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From the Editor's Desk

A Humane Organization

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Read more...

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Ernst Schumacher classified mineral, plant, animal, and human on the basis of their 'level of being'. If mineral is 'm', then plant is 'm+x', animal is 'm+x+y', and human is 'm+x+y+z'. Here 'x' is 'ontological discontinuity' which transforms a non-living entity to a living one. 'Consciousness' is represented by 'y'; animals are conscious because "they can be knocked unconscious". "Man has power of life like the plant, power of consciousness like the animal, and evidently something more". 'z' is that 'something more'. Schumacher called it 'self-awareness' meaning "man not only is able to think but is able to be aware of his thinking".

Abraham Maslow's well known human need hierarchy has five compartments: biological and physiological (food, shelter, warmth); safety (security, stability, law and order); belonging and love (family, affection, relationship, work); esteem (achievement, status, responsibility, reputation); and self-actualization (personal growth and fulfilment).

If the concepts of Abraham Maslow and Ernst Schumacher are integrated, the pattern of organization would look like this: 'mineral organization' – an organization where only people's monetary needs are fulfilled; 'plant organization' – an organization where people's monetary as well as security needs are fulfilled; 'animal organization' – an organization which fulfils the monetary, security, social and ego needs; and finally the 'humane organization' – an organization which fulfils the needs of 'animal organization' and as a bonus people can aspire to fulfil their own potential.

A humane organization motivates its people to give their best. Such an organization understands that "it is not the strongest species that survives, not the most intelligent; it is the one that is most adaptable to change". It understands that the right of any organization to exist is not perpetual but has to be continually earned. It believes that competition is a mission to go ahead, but also believes in winning by making its own line longer, rather than cutting others line shorter.

ACADEMY ACTIVITIES

Academy Announcements

- The Nomination Forms have been sent to the INAE Fellowship seeking nominations for election of Foreign Fellows. The last date of receipt of nominations for Foreign Fellows is May 31, 2017.
- Nominations have been invited for Innovative Student Projects Award 2017. The last date of the receipt of nominations is July 7, 2017.
- Nominations have also been invited for INAE Innovator Entrepreneur Award. The last date of the receipt of nominations is May 8, 2017.

INAE Innovator Entrepreneur Award

In order to increase the involvement with the industry, INAE has instituted the Innovator Entrepreneur Award with a view to encourage and recognize innovation and entrepreneurship among Young Engineers. The engineering innovations/inventions/concepts that have been actually realized and implemented in industry either in new processes or products would be given weightage. The award carries a **cash prize of Rs 2 lakhs** and the awardee would be conferred the same during the Awards Function to be held during the Annual Convention being held in December each year.

Salient points of the guidelines of the award are as under:

- The award would be conferred on individuals and not organizations/ corporates.
- The nominations would be sought from Fellows/CEOs/Directors/Heads of industry, R&D organizations, Engineering institutions and Departments. Self nomination is not permitted.
- Both innovation and entrepreneurship together would be considered important and young innovators from Academia/Research Groups whose novel engineering/ technology ideas have been translated into successful start up enterprises would be given preference.
- The patents/ publications to be mentioned in the format for inviting nominations should be related to the work of the nominee only.
- Only one award would be given every year.
- Award would be conferred to an individual or a group of individuals not exceeding three persons.
- A nomination not selected would not be carried forward for the next year, however re-nomination is permitted.
- The upper age limit of the awardees would be 45 years.
- The Nominees should be Citizens of India.
- The award would carry a citation and a cash prize of Rs 2 lakhs, to be shared by the group of individuals nominated for the award, not exceeding three persons.
- In case no nomination is found suitable, no award would be conferred during that year.
- There would be a three tier selection process wherein the initial shortlisting would be done by the Steering Committee. The details of the shortlisted nominees would then be

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- There would be a three tier selection process wherein the initial shortlisting would be done by the Steering Committee. The details of the shortlisted nominees would then be sent for Peer Review to the suggested experts from Industry. The shortlisted candidates would be called for presentation to the Selection Committee constituted for IP Award and Young Engineer Award. The Selection Committee would recommend the nominee for conferment of the Innovator Entrepreneur Award for approval of the Governing Council.
- The nominations would be invited in the prescribed Proforma each year and the last date of the receipt of nominations for this year is May 8, 2017.

An email has been sent to the INAE Fellowship for inviting nominations for the subject award.

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.

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.

Dr Jayanta Kumar Saha Deputy General Manager (Applications), Institute for Steel Development & Growth	Indian Institute of Engineering Sciences and Technology, Shibpur Feb 15-16, 2017	Delivered lectures on "Understanding of Engineering materials & their usage including processing" and "Interpretation of Codes & Standards and reading specification". According to the feedback from the engineering college the DVP has also helped in guiding Project and identify topics on reinforcement bars for research.
Dr Manish Roy Scientist 'F', Defence Metallurgical Research Laboratory, Kanchanbagh,	Department of Metallurgical Engineering, JNTUH, Hyderabad March 22, 2017	Delivered lecture on "High Temperature Wear of Thermal Sprayed Coatings". According to the feedback from the engineering college the scheme provides a platform for academics to interact with experts from Research establishment and industry.

International Conferences/Seminars being organized by IITs/other Institutions

To view a list of International Conferences/Seminars being held in the month of May 2017 click here

International Conference on Automation, Robotics and Mechatronics (ICARM2017) on 5th to 6th May 2017 at Chennai, Tamilnadu
https://conferencealerts.com/show-event?id=178669

Fifth International Conference on Recent Trends in Computer Science and Engineering (ICRTCSE 2017) on 5th to 6th May 2017 at Chennai, Tamil Nadu,
https://conferencealerts.com/show-event?id=179273

International conference on Energy, Power, Communication and Computing Systems (ICEPCCS-2017) on 13th to 14th May 2017 at Bangalore,
https://conferencealerts.com/show-event?id=178706

International Conference on Information, Communication and Computing Technology on 13th May 2017 at New Delhi
https://conferencealerts.com/show-event?id=179933

International Conference on Advances in Mechanical Engineering 2017-01 (ICAME 2017-01) on19th to 20th May 2017 at Kanyakumari, Tamilnadu,
https://conferencealerts.com/show-event?id=169504

Journey of a Teacher-Engineer

Ashok Jhunjhunwala

I came back to India in 1981 and joined IIT Madras as a faculty member. I wanted a telephone for my home. I had to wait for eight years in a waiting-list to get the telephone. I went to purchase a two-wheeler, a Bajaj Chetak Scooter, and paid for it; only to be told that I have been put in a queue and may have to wait for three to four years. I went to book an LPG gas cylinder for cooking; by then, I was prepared for a waiting list. When I asked the clerk at the booking counter to register for the wait-list, the old man told me, while entering my name and address, that I was unlikely to get it in my life-time, but I should still put the name as my children would benefit.

My engineer mind was perplexed – why had we got it so wrong in India. Why could we not change? I had spent six years in USA. I had not found the people there much wiser or more intelligent or more hard-working. What was wrong with us? What would be the role of an engineer in driving change?

The beginnings

I soon found out that there was no academia-industry interaction and entrepreneurs coming out of an educational institute were unheard of. Industry had very little R&D of its own and preferred to manufacture for a protected market by importing technology and know-how. Most goods were affordable only to a small section of the society.

It took me several years of struggle and experience to discover possible answers. I came to a peculiar conclusion that at times, businesses and policy-makers face constraints when driving certain services to scale. This is especially so, when a society imports technologies and products required to provide the service from an economy which has much higher purchasing capability. The products would have been designed to be affordable in that higher-income economy but not affordable for a low-affordability economy. Businesses and Policies, which would have otherwise driven the services based on these products to scale fail to do so. If the affordability gap is large, a quantum reduction in the cost of the product is required. Such quantum reduction requires disruptive innovation and when it succeeds, it makes the technology and the product way different from the original.

This learning did not come quickly and happened step by step, while I was experimenting, doing wrong things, failing but persisting.

My first Learnings

My first learning in this direction came from usage of lab-equipment for teaching at IITM. When I taught at Washington State University, a class of 50 students will have 25 (if not 50) lab kits, and the students will work in pairs (and sometime on their own) to carry out the experiments and learn. At IIT, these lab kits were imported or used imported technology, even when manufactured in India. They were quite expensive in the Indian context. So, while teaching a class of 50 even at a much-better funded IIT, only one or two experimental set-ups were available. Either the students worked in turn (each spending too little a time) or they would just watch a demonstration. I recognized that this would severely constrain learning. I wondered why these experimental set-ups and kits could not be redesigned to have much lower cost, so that 25 sets could be purchased by IITM. I took up this challenge and the first of the several kits that we designed (Fibre Optic Educator) and commercialised

reached most of the 4000 engineering colleges across India and millions of students and faculty were educated using these. Since then, I have participated in designing several other lab-kits.

