



## INAE Monthly E-News Letter Vol. VIII, Issue 7, July 1, 2017

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### From the Editor's Desk

#### Only a smart hires a real smart

Who has better chance of survival — the most selfish or the least selfish? What is better for survival — combat or networking, competition or cooperation?

According to one view, evolution by natural selection shapes organisms to fit their environment. Another view claims that living things alter their world to suit their needs. In nature, survival is based on adaptability, connectivity, communication, and cooperation. In other words, it is the whole ecosystem that has to evolve, if one wants to evolve. One of the messages is "if you want to succeed, others must succeed as well." In other words, both competitive and cooperative spirits must co-exist for a healthy evolution.

Purnendu Ghosh  
Chief Editor of Publications

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According to one interpretation, the driving force of evolution is not to be found in the chance events of random mutations but in life's inherent tendency to create novelty. This view recognises that cooperation in the evolutionary process is of vital importance. Some believe that "life did not take over the globe by combat, but by networking."

Combat happens because in some situations, combat can't be avoided. Competition and cooperation are essential, as growth and decay are, for our existence and continuance. Compete and when that is over, sync and swim together. "You don't have to be perfectly adapted to survive, you just have to be as well adapted as your competitors." We are more like chameleons. We instinctively change our behaviour as per the demands of our surroundings. Selfishness works only in the presence of goodness. A person of competitive spirits likes to be surrounded by the most competent. Only a smart hires a real smart.

According to a theory, called the broken windows theory put forward by James Wilson and George Kelling, people who are otherwise well-behaved, are more likely to commit crimes in neighbourhoods with broken windows. The 'broken window' area's residents don't care enough to maintain their property. The theory, rightly or wrongly, suggests that broken windows encourage vandalism. The more litter there is, more the waste accumulates.

## ACADEMY ACTIVITIES

### Academy Announcements

- Nominations have been invited for Innovative Student Projects Award 2017. The last date of the receipt of nominations is July 7, 2017.

#### 11<sup>th</sup> National Frontiers of Engineering Symposium (NatFOE-11)

The Eleventh National Frontiers of Engineering Symposium (NatFOE-11) is being held from June 30-July 1, 2017 at IIT Bombay. Prof. Dr. Kulkarni, Director, IIT Bombay has agreed to host the NatFOE-11 Symposium at IIT Bombay and Prof. Amit Agarwal, FNAE, IIT Bombay is the Coordinator of the event. The symposium has four themes as under:

- Alternate and Advanced Fuels
- Manufacturing and heat transfer for Aerospace applications
- Technology for improving Childcare and Mothercare
- Technology for tackling fog and pollutants

The Technical Program includes Plenary Talks, Keynote Addresses, Lectures and presentations by young engineers from Industry/Academia/R&D and Policy makers. The event is envisaged to be attended by 30-40 Young Engineers from Academia/R&D/Industry.

#### Dr. Abdul Kalam Technology Innovation National Fellowship

INAE and DST have taken an initiative to institute a Senior Level Fellowship in the area of Engineering. The subject Fellowship shall be considered to be named after 'Abdul Kalam Engineering Innovation Fellowship'. The guidelines for instituting the subject Fellowship has since been formulated and shall be announced shortly. The draft guidelines and proforma for Dr. Abdul Kalam Technology Innovation National Fellowship were discussed during the recently held INAE-DST Consultative Committee meeting held on May 15, 2017 at DST. A maximum of ten Fellowships were decided to be instituted which will be funded by DST. The objective of the fellowship is to recognize, encourage and support translational research by individuals to achieve excellence in engineering, innovation and technology development. Efforts are ongoing to finalize the guidelines and launch the Fellowship by Aug 15, 2017.

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#### **INAE Kanpur Local Chapter**

Brief details regarding recent events conducted by the INAE Kanpur Local Chapter are given below.

- **Half Day Workshop on Intellectual Property: A Strategic Enabler for Translational Research and Development**

INAE Kanpur chapter organized a half-day workshop on *Intellectual Property: A Strategic Enabler for Translational Research and Development* on April 08, 2017. This interactive workshop witnessed over 25 participants, mainly faculty members and post-doctoral researchers from IIT Kanpur, Harcourt Butler Technical Institute, Kanpur, Defence Materials & Stores Research & Development, Kanpur, Dean of Research and Development office, SIDBI Innovation and Incubation Center, Biomaterials Processing and Characterization Laboratory, and Samtel Center for Display Technology, among others. The participants were welcomed by Prof. K. Muralidhar, President, INAE Kanpur Chapter. Prof. Sameer Khandekar, Associate Dean Innovation and Incubation, IIT Kanpur provided the background and impetus for conducting this workshop. Prof. Indranil Manna, Director IIT Kanpur and Vice-President, INAE, elaborated on the importance of protecting IP and the need for such a workshop in this day and age.

Dr. Debankur Bandyopadhyay emphasized the importance of Intellectual Property and how academicians often under-value this aspect. He highlighted, with real-life examples, inventions from various researchers and scientists that were not recognized just because the inventors had not

patented their work. He emphasized the aspect of protecting business by filing patents. He also mentioned that adequate protection of an idea is good strategy, and that patenting can enhance the value of the company. IP protection must not be ignored even by start-ups since an incubating company, after securing IP rights, enhances its firmness in the market and provides an edge over its competitors. Dr. Debankur Bandyopadhyay listed two key types of IPs: (i) *Copyright*, an exclusive legal right available for one over another to copy, distribute, create, derive and adopt artistic material; and (ii) *Patents*, which provide rights to the owner of a device idea and prevents a third party from making, using, offering for sale the product without consent of the owner. Patents hold an edge as they provide legal rights to the owners with *Claims* as the enforceable part of a patent. Further, Dr. Debankur highlighted the importance of utilizing 'Trademark' and 'Tradenname' in business. The talk was interactive, and questions raised were responded to, in detail.

Dr. Debankur was emphatic that a patentable item must have the attributes of: (i) being novel and new, (ii) non-obvious, (iii) having an inventive step, and (iv) being useful. An agency that encourages patenting includes WIPO (World IP organization) and supporting agreements include PCT (Patent corporation treaty) and TRIPS (Trade-Related Aspects of Intellectual Property Rights). Patent filing is expensive and one must ensure that holding a patent at a certain cost is commensurate with its usefulness and value.

The workshop ended with many real-life examples and specific questions stemming from the experience of the participants. Overall, the event was satisfying, with a similar workshop for undergraduate and doctoral students being planned for the future. The successful conduct of the workshop on *IP: A Strategic Enabler for Translational Research and Development* impacted the participants in a very positive manner.

- **Life in the IIT System Talks by and discussion with Professor S. P. Sukhatme & Professor S.P. Mehrotra**

INAE Kanpur Chapter, successfully organized a half day event on *Life in the IIT System* on March 25, 2017 at Indian Institute of Technology (IIT) Kanpur. This event witnessed talks by and discussions with Prof. S.P. Sukhatme (Professor Emeritus, Indian Institute of Technology Bombay), and Prof. S.P. Mehrotra (Retd. Faculty, IIT Kanpur & Ex-Director, NML Jamshedpur). At the outset, Prof. S.P. Sukhatme and Prof. S.P. Mehrotra were welcomed by Prof. Indranil Manna, Director IIT Kanpur and Vice-President INAE. Prof. Sukhatme did express that this visit marks 50 years from when he had visited IIT Kanpur first. Prof. Mehrotra also marked his affiliation with IIT Kanpur to be over 49 years long.



PROF. I. MANNA WELCOMING PROF. S.P. MEHROTRA AND PROF. SUKHATME (RIGHT)

At first, Prof. S.P. Sukhatme's biosketch was read by Prof. Yogesh Joshi, Vice-Chair, INAE Kanpur Chapter. During the talk, Prof. Sukhatme provided a detailed history on the making of IITs starting from the Sarkar committee onwards. He stressed on the four pillars that make a successful IIT system: (i) students, (ii) faculty, (iii) funding, and (iv) administration. He, then, focused on the aspects expected of a faculty for making an impact on global community via incorporating proper plan of action, good teaching, pursuing research, consultancy and outreach, remaining committed and learning to live with pressure. Prof. Sameer Khandekar served as a moderator for the hour long discussion session. This talk was followed with a tea-break of fifteen minutes.

The biosketch of Prof. S.P. Mehrotra was read by Prof. Kantesh Balani, Secretary, INAE Kanpur Chapter. In the second talk, Prof. S.P. Mehrotra highlighted the history of IIT Kanpur. His vigour and enthusiasm could make you feel the energy and vibrance he felt when he had joined the institute as a student (in 1963), which continued well late into the 1980s. He also highlighted the reasons of why the institute's research profile continued to rise despite the setbacks of 1960-1970s faced by the country. He attributed this trend to the sense of *belonging* everyone felt for the institute. He emphasized that the excellence of the institute in the prime years was mainly due to the new ideas that were driven by the young minds. He also highlighted the necessity of bringing such a change back to provide new thrust to the system. Again, Prof. S. Khandekar moderated the hour long interaction session of Prof. Mehrotra with the faculty.

Prof. K. Muralidhar, Chair INAE Kanpur Chapter was instrumental in overseeing the successful conduct of the event. The program witnessed interaction of over 40 participants with Prof. S.P. Sukhatme and Prof. S.P. Mehrotra. The presence of Prof. Manindra Agrawal, Deputy Director, IIT Kanpur and Prof. Indranil Manna, Director, IIT Kanpur emphasized the importance of this interaction session. The animated questions and enthusiastic discussions for over an hour that followed after the 45 minute talks indicate the relevance and importance of the information conveyed by the elite speakers. Overall, this event conducted by INAE, Kanpur Chapter, was a great success.

### **INAE on Facebook and Twitter**

INAE has created a Facebook and twitter Account to post the news of recent INAE activities in the Social Media. The same can be viewed at the link below.

(a) Facebook -link <https://www.facebook.com/pages/Indian-National-Academy-of-Engineering/714509531987607?ref=hl>

(b) Twitter handle link <https://twitter.com/inaehq1>

All INAE Fellows are requested to visit and follow the above to increase the visibility of INAE in Social media.

