

Mind the gap: reflections on the art of science

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Scientific research in India has for too long been conducted at a distance from the public, within gated communities of select and chosen few. Fundamental research in basic science, which is the essential groundwork that eventuates in all of the advancements in technology and medicine as well as empowering economic development, goes uncommunicated outside the peer group and is often considered uncommunicable. The translations that approach the lay public also often continue at a distance and, consequently, the outreach that places the product in the public domain is restrained. This article attempts to explore many of the issues around the communication gap, questioning perceptions and convictions in the science-society landscape.

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The state of the nation

Ask a dozen scientists why they do science, or what it is to be doing science, and you get a surprisingly large range of answers and notions of the meaning of it all. Professional scientists and academics most naturally offer answers to the why and what of doing science that give significance and security to their individual and unique perch. They speak from their individual and peculiar scientific culture, which differs amongst the scientific cohort. To each his own!

Yet the lay public – and I really include the educated professionals here – engaged in the many walks of life, outside of our universities and research centres, seem to have a fairly monotone image of academic professors and scientists. There is this gap between the image and the reality of people in these institutions.

Today as I walk outside our island universes of scientific institutions I sometimes hear of activism against what some spirited lay public see as yet another unfortunate outcome of science-driven development that we as a human race seem to have a compulsion to nurture. Are they saying no to science per se, or are they really saying no to its products? And is this opposition arising from their perception of the economic reverberations of those products of science? Or perhaps the sociological consequences of some products of translational research? And are those at the helm of the political and economic agendas deliberately and conveniently identifying science as the target of the disapproval, when in reality it is the socio-economic impacts of product classes that are the spark for the flames of passionate outcry? Is science being portrayed as a ‘holy cow’ so that the advocates of

the merchandise occupy a moral high ground to thence silence furore against the ills of a dairy industry?

I hear a voice from concerned citizens beyond the hallowed walls for science to be ‘holistic’. It gets articulated in different ways. Should not the scientific community in universities and in our research institutions take a holistic view and tread with caution as they translate playful inventions of concepts and theories into tangible products that potentially impact on our lives and livelihoods? Should not our scientists be concerned and take responsibility for the end use of their efforts? How could they live in denial of the side effects to the physical health and well-being of people and the planet from products that arise from the development, which is in truth ultimately caused by their research? How could the scientists ignore the devastation to livelihoods, and the psychological trauma of the disadvantaged who find themselves on the far side of the ‘use by’ date pinned to their tunics by a development agenda, which is in truth essentially fuelled by science?

A few years ago the Government gave the thumbs down to introducing genetically modified brinjal in India. This was after a series of ‘Town Hall’ meetings where all opinions were given free expression. Talking about this a few days ago led an eminent scientist to throw me an interesting question: if X-ray machines were invented today and a public debate is launched on whether or not it ought to be used in hospitals, would public opinion disallow this? I do not think this is a pointless question; I do in fact think we may actually never have such diagnostics if their introduction were decided by a majority democratic vote, with free election-style campaigning from all sides! At the same time, I do not think we want a decision on end use of such inventions to be determined by the political-corporate stakeholders who have vested economic interests in its acceptance. How do we find a middle path?

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It is worthwhile attempting to make sense of the image that the public has of science and scientists, and the notions that scientists have of themselves and their place in society, so that we may try to divine the currents that grow the distance between scientists and the public, which leads to mutual distrust and hence a problem where perhaps genuine gifts that science may have to offer the public are rejected.

The art of science

Science to me is creative, inventive and playful. It plucks out of thin air hypotheses and configurations that would otherwise never exist and cannot be derived from what existed before. Of course, the converse is not true – to be creative, inventive and playful need not be science! We have several well-known examples of scientists in the Indian scene with seemingly inborn creativity or, in other words, an innate and perhaps unfair capacity to think outside the obvious extrapolations of history: C. V. Raman and Srinivasa Ramanujan, to name a few.