One of the most gratifying experiences was when I was called by the Secretary Higher education of Gujarat to a workshop for engineering teachers in January 2015. As some urgent work kept the secretary away, I landed amongst these teachers all by myself and started interacting informally. I was surprised that most seem to know of me. When I asked how they knew me, the answer came – oh, we learned our fibre-optics using your kit. I had even forgotten about this kit by then.

Economy of Shortages

I soon recognized that this problem was not confined to education alone. Most of the products were manufactured using licensed technologies from developed nations, and were affordable to only a small section of Indian society. Industry could therefore never scale. Services provided were limited to a few and the nation lived with shortages. I recognized that products and services have to be redeveloped at price-points affordable to a larger section of Indian public. This process required transformation in products and technology. I also recognized that this could not be done by Industry alone and a strong academia-industry collaboration was required.

I started making efforts to work with industry. I used to ask them how much would that imported equipment cost? I would ask them to give me the money that would buy them one such equipment and I would not only develop the equipment, but also transfer the technology to them. Trusting me, the Chairman of WS Industries gave me ₹100,000 to build a Power Line Communication Equipment. We jumped into it with an army of B.Tech. students. I had never built anything before. But we learned. One of the senior persons from industry helped us. It took us a year and we built the first equipment. But we learned that it was one thing to build a prototype, whereas it is quite different to build something which could be manufactured, would work 24X7 without failing, and also be a commercial success. We learned more from industry personnel than they learned from us. The system was never designed by us such that it could be commercialised. But WS placed our prototype in a display case, invited their international business partner and could bargain a 50% cost-reduction.

The word went around industries and I started getting calls to repair some imported equipment and build some small ones. My students, inspired by our success, plunged into each such opportunity. A surprising thing was that I was not just teaching them, but started learning from my students. Over time, I have found **learning from younger colleagues and students** is the best way to keep oneself abreast with technology. Technology changes rapidly. Continuous learning is the only way. I find many senior engineers learn primarily from vendors and from a bit of reading. This is not enough. Learning form youngsters who build things adds up and makes one innovative.

Taking Risks and Entrepreneurship

As we took up development of lower-cost products, we recognised that Indian industry not only had very little internal R&D, but was somewhat risk-averse. To introduce new products to the market, a different approach was needed. We discovered Start-ups and Entrepreneurship in the Indian context to bridge this gap. We started incubating companies somewhat informally in the beginning, as Indian Academia did not encourage start-ups in 80's and 90's. Questions used to be raised whether the educational institutes were to purse "Saraswati" or "Lakshmi." This however did not deter us, as we considered this the best way to translate technologies developed.

As mentioned earlier, India was struggling to install new telephones in India with waiting list as long as eight years. At the same time, telephones were no longer considered a luxury, but something that brought in work-efficiency and was a tool for development. Getting telephones to every village was considered equally important. We first thought that it was lack of technology which was preventing this. But by the early nineties, we started looking into the economics of telephony and costs involved in each element. We came to the conclusion that telephones in India could reach no more than 4% of

Indian homes at the prevailing capital and operational costs. These costs had to be brought down by a factor of four for the telephone to get to 50% of Indian homes. As costs of other elements involved in the electronic telephone network were going down due to Moore's Law, the copper based local loop was dominating the total cost per line. The only solution was to replace the copper local loop with wireless. Wireless was however relatively expensive at the time. But we recognised that we were replacing copper with electronics. Recognizing that Moore's law was on our side and a programmable architecture will help us bring down costs, our team consisting of a start-up and IIT R&D team, took the challenge to build a system and deliver by 1995 a solution. They designed a DSP based Wireless in local loop called corDECT WiLL. It brought down the costs of installing a telephone line by a factor of four and about a million lines were installed. This triggered the bringing down the price of mobile telephony and the cost-constraint was broken. From 7 million telephone lines when we started this development, India has grown today to 950 million telephones today.

Building a delivery team

The task of building Wireless in Local Loop was indeed a very challenging task. Fortunately, there were three of us amongst faculty at IITM, who were committed and knew the basics of what was to be done. With expertise in different disciplines, we had learnt the difficult art of working together. But we needed experienced industry personnel too, who can convert our ideas into products. We made a list of some 8 alumni of ours, who were working in different industries in India. We decided to travel and meet them to sell our dream of 100 million wireless phones (to begin with we could not envisage anything more) in India. If we could get 5 of them, we would start the effort. Fortunately, all eight of them quit their jobs and joined us, not knowing where their salaries would come from. Now we needed the funding as well as support of department of telecom to help us define specifications and carry out pilots. We decided not to go to Government for financial support. Instead we sold the dream to industry to support the development. We went to the Government only for defining specifications and for pilot-deployment. Having tied up all this, we needed a somewhat larger team. Students at IITM for the most part were inclined to go abroad for higher studies at that time. We had learnt that many young engineering graduates from tier-2 colleges were bright, even though they may not have got adequate undergraduate education. Once inspired, they were capable of working very hard and make up for their weak background. They would then deliver the impossible. We had done it and had learnt that an army of **inspired young men and women with proper guidance is the best resource that we in India have**. We just needed to identify them and build them up. They have never failed us. It is with such a team that we took up the challenge and built corDECT WiLL in two years, at the price target that we had set. We had set the stage for wireless to take off in the nation.

Once the industry-academia collaboration coupled with youngsters succeeded, the formula could be replicated to translate technology in many spheres and make a difference to lives of less-privileged people in India.

Proliferation of Start-ups

India has 600,000 villages and most did not even have a telephone line in 90's. CorDECT WiLL was used by a start-up to help setup a telephone and Internet kiosk in a village like an operator-assisted Public call office, except that it supported Internet service in addition to a telephone. A large number of services were provided to the villagers using this. Telemedicine was used to connect village folks to a city doctor. A telemedicine kit was developed by another start-up, which allowed a doctor to measure temperature, blood-pressure and ECG of the patients remotely. Internet was used to provide remote education by yet another start-up. A program was created to support the farmer in early identification of crop diseases using pictures transmitted over the Internet and providing timely advice for remedy. A whole host of Government services was provided on the Internet. This was carried out in 2001, when Internet was still in its early phase and data communication was yet to be supported on mobiles.

The successful translation of innovative technologies developed by IITM working with multiple start-ups, was the basis of changing the minds in academia. Saraswati and Lakshmi were recognised to work in tandem to strengthen technical institutions. We helped IITM formulate the first set of processes for setting up incubators in an institute. This started getting replicated throughout the country, with Department of Science and Technology taking an initiative to create incubators in various educational institutions. At IIT Madras, it took us time to set up formal incubators. But once they were set-up, start-ups happened fast. Till date, I have personally incubated **almost 100 companies**. A large number of technologies and products have been developed as a result. We founded IITM Incubation Cell and Rural Technology and Business Incubator (RTBI) and subsequently a Bio-incubator and Med-tech incubator at IITM.

These Incubators accelerated technology development and translational work. RTBI was focused on incubating companies providing products, services and employment in rural India. It was instrumental in setting up India's first rural BPO, so as to create livelihood in rural areas. Several companies looked at outsourcing production to Rural India. We developed an ATM machine, at a cost of 20% of what was available in the market, so that financial services could reach different parts of the country. Recognising that we were dealing with semi-literate people, when we worked in rural India, we decided to focus on using local language voice-based communication for all kinds of transactions. But voice recognition and text-to-speech were not available in local languages, and whatever recognition existed, gave a large number of errors. But a start-up specialised in ensuring reliable services in the presence of these errors. The technology was used in the financial domain, with farmers in agriculture, and for "conversations" with mothers in a mother-and child health care program. The academia start-up combination often enabled what was otherwise considered impossible.

Industry – Academia Connect and Research Parks

In 2004, I joined the board of SBI, the largest bank in India and IDRBT, a technology subsidiary of Reserve Bank of India. I found that technology can make a major difference in banking and financial systems. We computed the costs incurred by a bank when one goes and makes a deposit or withdraws money. If no technology was involved, it would amount to about ₹250 per transaction today. Half of it had to do with cash-teller (front-end), whereas the other half involved handling of accounts (back-end). Computers and communications connecting all the branches could significantly reduce the latter and could enable anywhere banking. ATMs, Internet banking and mobile banking could largely eliminate the former and introduce any-time banking. It appeared to be an impossible task in India to get all this done in India. But hard work and perseverance has moved the country. Not only anytime anywhere banking has become possible today, but a transaction involving Internet banking or Mobile banking costs a bank only between ₹2 to ₹3 per transaction and that involving ATM costs about ₹15. It was especially important in a country with large population and where most transaction amounts are very small. Later we helped create Mobile Payment Forum of India and were instrumental in defining the person-to-person mobile payment process, irrespective of their mobile operators, their banks and the technology providers. Mobile wallets and mobile payments are changing the country and bringing forth revolutions in sectors such as transport (Ola and Uber) and retail purchases. When the problem of frauds in credit-card transaction was brought to our notice, we came up with the idea of sending an SMS as soon as a transaction is carried out. It significantly reduces frauds and India may be the only country where this is adopted by all bankers.