### **Creation of Data for INAE Expert Pool**

INAE Expert Pool was created with the aim of identifying domain experts in various disciplines of engineering. There has been a good response from the Fellows and Young Associates in uploading their particulars on the INAE Expert Pool website. The INAE Fellows and Young Associates who have not uploaded their particulars are requested to submit their profile details online at the link <http://inae.in/expert-search/index.php/inae-members-form> The details of the INAE expert Pool have since been shared with DST, TIFAC, Niti Aayog and Office of PSA. The creation of the website on Expert Pool has been appreciated by all the agencies and the data would be used by them in identifying suitable domain experts and to involve the experts in their activities.

### **Important Meetings held during June 2017**

- **Finance Committee Meeting on June 22, 2017 Chaired by Dr BN Suresh, President, INAE** wherein the main agenda included approving of the Balance Sheet and the Income & Expenditure

Account for the year ended 31st March 2017 and considering the Budget Estimate for the year 2017-18.

- **Selection Committee on Lifetime Contribution Award; Prof Jai Krishna/Prof SN Mitra Memorial Awards and Outstanding Teachers Award on June 22, 2017 Chaired by Dr BN Suresh, President, INAE** wherein the main agenda included recommendations pertaining to selection of awardees.
- **Governing Council meeting on June 22, 2017 Chaired by Dr BN Suresh, President, INAE** wherein the main Agenda included approval of the recommendations of the Selection Committee on Lifetime Contribution Award; Prof Jai Krishna/Prof SN Mitra Memorial Awards and Outstanding Teachers Award and Finance Committee Meeting and laying of Annual Report 2016-17
- **Sectional Committee Meetings on June 23, 2017 Chaired by the Convenors of the Sectional Committees** wherein the main agenda included second round of shortlisting of the nominees for election to INAE Fellowship and candidates to be called for presentations before the Selection Committee for INAE Young Engineer Award.
- **General Body Meeting on June 23, 2017 Chaired by Dr BN Suresh, President, INAE** wherein the main Agenda included considering and adopting the Balance Sheet and the Income & Expenditure Account for the year ended 31st March 2017 and to receive and adopt the Annual Report 2016-17 and conduct of a Brain Storming Session for inputs from Fellows for enhancing the activities of the Academy.

#### **Academia Industry Interaction**

##### ***AICTE-INAE Distinguished Visiting Professorship Scheme***

Industry-academia interactions over technological changes have become essential in recent times so that relevant knowledge that would be sustainable in the changing conditions can be imparted to the students in the engineering institutions. While industries could gain by using the academia's knowledge base to improve the industry's cost, quality and global competitive dimensions; thereby reducing dependence on foreign know-how and expenditure on internal R&D, academics benefit by seeing their knowledge and expertise being fruitfully utilized practically and also by strengthening of curricula of educational programs being offered at engineering colleges/institutions. INAE together with All India Council for Technical Education (AICTE) launched "AICTE-INAE Distinguished Visiting Professorship Scheme" in 1999. Under this scheme, Industry experts are encouraged to give a few lectures in engineering institutions. This scheme has become popular among industry experts as well as engineering colleges.

Brief details pertaining to recent visits of industry experts under this scheme are given below.

<p>Dr. BC Pai CSIR Emeritus Scientist, National Institute for Interdisciplinary Science and Technology (NIIST)</p>	<p>Government College of Engineering, Tirunelveli Apr 4, 2017</p>	<p>Delivered lectures on "Corrosion Engineering", "Motivational talk" and "Surface Coatings". Guided projects and helped suggesting a change in curriculum. According to the feedback from the engineering college, the interaction between industry expert and students enhances research contributions of students and hence such a scheme should be encouraged.</p>
<p>Dr MR Kalgal Senior Vice-President, UltraTech Cement Ltd., Bangalore</p>	<p>BMS College of Engineering, Bangalore Apr 10, 17, 2017</p>	<p>Delivered lectures on "Sustainable Constructions-Eco-Data", "Sustainable Constructions - Rating Systems". According to the feedback from the engineering college this is a very useful programme for academic institutes. The DVP's lectures provide a new direction and thought process to students.</p>

Dr Chaitanyamoy Ganguly Retired Distinguished Scientist, DAE	Jadavpur University, Kolkata Apr 19-20,2017	Delivered lectures on "Nuclear Fuel Cycle I-Importance of Nuclear Safety, Security & Safeguards" and " Nuclear Fuel Cycle II-Importance of Nuclear Safety, Security and Safeguards". Has also proposed change in the curriculum.
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### **International Conferences/Seminars being organized by IITs/other Institutions**

To view a list of International Conferences/Seminars being held in the month of July 2017 [click here](#)

### **News of Fellows**

1.	Prof. N. Raghavan, FNAE, Professor of Practice IIT Madras is the Co-Chair of the "Indian Lean Construction Conference: Continuing on the Lean Journey for Indian Construction- ILCC 2017" being held on July 27-29, 2017 at IIT Madras, Chennai. Further details regarding the conference may be viewed at the link <a href="http://www.web.iitm.ac.in/ilcc2017/">www.web.iitm.ac.in/ilcc2017/</a>
2	Prof. Sanjit K. Mitra, FNAE, Research Professor of Electrical & Computer Engineering, University of California Santa Barbara was recognized as a pioneer in the area of circuits & systems and presented a talk in the special session on "Pioneers of Circuits & Systems II" held during the 50 <sup>th</sup> IEEE International Symposium on Circuits & Systems at Baltimore, Maryland, USA on May 28-31, 2017. Two special sessions entitled "50 Years of Circuits, Systems & Signals: A Session in Honour of Prof. Sanjit K. Mitra, FNAE," (Parts I and II) were also conducted. Nine papers by authors from Brazil, India, Italy, Singapore, and USA were presented in these two sessions.

ASRE- International Conference on Mechanical Engineering-2017 on July 1-3, 2017 at Lucknow,  
<https://conferencealerts.com/show-event?id=183250>

International Conference on Innovative Trends in Mechanical, Electrical, Civil, Computer Science  
and IT (MECIT-2017) on July 12, 2017 at New Delhi,  
<https://conferencealerts.com/show-event?id=187356>

International Conference on Recent Advances in Chemical Environmental Bioprocess, Textile  
Mining Mat and Met. (CEBTME-2017) on July 12, 2017 at New Delhi,  
<https://conferencealerts.com/show-event?id=187357>

International Conference on Computational Intelligence & Data engineering (ICCIDE-2017) on July  
14-15, 2017 at Vijayawada, Andhra Pradesh,  
<https://conferencealerts.com/show-event?id=180289>

International Conference on Signal Processing and Communication (ICSPC'17) on July 28-29, 2017  
at Coimbatore, Tamil Nadu  
<https://conferencealerts.com/show-event?id=175129>



## Products, Facets and Curses of LHGBRs



**S.N. Mukhopadhyay**

### **Introduction**

Living human genomic body/bio-reactors (LHGBRs) are examples of genes and genome (HG) regulated products. They are the results of natural process biotechnology (NPB) of almighty supra nature (ASN) using naturally acquired design engineering (NADE) and recombinatorially acquired design engineering (RADE) and anthropic principles. Life facets of LHGBRs consist of formation/creation or birth (B), functioning/working and finishing/vanishing or death (D) stages. Thus, LHGBRs creation to cremation are bound between B and D Limits. Within B and D they use metabolic engineering (ME) device that gives indicator of work power (WP) of an individual to deliver his/her visible and invisible products and generated wastes/pollutants through activities in the environment. This indicator known as cost of harvesting (COH) is the metabolic WP in watts required to generate one watt electrical power (EP) in LHGBR. Beyond B and D facets soul energy (SE) play imaginary roles. These are described in this article.

### **LHGBRs Characteristics**

LHGBRs are amylo-pro-lipo (apl) hybrido macromolecular biopolymeric anatomic/structural biomass synthesis systems imbued with SE (atman), brain and knowledge industry (KI). They are created by ASN/AGOU (almighty god of universe) in coordination with nature/SGOE (super god of earth). They may work as gods on earth (GOE) who are individual's perception, and follower's and promoters of business. This is because of many reasons, some of them are listed in Table 1. Genetically or genes and genome function wise they may be of different types as given in Table 2. LHGBRs social and functional working characteristics are given in Table 3.

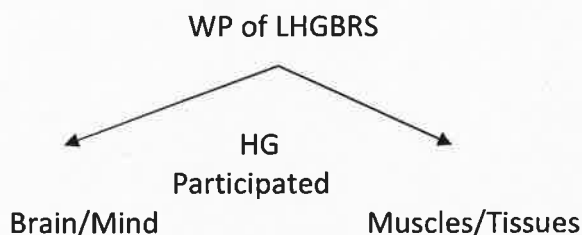
Various types of products and wastes/pollutants generated by consuming diet/food by LHGBRs are as given in Table 4. The wastes of LHGBRs are recyclable as per suitability. Their products and pollutants are generated all through the facets of life listed in Table 5. Once a LHGBR dies his/her body no longer needs the organs. The organs just after death may be used to save others lives. So, donations of their still functional organs may be regarded as a good deed urging every one not to waste the GOE which is AGOU's/SGOE's reusable resources and gift of life. Moreover, LHGBRs have learnt from their KI how to reuse the suitable generated wastes/pollutants for value added products (VAPs) formation through process biotechnology (PB) developed by themselves. LHGBRs feces, urine-night soil constitute a good resource material having C/N ratio suitable for biofuels production by anoxic digestion (AD).

**Table 1: List of a few reasons to call LHGBRs as GOE**

- Galaxy's Outstanding Designs
- Grow On Diet
- Gender Opportunity Detectors
- Geographical Occurrence Discoverers
- Governors Of Diseases
- Go On Discovering
- Go On Developing
- Genomic Order Decoders
- Genomic Order Determinators
- Genomic Order Designers
- Genomic Organ Donors
- Go On Dieing, etc.

### Uniqueness of LHGBRs

As given in Table 4 LHGBRs have WP which is huge in measure. This WP is manifested in parts as below.



