Event by Finnish Light Artist Kari Kola was a grand laser show in which laser light originating from the Eiffel Tower, illuminating the UNESCO and other prominent buildings in the area. Apart from this, Ghana inaugurated its first Museum of Light and Light-based Technologies at the Museum of Science and Technology. Also, the Auckland Harbour Bridge in New Zealand was lit at 12.01 am on 16 May.

IDL 2019

The UNESCO International Day of Light 2019 was held at Abdus Salam Centre for Theoretical Physics (ICTP), Trieste (Italy) on the theme, 'Illuminating Education'. It was a day-long programme in which dignitaries from UNESCO, ICTP, International Commission for Optics (ICO), distinguished scientists from optics and photonics streams participated.

The IDL 2019 celebrations were carried out worldwide in which 70 countries participated and 605 events were organized. There were over 1.7 million participants in these events.

IDL 2020

The main focus of the IDL 2020 was (i) the drive for cleaner energy; (ii) sustainable farming; (iii) high-speed connectivity; and (iv) better diagnostics and treatments. Since it coincided with the 60th anniversary of the innovation of laser, the scope of IDL 2020 had grown further. However, because of COVID-19 offline events were 25% less, registered through lightday.org as compared to 2019 and 83% of the events were online/virtual activities. The celebration of

#IDL2020 and #SEETHELIGHT reached 41,000 views of lightday.org in May 2020; 44% more as compared to 2019. Around 16 May 2020, 309 events in 69 countries were organised with 750,000 projected participants.

IDL 2021

From the past experience of IDL 2020, it was already expected that during IDL 2021 there would be strong focus on hybrid and online events in many countries and hence preparations were made accordingly. Although the maximum number of events were likely to be organized during 15-22 May, the UNESCO was quite flexible to allow organizing of events throughout the year.

For the convenience of organizers of IDL 2021 events, UNESCO prepared some important IDL resources, such as IDL Logo, IDL Official Video, Flyer of the International Day of Light, Presentation by the IDL Steering Committee, SPIE Resources, SEE THE LIGHT Resources etc. These resources may be used by IDL event organizers whose events have already been approved by UNESCO and are published on the IDL website.

The IDL 2021 has started a new regular



Karikola Flagship Event IDL2018

feature on 'Light Alumni', highlighting inspiring stories of individuals from the light outreach community who have been involved in International Year of Light or the International Day of Light. Apart from the general themes on light and light-based technologies, the IDL 2021 has special emphasis on:

- Improving interactions and broad public engagement between science and society as it plays a very important role in creating their trust in science and scientists.
- Collaboration with international organizations, such as the International Astronomical Union (IAU) as light is basic to the study of astronomy as well as the universe.
- Having a great focus to highlight the wonder of the light from the cosmos.
- Bringing awareness among the people about the importance of technology for minimizing energy losses in order to achieve greater energy efficiency and also to explore means to the reduction of pollution, which is extremely important for the preservation of dark skies.
- Promoting the role of women in science, which may be achieved by supporting the United Nations 'International Day for Women and Girls in Science', celebrated on 11 February each year.

The first issue of the IDL 2021 Newsletter was published by UNESCO on 16 December 2020 and the 6th issue on 16 May. These newsletters contained important announcements and prominent events planned to be held in selected countries. A new feature of the newsletters was Celebrating Light Alumni, with their stories that could inspire others.

This year we came with an innovative idea to educate people on the significance of light in their lives through integrating science with art and culture, with the focus on light. On 3 July 2021, we organized an event in collaboration with Prof. Danish Iqbal of Mass Communication Research Centre, Jamia Millia Islamia, New Delhi on the theme, "Reflections on Light in Poetry, Literature & Arts". More than 200 lovers of light participated seeing and appreciating it through the medium of poetry, art and culture.



IDL2019 Illuminating Education

The IDL 2021 'Trust Science Pledge'

The message of the International Day of Light 2021, 'Trust Science', encourages both scientists and the public alike to sign and support a declaration affirming their trust in science and the importance of public confidence in the scientific process. The announcement about the Trust Science pledge was published for the first time in the April issue of the IDL 2021 newsletter. The idea of the pledge was evolved as a result of the crises witnessed throughout the world during the pandemic. There were severe misconceptions about the COVID-19 virus and the vaccines that were developed or were in the stage of development. The situation was the

same in both the developed as well as in developing countries. Blind faith and superstition among some groups made the situation even worse. The society had been facing such challenges right from the beginning of the second quarter of 2020, which had been impacting its trust in science. It was at this juncture that the importance of scientific research was highly realized and, in fact, during the last one and half years, dedicated professionals and researchers who had been working tirelessly in healthcare and engineering, openly demonstrated the importance of evidence-based solutions to the society.

In the journey of seven years from IYL 2015 to IDL 2021, the public has



International Day of Light



International Day of Light

TRUST SCIENCE

Trust in evidence-based, scientific facts is essential for providing sustainable solutions to today's challenges. By adding my name to this declaration and pledge, I recognize the key role that scientific research and discovery plays in improving quality of life for all. I pledge to trust science.

www.trust-science.org

Pledge to [#TrustScience](https://twitter.com/TrustScience)

ENGLISH Trust Science Pledge



IDL2021 Event Reflections on Light



IDL2019 International Participants with Prof. John Dudley

realized the importance of light and light-based technologies in their daily lives. In particular, the impact of light in healthcare and fast communication through Internet is not hidden from anyone. In spite of this, there are new, unforeseen global challenges and hence we have to keep the public engaged through taking science to their doorsteps.