Our work in financial sector reinforced the value of industry - academia interaction. The problem is that Academia believes that Industry is not interested in working with them and only wants to import technology. On the other hand, Industry believes that Academia is too focused on publishing papers and cannot help them develop technologies which can be taken to the market. There are truths in both these sentiments, but they are partial truths. If prejudices are left aside and both learn from each other, wonders are possible. In fact, a combination of Academia, experienced industry persons and enthusiastic youngsters possibly defines the best Innovation eco-system today. After experimenting with this multiple times, we decided to formally enable it by setting up a Research Park, adjacent to

IIT Madras. IITM already had excellent faculty and bright youngsters. We needed to bring industry into the eco-system. Industry would be invited to set-up their R&D centers at the Research Park. However, the rental contract with industry would include an obligation for industry to work on R&D with IITM and earn certain amount of credits. The industry-auditors would then insist that joint R&D and earning credits become the responsibility of someone and impact their variable salary. These people will then do their utmost to work with IIT. Proximity and obligation would enable breaking of barriers; once they start working together and get some success, nothing will stop either of them. IITM Research Park (IITMRP) started operations in 2011 with 400,000 sq.ft of built-up space. It houses about 60 R&D centers of Industries, working closely with IITM. The incubators and incubated companies are also located at IITMRP. The Park has now been expanded to 1.2 million sft and over the next two years, the number of R&D companies in the park is likely to touch 200.

The Next Frontier

About three years back, we turned our attention to the chronic power-problems of India; huge power-cuts and large percentage of homes unconnected to the power-grid and significant section of people's inability to pay for even below-cost tariff. We needed a technological breakthrough, just as wireless was in telecom. We had little expertise in this area. But rather than simply complaining, we decided to learn and attempt to make a difference. Our formulae of leaning from youngsters and colleagues helped us once again. We started looking at how a simple Indian home could get some power from a roof-top solar panel to power at least some lights, fans and electronics items. We started with a small size (125 Watts) low cost (₹5000) solar panel. We were perplexed by what we learnt. While the solar panel gave us varying electrical power through the day, we found that 15% or more would be lost when we convert this DC power to AC power and synchronise to the grid. We tried to get better converters, but even at very high cost (disproportional to that of solar panel), the losses would not be below 10%. We were then told that another AC to DC converter will be needed to charge the battery from the combined solar and grid power and yet another DC to AC converter when power is drawn from battery to power load. Each of these converters would have similar losses. Then there will be battery losses (10% for Lead Acid batteries). In other words, 55% or more solar power would be lost before it reaches the load. There was no answer to my query why we are wasting expensive solar power. It was then pointed out to me that loads are becoming all DC needing DC power input. I knew all electronics needed AC-DC converters. But so do LED lights and the fan's Brushless DC motors (which saves over 50% power as compared to AC-motor based fans). All this made no sense. We therefore came up with the Solar-DC concept, departed from conventional wisdom, and introduced a DC power line for homes. Solar will power the line directly and so will be the battery. Loads will be DC powered. Only the grid-input will be converted from AC to DC. Of course, it involved complicated design to get this done minimising the losses. But far more difficult was to overcome the mind-set which had settled this issue over a century back and considered AC power-line as the only future. Technology development was only one task. But there were no manufacturers and no standards. We had to create a standard, develop the technologies required, and commercialized them and carried out pilot deployments in a significant number of homes in multiple cities and villages. Slowly the tide is turning. DC power-line at home and offices and DC-powered appliances will bring in sustainability and make solar energy the norm. May be India can get 50% of its power from solar by 2030.

We now work on electric vehicles. That is another frontier to capture. India's growing pollution and its forever dependence on imported oil will not go without it. By 2030, India can have all its transport running on electricity. While conventional power can charge the vehicles in the night time, solar power will do so in day time. Technology and Policy can enable this. We have to have faith in ourselves. An Engineering mind must be humble, committed to sustainability, in tune with human values and believe that "nothing is impossible."

My Professional Life Experience: A Continuously Rising Learning Curve

Yogendra Pal Anand

Born in present Pakistan (on 12 December, 1934), I was in 8th class when Pakistan was formed. Due to the travails of the Partition, our family suffered heavy loss of life (I lost my father and three small brothers) but somehow my education continued and in 1952 I joined Punjab Engineering College, then running as a guest institution at Roorkee (it shifted to Chandigarh in 1954) and passed my degree in Civil Engineering (then designated as B.Sc (Hons.) in 1955. I had topped in the Punjab University in both the Intermediate and the Engineering Degree examinations.

I appeared for the Central Engineering Services Examination of the UPSC in 1955 and being successful, joined Indian Railways (Indian Railway Service of Engineers) in May 1957. In the meantime, I had worked as Asst. Engineer (Design), PWD (Punjab), Chandigarh from April1956 to February 1957.

Professional Experience on the Indian Railways

I had the most enriching experience in various positions during my service with the Indian Railways and I had the privilege of superannuating from its highest position as Chairman, Railway Board, on 31 December, 1992. During the course of my nearly 36 years of service, I had the opportunity to work on Southern Railway, on North-east Frontier Railway, then in Research Design and Standards Organization (RDSO, Lucknow), on North-east Railway, in Railway Board, on Northern Railway, on Central Railway, and again in Railway Board. During my service on the Railways, I passed through the various hierarchical levels as Asst. Engineer, Executive Engineer, Deputy Director (Research), Deputy Chief Engineer, Divisional Superintendent, Addl. Chief Engineer, Director in Railway Board, Chief Track Engineer, Divisional Railway Manager, Chief Engineer, General Manager (Northern Railway, &, Central Railway), Member (Engineering) in Railway Board and retired as Chairman, Railway Board, and ex-officio Principal Secretary to Govt. of India.

Thus, I had the opportunity to work at various levels in the 'Open Line' (for maintenance of railway track and bridges and all other civil structures for the running of train services), 'Construction' (new lines, bridges, guage conversions, and surveys, and major works on the Open Line), and the prestigious administrative posts on Open Line and in Railway Board, and in Railway's R&D centre. While my whole service on Indian Railways has been an inspiring curve of continuous learning, I can recall the following as my most notable experiences during my service:

- 1959-65: I could make major contributions as AEN and XEN for construction of 38 km long new BG railway line from Old Malda to the bank on the Ganges opposite Farakka, for conversion from MG to BG of strategic line from Katihar to Sinhabad, and for construction of BG line from Kishenganj towards New Jalpaiguri, all these in record time targets on NF Railway. The innovative steps also included developing wagon ferry crossing arrangements opposite Farakka on the

Ganges, particularly during the 1962 Chinese War when, this being the only Broad Gauge route then available towards Assam, the ferry crossing capacity was raised from two to eleven ferries per day in the shortest possible time.

- 1965-72: I could make important contributions towards setting up and expanding track research, testing and monitoring systems in the RDSO, Lucknow, particularly for introduction of the first higher speed Rajdhani route from New Delhi to Howrah. Also, during 1969-70, I was sent as a member of the expert R&D team by Indian Railways for the upgradation of speeds on Bangkok - - Sila-at north line of State Railway of Thailand. It had been a rare experience.

- 1972-77: As Deputy Chief Engineer (Construction) on NE Railway, I could bring about major changes in construction methods, including those for track construcion and bridge rebuilding, during conversion of Samastipur-Sonepur section from MG to BG. For conversion of the first section from Samastipur to Muzaffarpur (52 km), the usual conversion method was totally changed. Earlier, many months were taken to convert a section under traffic and it was opened at low speeds which were raised gradually as the BG track structure got stabilized. For the first time, a 10 day complete traffic block was imposed and a welded track structure was provided and opened at near final speed after being tamped with on-track machines. This was a revolutionary change in the method of gauge conversion on IR. However, there was also a very tragic incident because Shri L.N. Mishra, the Railway Minister, was killed in a bomb attack at Samastipur station while inaugurating the first BG train to Muzaffarpur on 1 January, 1975.

- 1981-84: As Director (Track) in Railway Board, made special efforts towards setting up of concrete sleeper factories and introduction of concrete sleepers on a mass scale on IR. This not only introduced a massive upgradation in track structure (to a long-welded track laid on pre-stressed concrete sleepers with elastic fastenings and a deeper ballast cushion) but also the concomitant changes from manual to mechanized track maintenance and track laying systems.

- 1984-89: On NR, as CTE and CE, pushed through modernization of track structure and mechanization of track maintenance particularly on the Mughalsarai-Ghaziabad trunk route, which could yield higher line capacity in terms of train speeds and loads.

- 1989-90: As General Manager (Central Rly) I could get the work of remodeling of the Victoria Terminus station revived, which had been stalled for a long period. This remodeling was necessary to reduce the minimum time interval between successive local trains so that the line capacity could be raised. However, due to the likely heavy dislocations during the work of remodeling it had been practically shelved. The proposal was revived and work was started while I was there, and thereafter it was successfully completed.