**Table 2: Genetic types of LHGBRs**

Gender type	Characteristic
Male/Donor pole	Possessed with donor sex organ, have typical anatomical design form
Female/Acceptor pole	Possessed with acceptor sex organ, have unique anatomic design form
Transgender	Possessed with no sex organ, have mixed anatomic features
Gay/Lesbian	Possessed with homosexual nature, have usual anatomic features
Biotransformed	<p>Possessed with GOE transformed sex, have transformed anatomic features</p> <p style="text-align: center;">Biotransformed /</p> <p>Exs: Male <math>\longrightarrow</math> Female</p> <p style="text-align: center;">Bioengineered</p> <p>1. Roberto <math>\longrightarrow</math> Roberta</p> <p>2. Bruce <math>\longrightarrow</math> Caitlyn</p> <p>3. Gaurav <math>\longrightarrow</math> Gauri</p>

**Table 3: Social and Functional Deeds of LHGBRs**

<ul style="list-style-type: none"> <li>• Follow religion</li> <li>• Do good deeds as GOE</li> <li>• Deliver products and wastes/pollutants</li> <li>• Creators, discoverers, innovators, researchers, designers, developers</li> <li>• Make earth more and more beautiful</li> <li>• Possessed with KI in brain and mind</li> <li>• As generous organ donors their good deeds are remarkable to social benefits</li> <li>• Polluters of environment/climate through activities</li> <li>• Sufferers of ailments, diseases, genomic disorders</li> <li>• Damagers of society through bad deeds like terrorism, murdering etc. through wrong genome regulation etc.</li> </ul>
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**Table 4: Types of Products and wastes/Pollutants of LHGBRs**

Type	Products	Wastes/Pollutants generated
1. Visible	<ul style="list-style-type: none"> <li>• Anatomic body</li> <li>• Biomass/Flesh</li> <li>• Blood, bone, head and other organs</li> <li>• Work power (WP)</li> <li>• Deeds : Good/Bad between B and D</li> </ul>	<ol style="list-style-type: none"> <li>1. Solid/semi solid: <ul style="list-style-type: none"> <li>• Feaces/excreta</li> </ul> </li> <li>2. Liquids : <ul style="list-style-type: none"> <li>• Urine</li> <li>• Sweat</li> </ul> </li> <li>3. Gaseous: <ul style="list-style-type: none"> <li>• Waste gases (CO<sub>2</sub>, H<sub>2</sub>S)</li> <li>• Off smell</li> </ul> </li> <li>4. Energy: <ul style="list-style-type: none"> <li>• Waste heat</li> <li>• Soul</li> </ul> </li> <li>5. Body organs just after death</li> </ol>
2. Invisible	<ul style="list-style-type: none"> <li>• Mindmachine for thinking / KI</li> <li>• SE/Atman</li> <li>• God particles (GPs)</li> </ul>	

Being rich resource of energy measurable by backpack machine system its quantification will be useful. An average size LHGBR stores as much energy in fat/lipid as a 1000kg battery that is required in HG functions. This energy permits LHGBRs to harness the vertical oscillations of a 3.8 Kg load (average weight of a head) to generate nearly 7.4 watts of EP during fast walking. Thus, ME device of LHGBRs has a markedly low COH which is a dimensionless quantity. So, COH<sup>1</sup> is the additional metabolic power (MP) in LHGBR in watts required to generate 1 watt EP. Its value is given by

$$COH = \frac{\Delta MP}{\Delta EP} \quad (1)$$

where  $\Delta$  refers to walk while harvesting without back-pack and walking while carrying the spring loaded backpack device. From Equation (1) one may write

$$COH = \frac{1}{\text{Device effi.} \times \text{Muscle effi.}} \quad (2)$$

Lipid containing LHGBRs store as much energy in lipoproteins as a 1000 Kg battery that is needed in HG functions. This is, therefore, a must for NADE-RADE operated genes and genome

functions and regulations in LHGBRs for anatomical scale up dynamics in the facets of life performances as listed in Table 5.

**Table 5: Facets of LHGBRs between B and D and imaginary beyond**

FacetNo.	Facet's Functional Process Biotech.Steps	Humanism
1.	Like/Love(Biochemotaxis) Male/Boy-----Female (Donor Pole) (Acceptor Pole)	Social Benefits
2.	Cells Fusion/Biofertility Conceiving-----Delivering	LHGBRs Functions
3.	On Birth-----Earth (B)	Creation/Population explosion
4.	To Pro-----Grow	Biomass
5.	To Crawler-----Stroller	Biomechanics
6.	To Grow-----Show	Bioefficiency
7.	To Learn-----Earn	"
8.	For Name-----Fame	"
9.	For Vision-----Mission	"
10.	With Karma-----Dharma (Deeds) (Religion)	"
11.	And Finish-----Vanish (Death/D)	Cremation (Departed Soul)
12.	Play Soul-----Role	
13.	To Find Role-----Pole	For Rebirth
14.	(Fragmented) Subject-----Objective	In Hypercycles
15.	For Nirvana-----Paritrana	To get into ASN
16.	For Paritrana-----Mahanirvana	"
17.	For Mahanirvana-----Mahaparitrana (Moksha)	For no Rebirth and beyond ASN

### Curses of LHGBRs

LHGBRs anatomic/structural health hazards/disorders/ailments etc are occurring due to genomic aberrations/mutations/infections and damages by preventing normal functions of HG.

Pollutants of environment/climate are agents to cause such phenomena. Thus alarming curses of pollutants on land, waters, air/atmosphere and climate changes due to LHGBRs activities and metabolic functions need serious and judicious attentions in saving earth and its habitats from hazards.

### **Efforts of GOE Remedies**

For combating alarming problem of pollutions of air, water and land by effluents, garbage/wastes etc for supplying clean drinking water, natural and pure pollution free air supply and minimized land pollution LHGBRs plans are in operations and have been proposed as remedies of these crisis. Recently proposed 42 points action plan of Delhi in India may be said to be one of the good efforts by GOE for maintaining clean environment in world without border using science, engineering and technology (SET) skills of KI.

### **Conclusion**

It is the prime duty of every individual GOE/LHGBR to take the greatest possible care of one's body as it is indispensable medium for experiences and performances for good deeds in one life form. Nothing can be done, not even a simple task without an ailment free healthy LHGBR. For best uses of this invaluable creation of AGOU/ASN through support of SGOE/N minimization or free of curses of GOE's SET and KI is a must. In KI participated B and D limits bound LHGBRs life cycle SE/atman recycling is a mystery till to day. Its unfolding will be interesting and great help in the progress of life forms.

# My tryst with Destiny



R. K. Bhandari

In this article, I write about some of the episodes of my tryst with destiny, in my long professional career as a Civil Engineer.

Tryst means a private romantic rendezvous between two ardent lovers. And this is the *touch-and-go* story of love between me and my destiny. We have interludes of private conversations-long and short, scheduled and unscheduled, pleasant and unpleasant. Such meetings between us, leave me with all the time to pursue my work *without worrying* about what will happen of my actions or inactions because that role and responsibility, I have willingly and lovingly surrendered to my destiny. After going through the lights and shadows of the long years of experience, I regard this way of living as the best prescription for lasting happiness in life!

Brihadranayaka Upanishads tell us: "You are what your deep driving desire is; As your desire is, so is your will; As your will is, so is your deed; As your deed is, so is your destiny". Over the years of roller-coaster-ride on the rough road of life, I'm now convinced that -If you long for anything with unstinted purity of head and heart, you are someday going to hold it in your hand. The universe will start to rearrange itself to make things happen for you<sup>1</sup>.

When I was experimenting with the above thought in early years of my life, I came across a book by E. M. Forster titled: *The Life to Come*; written in 1922 but published posthumously half a century later, in 1972. It convinced me without a shadow of doubt that - "*We must be willing to let go the life we have planned, so as to have the life waiting for us*".

I keep reminding myself all the time that in life, four things cannot and will not comeback - the spoken word, the sped arrow, the past life and the neglected opportunity.<sup>2</sup> Further, our greatest glory in life is not linked with our rise, but in rising every time we fall. In life, "those who are overcautious about themselves fall into dangers at every step; those who are afraid of losing honour and respect, get only disgrace; and those who are afraid of loss, always lose."<sup>3</sup>

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<sup>1</sup> Dr Joe Vitale

<sup>2</sup> Annon

<sup>3</sup> Swami Vivekananda

The above message reverberates in the most autobiographies of great men and women. In her book, *Freedom from Fear*, Aung San Suu Kyi opines that "It is not power that corrupts but fear. Fear of losing power corrupts those who wield it and fear of the scourge of power corrupts those who are subject to it". Personally to me it makes not only sense but it makes miracles when we replace Fear with Faith in our lives. This simple leap over from Fear to Faith changes the whole landscape of life. Brick by brick, I'm trying hard to build absolute faith in myself and in my destiny, hugely inspired by the following two short stories:

My first story is from the book titled *Tales and Parables of Sri Ramakrishna*<sup>4</sup>. I regard its following parable as the most precious divine gift to me:

*"Once a man went to a certain place to see a theatrical performance, carrying a mat under his arm. Hearing that it would be some time before the performance began; he spread the mat on the floor and fell asleep. When he woke-up all was over. Then he returned home with the mat under his arm!"*

Although the message conveyed by the above parable is loud and clear, there is a need to read it a million times to understand the depth of its true meaning. During our sojourn in this world, when we are young, we feel there is plenty of time at our disposal to take things seriously. As the years roll-by in the dazzle of life, one day we suddenly find that *the game is over* and now it is the time to depart while we were still chasing glory and greatness!

My second story is the priceless gift of Raman Maharishi hand-picked from his Ashram at the foot of the Annamalai Mountain in Tiruvannamalai.<sup>5</sup> Destiny placed me at the VIT University, Vellore, so that I could be blessed by him with the most transformational opportunity of my life to spend a few hours at the Raman Maharishi Ashram. The nearly 10 hours of travel time to the Ashram, for me, melted like phantasm.

It is in the Ashram that I read the following golden words of the Maharishi:

*"The ordainar controls the fate of souls in accordance with their parabdhakarma. Whatever is destined not to happen will not happen, try as you may. Whatever is destined to happen will happen, do what you may to prevent it. The best course, therefore, is to remain silent."*

The above two stories, coming together as they do from the great souls like Ramakrishna and Raman Maharishi, unfailingly illuminate my path through the vortex of life. To me, *"Ideals are like stars: you will not succeed in touching them with your hands, but like seafaring man on the ocean desert of waters, you choose them as your guides, and following them, you reach your destiny."*

I have personally felt the transformational power of the great teachers of my time, starting from my mother who was the first among them. At my age of 5, she was the one who sent me back to my school on a rainy day to return a mistakenly picked pencil of someone else

<sup>4</sup> Published by Sri Ramakrishna Math, Madras 600004.

<sup>5</sup> Raman Maharishi himself had set his foot here on 1<sup>st</sup> September 1896.



(at the school) which she had found in my school bag. It is the blessings of my parents and teachers which has put me on the road on which destiny now leads me without giving me an iota of the feeling that I am following it. We march together in tandem.