In order to appreciate the central role played by science in society, the 'Trust Science' pledge invites the general public to join leading scientists worldwide to affirm confidence in the process of scientific research and discovery. For this, a website, www.trust-science.org was developed, which comprises three important sections: Take Action, Champions, and News and Resources.

In the 'Take Action' section, the text of the Trust Science pledge to be taken, is given, which is as under:

"Trust in evidence-based, scientific facts is essential for providing sustainable solutions to today's challenges. By adding my name to this declaration and pledge, I recognize the key role that scientific research and discovery plays in improving quality of life for all. I pledge to trust science".

The pledge has received enthusiastic support worldwide with the 'Champions of LightDay2021' who have been making

remarkable contributions in light science and related technology, and 'Founding Signatories' that include Nobel and Breakthrough Prize Laureates, UNESCO Prize Winners and Chairs, and Society & Academy Presidents, CEOs, Individual Signatories etc. Till the midnight of 1 November 2021, there were 4737 signatories to the pledge.

In the 'News and Resources' section of the Trust Science website, several thoughtful posts are published, such as:

- Let's spark students' interest in the science that makes a difference in their daily lives;
- Trust Science pledge calls for public to engage in scientific literacy;
- Educators can foster in science through global pledge;
- Explore the educational and information resources available from the societies that are partnering with us on this journey; and
- LightDay2021 National Node Resources.

During the pandemic, the students suffered the most as they had been out of their schools for about one and half years. However, in such a situation it was the Internet that helped them to remain connected to their teachers through online classes. They could also connect with their fellow students through social media, which was essential in their daily

lives. The situation was quite gloomy for students in rural areas in many developing countries due to extremely poor Internet connectivity, where online classes were a dream. Thus the digital divide widened further, seriously affecting the students who had no access to IT infrastructure. Needless to say, the closure of schools was unavoidable as COVID-19 could have affected the children seriously in the confines of their classrooms, leading to catastrophe. In view of this, creating students' interest in science is of great importance as some of them will become scientists and engineers and would contribute in solving such problems that they will face in future.

The National Node Resources include the Trust Science pledge in 18 languages. It includes the pledge in four Indian Languages which were translated on the suggestion from Professor John Dudley, International Day of Light Steering Committee Chair, so that the Trust Science message reaches a larger section of the society.

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Ramanujan and Continued Fraction

finished reading, Ramanujan retorted. "Why have the restriction between 50 and 500, I shall give you solution and proceeded to give off a series of values.

The first 10 values are:

Sl.No.	House number (h)	Total houses in the street (x)
1	0	0
2	1	1
4	35	49
5	204	288
6	1189	1681
7	6930	9800
8	40391	57121
9	235416	332928
10	1372105	1940449

Implication

Trivial

$$1=1$$

$$1+2+..5 = 7+8$$

$$1+2+3+...34 = 36+37+...49$$

$$1+2+3+...203 = 205+206+...288$$

$$1+2+3+...+1188 = 1190+1191+..1681$$

Amazed, Mahalanobis asked, "How did you get this solution in a flash!"

"As soon as I heard the problem, it was clear to me that the solution was obviously a continued fraction; I then scratched my head, 'Which continued fraction?' and the answer came to my mind.

It was just as simple as this."

Mahalanobis was speechless!

Solving the puzzle

Recall the mathematical formulation of the puzzle: $1+2+3+...+(h-1) = (h+1)+(h+2)...+x$; where 'h' is the house number and 'x' is the total number of houses in the street.

From our high school maths, we know $1+2+3+4.. +n$ is $n(n+1)/2$. Using the above, we know

$$1+2+3+...+(h-1) = (h-1)h/2 \text{ and } (h+1)+(h+2)...+x = [x(x+1)/2] - [h(h+1)/2]$$

Unaware to anyone that Sunday morning of December 1915 became an eventful day. As was the usual practice, tucked with the latest issue of monthly Strand Magazine under his arm, Prasanta Chandra Mahalanobis stormed into Ramanujan's room at the Trinity College, London. They had agreed to meet for lunch.

Stirring vegetables in a pan over the fire, Ramanujan was busy in the kitchen. Nothing to do before the lunch is ready, Mahalanobis was turning the pages of the magazine he had brought. A puzzle arrested his attention. Mumbling to himself, Mahalanobis immersed himself in calculations.

Written by Henry E Dudeney, 'Puzzles at a Village Inn' posed a recreational mathematics problem. The puzzle itself was about a street in the town of Louvain in Belgium. The puzzle read:

"I was talking the other day," said William Rogers to the other villagers gathered around the inn fire, "to a gentleman about the place called Louvain, what the Germans have burnt down. He said he knew it well—used to visit a Belgian friend there.

He said his friend's house was in a long street, numbered on this side one, two, three, and so on, and that all the numbers on one side of him added up precisely the same as all the numbers on the other side of him. Funny thing that! He said he knew more than fifty houses on that side of the street, but not so many as five hundred. I made mention of the matter to our parson, and he took a pencil and worked out the number of the house where the Belgian lived. I don't know how he did it."

Perhaps the reader may like to discover the number of that house."