- 1990-92: As Member (Engineering) and as Chairman, Railway Board, I sponsored and pushed through the revolutionary Uniguage programme for the conversion of nearly 9,000 km from MG/NG to BG, including 6,000 km being converted @ 1200 km per year within the Eighth Five-year Plan itself. The proposal was presented before the Prime Minister himself and was soon approved. This introduced the project of gauge conversion on a mass scale on Indian Railways. Basic changes were introduced in procedures for sanction of specific proposals without delay and in guidelines for conversion procedures and its execution. Also, I could get the work started on the construction of rail-um-road Chittauni-Bagaha bridge connecting U.P. and Bihar across the Gandak river, which project had been practically shelved after its foundation stone had been laid

in 1973 by the Prime Minister herself. This had been done due to the fear of the risks involved in the success of the proposed river training system. The problem was reconsidered and successfully resolved. The project proved to be a great success in establishing a direct rail-cum-road communication between east UP and north Bihar, and also in reclamation of a large area of flood affected lands.

Foreign Experience

During service on the Indian Railways (1957-1992), I also had the opportunity of visiting many foreign countries on officially sponsored professional assignments. I was sent to Switzerland by IR for 1-month training on Swiss Railways (1969). Again, I was deputed to Thailand for seven months as a member of the Experts Team from Indian Railways (RDSO) to study and upgrade their Bangkok -- Sila-at North route during 1969-70. I was deputed to visit China on a brief Seminar-cum-study tour of Chinese Railways in 1986. Again, I visited Germany, UK, USA and Canada on official assignments to review the advanced procedures of track management (1988). I was privileged to visit USSR to attend meetings as Co-Chairman of the Indo-USSR Railway Working Group (1991) and to be deputed for visits to Paris, Lisbon, Brussels, Frankfurt to attend meetings of UIC/ORE and IRCA (1992). Just before my retirement I had the unique opportunity of going on an official visit to Pakistan as head of a team from IR in November, 1992. There, I led discussion with the Pakistan Railways including a meeting with their Minister for Railways. Soon after retirement too, I was officially invited to attend an International. Railway Seminar (April, 1993), held at Tehran, Iran, and there I presented a Paper on 'Problems, Opportunities and Perspectives of the Indian Railways as a National Transport System'.

Academic Qualifications & Professional Memberships

While working in various positions on the Indian Railways I also kept pursuing further studies and was awarded Ph D by IIT, Delhi, in the subject of 'Waste Management' in 1991. I had also studied for and obtained Post-Graduate Diplomas in 'Gandhian Studies' in 1984 from Punjab University and just after retirement in 1993 in 'Econometrics' from Annamalai University.

During the course of my service, I also acquired many professional memberships and took active interest in their proceedings. These include: Fellow, Indian National Academy of Engineering; Fellow, Institution of Engineers (India); Life Member, Indian Building Congress; Life Member, Solar Energy Society of India; Fellow, Indian Institute of Bridge Engineers; Fellow, Institute of Urban Transport (India); Fellow, Indian Arbitration Council; Fellow, Institute of Rail Transport; and Fellow, Indian Inst. of Permanent Way Engineers (India).

<u>After Retirement from Indian Railways—Professional Experience</u>

After retirement from the Indian Railway service I have remained involved in professional (engineering) activities even while I gradually moved progressively towards the Gandhian field. Soon after retirement, I worked with the UNDP on a 10-week assignment for a study on India's Transport Sector (1993). I was also associated with the Asian Institute of Transport Development as a Senior Research Scholar from April 1993 to May 1996. During this period, I also participated actively in a project to upgrade the design of Cycle Rickshaws and wrote articles on transport-energy issues and non-motorized transport in journals as well as jointly authored books on 'Non-motorized Transport of India: Current Status and Policy Issues' (1996) and 'Transport energy Nexus – Towards Sustainability' (1999), both published by the AITD.

Soon after retirement, I was actively associated in setting up an INAE Study Group, named as 'Indian

Engineering Heritage (Railways)', and constituted by highly experienced recently retired railway officers from all branches. It remained active till 2015, holding periodic meetings regularly and collecting historical information and data since the inception of Indian Railways in 1850s covering its all branches of engineering and train operation. The Group has published four reports, the fourth being titled, 'Role of Technology in Capacity Augmentation and Railway Development' in 2015.

Because of my deep interest in the subject of 'Waste Management' I had been trying for the setting up of an appropriate institution for taking up practical projects in this area. Finally, with the initiative of Vigyan Bharati, I succeeded in having the 'International Institute of Waste management' set up in Bhopal in 2009 and functioned as its first Chairman during 2009-2010.

I have also been a Member of the INAE's 'Technology Foresight and Management Forum' since it was set up in 2012. The Forum has nine members who hold discussions and take up and work on selected areas of technology. As a part of my contribution, I had finalized a short thesis, titled 'Issues in Waste Management' (published by INAE in 2015). In the same context, my detailed paper, titled 'Cleanliness-Sanitation: Gandhian Movement and Swachh Bharat Abhiyan', has been published in the RITES JOURNAL, vol.17/ 2, July 2015.

After retirement, I have been honoured as an 'Engineering Personality' by Institution of Engineers (India) in 2004, with 'Outstanding Contribution Award' by Indian Building Congress in 2010, and with the 'Alumni Achievement Award', 2013, by the National Academy of Indian Railways, Vadodara.

After Retirement from Indian Railways--Experience in the Gandhian Field

Since retirement, I have also been closely associated with a number of Gandhian institutions and studies in Gandhian thought. I joined the Governing Body of the National Gandhi Museum (and Library), Rajghat, New Delhi, in 1994 and then worked as its Director for ten years from June 1996 to July 2006. I had the opportunity to participate in an International Conference on Gandhian Concept of Non-violence, in Santa Cruz, USA (1995), in an International Seminar on Gandhian Concept of Freedom, in University of Calgary, Calgary, Canada (1997), and in a Seminar on Gandhian Political Thought in University of Trieste, Italy (2000). On invitation by Indian Council of World Affairs, I delivered Keynote Address on 'Gandhian Legacy: Its Relevance in the 21st Century' at IIIrd Spain – India Dialogue Forum 2007 at University of Valladoid in Spain on October 16, 2007.

At present, I am a Life Member of the Indian Society of Gandhian Studies; Vice-Chairman, Working Committee, Gandhian Seva & Satyagraha Brigade, New Delhi; Member, High Level Dandi Memorial Committee (under Ministry of Culture, Govt. of India); and Hon. Fellow, Centre of Gandhian Studies, GITAM University, Visakhapatnam.

During this period I have written a number of papers related to Gandhian thought. My published books and compilations in this field include: *The Essential Relationship between Netaji Subhas Bose & Mahatma Gandhi* (1997); *Birth of Free India's National Anthem: A Gift from Netaji Subhas Bose* (1997); *Non-violence in a Violent World: A Gandhian Response* (1995); *What Mahatma Gandhi Said about Atom Bomb* (1998); *Mahatma Gandhi & the Railways* (English and Hindi editions, 2002); *Mahatma Gandhi on Lord Buddha and Buddhism* (2003); *Mahatma Gandhi and Art* (2003); *Mahatma Gandhi and Satyagraha: a Compendium* (2006); *Albert Einstein and Mahatma Gandhi: The Centenary of Physics, War, Satyagraha and Peace* (2006/2010); *Mahatma Gandhi's Works and Interpretation of the Bhagavad Gita* (in 2 Volumes) (2009); *Gitapadarthakosh* (by Mahatma Gandhi), trans. into Hindi (2010); and '*Historical background to Mahatma Gandhi's taking up Satyagraha against Salt Tax (1930), as the Key*

Issue for the Civil Disobedience Movement for Poorna Swaraj' (published by Ministry of Culture, GOI, 2015, also by IIT, Mumbai).

After retirement, along with other colleagues I had also set up in 1994, 'GODHULI', an NGO for educating non-school going slum children in Delhi, and since then I have been functioning as its Chairman. At present, it runs four such centres and provides preliminary school education to over 400 children.

Conclusion

As explained above, I have had a very varied professional experience in multiple fields since I passed my degree in Civil Engineering from Punjab Engineering College, Chandigarh in 1955. I consider myself privileged to have had nearly 36 years' experience of service on Indian Railways, starting as an Asst. Engineer and retiring (on 31 December,1992) from the topmost position of Chairman, Railway Board. After retirement, I have remained deeply involved in both the professional and the Gandhian fields through my association with prestigious institutions/ activities and my continuing studies. I have been a student throughout and continue to remain one. Throughout my service on Indian Railways as well as my professional involvements after retirement I have continued to learn and the learning curve continues to grow along with the experience, for which I remain deeply grateful to all institutions and to everyone with whom I have had the privilege to be associated.