My professional journey into the World of Engineering began after obtaining M.Tech degree from Indian Institute of Technology, Bombay in 1964. Soon thereafter, I joined CSIR-Central Road Research Institute, New Delhi, as a scientist. I was given the responsibility to carry out research and consultancy on Landslides affecting roads in the entire Himalayan belt. Little did I realise at that time that I am being wedded for life to the subject of Landslides!

In the monsoon of 1965, landslides struck various parts of the Himachal and Sikkim Himalayas opening a floodgate of learning opportunities for me. Professor S.R. Mehra, the then Director, asked me to lead a team of scientists to study spate of landslides in Shimla. With the limited knowledge of the subject and almost no previous experience, I did as best as I could and worked hard to produce a report. Without looking at the report, Professor Mehra asked me to apprise him of the scientific logic behind the decisions I have taken and the people I had met during my visit. He was not very happy when he heard in reply that I only met the concerned Executive Engineer and told him that the decisions on the landslide control will be conveyed after the approval of the Director. Professor Mehra asked me to sit down on the chair opposite to him and said- "Look, next time you lead a team, go as an Ambassador of this Institute and try to meet the highest person in that organization. And learn to take decisions. Your right decisions will make you a better engineer and in case your decisions turn out to be wrong, there will be always time to correct them, and I will protect you."

While at CRRI, in early 1966, I was selected for a scholarship to pursue my higher studies abroad. I was, however, not permitted study leave by my employer because as per the rules prevalent then, I had not completed the obligatory two years of service. A great majority of my relations, well-wishers and friends advised me to quit the job and go, with the sole exception of my Director Professor Mehra. He told me to decline the offer and learn to have patience, assuring me of his support for a better opportunity in the near future. I declined the offer and continued without knowing that indeed destiny has something better in store for me!

Six months from then, Professor Mehra asked me to apply for the Science Research Scholarship of the Royal Commission of the United Kingdom for the Exhibition of 1851 – the most prestigious and high value scholarship of that time. In the application form, I was required to write about my proposal for research and suggest three institutions from any one of the commonwealth countries where I would like to pursue my research studies. In my application, I connected my proposal on landslide research with flagship areas of research at the Imperial College and repeated Imperial College London three times as the first, the second and the third choice as the preferred place of work- much against the advice of my friends. Everyone other than me felt that, if a slot for placement at Imperial College is not available, I may lose the very opportunity on that count. Exactly the opposite

was destined to happen. One of the reasons I got the scholarship was also because the selection committee was impressed by my decisiveness in picking the topic of research and opting for Imperial College, U.K. as the only place of study. I came to know of this fact a few months after joining Imperial college from none other than Sir W. D. Sturch, the then Secretary of the Royal Commission. It may not be out of place to mention that Professor A. W. Skempton, FRS, of Imperial College was himself the Chair of the Selection Committee.

Destiny played the game yet again and I found my dream placement with legendary Professor J. N. Hutchinson, FRSE who happily accepted me as his research student. Apart from being a professional giant in landslide research, he was known for his disciplined way of life, exemplary humility, exceptional power of imagination, focussed thinking and a deep sense of commitment to research and teaching.

I had dozens of rare opportunities to spend quality time with him, especially during the field work in connection with my research and at his home. Whenever we moved up and down the slopes of the Isle of Wight and the Isle of Sheppey in the United Kingdom, his eyes invariably saw at least one-hundred times more than what I could see or comprehend. My earlier education at IIT Bombay had equipped me to explain away, why landslides had occurred where they did and why landslides did not occur, where there were none. But he was the first one to introduce me to the mind boggling spectre of landslides in the theatre of Nature and taught me to learn from every shred of field evidence and signatures left behind by landslides. His mastery to dig deep into the interplay of a variety of causative factors acting on the slopes over the geological time scale had no parallel. It was for the first time I began to realize that in Nature there is always much more to it than that meets the eye and the deeper we dig, the bigger is the haul!

My research at the Imperial College was supported both by the Royal Commission and the National Environment Research Council of the U.K. In the early period of my research on the Cliffs of the Isle-of-Wight, Professor Hutchinson and I came across a well-developed mudslide, moving discreetly on nearly a flat slope. I never realized that a glance of the mudslide will show-up on his face as a *Eureka moment*. Swiftly he turned his face towards me and told me that here is a hitherto unexplained problem I should consider to work on. I nodded without thinking as I heard him say that if the mudslide in the stiff fissured clay slopes could be scientifically explained, the research can probably fetch me the degree of Ph.D.

For close to two years, I could not explain the fundamental mechanism of the mudslide despite a comprehensive program of meticulously conducted geomorphological mapping, Geotechnical field and laboratory investigation, instrumentation, field monitoring and slope analysis. I was a bit disappointed by the outcome of my research but Professor Hutchinson became even more excited to dig deeper and asked me to intensify the investigations and take recourse to field monitoring of transient pore water pressures along the discrete basal boundary shears. He had the sixth sense to *foresee* the artesian pressures arising from the

undrained loading in the head region of the mudslide, long before I could demonstrate the same by field measurements.

Again, the providence has something bigger in store for me. The challenge naturally shifted to the measurement of excess hydrostatic pressures on discrete basal boundary shears of the mudslide under study. To monitor rapid variations of pore water pressures within a slope, I needed quick-reading piezometers. Since no such piezometers were available in the market in the late 1960's, Professor Hutchinson insisted that I develop such piezometers in order to bring my study to fruition.

Jointly with the Bell and Howell Company of the UK, a strain-gauge type, transducerised stiff diaphragm piezometer was developed for the first time in the UK and rigorously tested and calibrated in the field. Subsequently, the mudslide in the Hampstead beds of the Isle-of-Wight was fully instrumented and its piezometric profiles were established. The field measurements provided for the first time –the much awaited hard evidence of artesian pore pressures arising from the undrained head loading of mudslides.

The above research not only earned me the Ph.D degree from the Imperial College in 1970 but it also yielded a game changing research case record in Geotechnique which continues to appear in the Google search as one of the ten greatest papers on landslide research. After 42 years of sustained work in this field, it was in my luck to become the first and the only Indian so far to receive the 2012 Varnes Medal, the highest International Award for excellence in landslide research and practice at the UNESCO Headquarter in Paris. I felt really honoured especially because my supervisor, Late Professor Hutchinson was the recipient of the same award in 2004.

Soon after earning my Ph.D degree, I had several job offers in the U.K., and yet what is it if not the destiny which brought me back home in early 1971. I came fully charged and inspired by the living legends like Professor A. W. Skempton, FRS; Professor A. W. Bishop; Dr Norbert Morgenstern, Professor Nick Ambraseys and Professor J. N. Hutchinson, FRSE, among others. Back at CRRRI, I dedicated myself fully to strengthening of the foundations of landslide research and practice in India.

In 1975, I moved over to the Central Building Research Institute and had the honour to establish India's first Laboratory of Excellence in landslide studies. Within a period of five years, the CBRI became the first and the only institution in the country to be equipped with the first state-of-the-art Ground Penetrating Radar for subsurface exploration, the first Geotechnical Digital System for simulated stress path testing of soils, the first laser particle analyser for study of discrete boundary shears, the first pile drive analyser for diagnostics of pile foundations, the first set of vibrating wire piezometers for insitu pore pressure profiling of landslides and a fleet of sensors and field instruments for time-based monitoring and early warning against landslides. CBRI became the first institution in India with state-of-the-art capacity for scientific investigation of landslides.

In the year 1989, destiny suddenly opened a totally unforeseen, new window of opportunity for me to put my ideas to practice and create pace-setter examples. At that time-HABITAT in Nairobi was looking for a professional to lead a UN team in Sri Lanka, in the aftermath of several devastating landslide disasters. My name somehow reached the ears of Dr Ignacio Armillas, the UN-Habitat's Programme Director. He started looking for me in India at a time when I was in Tanzania on a CSIR Mission. On my journey back to India, it was just by chance that I decided to visit UN-HABITAT Headquarters in Nairobi to meet my friend Dr M. Ramaiah, the Director of SERC, Chennai, on deputation to UN-HABITAT. While I was sipping a cup of tea in the UN-HABITAT cafeteria, it was Dr Ramaiah who informed me of Dr Armillas effort to contact me in Roorkee. Within minutes, I met Dr Armillas and was interviewed for the position of Chief UN Adviser to the Government of Sri-Lanka. As he had already made enquiries about me during the process of short listing candidates, within about an hour or two of the interview, I was selected for the post. Within the next four months, I was already in Sri Lanka to lead the UN project on Landslide Risk Reduction.

I had the privilege of establishing Sri Lanka's first laboratory on Landslide Studies and Services at the National Building Research Institute, Colombo in the early 1990s, which has attained new heights over the period of the last two decades. My team made a history of sorts when a 100-year-old-landslide at Watawala (which was a recurring annual nightmare) was permanently fixed by 1994 using, for the first time in the world, the innovative technology of directional drilling to effectively drain out the water saturated unstable slopes by constructing an array of very deep and long sub-slope drains. So successful was the project that for the Sri Lankans, Watawala landslide exists only in the books of history now.

Back in India from Sri Lanka in 1995, my engagement with natural disaster mitigation initiatives grew faster than I could imagine. CSIR gave me the opportunity to sustain my active participation in the disaster mitigation related national projects. I studied the Malpa landslide tragedy of 1998; Gujarat Earthquake of 2001; Orissa Super cyclone of 1999 and the frequently occurring landslides in Uttarakhand. Though not named in the original composition, I was inducted as a member into the High Powered Committee on Disasters constituted by the Government of India. Of the many areas of my intervention and engagement with the HPC, my proposal on National Disaster Knowledge Network captured national attention and eventually became an important recommendation in the report of the High Powered Committee.

My destiny again played its part and sprang a surprise. During the coffee break after my presentation to the HPC on the subject, a gentleman (whom I did not know at that time) approached me and asked me to join Anna University in Tamil Nadu, and establish a Centre for Disaster Mitigation and Management in the University Campus in Chennai. The gentleman introduced himself as Dr A. Kalanidhi-the Vice Chancellor of the University. The offer was totally unexpected, but genuine. Within days I got the formal offer and joined the Anna University by invitation in 2001. The Centre for Disaster Mitigation and Management

at the Anna University thus owes its origin to that accidental opportunity and rare initiative by the Vice Chancellor.