What does this puzzle imply? Suppose let us say there are total 'x' houses in the road and the house number of the British officer was 'h'. Each home in the street

was consecutively numbered, without any number missing in between. The second officer commenced summing the door numbers from the head of the street all the way until he reached the first officer's home. That is he computed the sum, $1+2+3...+h-1$.

After spending some time with his friend, he proceeded to the other end of the road. While going towards the other end of the road, he added the number of houses until the last place. That is he computed the sum $(h+1)+(h+2)...+x$; 'x' being the terminal house number. He found that the sum $1+ 2+ 3+ ... + (h-1)$ is same as the sun $(h+1) + (h+2)... +x$. The puzzle asked the readers to find the value of x and h.

This is not that difficult. With trial and error, we can hit upon an answer. For example, if the street had 8 houses, the officer stayed at house number "6".

1+2+3+4+5					=	7+8	
1	2	3	4	5	6	7	8

$$\underbrace{1 \ 2 \ 3 \ 4 \ 5}_{15} \quad \boxed{6} \quad \underbrace{7 \ 8}_{15}$$

We can see that $1+2+3+4+5 = 15$; so is $7+8$.

The puzzle had another rider; that the value of x was more than 50 but less than 500.

Mahalanobis recalls, "It was not at all difficult. I got the solution in a few minutes by trial and error." The answer is 288 houses in the street, and the door number of the officers' house is 204.

That is $1+2+3... +203 = 205+206+...288$. You can verify and check for yourself.

Having got the answer, playfully Mahalanobis said, 'Ramanujan, 'here is a problem for you'. Still facing the oven and stirring the pan, Ramanujan asked, 'what problem?'. Mahalanobis read out the teaser. Even before Mahalanobis

but $1+2+3+\dots+(h-1) = (h+1)+(h+2)+\dots+x$
 Therefore,
 $(h-1)h/2 = [x(x+1)/2] - [h(h+1)/2]$
 Or,
 $(h-1)h/2 = [(x+1)h/2] - [(h+1)h/2]$
 Rearranging, we get
 $h^2 = x(x+1)/2$, or $2h^2 = x^2 + x$

If we rearrange we get $x^2 + x - 2h^2 = 0$; which is nothing but Brahmagupta-Pell's equation.

For various values of h, the value of h^2 is a square number. That is the series 1, 4, 9, 16, 25, 36, 49 ...and so on.

For various values of x, $[x(x+1)/2]$ is 1, 3, 6, 10, 15, 21, 28, 36, 45, 55... and so on. That is triangle numbers series.

If $h^2 = x(x+1)/2$, it means h^2 is not only a square but also a triangle number. The value of h is such that it must be common among the sequence of squares and a series of triangle numbers.

From the first two solutions for 'h', being 1 and 6, Ramanujan perhaps formulated the following continued fraction:

$$6 - \frac{1}{6 - \frac{1}{6 - \frac{1}{6 - \dots}}}$$

The truncated partial sums of this continued fraction are and so on.

$$\frac{1}{6}, \frac{1}{6 - \frac{1}{6}} = \frac{6}{35}, \frac{1}{6 - \frac{1}{6 - \frac{1}{6}}} = \frac{35}{204}$$

Look at the series of the denominators (or numerators) of these partial sums. They are 6, 35, 204, 1189 and so on. They are the house numbers 'h' in the puzzle! Now, for a careful observer, the series of 'h', 1, 6, 35, 204, 1,189, 6930 has an interesting pattern. The solution 1 is trivial case. The next one 6 can be arrived easily. $(6 \times 6) - 1 = 35$; $(6 \times 35) - 6 = 204$; $(6 \times 204) - 35 = 1189$; $(6 \times 1189) - 204 = 6930$. The 7th term in this series would be 40391 which is $(6 \times 6930) - 1,189$. Once you have the value for 'h', the corresponding value for 'x' can be computed by the formula $h^2 = x(x+1)/2$. Once you get the continued fraction, computing the values becomes simpler.

A gentle introduction to continued fraction

But what is this animal called 'continued fraction'? It is a fantastic way of representing both the rational and irrational numbers. In addition to familiar decimal expression and fractional form, there is a third way, continued fractions, to represent any real number (both rational and irrational).

Trivially, a whole number such as 19 can be written in a fractional form = $1/(1/19)$ and a negative 'integer', say -23 , can be expressed as $-23/1 = -1/(1/23)$. A rational fraction, say $72/28$, can be written as:

$$\begin{aligned} \frac{72}{28} &= 2 + \frac{16}{28} = 2 + \frac{1}{\frac{28}{16}} = 2 + \frac{1}{1 + \frac{12}{16}} \\ &= 2 + \frac{1}{1 + \frac{3}{4}} = 2 + \frac{1}{1 + \frac{1}{\frac{4}{3}}} = 2 + \frac{1}{1 + \frac{1}{\frac{3}{1}}} \end{aligned}$$

This means, $72/28$ is = $2 + \frac{1}{1 + \frac{1}{1 + \frac{1}{3}}}$

The irrationals like $\sqrt{2}$ cannot be written as a fraction of two whole numbers. Continued fraction elegantly handles the representation.