Civil Engineering

1. Performance of Earthquake Early Warning Systems

The future of earthquake early warning systems may be contained in smartphones -- and vehicles, and "smart" appliances and the increasing number of everyday objects embedded with sensors and communication chips that connect them with a global network. At a presentation at the 2017 Seismological Society of America's (SSA) Annual Meeting, Benjamin Brooks of the U.S. Geological Survey and colleagues will share data from a recent project in Chile that provided early detection, estimates and locations for earthquakes using a network of sensor boxes equipped with smartphones and consumer-quality GPS chips. Data collected by the sensor boxes is transmitted through an Android app developed by the researchers and analyzed to produce earthquake source models, which in turn can be used to create ground shaking forecasts and local tsunami warnings. The sensor stations have successfully detected three magnitude 5 or larger earthquakes since December 2016, with no false alarms. Although the smartphone-based sensors in the study are distributed in a fixed network, Brooks and colleagues say, it may be possible to someday harness individual smartphones and "smart" appliances into a crowd-sourced network for earthquake early warning. On the U.S West Coast, seismologists at the University of Washington are expanding and testing the capabilities of earthquake early warning systems already under development, such as the G-FAST system in the Pacific Northwest, and ShakeAlert in California. Brendan Crowell and colleagues will discuss the performance of G-FAST as tested by 1300 simulated megathrust earthquakes of magnitudes between 7.5 and 9.5 in the Cascadia region. Renate Hartog will present data suggesting that the algorithms behind ShakeAlert can be configured to work for the Pacific Northwest as well as California, suggesting that a West Coast-wide earthquake early warning system could be closer to reality. In other presentations at the SSA Annual Meeting, researchers will also discuss how earthquake early warning systems are developing ways to improve real-time ground motion alerts. Many early warning systems perform best when asked to pinpoint the magnitude and location of earthquakes, but ground motion warnings are also key to predicting and preventing infrastructure damage and destruction.

Source https://www.sciencedaily.com/releases/2017/04/170411130741.htm

2. Internet Atlas Maps the Physical Internet to Enhance Security

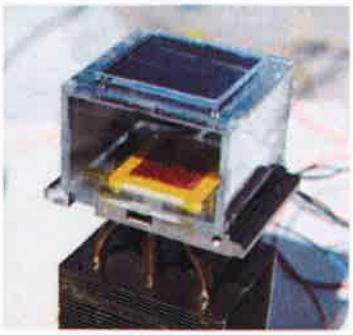
A team of scientists developed Internet Atlas, the first detailed map of the internet's structure worldwide. The lines represent crucial pieces of the physical infrastructure of the internet that billions of people rely on.

Despite the internet-dependent nature of our world, a thorough understanding of the internet's physical makeup has only recently emerged, thanks to painstaking work by University of Wisconsin-Madison researchers and their collaborators. Professor of Computer Sciences Paul Barford, Ph.D. candidate Ramakrishnan Durairajan and colleagues have developed Internet Atlas, the first detailed map of the internet's structure worldwide. While average users rarely think of these elements, things like submarine cables -- buried below the ocean floor -- run between continents to enable communication. Data centers in buildings all over the world are packed with servers storing many types of data. Traffic exchange occurs between different service providers at internet exchange points. Though these and other elements may be out of sight for the average user, they are crucial pieces of the physical infrastructure that billions of people rely on. Internet Atlas was one of a select group of DHS-funded projects invited to present at the conference. Mapping the physical internet helps stakeholders boost performance and guard against a number of threats, from terrorism to extreme weather events like hurricanes. Furthermore, "a lot of infrastructure is by major right-of-ways, like railroad lines," says Barford, meaning that an event like a train derailment could end up disrupting internet communications. "The question of 'how does mapping contribute to security?' is one of our fundamental concerns," says Durairajan. The project has helped direct attention to the problem of shared risk, the subject of an influential 2015 paper by the team. Physical infrastructure is commonly shared by multiple networking entities, so damage to any particular piece of infrastructure can impact more than one entity. "We quantified that for the first time," says Barford. Much of the data used to create the Internet Atlas comes from publicly available information, such as what internet service providers publish on their websites. Other data has taken more legwork to uncover, such as combing through mundane items like local permits for laying cables. "The core work is grunt work, but by rolling up our sleeves, we assembled a unique data set," says Barford. Now, the team is looking to enhance the maps even further and share their work so it can be deployed by others to boost network performance and security. "We'll complement the static maps with the ability to actually examine the status of the network in real time," says Barford. "We've built certain capabilities that allow exactly that to be done, and one of the important focuses going forward is to enhance that capability, basically putting the maps in motion."

Source https://www.sciencedaily.com/releases/2017/04/170411141033.htm

Mechanical Engineering

3. Device Pulls Water from Dry Air, Powered Only by The Sun



This is the water harvester built at MIT with MOFs from UC Berkeley. Using only sunlight, the harvester can pull liters of water from low-humidity air over a 12-hour period.

Imagine a future in which every home has an appliance that pulls all the water the household needs out of the air, even in dry or desert climates, using only the power of the sun. That future may be around the corner, with the demonstration this week of a water harvester that uses only ambient sunlight to pull liters of water out of the air each day in conditions as low as 20 percent humidity, a level common in arid areas. The solar-powered harvester was constructed at the Massachusetts Institute of Technology using a special material -- a metal-organic framework, or MOF -- produced at the University of California, Berkeley. "This is a major breakthrough in the long-standing challenge of harvesting water from the air at low humidity," said Omar Yaghi, one of two senior authors of the paper, who is a faculty scientist at Lawrence Berkeley National Laboratory. "There is no other way to do that right now, except by using extra energy. Your electric dehumidifier at home 'produces' very expensive water." The prototype, under conditions of 20-30 percent humidity, was able to pull 2.8 liters of water from the air over a 12-hour period, using one kilogram of MOF. Rooftop tests at MIT confirmed that the device works in real-world conditions. "One vision for the future is to have water off-grid, where you have a device at home running on ambient solar for delivering water that satisfies the needs of a household," said Yaghi, who is the founding director of the Berkeley Global Science Institute. Yaghi invented metal-organic frameworks more than 20 years ago, combining metals like magnesium or aluminum with organic molecules in a tinker-toy arrangement to create rigid, porous structures ideal for storing gases and liquids. Since then, more than 20,000 different MOFs have been created by researchers worldwide. Some hold chemicals such as hydrogen or methane: the chemical company BASF is testing one of Yaghi's MOFs in natural gas-fueled trucks, since MOF-filled tanks hold three times the methane that can be pumped under pressure into an empty tank. Other MOFs are able to capture carbon dioxide from flue gases, catalyze the reaction of adsorbed chemicals or separate petrochemicals in processing plants. In 2014, Yaghi and his UC Berkeley team synthesized a MOF -- a combination of zirconium metal and adipic acid -- that binds water vapor, and he suggested to Evelyn Wang, a mechanical engineer at MIT, that they join forces to turn the MOF into a water-collecting system. The system Wang and her students designed consisted of more than two pounds of dust-sized MOF crystals compressed between a solar absorber and a condenser plate, placed inside a chamber open to the air. As ambient air diffuses through the porous MOF, water molecules preferentially attach to the interior surfaces. X-ray diffraction studies have shown that the water vapor molecules often gather in groups of eight to form cubes. Sunlight entering through a window heats up the MOF and drives the bound water toward the condenser, which is at the temperature of the outside air. The vapor condenses as liquid water and drips into a collector. "This work offers a new way to harvest water from air that does not require high relative humidity conditions and is much more energy efficient than other existing technologies," Wang said. This proof of concept harvester leaves much room for improvement, Yaghi said. The current MOF can absorb only 20 percent of its weight in water, but other MOF materials could possibly absorb 40 percent or more. The material can also be tweaked to be more effective at higher or lower humidity levels. "It's not just that we made a passive device that sits there collecting water; we have now laid both the experimental and theoretical foundations so that we can screen other MOFs, thousands of which could be made, to find even better materials," he said. "There is a lot of potential for scaling up the amount of water that is being harvested. It is just a matter of further engineering now." Yaghi and his team are at work improving their MOFs, while Wang continues to improve the harvesting system to produce more water. "To have water running all the time, you could design a system that absorbs the humidity during the night and evolves it during the day," he said. "Or design the solar collector to allow for this at a much faster rate, where more air is pushed in. We wanted to demonstrate that if you are cut off somewhere in the desert, you could survive because of this device. A person needs about a Coke can of water per day. That is something one could collect in less than an hour with this system."