I view the rendition of science exactly in the same light as an artist creating an expression on a canvas. ‘Good’ scientists are people that create for humanity. And we do expect that they create imaginations in thought, mathematical expressions, clever gizmos that might be expected to be beautiful, useful and durable. These three qualities together are known as the BUD principle, which I first learnt from the writings of Satish Kumar, who has been editor of *Resurgence Magazine* since 1973. The BUD principle that has been proffered as a measure of the goodness of honest work of an artisan, is perhaps also a worthwhile measure for creations of science? From a perspective of what it is to be human, I wonder if the art of science, as I have sketched it, is any different from the creations of passionate studio potters?

And the technique of science

Most of my colleagues who practise science day in and day out have indeed a strong schooling in what is called the method of doing science: the scientific method. Which is today no longer a method but a whole class of methods, some of which may be stamp collection to the purists, but which may nevertheless score the highest in the perpetually debated metrics!

The advancement of the knowledge of humanity, in this professional quest, is conducted most often by incremental progress that rests on the laurels of the imaginations of the past, and creates a petal here, a branch there, a flower somewhere else, all of which may potentially be refuted and reset to nothingness or to a different fabrication by peers.

The quest is necessarily lost in the local weave of the fabric of the canvas, mindless to the distractions of the

real world outside. I wonder if this progressive effort could even happen without such an unholistic style, which may nevertheless be well intentioned towards humanity in its endeavour. That any focused research could mean well may be difficult to palate for the uninitiated outside the walls, but such is the reality of life in the sanctuaries.

Plurality within the proponents

Every species on Earth abounds in diversity, and this has presumably always been so. India is blessed with a wonderful plurality in its people; this is not merely an idea. The plurality in people is not only in appearances; the outlooks, the worldviews, perceptions of the place of rationalism, belief systems, mysticism, and religiosity appear together as a confusing and self-contradicting melange. What may apparently seem to be opposites happily coexist in individuals, families, and institutions.

I think it wonderful and progressive that most research institutes of the country can engage in very rational and objective scientific research with modern equipment, on problems in mainstream science, with methods and outcomes that are perfectly acceptable in the scientific world, and yet be comfortable celebrating together occasions like *Ayudha Pooja* every year! It is not only the once-removed ancillary staffs that celebrate the culture; the scientific staffs also mindfully engage with the joy befitting the occasion.

The plurality is in individual people – does not matter whether they are public or scientists. There is a similar spectrum in attitudes and outlooks amongst scientists and professors in universities as in the public, and I wonder what it would take for the public and for the academic communities to see this actuality, and drop any colourless image of academics that may have been the norm some centuries ago.

Driving encounters the spectrum of the people in any city; drivers are a reasonable mix of the attitudes in a city. And the encounters on the street are the same as the encounters in any walk of life, including within scientific bodies and even within the highly selective learned academies.

Scientists are indeed humans who have undoubtedly been moulded by their spending considerable time in select company reading select literature and engaging in communications with peers that requires a language that is learned and evolves within that fraternity. But as the mystic J. Krishnamurti often reminds us, let’s not forget the million years of evolution that has shaped us and may totally dominate the innate aspects of our comportment. There may be much more to common *nature* across humanity that has flowered through the togetherness over millennia, and expressed as relationships, compared to the individuality that is *nurtured* in the brief and most recent history of separateness.

Inevitably the plural landscape leads to a variety of inventions and devices based on primal frolic and these are

admittedly inclusive of high-risk bestowals that have time and again proved disastrous. Sometimes these hand downs have been cleverly packaged; sometimes they are creations of small minds with blinkered vision. While we focus on the ills, we tend to forget the positives. But that is no consolation for the radicals, who understandably desire that those with the higher learning exhibit only a holistic and responsible outlook.

Much is labelled as ills of science, as examples of how science has been negative for humankind. Activists see GM foods as a disservice of science and atomic energy as a disservice of science. His Holiness the Dalai Lama gives us a perspective of science as an empowering imagination gifted to the world by the creative side of scientists, after which what humankind – including scientists themselves – does with it depends on who amongst the spectrum picks it up and towards what point of the compass they run with it.