Suppose $x = \sqrt{2}$, it means $x^2 - 2 = 0$
 we can write this as $x^2 - 1 = 1$
 or as $x^2 - 1 = 1$ (as $1 \times 1 = 1$)
 $(x+1)(x-1) = 1$
 $x-1 = 1/(x+1)$

$$\begin{aligned} x &= 1 + \frac{1}{x+1} \\ x &= 1 + \frac{1}{1 + \frac{1}{x+1}} \end{aligned}$$

Observe, $1 + 1/(x+1)$ is same as x. We can replace on the left-hand side the x with $1 + 1/(x+1)$. Now, this becomes

$$x = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{2 + \frac{1}{x+1}}}}$$

If we continue this recursively, we get

$$x = 1 + \frac{1}{2 + \frac{1}{2 + \frac{1}{2 + \dots}}}$$

Recall $x = \sqrt{2}$. Therefore, we get

$$\sqrt{2} = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \dots}}}$$

In the above notation, the "... " imply infinite recursion.

In fact, any real number 'r' can be expressed in this 'continuous' fraction.

$$x = b_0 + \frac{a_1}{b_1 + \frac{a_2}{b_2 + \frac{a_3}{b_3 + \frac{a_4}{b_4 + \dots}}}}$$

Where all the 'a' and 'b's are integers.

The beauty of continued fractions

Ramanujan was a world expert on continued fractions. He found exquisite expressions for the golden ratio, the number phi and π .

$$\phi = \frac{1 + \sqrt{5}}{2} = 1 + \frac{1}{1 + \frac{1}{1 + \frac{1}{1 + \dots}}}$$

The value of π can be expressed as continued fractions:

$$\pi = \frac{4}{1 + \frac{1^2}{2 + \frac{3^2}{2 + \frac{5^2}{2 + \frac{7^2}{2 + \frac{9^2}{2 + \dots}}}}} = 3 + \frac{1^2}{6 + \frac{3^2}{6 + \frac{5^2}{6 + \frac{7^2}{6 + \frac{9^2}{6 + \dots}}}} = 1 + \frac{1^2}{3 + \frac{2^2}{5 + \frac{3^2}{7 + \frac{4^2}{9 + \dots}}}}$$

Today we use continued fractions to find rational approximations of transcendental and irrationals and to solve movements involving two different periods, such as stars that first orbit around the centre of galaxy and wobble up and down through the galaxy's plane. These two oscillations are often irrational numbers resulting in a non-periodic motion. The continued fractions shed enchanting illuminations on these chaotic motions.

“If you want to find the secrets of the universe, think in terms of energy, frequency, and vibration.”

Nikola Tesla

We all love to listen to music! Be it Indian or Western; vocal or instrumental. Within the Indian genre, it could be classical, film music, ghazal, folk, bhajan and so on and so forth. Some of us love to sing too. But, unfortunately, many of us carry the belief that singing is a higher order gift and that only a few are born with such talent. Under this weight, even if they would want to sing, they would not do it beyond the bathroom.

This is a myth that needs to be shattered (We will restrict to Indian vocal music here, for lack of space, and the same may be extended to other genres). Everyone should sing. For, it brings happiness, peace, and harmony in life. For young children, it is also an opportunity to see the laws of physics in action, understanding simple mathematical relations, biological phenomena and

on which singing is based. Our body comprises a combination of bony skeleton and soft tissues. The cavities formed by the hard bones are excellent resonance chambers. The soft tissues also vibrate and resonate but to a lesser degree. Just like any object, these bones (and tissues) have natural frequencies. When the sound produced by our vocal apparatus matches that of a particular cavity, it resonates. Most often the oral cavity, skull and the vertebra are activated using various combinations of notes that are produced by our voice production apparatus (voice box and vocal cords).

We know that there are 12 notes that can be distinctly heard and differentiated and can be produced and heard by humans (although there are about 22 shrutis or microtones, a maximum of 12 at a time are used for most of the songs

SINGING IS SCIENCE TOO!

SEEING PHYSICS IN ACTION

so on. Majority of us have singing skills which will fall in the normal distribution. Those having extraordinary talent are outliers. Just as any other art or sport, it needs practice and some guidance to be able to sing well.

Singing is, therefore, not only an art, but it is science too. Just as visual arts like painting and graphics employ optical principles like perspective, the colour wheel, chiaroscuro, etc. music is embodied in laws of physics, notably mechanics and acoustics. At a higher level, it is metaphysics personified, a way to connect with the universe!