Source https://www.sciencedaily.com/releases/2017/04/170413141104.htm

4. Chemists Devise Simple Method for Making Sought-After Boronic Acid-Based Drugs and Other Products

Chemists at The Scripps Research Institute (TSRI) have developed a broad and strikingly easy method for synthesizing a class of molecules that have demonstrated value as pharmaceuticals. The difficulty of preparing these compounds -- boronic acids and closely related molecules known as boronate esters -- has greatly limited their use in the pharmaceutical industry, and to date there are only three FDA-approved drugs in this category. With the new method chemists can take abundant, inexpensive, structurally diverse compounds known as carboxylic acids and convert them easily into similarly structured boronic acids and related compounds. "Carboxylic acids are the ideal starting material for synthesizing boronic acids, but until now there hasn't been any method for getting from one to the other," said principal investigator Phil S. Baran, Darlene Shiley Professor of Chemistry at TSRI. Among the boronic acid-derived molecules Baran and his team made in demonstrating the new method were several novel compounds that are now being investigated further as potential treatments for COPD and other lung disorders. The development of the new method, known as decarboxylative borylation, follows a breakthrough made a year ago when Baran and his team were studying a reaction commonly used in laboratory chemistry as well as in nature: the amide-bond forming reaction, which among other things, helps stitch amino acids into proteins. "We realized that the principles of amide bond formation, still the most utilized reaction in all of chemical synthesis, could be used to simplify a much broader set of molecule-building tasks," Baran said. In this case, the insight enables the transformation of virtually any carboxylic acid, whether simple or complex, using just a single reaction step and inexpensive nickel catalysts. The new method essentially replaces a key carbon atom on a carboxylic acid with a boron atom. "Instead of devoting 95 percent of their effort to introducing a single boron atom, chemists can now easily install boron at any stage," Baran said. Borylated versions of drug compounds should often have superior properties to their carboxylic acid counterparts. The new method for the first time makes it broadly practical for pharmaceutical chemists to create and investigate these borylated structures. To demonstrate, Baran and his team used the new method to make boronic acid versions of several common drugs, including Lipitor (atorvastatin) and vancomycin. In a collaboration to demonstrate the translational utility of the discovery, Baran's team and chemists from the California Institute for Biomedical Research (Calibr), also used the method to make boronic acid-based compounds that inhibit a human enzyme known as neutrophil elastase. Immune cells release this enzyme within the lungs during infections and other conditions involving lung inflammation. Elastase is considered a major cause of the lung damage seen in COPD, cystic fibrosis, and related respiratory ailments. To date, elastase inhibitors developed through other methods have shown limited effectiveness and/or significant side effects, and so far none has been FDA-approved. However, the team found in initial lab-dish tests that their boronic acid-based compounds inhibit elastase more strongly than older elastase-inhibiting compounds. "We found that we could get a significant boost in potency by using a boronic acid group," said study co-author Arnab Chatterjee, director of medicinal chemistry at Calibr. These boronic acid-based compounds can bind very tightly to their target molecules but in a way that allows them to detach eventually, thus potentially reducing the impact of off-target interactions that cause unwanted side effects. "The next step is to see how well these compounds perform in animal models," said Chatterjee. "In general, this new method allows us in a practical way to get into this largely unexplored but promising chemical space of borylated compounds, and thus enables us to revisit old targets, such as elastase, that have largely resisted prior drug development efforts."

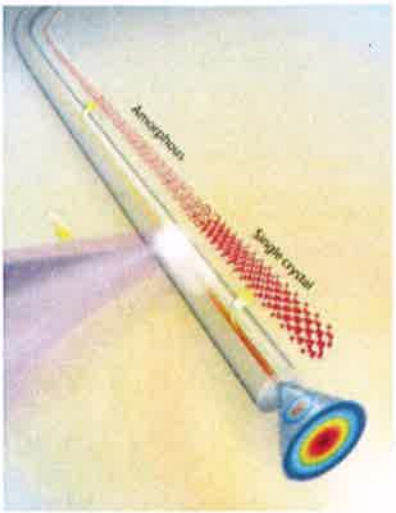
Source https://www.sciencedaily.com/releases/2017/04/170414123731.htm

5. Tunable Electric Eyeglasses Bend to The Will of The Wearer

Engineers funded by the National Institute of Biomedical Imaging and Bioengineering (NIBIB) have developed glasses with liquid-based lenses that "flex" to refocus on whatever the wearer is viewing. The adjustable "smart glasses" were developed by a University of Utah team led by electrical and computer engineering professor Carlos H. Mastrangelo, Ph.D., and his doctoral student Nazmul Hasan. "The glasses incorporate an impressive array of electrical, mechanical, optical, sensor, and computer technologies with the goal of developing a one-size-fits-all approach to vision correction," said Andrew Weitz, Ph.D., NIBIB program director, whose expertise includes bioelectronic vision technologies. The glasses are designed to mimic the behaviour of the eye's natural lens -- flexing to focus on wherever an individual is looking: near, far or in-between. Unfortunately for many of us, as we age our lenses become stiffer and lose the ability to bend enough to focus at different distances. Standard glasses compensate for the bend our ageing eyes can no longer achieve to focus. This becomes more complicated if we are unable to focus at multiple distances, which necessitates glasses with multiple lenses for different distances, such as bifocals, trifocals or progressive lenses, which must be regularly replaced as our eyesight changes. The central technology of the glasses created by the research team are lenses made of glycerin, a clear thick liquid sandwiched between flexible membranes. The lenses are mounted into frames that have an electromechanical system that causes the membranes to bend to adjust their focus. The ability of the lens to flex and bend allows the single lens to act like multiple lenses. The glasses are designed to work for most people at a wide range of distances due to a sophisticated computer algorithm that works with two critical variables. One is the eyeglass prescription that the user enters into the system using an attached mobile app. The other is where the user is looking -- specifically how far away. This information is provided by a sensor mounted in the bridge of the glasses that uses pulses of infrared light to identify where the user is looking and provide the precise distance. The combination of the user's prescription information and the distance information is used by the algorithm to instantly adjust the shape of the liquid lenses to allow the user to focus on what they are viewing. Remarkably, if the user looks elsewhere, the change in lens shape needed to focus at the new distance is made in a staggering 14 milliseconds -- 25 times faster than an eye blink. "Theoretically, these would be the only glasses a person would ever have to buy because they can correct the majority of focusing problems," says Mastrangelo. "Users just have to input their new prescription as their eyesight changes." Because they house a lot of technology, including a rechargeable battery, the current prototype is on the bulky side. However, the research team is constantly improving the design to make them smaller and lighter. A startup company, Sharpeyes, has been created to move toward commercialization with the aim of making the glasses available on the market in about three years.

Source https://www.sciencedaily.com/releases/2017/04/170411182509.htm

6. Method Improves Semiconductor Fiber Optics, Paves Way for Developing Devices



Amorphous silicon core is inside a 1.7-micron inner-diameter glass capillary.

A new method to improve semiconductor fiber optics may lead to a material structure that might one day revolutionize the global transmission of data, according to an interdisciplinary team of researchers. Researchers are working with semiconductor optical fibers, which hold significant advantages over silica-based fiber optics, the current technology used for transmitting nearly all digital data. Silica -- glass -- fibers can only transmit electronic data converted to light data. This requires external electronic devices that are expensive and consume enormous amounts of electricity. Semiconductor fibers, however, can transmit both light and electronic data and might also be able to complete the conversion from electrical to optical data on the fly during transmission, improving delivery speed. Think of these conversions as exit ramps on the information superhighway, said Venkatraman Gopalan, professor of materials science and engineering, Penn State. The fewer the exits the data takes, the faster the information travels. Call it "fly-by optoelectronics," he said. In 2006, researchers, first developed silicon fibers by embedding silicon and other semiconductor materials into silica-fiber capillaries. The fibers, comprised of a series of crystals, were limited in their ability to transmit data because imperfections, such as grain boundaries at the surfaces where the many crystals within the fiber core bonded together, forced portions of the light to scatter, disrupting the transmission. A method improves on the polycrystalline core of the fiber by melting a high-purity amorphous silicon core deposited inside a 1.7-micron inner-diameter glass capillary using a scanning laser, allowing for formation of silicon single crystals that were more than 2,000 times as long as they were thick. This method transforms the core from a polycrystal with many imperfections to a single crystal with few imperfections that transmits light much more efficiently. That process demonstrates a new methodology to improve data transfer by eliminating imperfections in the fiber core that can be made of various materials. Because of the ultra-small core, the researcher was able to melt and refine the crystal structure of the core material at temperatures of about 750 to 930 degrees Fahrenheit, lower than a typical fiber-drawing process for silicon core fibers. The lower temperatures and the short heating time that can be controlled by the laser power and the laser scanning speed also prevented the silica capillary, which has different thermal properties, from softening and contaminating the core. "High purity is fundamentally important for high performance when dealing with materials designated for optical or electrical use," said a researcher. The important takeaway, said a scioentist, is that this new method lays out the methodology for how a host of materials can be embedded into fiber optics and how voids and imperfections can be reduced to increase light-transfer efficiency, necessary steps to advancing the science from its infancy. "Glass technology has taken us this far," he said. "A researcher has been able to start from nicely deposited amorphous silicon and germanium core and use a laser to crystallize them, so that the whole semiconductor fiber core is one nice single crystal with no boundaries," said Gopalan. "This improved light and electronic transfer. Now we can make some real devices, not just for communications, but also for endoscopy, imaging, fiber lasers and many more." Gopalan said he is not only in the business of creating commercially viable materials. He is interested in dreaming big and taking the long view on new technologies. Perhaps one day, every new home constructed might have a semiconductor fiber, bringing faster internet to it.