Four years later, in 2005, I received an invitation from the Chancellor of the VIT University through Dr Kalanidhi, to establish a similar Centre. We both drove from Chennai to Vellore to meet the Chancellor. The chancellor was very quick in decision making and within minutes of the conversation, I was formally invited to establish a Centre for Disaster Mitigation and Management at the VIT University. Within less than six months of my joining, because of the exceptional commitment shown by the Chancellor, a state-of-the-art, well-equipped and fully staffed Centre for Disaster Mitigation and Management could be created. It was inaugurated by the Union Home Minister Shri Shivraj Patil in the presence of Gen N C Vij, Vice Chairman and Shri K M Singh, Member, National Disaster Management Authority; Shri V Shankar, Secretary, Border Management and dozens of disaster management experts from across the country. Today the Centre for Disaster Mitigation and Management at the VIT University is contributing to disaster education in a significant way.

While still at the Anna University, I unexpectedly got an invitation in 2003 to attend an interview in Nairobi for the position of Chief Technical Adviser (CTA) for the UN-Habitat's Iraq Programme. Upon reaching Nairobi, I came to know from a friend that my name was not on the original short list of candidates to be interviewed. Dr J. H. Moor in the Office of the Executive Director, UN-Habitat, reportedly added my name in the short list because he not only knew me well professionally but, in 1995, he had rated me as UN-Habitat's best CTA in the Asian region. With his providential intervention, I went through the process of formal interview and topped the panel, for the final interview with the Executive Director of UN HABITAT, Ms Anna Tabaiyuka. After an hour-long interview the same day, she put her signatures in the file. Although I was initially selected only as a CTA, after observing me perform under the most trying conditions in the war-torn Iraq, I was elevated to the position of the Programme Director of the \$660m Habitat's Iraq Programme during the period 2003-5. All this happened so swiftly as though the destiny had taken full control of my fortune.

In Iraq, the most deflating moment for me was the ghastly view of the death and devastation unleashed by the bombing of the UN Head Quarter building at the Canal Hotel in Baghdad on 19 August 2003. This was the place where, upon reaching Baghdad, I had lived in a tent until a few days before the bombing incident. I could easily have been one of those killed but the providence again had different design for me. What this single incident taught me in terms of disaster management, no class room education could ever teach. By hindsight, my disaster education would have been incomplete without the huge exposure to the highly professional and measured post disaster response by the Americans. I could see for myself the very thin line between life and death and the huge difference disaster managers can make in saving lives.

Disasters are the best school masters, a fact we often ignore in India. After the devastating Gujarat earthquake of 26 January 2001, I drew the attention of Director General of CSIR, Dr R.A Mashelkar about contribution CSIR could make to the world of learning. The various

possibilities were also discussed with the then Secretary DST, Professor V.S. Ramamurthy and the then INAE President Dr A. Ramakrishna. Both of them also responded positively to my proposal. DST funded my proposal on Seismic microzonation for safer construction. After the report was ready, the President, INAE, himself chaired a roundtable meeting at SERC, Chennai on 24 February 2003. The study report was eventually adopted by the Department of Science and Technology of the Government of India. This activity laid the foundation of disaster risk related initiatives by the INAE.

When the Kedarnath tragedy struck the State of Uttarakhand in 2013, I again approached Dr Baldev Raj, the then President INAE, requesting him to establish a Forum on Disaster Mitigation. To discuss my proposal, he himself chaired the first informal meeting of the Adhoc Committee on 29 January 2013. The follow-up meetings were held on 12 February and 19 July 2013 which eventually climaxed in the establishment of the INAE Forum on Engineering Interventions for Disaster Management on 26 July 2013. Inter alia, the Forum organized two highly successful roundtable meetings on Landslides in May 2015 and November 2015. The ensuing recommendations were well received by NDMA and other related institutions.

In the aftermath of the devastating Chennai floods of 2015, it was at the initiative of Dr B N Suresh, the current President, INAE that the Forum launched a Study on Urban Flood Disaster Mitigation under the leadership of Dr C.D. Thatte. By now the INAE Forum on Disaster Mitigation is well established and is very closely connected with National Disaster Management Authority and the National Institute of Disaster Management. With my sustained engagement with the INAE Forum and recent nomination by the Government of India on the National Advisory Committee of NDMA, it has become possible to pilot the recommendations of the Forum with the Government and the NDMA.

Although the focus throughout my career remained on Disaster Mitigation, my narrative for this paper will be incomplete if I do not mention about some of the totally unexpected opportunities that knocked my door at CBRI, Roorkee. In the year 1986, soon after assuming charge as the Director of the Institute, I had an accidental opportunity to meet the Union Minister of Human Resource Development, Shri P. V. Narsimha Rao, who had come to Roorkee to deliver the convocation address. The Minister, in his speech, was highly critical of the Civil Engineers for designing buildings *which turn ovens in summer and refrigerators in winter*. At the luncheon hosted by the University Vice-Chancellor, I thanked him for alerting the civil engineers of the country, and conveyed that, without a strong political will, the situation is unlikely to improve. I most humbly expressed my disappointment that although the Government of India has created institutions like CBRI with all the sub-disciplines of Building Science under one roof, yet the Government itself keeps ignoring CBRI even while dreaming of building resurgent India!

I was asked by the Minister to report at his residence in New Delhi, the next day which I did. Hon'ble Minister told me briefly about the Government's plan to build a network of functionally efficient Navodaya Vidyalaya across the length and breadth of India, and asked

if I was ready to mount a tiger? My nod was spontaneous and without any prior thought. Against the fierce competition from CPWD and despite the stiff resistance from its then Director General, Shri Harish Chandra, the Navodaya Vidyalaya project was assigned to CBRI. My team lost no time to spring into action, and within a few months, the models of the designs of school buildings for different regions of the country were personally inspected and approved by none other than the then Prime Minister Shri Rajiv Gandhi. The Navodaya Vidyalaya Project, which started in 1987 continued until 1999, well beyond the date I left CBRI in 1989 because of the leadership provided by Shri V.K. Mathur. The project involved the planning, design and construction of 305 schools, spread over 30 States and Union Territories for which HRD Ministry paid more than Rs 10 crore to CBRI at that time, giving it the most visible project since its inception. In 1988, from the Hon'ble Minister, I received the Science and Technology Award instituted by the Bhasin Foundation and CBRI benefitted immensely from the rapport with the Minister who a few years later became the Prime Minister of India.

In 1995, when Dr R.A. Mashelkar became the Director General of CSIR, he wanted me to return to CSIR Headquarters from my UN assignment in Sri Lanka and asked me to raise the level of CSIR's International networking, bilateral and multi-lateral overseas programmes. While in the flight from Colombo to Chennai on way to New Delhi, I conceived establishment of International Science and Technology Affairs Directorate (ISTAD) at the CSIR Headquarter. Dr Mashelkar agreed to the idea of establishing ISTAD and gave a formal nod to the proposal on the day of my joining. What ISTAD could achieve during my five year tenure during 1995-2000 is a part of CSIR's glorious history!

In the wrap-up to this article, I will like to say four things. First, I am firmly of the belief that the real beauty of our contribution lies not in the number of patents filed or in the high impact factor of our research publications but in our nameless acts of accomplishments which grow the culture of science around us. Second, we often meet our destiny on the roads which often fall outside the printed maps in the Atlas of our making. Third, all our dreams can come true, if we have courage to pursue them. And finally, as Forster had said, "Failure and success seem to have been allotted to men by their stars. But they retain their power of wriggling, of fighting with their stars, and in the whole universe the only interesting movement is this wriggling."

Fifty two years ago, I have had the privilege to be a student in the Department of Civil Engineering at the IIT Bombay and in August 2016, as its distinguished Alumnus, I had the honour to deliver its Convocation Address. While congratulating the graduating students-I asked them to join *the wriggle dance* with me in the global arena!

## Civil Engineering

### 1. This Hydrogen-Powered Train Emits Only Water



*Imagine a nearly silent train that glides along its tracks emitting nothing more toxic than water.*

In March 2017, Germany conducted successful tests of the world's first "Hydrail" -- a hydrogen powered, zero-emission train. "The new train is 60% less noisy than a traditional diesel train, completely emission free," said Jens Sprotte of Alstom, the French producer of the train. "Its speed and the possibility to transport passengers match the performance of a diesel train." "The only sound it gives off comes from the wheels and air resistance," Sprotte added. Here's how the new technology works: The Hydrail uses the same equipment as a diesel train but substitutes hydrogen as its fuel source. Large fuel cells sitting on top of the train combine hydrogen and oxygen to generate electricity, which is then transferred to lithium ion batteries. Energy that is not immediately used can be stored for later use, increasing fuel efficiency. The train's only emissions are steam and water, resulting in minimal impact to the environment. " Each two-car train set requires a fuel cell and a 207 pound tank of hydrogen to supply it. The oxygen is supplied from the air around the train. The train can travel up to 500 miles per day on a single tank of hydrogen, carrying 300 passengers at a time. The first operational trains will roll out by the beginning of 2018, providing a green alternative to the 4,000 diesel trains currently operating in Germany. According to the EU, about 20% of Europe's current rail traffic runs on diesel. The new train is ideally suited for short stretches of the European network that have not been converted to electric rails. Germany is particularly interested in reducing its greenhouse gas emissions. Kristina Juhrich of the German Environment Agency said last year's emissions levels will make it difficult for the country to reach its climate target and reduce emissions by 40% in 2020. Alstom are hoping the train will turn a profit within its first couple years of operation. They hope the model will replace Germany's fleet of diesel trains in five to 20 years.