From the perspective of laws of physics, resonance is the foundation

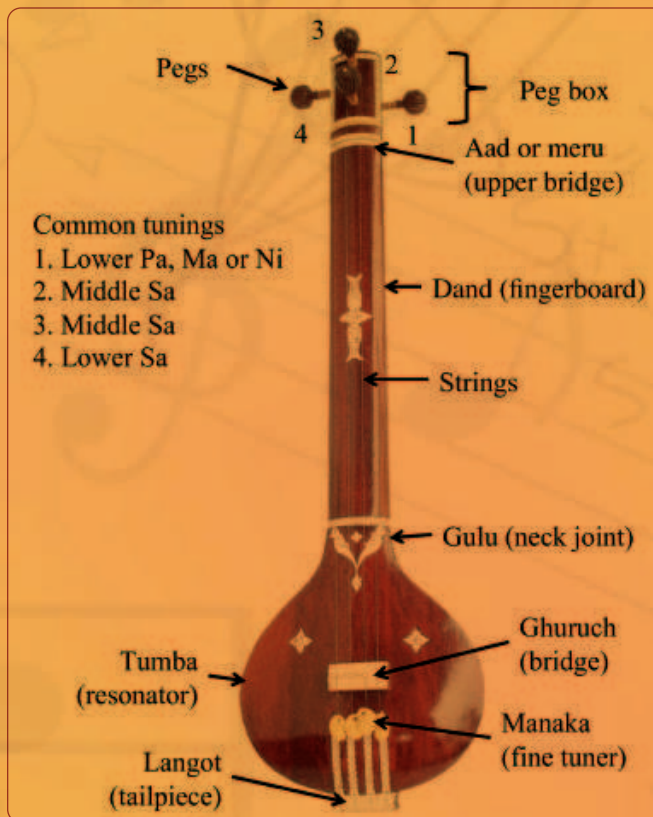
or ragas). These are 7 natural or shudhha notes—we will notate them as Sa, Re, Ga, Ma, Pa, Dha and Ni. Apart from these there are 4 komal notes (Re, Ga, Dha, Ni) and one tivra note (Ma). Typically, a singer sings in a maximum of three octaves—mandra, madhya, and tara. Therefore, overall, 36 notes are used at the most (12 notes each in 3 octaves) in songs.

The tanpura (Indian chordophone) has 4 strings of different gauge and material. The two middle ones are of same gauge and are tuned to the madhya Sa. These are called the jora strings. The leftmost one is tuned to mandra Pa (in some select ragas this is tuned to either

mandra shuddha Ma or Ni) and the rightmost to mandra Sa, and is called the kharja string. It is then plucked from left to right while playing. The result is that we get a sonic canvas made of not only the tuned notes but also unstruck notes or swayambhu notes. The singer aligns the notes to this sonic canvas. When a voice produce note matches one of the notes of this sonic canvas, resonance is produced and the note is 'approved'. It is not just one note, the voice apparatus produces a gamut of natural harmonics (remember simple harmonic motion!) which gives timbre to it.

Therefore, it is important to 'hear' the notes emanating from the tanpura correctly to be able to produce it correctly. This is what is achieved through guidance from a master and practice and is called ear training. The timbral richness is achieved through guided practice of voice culture. The larger the number of harmonics produced, the richer is the timbre. Thus, note precision and timbral richness are the two important goals of sound singing, the former being far more important than the latter. People born with good voice can exhibit rich timbre, but those who do not have a 'good singing voice' will sound melodious if pitch perfection is achieved. A certain amount of timbre is there in every voice. So, everybody can sing, and should sing.

Sir CV Raman was perhaps the first Indian scientist to publish a scientific article on the tanpura (and Veena) and the acoustics involved with it. By simply inserting a thread or a jawari between



Melody Extraction from Polyphonic Music Signals, Justin Salamon

the strings and the bridge, the harmonic content of the notes can be altered. This gives immense possibilities to manipulate the notes and therefore to set a mood in a concert. It also throws challenges to a learner to 'set' the right jawari position. In a contemporary study, a TIFR scientist, Dr Paritosh K Pandya, has demonstrated the presence of harmonics in a certain sequence in consistence with the principles of Simple Harmonic Motion and therefore existence of the perceived notes. It gives the scientific basis of the rather conspicuous presence of swayambhu Ga in a Pa-Sa-Sa-Sa tuned tanpura.

These days electronic tanpura and mobile apps are available, which makes it convenient to use. However,

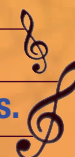
although tuning of a manual tanpura is time-consuming and cumbersome, it is recommended that everyone should take it up at least during the formative stages of learning ear training. It is an essential step of learning to sing. Once one achieves some degree of mastery of tuning the tanpura and if time is a constraint or carrying a manual tanpura is inconvenient, one may integrate use of electronic/mobile tanpuras with practice. In concerts, it may be good to have an electronic tanpura running along with the manual tanpura so that if any string goes out of tune the performance can go on uninterrupted. This is indeed a feature one sees in many modern concerts today.

Just as Indian music is based on melody, i.e., a horizontal sequence (one after the other) of notes in a particular order,

western music is based on harmony, or vertically (simultaneous playing) arranged notes—these are chords. Western music also has 12 corresponding notes as its Indian counterpart, but these notes are equal tempered, i.e., each successive note is at an equal distance from its predecessor. Indian music is based on just intonation or intervals of naturally progressing harmonics. This leads to a slightly different alignment of ear training for engaging with the culturally different music. This may sound insignificant to an untrained or semi-trained ear, but will be out of place for those practicing Indian music at a depth. Piano and harmoniums are equal-tempered musical instruments. Harmoniums are unsuitable for raga exploration (or any melody based on just intonation) but are good for chord-based singing as in many film songs.



Just as Indian music is based on melody, i.e., a horizontal sequence (one after the other) of notes in a particular order, western music is based on harmony, or vertically (simultaneous playing) arranged notes – these are chords.



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Climate Change and Weed Management

Climate change at global scale has widely influenced almost every ambit of our ecosystem. Unprecedented increases in levels of carbon dioxide, methane, and other greenhouse gases coupled with unprecedented temperature hikes are posing a massive ecological challenge in the current scenario. One of the prime sectors getting affected due to these weather extremities is agriculture, the productivity of which is being negatively impressed by various direct and indirect stresses. This ultimately is affecting the concept of sustainable agriculture (productivity, accessibility, availability, and utilization) and conservation of natural resources for future usage. Few such environmental changes dictated by increased carbon footprint includes rainfall shifts, increasing drought and flood occurrences, rising sea level, heat stress, alteration in precipitation and wind pattern, etc. that are potentially affecting crop growth pattern, niche, distribution, and traits at both landscape and community level.