Source https://www.sciencedaily.com/releases/2017/04/170413101840.htm

7. Hubble Takes Close-Up Portrait of Jupiter

On April 3, 2017, as Jupiter made its nearest approach to Earth in a year, NASA's Hubble Space Telescope viewed the solar system's largest planet in all of its up-close glory. At a distance of 668 million kilometers from Earth, Jupiter offered spectacular views of its colourful, roiling atmosphere, the legendary Great Red Spot, and it smaller companion at farther southern latitudes dubbed "Red Spot Jr." The giant planet is now at "opposition," positioned directly opposite the sun from the Earth. This means that the sun, Earth and Jupiter line up, with Earth sitting between the sun and the gas giant. Opposition also marks Jupiter's closest point to us, and the planet appears brighter in the night sky than at any other time in the year. This positioning allowed a team led by Amy Simon of NASA's Goddard Space Flight Center in Greenbelt, Maryland to observe Jupiter using Hubble's Wide Field Camera 3. Hubble photographed exquisite details in Jupiter's atmosphere, as small as about 129 kilometers across. With its immense and powerful storms and hundreds of smaller vortices, the atmosphere of Jupiter is divided into several distinct, colourful bands, parallel to the equator. These bands, with alternating wind motions, are created by differences in the thickness and height of the ammonia ice clouds; the lighter bands rise higher and have thicker clouds than the darker bands. The bands are separated by winds that can reach speeds of up to 644 kilometers per hour. Jupiter is best known for the Great Red Spot, an anticyclone that has raged for at least 150 years. This famous storm is larger than Earth. However, the Great Red Spot is slowly shrinking -- a trend seen since the late 1800s. The reason for this phenomenon is still unknown. Hubble will continue to observe Jupiter in hopes of solving this mysterious riddle. The images are part of the Outer Planets Atmospheres Legacy program or OPAL. This program provides yearly Hubble global views of the outer planets to look for changes in their storms, winds, and clouds. It began in 2014 with Uranus, and has been studying Jupiter and Neptune since 2015. In 2018, it will begin viewing Saturn. The team timed the Hubble observation to coincide with when NASA's space probe Juno would be near its closest point to Jupiter, so that scientists could get concurrent observations. The Hubble Space Telescope is a project of international cooperation between NASA and ESA (European Space Agency). NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the telescope. The Space Telescope Science Institute (STScI) in Baltimore conducts Hubble science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy, Inc., in Washington, D.C.

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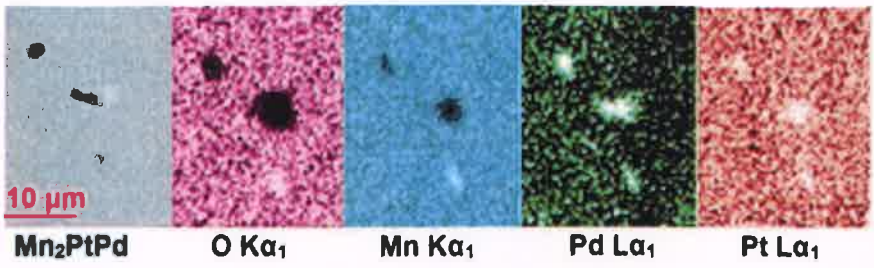
8. Computers Create Recipe for Two New Magnetic Materials



This is a microscopic look at the atomic structure of a manganese- platinum-palladium mixture (Mn2PtPd), that is one of the newly predicted and manufactured magnetic materials. Each color shows the distribution of a different element. The uniformity for each material -- with the exception the small spots indicating a different phase state -- matches the predictions for a stable three-element material.

Material scientists have predicted and built two new magnetic materials, atom-by-atom, using high-throughput computational models. The success marks a new era for the large-scale design of new magnetic materials at unprecedented speed. Although magnets abound in everyday life, they are actually rarities -- only about five percent of known inorganic compounds show even a hint of magnetism. And of those, just a few dozen are useful in real-world applications because of variability in properties such as effective temperature range and magnetic permanence. The relative scarcity of these materials can make them expensive or difficult to obtain, leading many to search for new options given how important magnets are in applications ranging from motors to magnetic resonance imaging (MRI) machines. The traditional process involves little more than trial and error, as researchers produce different molecular structures in hopes of finding one with magnetic properties. Many high-performance magnets, however, are singular oddities among physical and chemical trends that defy intuition. In a new study, materials scientists from Duke University provide a shortcut in this process. They show the capability to predict magnetism in new materials through computer models that can screen hundreds of thousands of candidates in short order. And, to prove it works, they've created two magnetic materials that have never been seen before. The group focused on a family of materials called Heusler alloys -- materials made with atoms from three different elements arranged in one of three distinct structures. Considering all the possible combinations and arrangements available using 55 elements, the researchers had 236,115 potential prototypes to choose from. To narrow the list down, the researchers built each prototype atom-by-atom in a computational model. By calculating how the atoms would likely interact and the energy each structure would require, the list dwindled to 35,602 potentially stable compounds. From there, the researchers conducted a more stringent test of stability. Generally speaking, materials stabilize into the arrangement requiring the least amount of energy to maintain. By checking each compound against other atomic arrangements and throwing out those that would be beat out by their competition, the list shrank to 248. Of those 248, only 22 materials showed a calculated magnetic moment. The final cut dropped any materials with competing alternative structures too close for comfort, leaving a final 14 candidates to bring from theoretical model into the real world. But as most things in a laboratory turn out, synthesizing new materials is easier said than done. After years of attempting to create four of the materials, researchers succeeded with two. Both were, as predicted, magnetic. The first newly minted magnetic material was made of cobalt, magnesium and titanium (Co2MnTi). By comparing the measured properties of similarly structured magnets, the researchers were able to predict the new magnet's properties with a high degree of accuracy. Of particular note, they predicted the temperature at which the new material lost its magnetism to be 940 K. In testing, the actual "Curie temperature" turned out to be 938 K -- an exceptionally high number. This, along with its lack of rare earth elements, makes it potentially useful in many commercial applications. "Many high-performance permanent magnets contain rare earth elements," said a researcher. "And rare earth materials can be expensive and difficult to acquire, particularly those that can only be found in Africa and China. The search for magnets free of rare-earth materials is critical, especially as the world seems to be shying away from globalization." The second material was a mixture of manganese, platinum and palladium (Mn2PtPd), which turned out to be an antiferromagnet, meaning that its electrons are evenly divided in their alignments. This leads the material to have no internal magnetic moment of its own, but makes its electrons responsive to external magnetic fields. While this property doesn't have many applications outside of magnetic field sensing, hard drives and Random Access Memory (RAM), these types of magnets are extremely difficult to predict. Nevertheless, the group's calculations for its various properties remained spot on. "It doesn't really matter if either of these new magnets proves useful in the future," said a lead researcher. "The ability to rapidly predict their existence is a major coup and will be invaluable to materials scientists moving forward."

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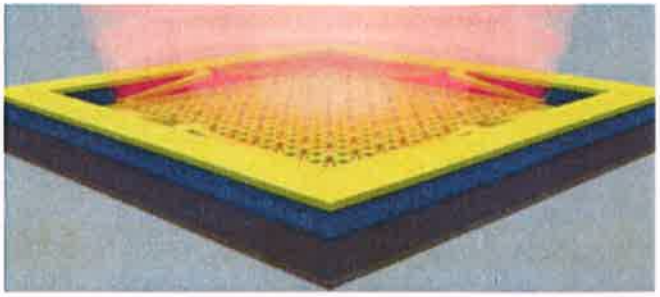
9. New Infrared-Emitting Device Could Allow Energy Harvesting from Waste Heat



This illustration shows the room temperature MEMS metamaterial, which can achieve reconfigurable infrared intensities equivalent to a temperature change of nearly 20 degrees Celsius.