Source <http://money.cnn.com/2017/04/12/technology/germany-hydrogen-powered-train/index.html>

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### 2. Learning with Light: New System Allows Optical 'Deep Learning'



*This futuristic drawing shows programmable nanophotonic processors integrated on a printed circuit board and carrying out deep learning computing.*

"Deep Learning" computer systems, based on artificial neural networks that mimic the way the brain learns from an accumulation of examples, have become a current topic in computer science. In addition to enabling technologies such as face- and voice-recognition software, these systems could scour vast amounts of medical data to find patterns that could be useful diagnostically, or scan chemical formulas for possible new pharmaceuticals. But the computations these systems must carry out are highly complex and demanding, even for the most powerful computers. Now, a team of researchers at MIT and elsewhere has developed a new approach to such computations, using light instead of electricity, which they say could vastly improve the speed and efficiency of certain deep learning computations. A researcher says that many researchers over the years have made claims about optics-based computers, but that "people dramatically over-promised, and it backfired." While many proposed uses of such photonic computers turned out not to be practical, a light-based neural-network system developed by this team "may be applicable for deep-learning for some applications," he says. Traditional computer architectures are not very efficient when it comes to the kinds of calculations needed for certain important neural-network tasks. Such tasks typically involve repeated multiplications of matrices, which can be very computationally intensive in conventional CPU or GPU chips. After years of research, the MIT team has come up with a way of performing these operations optically instead. "This chip, once you tune it, can carry out matrix multiplication with, in principle, zero energy, almost instantly," the lead researcher says. "We've demonstrated the crucial building blocks but not yet the full system." By way of analogy, he points out that even an ordinary eyeglass lens carries out a complex calculation (the so-called Fourier transform) on the light waves that pass through it. The way light beams carry out computations in the new photonic chips is far more general but has a similar underlying principle. The new approach uses multiple light beams directed in such a way that their waves interact with each other, producing interference patterns that convey the result of the intended operation. The resulting device is something the researchers call a programmable nanophotonic processor. The result is that the optical chips using this architecture could, in principle, carry out calculations performed in typical artificial intelligence algorithms much faster and using less than one-thousandth as much energy per operation as conventional electronic chips. "The natural advantage of using light to do matrix multiplication plays a big part in the speed up and power savings, because dense matrix multiplications are the most power hungry and time consuming part in AI algorithms" a researcher says. The new programmable nanophotonic processor uses an array of waveguides that are interconnected in a way that can be modified as needed, programming that set of beams for a specific computation. "You can program in any matrix operation," a researcher says. The processor guides light through a series of coupled photonic waveguides. The team's full proposal calls for interleaved layers of devices that apply an operation called a nonlinear activation function, in analogy with the operation of neurons in the brain. To demonstrate the concept, the team set the programmable nanophotonic processor to implement a neural network that recognizes four basic vowel sounds. Even with this rudimentary system, they were able to achieve a 77 percent accuracy level, compared to about 90 percent for conventional systems. There are "no substantial obstacles" to scaling up the system for greater accuracy, he says. A researcher adds that the programmable nanophotonic processor could have other applications as well, including signal processing for data transmission. "High-speed analog signal processing is something this could manage" faster than other approaches that first convert the signal to digital form, since light is an inherently analog medium. "This approach could do processing directly in the analog domain," he says. The team says it will still take a lot more effort and time to make this system useful; however, once the system is scaled up and fully functioning, it can find many user cases, such as data centres or security systems. The system could also be a boon for self-driving cars or drones, says a researcher, or "whenever you need to do a lot of computation but you don't have a lot of power or time."

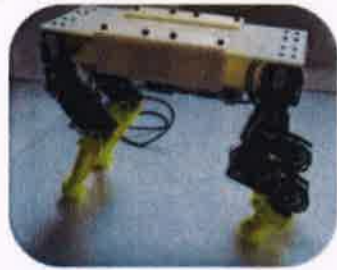
### 3. Interactive Tool Helps Novices and Experts Make Custom Robots

**Robo-calligrapher**



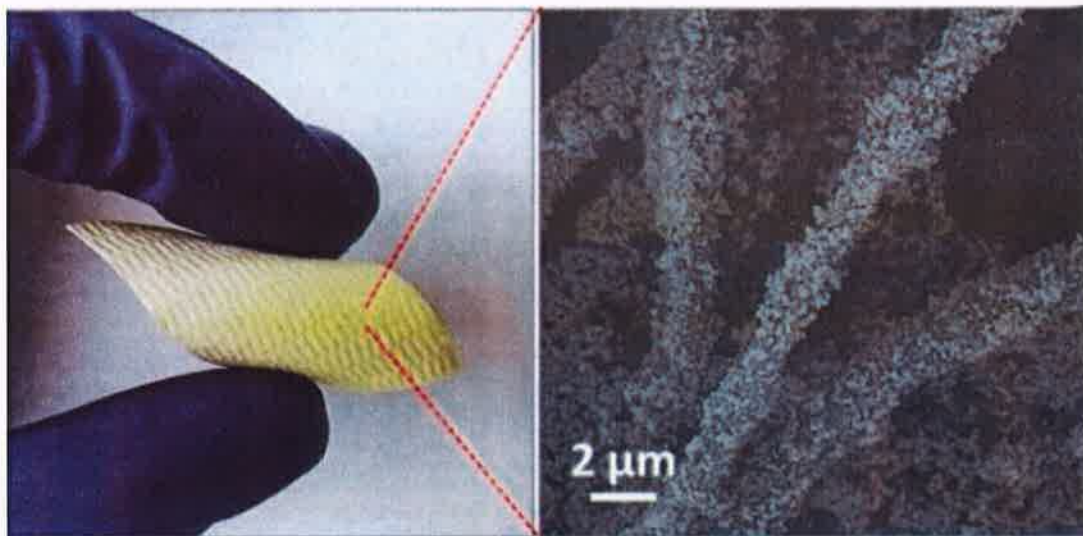
*An interactive design tool developed by Carnegie Mellon University was used to design and test in simulation two robots that were then produced using off-the-shelf components and 3-D-printed parts.*

**Puppy**



A new interactive design tool developed by Carnegie Mellon University's Robotics Institute enables both novices and experts to build customized legged or wheeled robots using 3D-printed components and off-the-shelf actuators. Using a familiar drag-and-drop interface, individuals can choose from a library of components and place them into the design. The tool suggests components that are compatible with each other, offers potential placements of actuators and can automatically generate structural components to connect those actuators. Once the design is complete, the tool provides a physical simulation environment to test the robot before fabricating it, enabling users to iteratively adjust the design to achieve a desired look or motion. "The process of creating new robotic systems today is notoriously challenging, time-consuming and resource-intensive," said Stelian Coros, assistant professor of robotics. "In the not-so-distant future, however, robots will be part of the fabric of daily life and more people -- not just roboticists -- will want to customize robots. This type of interactive design tool would make this possible for just about anybody." Coros' team designed a number of robots with the tool and verified its feasibility by fabricating two -- a wheeled robot with a manipulator arm that can hold a pen for drawing, and a four-legged "puppy" robot that can walk forward or sideways. "The system makes it easy to experiment with different body proportions and motor configurations, and see how these decisions affect the robot's ability to do certain tasks," said a researcher. "For instance, we discovered in simulation that some of our preliminary designs for the puppy enabled it to only walk forward, not sideways. We corrected that for the final design. The motions of the robot we actually built matched the desired motion we demonstrated in simulation very well." The research team developed models of how actuators, off-the-shelf brackets and 3D-printable structural components can be combined to form complex robotic systems. The iterative design process enables users to experiment by changing the number and location of actuators and to adjust the physical dimensions of the robot. The tool includes an auto-completion feature that allows it to automatically generate assemblies of components by searching through possible arrangements. "Our work aims to make robotics more accessible to casual users," Coros said. "This is important because people who play an active role in creating robotic devices for their own use are more likely to have positive feelings and higher quality interactions with them. This could accelerate the adoption of robots in everyday life."

### 4. New Fabric Coating Could Thwart Chemical Weapons, Save Lives



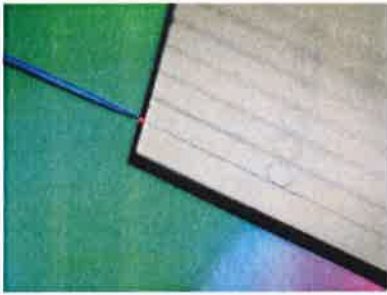
*A new fabric coating could neutralize chemical weapons and help save countless lives.*

Chemical weapons are nightmarish. In a millisecond, they can kill hundreds, if not thousands. But, in a study scientists report that they have developed a way to adhere a lightweight coating onto fabrics that is capable of neutralizing a subclass of these toxins -- those that are delivered through the skin. The life-saving technique could eventually be used to protect soldiers and emergency responders. Since their first use in World War I, dozens of chemical weapons with devastating potential have been developed. For example, just a pinprick-sized droplet of the nerve gas sarin on the skin is lethal. Recently, scientists have begun exploring the use of zirconium-based metal-organic framework (MOF) powders to degrade and destroy these harmful compounds. MOFs are miniscule, porous structures that have large surface areas that allow them to absorb vast amounts of gases and other substances. The zirconium within them helps neutralize toxic materials. But making MOFs can be tedious, requiring high temperatures and long reaction times. Plus, most MOF powders are unstable and incorporating them onto clothing has proven challenging. Dennis Lee, and colleagues wanted to see if they could "grow" MOFs onto fabric at room temperature, potentially creating a lightweight shield that could be used on uniforms and protective clothing. Building on previous work, the researchers exposed polypropylene, a nonwoven fabric commonly used in reusable shopping bags and some clothing, to a mixture consisting of a zirconium-based MOF, a solvent and two binding agents. To ensure that the coating spread evenly across the cloth, they treated the fabrics with thin layers of aluminum, titanium or zinc oxide. They tested this combination with dimethyl 4-nitrophenyl phosphate (DMNP), a relatively harmless molecule that has similar reactivity as sarin, soman and other nerve agents. They found that the MOF-treated cloths deactivated the DMNP in less than 5 minutes, suggesting this process is a viable means to create improved protective clothing.