Pluralism within any fraternity is essential to the development of imaginative thinking; plurality is essential to keeping both the arts and science alive. Perhaps this is a trait within, which we cannot be without.

Pathways in science

The artistry of pure science is, of course, merely a small dimension amongst the plurality within the community. The spread of ingredients that flavour the potpourri is well beyond the imaginative capacity of even the proponents of the trade.

As children amazed by experiences of creations of nature and mankind, many of us have asked the why and how of fascinations from motorcars to the heavens above. To be positively generative has been believed to be encouraging questioning and finding out – within the scientific world of reasoning. There is a certain joy in being acquainted with science for science's sake, and the epitome of scholarship and higher learning is universally assumed to be academic professionals – professors – in universities.

There is undoubtedly personal happiness to be gained with deep appreciation of the beauty in creations in science, and excellence in higher learning provides genuine seekers this delight. Deriving joy via higher learning is akin to the joy that derives from acquiring and internalizing an appreciation for music, or for art forms, which may also require considerable perseverance. And erudition in the teaching fraternity is inspiring for the aspiring.

While there are pro grade pathways, there are also retrograde alleyways lacking illumination. While erudition and scholarship are obviously significant districts in the landscape of science, I would question any interpretation of research that frames it to be essentially re-search, as any agenda that attempts a refocus to mythology would have us believe. The advancement of the knowledge of our scientists – knowledge creation – is a very artistic

quest at times and a methodical exploration at times but certainly not a historical summary.

Most scientists today work in laboratories and institutions in directed research, working together in a focused planned effort towards set goals deemed to be of importance to economics and society. The managed research often explores multiple trackways – feeling its way almost organically – finding an economical path of least resistance. The enterprise efforts towards capacity building in atomic energy and the development of enabling technologies related to deploying payloads in space near and far from Earth are excellent successful examples of such research in India, which are also prominent in the public face of science.

Professor Kulkarni at CalTech has, on his website, reproduced an age-old definition of what most scientists might do as part of the furtherance of the frontiers of our knowledge – that the work of science is 99% perspiration and 1% inspiration. In the current global model of mega-project based science, which is the preferred philosophy of science management when directed by a body corporate, we have conglomerates with 99% of scientists perspiring and a pathetic 1% inspiring. This character of the scientific community is a far cry from the profile that scientists have in the public imagination.

There is, of course, no bimodality in the dispersal of scientists in this landscape; most may balance their livelihoods and find themselves a comfortable mix of styles, which may change with their movements in time and space.

Technologists or engineers, or what we may call scientists involved in 'translational research', develop products responding to a need, or more often develop products responding to a perceived opportunity to create a want. It is at the other end of the compass, hidden within the folds of these gigantic missions and dispersed amongst the hundreds of universities, research laboratories and institutions of the country, that we have scientists who are academically free, free from research management in the sense that they are by and large free to choose their research areas and themes, even though – and correctly so – not free from peer review that enshrines their academic freedom.

Whereas the scientists in the managed research laboratories are selected and hired on the basis of their expertise in the specific problem they would be expected to solve in their job function, those in the academically free worlds are selected on the basis of their demonstrated expertise in their own chosen areas of research, and are simply expected to continue with and better 'the good work'.

It's the 'free souls' – both in the academic world of research as well as in the community of inventive start-ups – that are often the ones most capable of engendering disruptive paradigm shifts that time and again shake the notional security of humankind. These are the sparks that make Silicon Valley light up, and give the activists sleepless nights.

.....Moving on

To understand the standpoint from which most scientists speak their mind, it is of interest to explore the question of whether scientific theories require belief. Do scientists 'believe' in their theories? Do scientists consider their theories as a representation of the actuality we experience? Another way of posing this question is to ask whether or not the laws of physics are imagined to be *discovered* or *invented*!