A new reconfigurable device that emits patterns of thermal infrared light in a fully controllable manner could one day make it possible to collect waste heat at infrared wavelengths and turn it into usable energy. The new technology could be used to improve thermophotovoltaics, a type of solar cell that uses infrared light, or heat, rather than the visible light absorbed by traditional solar cells. Scientists have been working to create thermophotovoltaics that are practical enough to harvest the heat energy found in hot areas, such as around furnaces and kilns used by the glass industry. They could also be used to turn heat coming from vehicle engines into energy to charge a car battery, for example. "Because the infrared energy emission, or intensity, is controllable, this new infrared emitter could provide a tailored way to collect and use energy from heat," said Willie J. Padilla of Duke University, North Carolina. "There is a great deal of interest in utilizing waste heat, and our technology could improve this process." The new device is based on metamaterials, synthetic materials that exhibit exotic properties not available from natural materials. Padilla and doctoral student Xinyu Liu used a metamaterial engineered to absorb and emit infrared wavelengths with very high efficiency. By combining it with the electronically controlled movement available from microelectromechanical systems (MEMS), the researchers created the first metamaterial device with infrared emission properties that can be quickly changed on a pixel-by-pixel basis. The new infrared-emitting device consists of an 8 × 8 array of individually controllable pixels, each measuring 120 X 120 microns. They demonstrated the MEMS metamaterial device by creating a "D" that is visible with an infrared camera. The researchers report that their infrared emitter can achieve a range of infrared intensities and can display patterns at speeds of up to 110 kHz, or more than 100,000 times per second. Scaling up the technology could allow it to be used to create dynamic infrared patterns for friend or foe identification during combat. In contrast to methods typically used to achieve variable infrared emission, the new technology emits tunable infrared energies without any change in temperature. Since the material is neither heated nor cooled, the device can be used at room temperature while other methods require high operating temperatures. Although experiments with natural materials have been successful at room-temperature, they are limited to narrow infrared spectral ranges. "In addition to allowing room-temperature operation, using metamaterials makes it simple to scale throughout the infrared wavelength range and into the visible or lower frequencies," said Padilla. "This is because the device's properties are achieved by the geometry, not by the chemical nature of the constituent materials that we're using." The new reconfigurable infrared emitter consists of a movable top layer of patterned metallic metamaterial and a bottom metallic layer that remains stationary. The device absorbs infrared photons and emits them with high efficiency when the two layers are touching but emits less infrared energy when the two layers are apart. An applied voltage controls the movement of the top layer, and the amount of infrared energy emitted depends on the exact voltage applied. Using an infrared camera, the researchers demonstrated that they could dynamically modify the number of infrared photons coming off the surface of the MEMS metamaterial over a range of intensities equivalent to a temperature change of nearly 20 degrees Celsius. The researchers say that they could modify the metamaterial patterns used in the top layer to create different colored infrared pixels that would be each be tunable in intensity. This could allow the creation of infrared pixels that are similar to the RGB pixels used in a TV. They are now working to scale up the technology by making a device with more pixels -- as many as 128 X 128 -- and increasing the size of the pixels. "In principle, an approach similar to ours could be used to create many kinds of dynamic effects from reconfigurable metamaterials," said Padilla. "This could be used to achieve a dynamic infrared optical cloak or a negative refractive index in the infrared, for example."

Source https://www.sciencedaily.com/releases/2017/04/170413101843.htm

10. Nanoparticle Research Tested in Locusts Focuses on New Drug-Delivery Method

Delivering life-saving drugs directly to the brain in a safe and effective way is a challenge for medical providers. One key reason: the blood-brain barrier, which protects the brain from tissue-specific drug delivery. Methods such as an injection or a pill aren't as precise or immediate as doctors might prefer, and ensuring delivery right to the brain often requires invasive, risky techniques. A team of engineers from Washington University in St. Louis has developed a new nanoparticle generation-delivery method that could someday vastly improve drug delivery to the brain, making it as simple as a sniff. "This would be a nanoparticle nasal spray, and the delivery system could allow a therapeutic dose of medicine to reach the brain within 30 minutes to one hour," said Ramesh Raliya, research scientist at the School of Engineering & Applied Science. "The blood-brain barrier protects the brain from foreign substances in the blood that may injure the brain," Raliya said. "But when we need to deliver something there, getting through that barrier is difficult and invasive. Our non-invasive technique can deliver drugs via nanoparticles, so there's less risk and better response times." The novel approach is based on aerosol science and engineering principles that allow the generation of monodisperse nanoparticles, which can deposit on upper regions of the nasal cavity via diffusion. Working with Assistant Vice Chancellor Pratim Biswas, chair of the Department of Energy, Environmental & Chemical Engineering and the Lucy & Stanley Lopata Professor, Raliya developed an aerosol consisting of gold nanoparticles of controlled size, shape and surface charge. The nanoparticles were tagged with fluorescent markers, allowing the researchers to track their movement. Next, Raliya and biomedical engineering postdoctoral fellow Debajit Saha exposed locusts' antennae to the aerosol, and observed the nanoparticles travel from the antennas up through the olfactory nerves. Due to their tiny size, the nanoparticles passed through the brain-blood barrier, reaching the brain and suffusing it in a matter of minutes. The team tested the concept in locusts because the blood-brain barriers in the insects and humans have anatomical similarities, and the researchers consider going through the nasal regions to neural pathways as the optimal way to access the brain. "The shortest and possibly the easiest path to the brain is through your nose," said Barani Raman, associate professor of biomedical engineering. "Your nose, the olfactory bulb and then olfactory cortex: two relays and you've reached the cortex. The same is true for invertebrate olfactory circuitry, although the latter is a relatively simpler system, with supraesophageal ganglion instead of an olfactory bulb and cortex." To determine whether or not the foreign nanoparticles disrupted normal brain function, Saha examined the physiological response of olfactory neurons in the locusts before and after the nanoparticle delivery. Several hours after the nanoparticle uptake, no noticeable change in the electrophysiological responses was detected. "This is only a beginning of a cool set of studies that can be performed to make nanoparticle-based drug delivery approaches more principled," Raman said. The next phase of research involves fusing the gold nanoparticles with various medicines, and using ultrasound to target a more precise dose to specific areas of the brain, which would be especially beneficial in brain-tumour cases. "We want to drug target delivery within the brain using this non-invasive approach," Raliya said. "In the case of a brain tumour, we hope to use focused ultrasound so we can guide the particles to collect at that particular point."

Source https://www.sciencedaily.com/releases/2017/04/170412145225.htm

Engineering Innovation in India
India's Longest Road Tunnel in Kashmir Inaugurated

Hon'ble Prime Minister Shri Narendra Modi has formally inaugurated the longest road tunnel in South Asia, between Chenani and Nashri in Jammu & Kashmir. The 9.2 km tunnel, which will bypass snow-and landslide -prone Kud, Patnitop and Batote on National Highway 44, marks significant road building firsts in India, including an unprecedented stress on user safety.

Here are ten things to know about the tunnel:

1) The work on the 9.2 km-long twin-tube tunnel, which is part of a 286-km-long four-lane project on the highway, started on May 23, 2011, in the lower Himalayan mountain range, and cost Rs 3,720 crore. It is built by Infrastructure Leasing & Financial Services (IL&FS) Ltd.
2) It is located at an altitude of 1,200 metres (nearly 4,000 feet) in difficult Himalayan terrain. It will reduce the travel time on National Highway 44 between Jammu and Srinagar by about 2 hours by shortening the distance between the cities by 30 km, and will altogether bypass Kud, Patnitop and Batote, locations where the highway is prone to being blocked by snow and landslides.
3) The tunnel will be the first in India to be equipped with world class "integrated tunnel control system" through which ventilation, fire control, signals, communication and electrical systems will be automatically actuated.
4) The tunnel comprises two tubes that run parallel to each other — the main traffic tunnel of diameter 13 m, and a separate safety or escape tunnel of diameter 6 m alongside. The two tubes — each approximately 9 km long — are connected by 29 cross passages at regular intervals along the entire length of the tunnel.
5) With inlets every 8 m bringing fresh air into the main tube, and exhaust outlets every 100 m opening into the escape tube, the Chenani-Nashri tunnel is the country's first — and the world's sixth — road tunnel with a transverse ventilation system.
6) Transverse ventilation will keep tailpipe smoke inside the tunnel at a minimum level — this is important, to prevent suffocation and keep visibility at acceptable levels, especially since the tunnel is so long.
7) SOS boxes installed every 150 m will act as emergency hotlines for commuters in distress. To connect to the ITCR to seek help, one would only need to open the door of the SOS box and say 'Hello'. The SOS boxes are also equipped with first-aid facility and some essential medicines. In case of breathlessness, claustrophobia or other discomfort, or in case of breakdown of a vehicle, the commuter will be expected to inform the ITCR the number of the nearest crossway, and an ambulance or crane will be rushed through the parallel escape tunnel.
8) Commuters will also be able to use their mobile phones inside the tunnel. BSNL, Airtel and Idea have set up facilities inside the tunnel to carry signals. To prevent diminution of vision as a result of change in the light while going in or coming out of the tunnel, the lighting inside has been adjusted at a gradient of luminous strength.
9) Despite having been excavated in a difficult Himalayan region, both tubes are 100% waterproof. There will be no seepage of water from the ceilings or any of the walls of the tunnels.
10) Travel will cost an LMV vehicle Rs 55 on one side and Rs 85 for a to-and-fro journey and Rs 1,870 for one month travel, while bigger vehicles like mini buses will have pay Rs 90 as one side toll and Rs 135 for a to-and-fro toll. Buses and trucks will have pay Rs 190 as one side toll and Rs 285 as two side toll.

Source http://www.financialexpress.com/india-news/modi-to-open-longest-chenani-nashri-road-tunnel-in-kashmir-on-sunday-10-cool-things-to-know/609639/