Of various biotic and abiotic factors

affecting crop stand and productivity, weed infestations are known to cause far more loss than that caused by pest attacks. More than 50% yield reductions are known to be caused due to crop-weed competition (Table 1). Weeds share the similar tropic level with crops, thus making the hitch to be steady in comparison to random and irregular damages caused by pests and diseases, and eventually having more serious implications posed by the former. These losses further aggravate under organic agricultural practices that restrain to use of any agrochemical and rely on manual weeding or natural concoctions to control these undesirable flora. Crop and weed plants when growing together obtain their growth requirements from the limited resources, thus generating a sort of competition for common resources between them. Crop yield, as a result, depends on the balance fraction of resources between weed and crop obtained after the competition. Crop-weed competition is a function of several features such as the timing of weed infestation, agricultural practices, and others. In India, the economic

loss due to weed infestation is USD 11 billion as estimated by All India Coordinated Research Project on Weed Management conducted between 2003 and 2014.

Elevated CO₂ concentration and its associated temperature regimes cause a differential response among species and also change the nature and level of crop-weed competition. The change in response could be manifested in several terms such as alterations in weed growth, plant phenology, population dynamics, geographical distribution and range expansion, etc. For instance, climate change has induced transformations in the weed flora of arable ecosystems in Europe. Thermophile weeds, late-emerging weeds, and some opportunistic weeds have become more abundant in some cropping systems. The composition of arable weed species is indeed ruled by environmental conditions such as temperature and precipitation. Thus the weed spectrum changes are ostensibly governed by climatic shifts and warrant a deeper understanding of weed biology and its interaction to devise efficient management strategies for different agricultural practices.

Differential crop-weed responses due to rising carbon footprint are fundamentally centred on the carbon fixation process. It is presumed that plants with C₃ photosynthetic pathways are expected to benefit more than C₄ from CO₂ enrichment, thereby limiting the photorespiratory loss and enhancing carbon dioxide concentration in the leaf interior of C₃ plants. However, C₄ plants already equipped with a system to concentrate carbon dioxide at the site of carbon fixation are not likely to benefit much. Overall, the current scenario is expected to stimulate photosynthesis and vegetative growth in C₃ plants. This differential response of C₃ and C₄ plants to elevated CO₂ and temperature thus can have important implications on crop-weed competition. The situation seems ideal under a cropping system composed of

Table 1: Some of the important crops and percentage of losses caused by weeds

Crop	Reduction in yields due to weeds (%)	Crop	Reduction in yields due to weeds (%)
Rice	41.6	Groundnut	33.8
Wheat	16.0	Sugarcane	34.2
Maize	39.8	Sugar beet	70.3
Millets	29.5	Carrot	47.5
Soybean	30.5	Cotton	72.5
Gram	11.6	Onion	68.0
Pea	32.9	Potato	20.1

Source: www.eagri.org

C3 plants such as rice competing with C4 grassy and broad leaf weeds. Though most of the weeds are C4, however, this fundamental idea could not be viewed as a universal axiom. There are some economically important crops that belongs to C4 group like corn, pearl millet, sorghum, and sugarcane, and some important weeds belong to C3 group like *Chenopodium album*, *Avena ludoviciana*, *Phalaris minor*, *Eclipta prostrata*, *Ammania baccifera* etc. Therefore, it can be argued that because of C3 photosynthetic pathway of many weed species, they will show a larger response to elevated CO₂ relative to C4 crops (Table 2). Under such scenarios, a deeper insight into the physiology of weed, its dominance and interaction in a particular cropping system becomes crucial in devising an efficient weed management system. There could also be potential changes in photosynthate composition, concentration, and translocation attributes of photosynthesis, that need a

competitive ability in commendation of particular crop species over time. For instance, an insurgence in the dynamics of perennial weeds is expected over increasing carbon dioxide concentration, which would favour an increase in the number of rhizomes, tubers, and their biomass. This would also dilute the effect of applied herbicides. Such study needs to be undertaken under both weedy vegetation as well as under crop cultivation scenarios. The variation in weed distribution might influence some globally important cropping systems, like weed shifting to high latitudes and altitudes in rice-based cropping systems, an extension of *Striga* spp. to moderate climatic zones. If this concept is generalized for all parasitic weeds in the Orobanchaceae, these weeds could pose a serious threat to global crop production, especially in fodders, in the near future. Many C4 weeds, such as *Amaranthus retroflexus* L., *Setaria* sp., *Digitaria* sp., *Sorghum halepense* (L.) Pers., and *Paspalum dichotomiflorum* (L.) Michx.

changes, and looming water concerns could pose a serious threat to the rice–weed ecosystem. Similarly, increased tolerance to glyphosate under high CO₂ as documented would favour the invasive weed species in wheat.