Most scientists schooled in modern traditions and growing up in our scientific nation do believe in science, which is the seed of rationalism or rational thinking, however disconnected it may be with the plurality of our cultural experience and living truths in India. The evolution from natural philosophy to scientific rationalism as a basis for our house of cards has been a paradigm shift in history, and I wonder if modern science would suffer if we were to drop the notion – if and where it exists – that all of the associated erudition is representative of a truth rather than an artistic expression. And I wonder if science would be of any less value to humanity if we were to accept that the laws of physics are inventions of their scientist-inventors – in here in our minds rather than out there in nature. Would such an 'awakening' expand and deepen the perspectives of the scientific community, 'demote' them from any status equivalent to interpreters of sacred texts, and lend connectedness with society at large?

There are aspects of scientific imaginations that appear counterintuitive, and hence almost mystical, and laypersons or even philosophers sometimes adopt these domains that appear to be esoteric to seemingly give a scientific basis for intangibles and experiential subjectivity.

Perhaps we may question the notion, which is widespread among the scientific cadre, that the more classical 'Newtonian' physics is intuitive. Does our comfort with classical physics stem from an evolved innate notion of the geometry of the space we experience and the symmetries in nature? That it is in our genes, so to speak, rather than in the objective science we profess?

And on the other hand, why the obsessive compulsion to give a 'scientific' theory for astrology, or 'scientific' evidence for the (super?) natural powers of the Ganga? Do we want to attempt to have 'scientific' theories for the 'unscientific' practices and predictions? Perhaps it is time to debate whether the nation state might be deemed as plural rather than scientific, to allow for plurality in evidencing as well?

I have been intrigued by the choice of words sometimes used to glorify the sciences. A title such as 'Truth and beauty: aesthetics and motivations in science' appears to give synonymy to beauty and truth in the context of scientific imaginations. Is a theory that appears beautiful likely a closer representation of the truth? Does scientific progress require such notions, or do such prejudices come at a cost of widening the distance between practi-

tioners of science and the bigger world in which we have no choice but to coexist?

There is to me a lack of public appreciation of the risk factors inherent in every gift from science. Perhaps it is a mistake to 'believe' that science is complete in its knowledge. Perhaps it is a mistake to have labelled India as a 'scientific' nation, without a dialogue of what is science, what it is to be scientific and whether such a sticker may be narrow and exclusive.

The frontiers of our scientific knowledge are very different from that of traditional knowledge, which has been time tested and experientially evolved through millennia. Research at the frontiers is competitive. And new data and new interpretations are continually feeding the arguments, taking the results to different sides of the coin, sometimes also depending on the biases of the interpreters, who may have different limitations in their own knowledge. The outcomes of scientific research can never be conclusively proven to be without side effects: perhaps in the same way that traditional knowledge has been evolved through time testing in communities, so also may scientific knowledge and the products of translational research be tested by our experience.

In the public eye, science often appears to have conclusive answers only for trivial questions; the complex issues that trouble us today – is climate change anthropogenic, are genetically modified crops the path to take, is the exposure to radiation from mobile phones harmless, are nuclear power plants safe, is the use of plastics for food storage safe – often do not appear to have definitive answers. Thence arises the question: if our scientists cannot provide us with 'scientific' conclusive answers to these significant questions, then what good is their research?

How are we to live with a scientific perspective that research to date has not revealed any harmful effects of an everyday practice, when we have come to believe that tomorrow's research could very well upturn history and reverse the understanding?

We may question the wisdom in scientists giving the public the idea that science does know a great deal, and that the results of research are conclusive. And question the trend amongst the scientific community and the development agenda to not portray the dangers, even when they are known. Can we, as a community, understand that there is a formal methodology adopted by the practitioners of science, and accept that there may be issues that require alternate approaches and methods, and that there is a place for scientific knowledge and also for traditional knowledge, which may have different methods from that of the scientific fraternity? That there is a plurality in our people – both within and outside the walls of our scientific institutions – and a plurality in methods that we may adopt for understanding and bettering the lives of the people and the Earth.

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