Source <https://www.sciencedaily.com/releases/2017/06/170607123930.htm>

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### 5. Optical Communication Using Solitons on A Photonic Chip



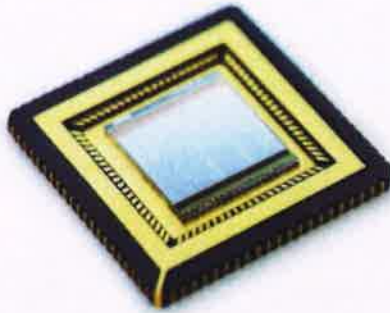
*These are optical micro resonators made from silicon nitride on a chip using for soliton based communications.*

Optical solitons are special wave packages that propagate without changing their shape. They are ubiquitous in nature, and occur in Plasma Physics, water waves to biological systems. While solitons also exist in optical fibre, their technological use so far has been limited. While researchers studied their use for optical communication, eventually the approach was abandoned. Now, a collaboration of a research group at KIT's Institute of Photonics and Quantum Electronics (IPQ) and Institute of Microstructure Technology (IMT) with EPFL's Laboratory of Photonics and Quantum Measurements (LPQM) have shown that solitons may experience a comeback: Instead of using a train of soliton pulses in an optical fibre, they generated continuously circulating optical solitons in compact silicon nitride optical microresonators. These continuously circulating solitons lead to broadband optical frequency combs. Two such superimposed frequency combs enabled massive parallel data transmission on 179 wavelength channels at a data rate of more than 50 terabits per second -- a record for frequency combs. Optical frequency combs consist of a multitude of neighbouring spectral lines, which are aligned on a regular equidistant grid. Traditionally, frequency combs serve as high-precision optical references for measurement of frequencies. The invention of so-called Kerr frequency combs, which are characterized by large optical bandwidths and by line spacings that are optimal for communications, make frequency combs equally well suited for data transmission. Each individual spectral line can be used for transmitting a data signal. In their experiment, the researchers from KIT and EPFL used optical silicon nitride micro-resonators on a photonic chip that can easily be integrated into compact communication systems. For the communications demonstration, two interleaved frequency combs were used to transmit data on 179 individual optical carriers, which completely cover the optical telecommunication C and L bands and allow a transmission of data rate of 55 terabits per second over a distance of 75 kilometers. "This is equivalent to more than five billion phone calls or more than two million HD TV channels. It is the highest data rate ever reached using a frequency comb source in chip format," explains Christian Koos, professor at KIT's IPQ and IMT and recipient of a Starting Independent Researcher Grant of the European Research Council (ERC) for his research on optical frequency combs. The components have the potential to reduce the energy consumption of the light source in communication systems drastically. The basis of the researchers' work are solitons generated in low-loss optical silicon nitride micro-resonators. In these, an optical soliton state was generated for the first time by Kippenberg's lab at EPFL in 2014. "The soliton forms through nonlinear processes occurring due to the high intensity of the light field in the micro-resonator" explains Kippenberg. The microresonator is only pumped through a continuous-wave laser from which, by means of the soliton, hundreds of new equidistant laser lines are generated. The silicon nitride integrated photonic chips are grown and fabricated in the Center for MicroNanotechnology (CMi) at EPFL. Meanwhile, a startup from LPQM, LiGenTec SA, is also offering access to these photonic integrated circuits to interested academic and industrial research laboratories. The work shows that microresonator soliton frequency comb sources can considerably increase the performance of wavelength division multiplexing (WDM) techniques in optical communications. WDM allows to transmit ultra-high data rates by using a multitude of independent data channels on a single optical waveguide. To this end, the information is encoded on laser light of different wavelengths. For coherent communications, microresonator soliton frequency comb sources can be used not only at the transmitter, but also at the receiver side of WDM systems. The comb sources dramatically increase scalability of the respective systems and enable highly parallel coherent data transmission with light. According to researchers, this is an important step towards highly efficient chip-scale transceivers for future petabit networks.

## Electronics and Communication Engineering

### 6. Graphene and quantum dots put in motion a CMOS-integrated camera that can see the invisible

*Graphene-quantum dots-CMOS-based sensor for ultraviolet, visible and infrared.*



Over the past 40 years, microelectronics has advanced by leaps and bounds thanks to silicon and CMOS (Complementary metal-oxide semiconductors) technology, making possible computing, smartphones, compact and low-cost digital cameras, as well as most of the electronic gadgets we rely on today. However, the diversification of this platform into applications other than microcircuits and visible light cameras has been impeded by the difficulty to combine semiconductors other than silicon with CMOS. This obstacle has now been overcome. ICFO researchers have shown for the first time the monolithic integration of a CMOS integrated circuit with graphene, resulting in a high-resolution image sensor consisting of hundreds of thousands of photodetectors based on graphene and quantum dots (QD). They operated it as a digital camera that is highly sensitive to UV, visible and infrared light at the same time. This has never been achieved before with existing imaging sensors. In general, this demonstration of monolithic integration of graphene with CMOS enables a wide range of optoelectronic applications, such as low-power optical data communications and compact and ultra sensitive sensing systems. The graphene-QD image sensor was fabricated by taking PbS colloidal quantum dots, depositing them onto the CVD graphene and subsequently depositing this hybrid system onto a CMOS wafer with image sensor dies and a read-out circuit. As a researcher comments, "No complex material processing or growth processes were required to achieve this graphene-quantum dot CMOS image sensor. It proved easy and cheap to fabricate at room temperature and under ambient conditions, which signifies a considerable decrease in production costs. Even more, because of its properties, it can be easily integrated on flexible substrates as well as CMOS-type integrated circuits." As an expert in quantum dot-graphene research comments, "we engineered the QDs to extend to the short infrared range of the spectrum (1100-1900nm), to a point where we were able to demonstrate and detect the night glow of the atmosphere on a dark and clear sky enabling passive night vision. This work shows that this class of phototransistors may be the way to go for high sensitivity, low-cost, infrared image sensors operating at room temperature addressing the huge infrared market that is currently thirsty for cheap technologies." "The development of this monolithic CMOS-based image sensor represents a milestone for low-cost, high-resolution broadband and hyperspectral imaging systems" a lead researcher highlights. He assures that "in general, graphene-CMOS technology will enable a vast amount of applications, that range from safety, security, low cost pocket and smartphone cameras, fire control systems, passive night vision and night surveillance cameras, automotive sensor systems, medical imaging applications, food and pharmaceutical inspection to environmental monitoring, to name a few." This project is currently incubating in ICFO's Launchpad. The team is working with the institute's tech transfer professionals to bring this breakthrough along with its full patent portfolio of imaging and sensing technologies to the market.

Source <https://www.sciencedaily.com/releases/2017/05/170529142108.htm>

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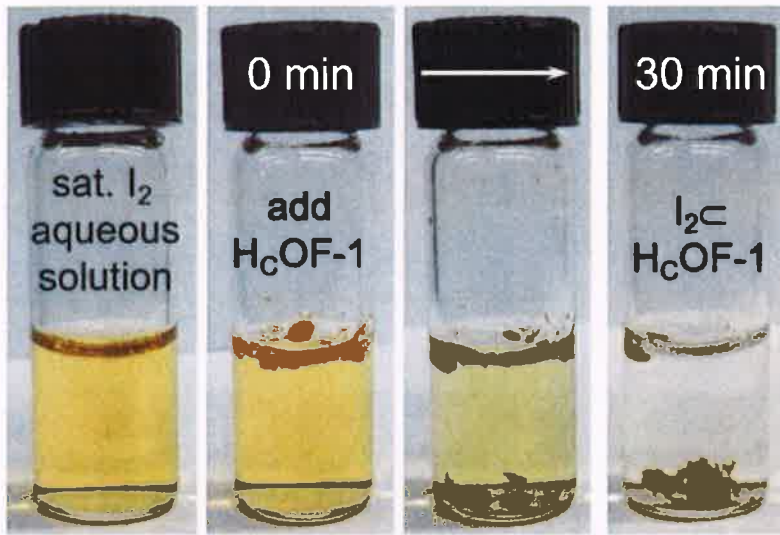
### 7. ISRO launches India's heaviest rocket: GSLV Mark-III



Indian Space Research Organization (ISRO) launched the country's heaviest rocket – Geosynchronous Satellite Launch Vehicle-Mark III (GSLV-Mk III) – along with a communications satellite GSAT-19 on June 5, 2017. A successful launch of this rocket is yet another major step towards being self-reliant in the country's space programme. Here is all you want to know about the rocket described as a “game-changer” in the first of its kind space mission.

- It will also enable ISRO to launch from India heavier communications spacecraft to geostationary orbits of 36,000 km. Because of the absence of a powerful launcher, ISRO currently launches satellites above 2 tonnes on European rockets for a big fee.
- The GSAT-19, with a lifespan of 10 years, is a multi-beam satellite that will carry Ka and Ku-band payload along with a Geostationary Radiation Spectrometer (GRASP) payload to monitor and study the nature of the charged particles and influence of space radiation on spacecraft and electronic components.
- The rocket, weighing 640 tonnes and standing 43.43 metres tall, blasted off from the second launch pad at India's rocket port at Satish Dhawan Space Centre in Sriharikota in Andhra Pradesh at 5:28pm. It carried a 3,136-kg GSAT-19 communications satellite – the heaviest to be lifted by an Indian rocket till date – to an altitude of around 179km above the Earth after just over 16 minutes into the flight.
- The rocket's main and bigger cryogenic engine has been developed by space scientists indigenously. It will help India get a greater share of the multi-billion dollar global space market and reduce dependency on international launching vehicles.
- It would also employ advanced spacecraft technologies including bus subsystem experiments in the electrical propulsion system, indigenous Li-ion battery and indigenous bus bars for power distribution, among others.
- ISRO had flown a similar rocket without the cryogenic engine but with 3.7-tonne payload in 2014 mainly to test its structural stability while in flight and the aerodynamics. The inputs of the 2014 mission enabled the ISRO to reduce the rocket load by around 20%.
- GSLV-Mk III, at around 43 metres, is slightly shorter than Mk-II version that is around 49 metres tall. “The new rocket may be slightly short but has more punch power,” an ISRO said.
- India presently has two rockets -- the Polar Satellite Launch Vehicle and GSLV-Mk II -- with a lift-off mass of 415 tonnes and a carrying capacity of 2.5 tonnes.
- Earlier in May, India successfully launched the South Asia Satellite, intended to serve “economic and developmental priorities” of South Asian nations, using its heavy rocket Geosynchronous Satellite Launch Vehicle (GSLV-F09).
- India has two rockets – the Polar Satellite Launch Vehicle and GSLV-Mk II – with a lift-off mass of 415 tonnes and a carrying capacity of 2.5 tonnes.

