Machines; http://igem.org) contest from IISER Pune was also notable by its presence. For the past few years, several student-teams from India are participating in the iGEM, an international competition where teams of students use standard, interchangeable parts to build genetically engineered biological systems to solve real-world challenges. In the midst of the busy schedule of the meeting, participants also visited the famed Karla Caves. The carving of these Buddhist caves is thought to have begun in 200 BCE and completed in 500 CE. However, for some of us it also struck a chord of the similarity between the complex biological networks, for which we are seeking to make design plans, and these ancient caves whose design plans are all but lost. Thankfully however, as the meeting highlighted, discovering the 'plan' from biological networks is a more tractable problem, if we can develop mathematical models and test them experimentally.

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OPINION

An expedition from 'time-pass research' to innovative research

S. Chandrasekaran

Human society is under severe threat from the problems triggered by natural as well as human-mediated activities. Providing solutions to these emerging problems by the conventional way of thinking is largely insufficient to meet these challenges. Therefore, innovative research is mandatory to efficiently tackle them. The problems faced by developing countries, particularly India, are different from those of the developed nations. At this juncture, it is highly expected from Indian researches to find suitable solutions through innovative research. Being the fastest growing economy in the world, the Government of India (GoI) supports many of these nonconventional research ideas which can be witnessed through many of its recent programmes. The 'High Risk High Reward' programme initiated by the Department of Science and Technology, New Delhi, addresses and funds research activities that are conceptually new and risky, mainly to promote new hypotheses and scientific breakthroughs. Another initiative by the Ministry of Human Resource Development (GoI), 'Impacting Research Innovation and Technology' (IMPRINT-India) is in place to link the gap prevailing between the science and technological institutions and to find innovative solutions to the problems faced by humans. A fund of Rs 1000 crores has been allocated for this programme. Though presently university researchers like us are unable to participate as Principal Investigators in this programme, we hope to be included in the future. The latest budget announcement stated that 10 universities in our country will be given Rs 500 crores each to upgrade their status to world-class institutions. The University Grants Commission (UGC), New Delhi plays a vital role in providing favourable atmosphere for taking up research activities. The Information and Library Network (INFLIBNET) takes care of providing most of the journals and books to researchers through the internet. Many central funding agencies generously support the development of infrastructure facilities in the institutions. All these programmes clearly convey the message that financial assistance is not a constraint to pursue innovative research in India.

Apart from the infrastructure facilities, researchers need an original and worthwhile research idea. Most of the present generation scientists think that research happens somewhere in the air-conditioned laboratories with uninterrupted internet access and sophisticated equipments. The information available to address a research problem is not necessarily restricted within the concrete walls of a laboratory. If we recall the history of scientific discovery, we will notice that most of the findings arose from keen observations. One of the best examples is that of C. V. Raman, who conceived the path-breaking discovery by intently observing the scattering of the sunlight by water molecules in his leisure hours, while travelling back on a ship from England. This critical observational skill is essential for innovative research. Once we cultivate the skill to identify innovative ideas, such ideas will keep us engaged lifelong. This might be the reason why many scientists could discover more than one significant research finding in their lifetime in different fields.

Marvin Herndon[1] stated that science is evolving by replacing less precise knowledge with more precise understanding. However, most researchers are now satisfied with the 'less precise knowledge' and keep themselves from thinking out of the box. When I happened to see a large number of honey bees foraging on disposed paper cups in a dust bin of a coffee shop, it provoked me to

ask so many questions and understand the phenomenon. The publication received greater attention among the ecologists and one of the co-authors was given the DST-SERB Young Scientist award for further research on the topic. From an innovative research idea to project, paper and any deliverable, needs passion, collaboration, exchange of ideas and ever-constant effort. Such efforts, even though carried out in low numbers, yield high rewards.

There is no doubt about the growth of Indian science in terms of the number of higher education institutes, research papers published, research degrees awarded, projects sanctioned, patents filed, etc. When we critically analyse the growth, it is mostly 'horizontal' and rarely 'vertical'. Specialized institutes established in the unique niches also address more general problems. Most of the time, personal research interests of a scientist mask the research objectives of his/her host institution. It is convenient to conduct research on what we know, but this will not help us to develop or think vertically and eventually will only lead to horizontal growth. Predatory stress-free dodo were wiped off from the face of the earth when they suddenly came across their predators. On the contrary, 'predatory' journals may lead to the 'extinction' of innovative thinkers in certain disciplines. The steps taken by the UGC to promote teaching and research through Academic Performance Index (API) resulted in the proliferation of numerous journals and conferences having no scientific value. The innovative ideas have to be complemented with a commitment to deliver results. Darwin[3] in his autobiography describes his degree of eagerness in studying nature as follows: '... saw two rare beetles, and seized one in each hand; then I saw a third and new kind, which I could not bear to lose, so that I popped the one which I held in my right hand into my mouth'. This incident is one of the few well-known examples stating now a researcher has to perform in the face of a new finding. It has been entrusted to us in the hope that the tax-payer's money will be put to good use in addressing and analysing the problems faced by the common people. Thus it is our responsibility to stop 'time-pass research' and work towards greater understanding of the problem and apply the knowledge gained into something useful to our society.

Researchers require a medium of communication to share their findings to the world. Traditionally conferences, seminars and symposia, journals and books have served this purpose. Now-a-days, after the introduction of the 'impact factor' in research journals, researches have become crazy about it. Most recently, the very purpose of conducting research has shifted from pioneering to publishing in 'high impact factor journals'. To make money out of this mania, predatory journals have started posting misleading 'original' impact factors on their websites to lure authors. These publications can mislead experts in interview panels into making 'inappropriate appointments' (intentionally/unintentionally) with those research articles as criteria, which neither serve any social purpose nor have a 'real impact factor'. Thus, to sustain real innovative research, India-based innovative measures have to be developed to protect scientific progress.

Some researchers are never satisfied with the facilities provided by their host institutions and also discourage people who are enthusiastic about research. I want to convey that we can contribute to nation-building, irrespective of the available resources by means of innovative thinking and serious commitment. So far, many of us have and are still working on the scientific hypothesis proposed by other countries to address their local/national problems. It is high time to develop our own hypothesis and address the issues at hand. We have had a tendency to overlook or underestimate problems at the back of our hand unless and until a foreign entity recognizes it and gains from it; then we follow their footsteps. It seems that we are still mentally enslaved to the West and are failing to recognize our own ability.

Any society that has a long history and rich heritage will have a lot of things to study, and luckily, we are living in one such country with a diverse societal group. The knowledge base and practices inculcated in each individual societal group in the country are innumerable. This can be witnessed from the two Nobel laureates, George Arthur Akerlof and Angus Deaton, who developed their principles based on the studies carried out in India. We have been and are still looking 'elsewhere' for innovative ideas, but fail to recognize that problems and their solutions are 'hidden in plain sight' everywhere in the country. Uma Shaanker[4] has mentioned about the 'Martina Hingis effect' in Indian science. In general, most of the foreign-returned scholars are either working on 'exotic problems' or on the 'crossroad' to the Indian scenario. I believe that if these researchers focused on innovate research rather than working on borrowed ideas from their western counterparts, we could better address the problems at hand in our country. All we have to do is observe keenly with a wider perspective. Maybe we might soon land on one such discovery which would impact or change life as we know it. Though we have had a few hiccups in identifying a potential problem, we hold huge potential for innovative research. The expedition from 'time-pass research' to innovative research will bring more laurels to our scientists and our nation.

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ACKNOWLEDGEMENT. I thank the reviewer for his constructive comments which helped improve the manuscript.

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