Weed pressure is thus a serious threat over current scenario of documented and projected changes in atmospheric carbon dioxide concentration and other gases, the current knowledge on various aspects of which still seems to be limited. Weed management systems heavily depend on herbicides which are now considered as unsustainable mitigating method due to the evolution of herbicide-resistant weeds and causing serious lethal diseases to human beings. Under these climatic shifts, the food security component, at both regional and global level, is thus positioned at the cusp of vulnerability. Thus, outcomes of anticipated carbon levels and associated parameters need to be assessed under both managed and natural ecosystems of crop–weed interactions. The diversification of current toolbox for weed management and development of newer strategies along with its synchronization of application in relation to the weed life cycle require integration of several scientific domains. Development of more weed-competitive germplasm under elevated CO₂ conditions needs characterization of landraces and wild species. Unravelling the crop–weed interactions between C3 crop/weed; C4 crop/weed; C3 crop/C4weed; and C4 crop/C4weed system needs a thorough and in-depth characterization. Hence, the development of a more comprehensive, integrated, and sustainable weed management system encompassing a range of cultural, mechanical, biological, and chemical methods is required for the economic production of crops.

Table 2: Important C3 and C4 weed species of rice and wheat crops in India

Crop	C3 weeds	C4 weeds
Rice	Weedy rice, <i>Scirpus</i> spp., <i>Monochoria</i> , <i>Eclipta prostrata</i> , <i>Ammania baccifera</i>	<i>Echinochloa</i> spp., <i>Cyperus</i> spp., <i>Leptochloa chinensis</i> , <i>Bracharia</i>
Wheat	<i>Chenopodium album</i> , <i>Phalaris minor</i> , <i>Avenafatua</i> , <i>Convolvulus arvensis</i> , <i>Canada thistle</i>	<i>Cynadon dactylon</i>

Source: Climate Change and Its Possible Impacts on weeds, Singh et al., 2016

thorough investigation under different ecosystems. Moreover, these weather extremities in relation to weed dynamics (biology, ecology, interference potential etc.) and crop competitive ability becomes much more salient to be studied from the farmers' perspectives for devising efficient and integrated crop-management strategies.

Many studies have already argued a shift in weed population in terms of their abundance, survival, and

are expected to expand further north which would have a more pronounced effect in northern Europe, where the number of weed species is lower than in the south. The winter annual weeds would likely prefer milder and wetter winters to increase the survival rate while the thermophile summer annual weeds prefer favourably warmer summers to flourish, enabling them to grow further in the north. Elevated carbon levels, associated temperature

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Science Heroes of India's Independence Movement (part-3)

With the commencement of the 75th Year of India's Independence, the unquestionable importance of the contribution of Indian scientists has been well documented. Facts that were forgotten or were not known to the younger generation were dug out and retold. *Azadi ka Amrit Mahotsav* gives us an opportunity to share the saga of struggles of those scientists.

C.V. Raman (1888-1970)

First Nobel winner Indian scientist Chandrasekhar Venkata Raman faced several hurdles in his academic career during the colonial period. Lack of resources for scientific research was the major constraint. Raman also confronted adverse situations like other Indian scientist of his time.

When Raman published his first research paper titled Unsymmetrical diffraction-bands due to a rectangular aperture, he was just 18. Scientific knowledge and understanding of this young physicist was far beyond his age. When he submitted his second paper in the 'Philosophical Magazine', in response, eminent British physicist Lord Rayleigh wrote a letter addressing him "Professor Raman".

Raman wanted to get into the scientific research. But with his family's insistence, he served under the British Government as a civil servant for about 10 years. His passion for research got its wings when he entered the office of the Indian Association for the Cultivation of Science (IACS) in Calcutta (now Kolkata). IACS was the brain child of Mahendra Lal Sircar, a medical doctor and a proponent of scientific studies in nineteenth

century India. As the name reflects, this organisation was engaged in promotion of science and scientific research by Indian scientists. Raman's entry gave IACS new energy. He started doing part-time research work there and also gave popular science lectures in Calcutta.

Although there was no financial and moral support, Raman continued his research and experiments. In 1930,

Raman was awarded Nobel Prize in physics for his work on the scattering of light and for the discovery of the effect named after him. This Nobel Prize winning work of Raman was initially inspired by observations he made on a voyage in the Mediterranean Sea. Raman was the first Indian scientist to receive Nobel in physics and first Asian to receive a Nobel Prize in any branch of science. This highest honour to Raman was enough to quash the hypothesis of British rulers that Indian scientists were of lower calibre.

With the support of J.C. Bose, S.N. Bose and M.N. Saha, Raman constituted the 'Indian School of Physics'. In later years, A. Dey, S.K. Banerjee, S. Appasamyar, S.K. Mitra, D.N. Ghosh, D. Banerjee, T.J. Chinmayanandan,



C. V. Raman

K.S. Rao, and K.S. Krishnan were part of this school of Physics.

Discrimination with Indian scientists during colonial period inspired them to contribute more in science. As a result of this colonial India witnessed contribution of many seminal works by our scientists. They were engaged in scientific research with a 'nationalistic' zeal. P.C. Ray in a letter expressed his inner thoughts about doing science as a service to the motherland, '... in serving my favourite science, I have only one idea in my mind, namely, that through her I should serve my country.'

To strengthen the scientific foundation in our country, these science heroes of pre-independence India established institutions like Indian Association for the Cultivation of Science (IACS), Bose Institute (Basu Bigyan Mandir), Indian Institute of Science (IISc), Indian Science Congress Association (ISCA), and more. These institutions were the cumulative response to discrimination against Indian scientists by British rulers. These scientific institutions were very productive during colonial period and are the pillars of modern science in India.