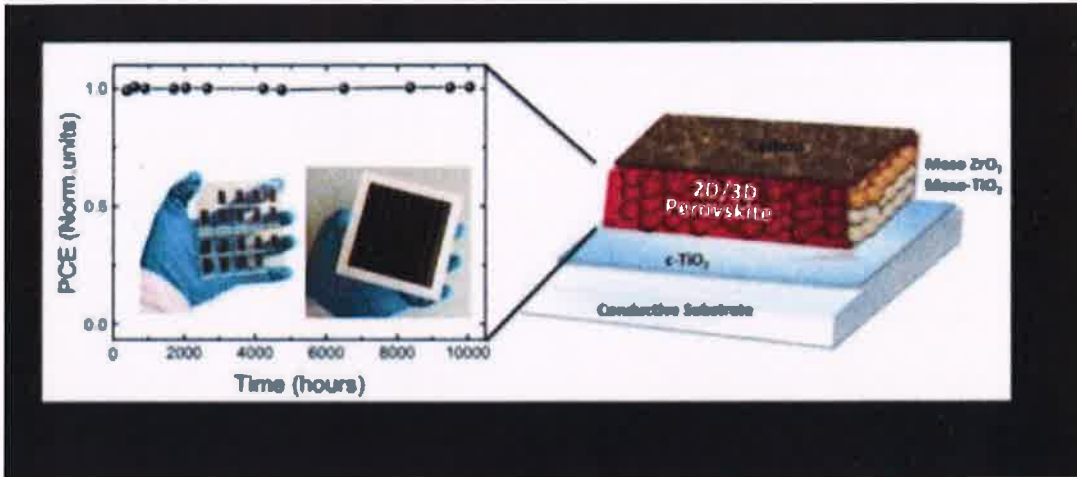
## 8. New-Generation Material Removes Iodine from Water: Advancement Could Dramatically Improve Nuclear Cleanup



*Iodine is removed from an aqueous solution after the addition of HCOF-1.*

Researchers at Dartmouth College have developed a new material that scrubs iodine from water for the first time. The breakthrough could hold the key to cleaning radioactive waste in nuclear reactors and after nuclear accidents like the 2011 Fukushima disaster. The new-generation microporous material designed at Dartmouth is the result of chemically stitching small organic molecules to form a framework that scrubs the isotope from water. "There is simply no cost-effective way of removing radioactive iodine from water, but current methods of letting the ocean or rivers dilute the dangerous contaminant are just too risky," said a researcher in the Department of Chemistry at Dartmouth College. "We are not sure how efficient this process will be, but this is definitely the first step toward knowing its true potential." Radioactive iodine is a common by product of nuclear fission and is a pollutant in nuclear disasters including the recent meltdown in Japan and the 1986 Chernobyl disaster. While removing iodine in the gas phase is relatively common, iodine has never been removed from water prior to the Dartmouth research. "We have solved the stubborn scientific problem of making a porous material with high crystallinity that is also chemically stable in strong acidic or basic water," said the principle investigator for the research. "In the process of developing a material that combats environmental pollution, we also created a method that paves the way for a new class of porous organic materials." The research, describes how researchers used sunlight to crosslink small molecules in large crystals to produce the new material. The approach is different from the traditional method of combining molecules in one pot. During the research, concentrations of iodine were reduced from 288 ppm to 18 ppm within 30 minutes, and below 1 ppm after 24 hours. The soft stitching technique resulted in a breathable material that changed shape and adsorbed more than double its weight of iodine. The compound was also found to be elastic, making it reusable and potentially even more valuable for environmental cleanup. According to the researchers, the compound could be used in a manner similar to applying salt to contaminated water. Since it is lighter than water, the material floats to adsorb iodine and then sinks as it becomes heavier. After taking on the iodine, the compound can be collected, cleaned and reused while the radioactive elements are sent for storage. The lab research used non-radioactive iodine in salted water for the experiment, but researchers say that it will also work in real-world conditions. The scientists hope that through continued testing the material will prove to be effective against cesium and other radioactive contaminants associated with nuclear plants. "It would be ideal to scrub more radioactive species other than iodine -- you would want to scrub all of the radioactive material in one go," they said. Researchers at Dartmouth's Functional Materials Group are also hopeful that the technique can be used to create materials to target other types of inorganic and organic pollutants, particularly antibiotics in water supplies that can lead to the creation of super-resistant microorganisms.

9. Ultra-Stable Perovskite Solar Cell Remains Stable for More Than a Year



*This is a schematic representation of the findings of this study.*

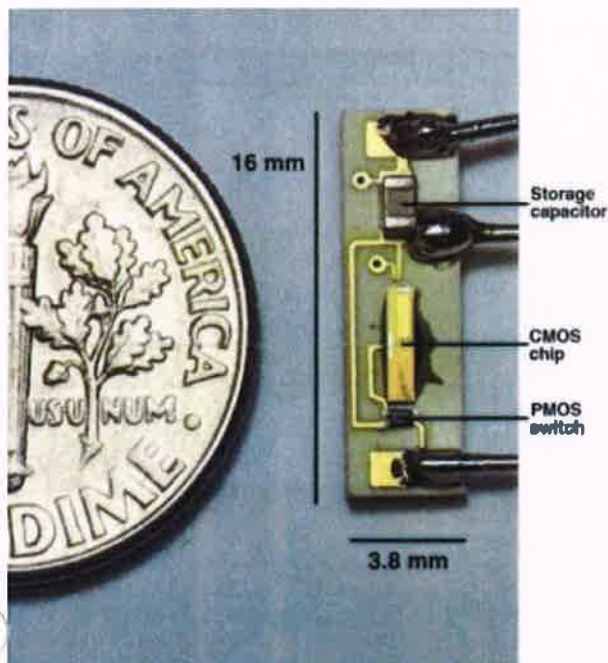
Perovskite solar cells promise cheaper and efficient solar energy, with enormous potential for commercialization. But even though they have been shown to achieve over 22% power-conversion efficiency, their operational stability still fails market requirements. Despite a number of proposed solutions in fabrication technology, this issue has continued to undercut whatever incremental increases in efficiency have been achieved. EPFL scientists have now built a low-cost, ultra-stable perovskite solar cell that has operated for more than a year without loss in performance (11.2%). The lab at EPFL in collaboration with Michael Grätzel and Solaronix company has engineered what is known as 2D/3D hybrid perovskite solar cell. This combines the enhanced stability of 2D perovskites with 3D forms, which efficiently absorb light across the entire visible spectrum and transport electrical charges. In this way, the scientists were able to fabricate of efficient and ultra-stable solar cells, which is a crucial step for upscaling to a commercial level. The 2D/3D perovskite yields efficiencies of 12.9% (carbon-based architecture), and 14.6% (standard mesoporous solar cells). The scientists built 10x10 cm<sup>2</sup> solar panels using a fully printable industrial-scale process. The resulting solar cells have now delivered a constant 11.2% efficiency for more than 10,000 hours, while showing zero loss in performance as measured under standard conditions. The breakthrough resolves the problem of perovskite solar-cell stability, and can viably move the technology into the commercial sphere.

Source <https://www.sciencedaily.com/releases/2017/06/170601082234.htm>



## Interdisciplinary Engineering and Special Fields

### 10. Battery-Less Pacemaker: Researchers Test Microwave-Powered Device



*The internal components of a battery-less pacemaker introduced this week by Rice University and the Texas Heart Institute. The pacemaker can be inserted into the heart and powered by a battery pack outside the body, eliminating the need for wire leads and surgeries to occasionally replace the battery.*

A wireless, battery-less pacemaker that can be implanted directly into a patient's heart is being introduced by researchers from Rice University and their colleagues at the Texas Heart Institute (THI). The pacemaker designed by the Rice lab of electrical and computer engineering professor Aydin Babakhani harvests energy wirelessly from radio frequency radiation transmitted by an external battery pack. In the prototype presented at IMS, the wireless power transmitter can be up to few centimeters away. Pacemakers use electrical signals to prompt the heart to keep a steady beat, but they've traditionally not been implanted directly into a patient's heart. Instead, they're located away from the heart, where surgeons can periodically replace their onboard batteries with minor surgery; their electrical signals are transmitted to the heart via wires called "leads." Some of the common problems with this arrangement are complications related to the leads, including bleeding and infection. Babakhani said Rice's prototype wireless pacemaker reduces these risks by doing away with leads. He said other recently introduced lead-less pacemakers also mitigate some of these complications, but their form factors limit them to a single heart chamber and they are unable to provide dual-chamber or biventricular pacing. In contrast, battery-less, lead-less and wirelessly powered microchips can be implanted directly to pace multiple points inside or outside the heart, Babakhani said. "This technology brings into sharp focus the remarkable possibility of achieving the 'Triple Crown' of treatment of both the most common and most lethal cardiac arrhythmias: external powering, wireless pacing and -- far and away most importantly -- cardiac defibrillation that is not only painless but is actually imperceptible to the patient," said Dr. Mehdi Razavi, director of clinical arrhythmia research and innovation at THI and an assistant professor at Baylor College of Medicine, who collaborated with Babakhani on development and testing of the new pacemaker. The chip at the system's heart is less than 4 millimeters wide and incorporates the receiving antenna, an AC-to-DC rectifier, a power management unit and a pacing activation signal. A capacitor and switch join the chip on a circuit board that is smaller than a dime. The chip receives power using microwaves microwaves in the 8 to 10 gigahertz electromagnetic frequency spectrum. The frequency of the pacing signals produced by the pacemaker can be adjusted by increasing or decreasing power transmitted to the receiving antenna, which stores it until it reaches a predetermined threshold. At that point, it releases the electrical charge to the heart and begins to fill again. The team successfully tested the device in a pig and demonstrated it could tune the animal's heart rate from 100 to 172 beats per minute. Babakhani said the invention has prompted new collaborations among the Texas Medical Center institutions as well as the University of California at San Diego. The team is further developing its technology.

## Engineering Innovation in India

### India's Longest Bridge Inaugurated in Assam



Hon'ble PM Shri Narendra Modi inaugurated India's longest bridge last month, over the Lohit in Assam, and named it after singer Bhupen Hazarika. The bridge has strategic significance since it is near Anini, 100km from China border, and can withstand the weight of a 60-tonne battle tank. India's longest bridge, spans 9.3 km across the Brahmaputra, promising to turn the north-east into a showpiece of infrastructure development. The road bridge, connecting Dhola in Arunachal Pradesh to Sadiya in Assam, has been built at a cost of Rs2,056 crore by the ministry of road transport and highways. The government was now keen to develop inland waterways on the Brahmaputra river. The government plans to spend money on projects including power, optical fibre network structures, road and railways to ensure that the north-east is connected with all parts of India. Built by Navayuga Engineering Co. Ltd, the Dholai-Sadiya bridge is 3.55 km longer than the sea link over the Mahim Bay in Mumbai. It has strategic significance as it's near Anini, 100 km from the China border. The bridge will reduce the distance by 165 km, saving six hours of travel time and fuel worth Rs10 lakh per day in the region.

Source <http://www.livemint.com/Politics/CosYRyb60E1nT9rB5ku3uJ/PM-Narendra-Modi-inaugurates-Indias-longest-river-bridge-Dh.html>

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