Mahender Lal Sircar (1833-1904)

During colonial era, Indian scientists with the support of a few missionaries and British scientists started promoting scientific research in India with a national enthusiasm. The first organized effort in this direction was the creation of the Indian Association for the Cultivation of Science in 1876. Bengali medical doctor Mahender Lal Sircar (1833-1904) established this organization with the objective to enable Indians to cultivate science in

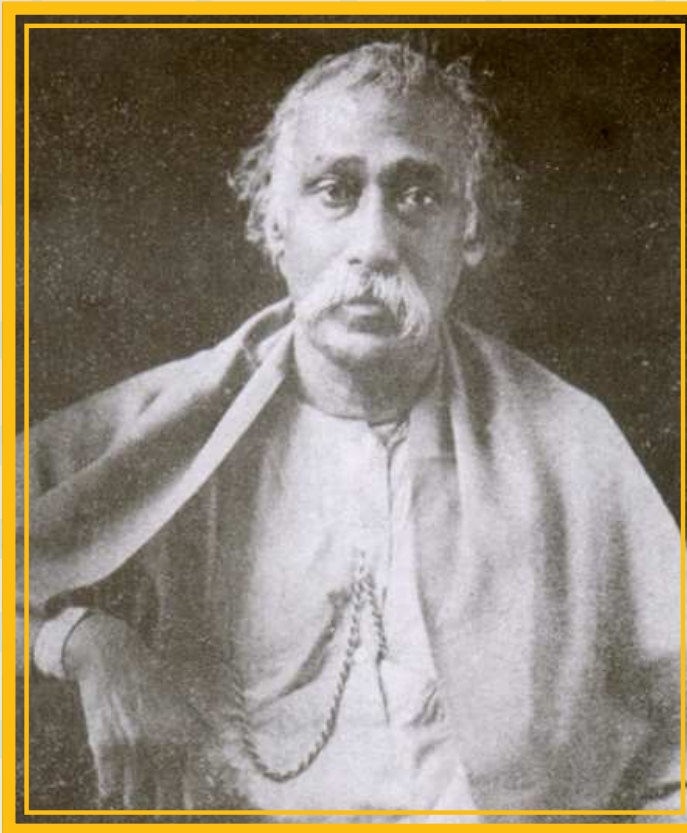
all its disciplines. With a collection of Rs. 61,000, Sircar pleaded that we should carry on the work of IACS with our own efforts, unaided by the government. In a time span of only few years, IACS set-up seven sections in general physics,

the scattered scientists on a national platform.

A common opinion that prevails in our society is 'Satyagraha', civil disobedience, boycotting foreign goods, armed revolution and similar activities were the only means and ways of the Swatantrata Andolan; and those who participated through these efforts only were the 'freedom fighters'. However, the silent contribution of our scientists also strengthened the goal of independence. Some prominent examples include taking up a challenge to demonstrate the Indian intellectual capability, outstanding contributions to the modern science, founding research institutes and laboratories by Indians and for Indians, establishing science-based industries, and more.

British rulers used science as a tool to consolidate and magnify their dominion over the country. They imposed western science to undermine Indian science and its traditional knowledge. The motive was to exploit the local resources and rule the country. Our scientists faced discrimination but upheld the country's honour and brought highest laurels.

The celebration of the 75th year of Indian Independence has offered us an opportunity to revisit the struggle for 'Swatantrata' in the scientific domain. Let's make use of this momentous time to create awareness about the scientific struggle (Vaigyanik Satyagrah) and motivate our citizens.



Mahender Lal Sircar

chemistry, astronomy, systematic botany, systematic zoology, physiology, and geology.

The establishment of the Indian Science Congress Association (ISCA) in 1914 was another major landmark. ISCA was a common forum for scientists working in different parts of the country. This forum was created by two chemistry professors, J.L. Simonsen and P.S. MacMohan. Beginning with a membership of sixty scientists in 1914, ISCA quickly expanded to 360 members in 1920. This organisation has played a key role to catalyse community consciousness as well as unify and bring

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INVITATION FOR THE AUTHOR

In an effort to celebrate the 75th year of Indian independence Vigyan Prasar is inviting book/graphic novel proposals from College/University faculties, Engineering and Medicine professionals, Subject Matter Experts, Journalists, Science Communicators, and Science Historians on

- * Role of Indian scientists, science communicators and teachers in Indian independence movement;
- * Historical Introspection in Indian Science and Technology with contemporary perspective;
- * Scientific institutions of India;
- * Freedom Struggle: Events to remember the role of the scientific community in the freedom movement;
- * Ideas @ 75: New Science and Technology ideas for New India;
- * Achievements @ 75: Showcasing the S&T Achievements of our country in the last 75 years;
- * Actions @ 75: S&T Action plan for New India;
- * Resolves @ 75: To make Atmanirbhar and prosperous India

Number of words can be in the range of 30000-35000. The book should describe inspiring and motivating aspects of the scientists and science leaders and throw light on their research and lesser known yet significant facts/achievements.

**Last date for receiving proposals:
31 January 2022**

The proposal should include a detailed Table of Content and small brief abstract about the book chapters in 2000 words.

The proposal can be emailed at: vigyanprasar.publications@gmail.com