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Fun & joy of science

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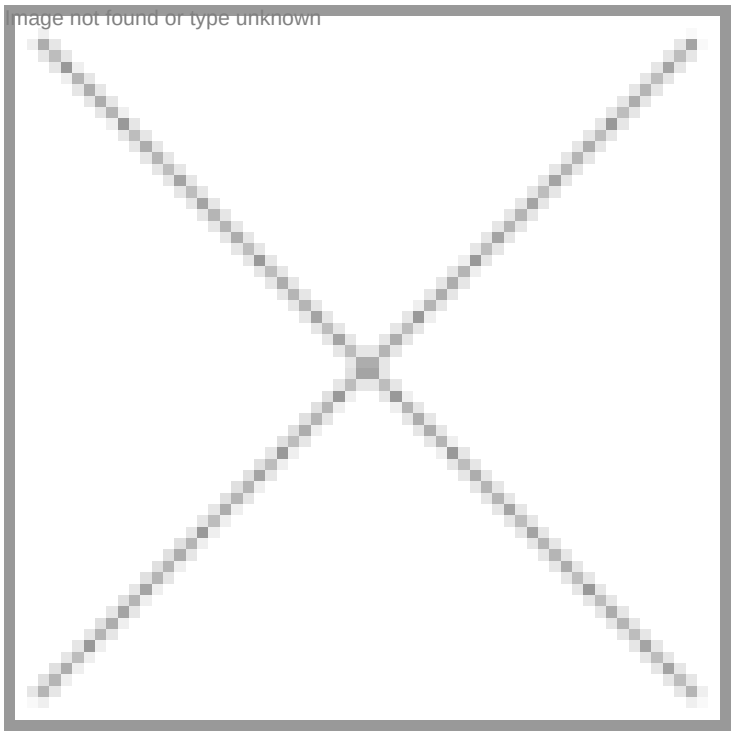

James Watson felt sure that it was going to be possible to discover the molecular nature of the gene and worked hard at it, even to such an extent that he was fired from the Rockefeller Fellowship that he had. Einstein has been quoted as saying that, when he was 15 years old, he asked himself what would the world look like if [he] were moving with the velocity of light. To attack that problem he inquired into the nature of equations that had been set up for electro-magnetic fieldsâ€"Maxwell's equations. It was the study of Maxwell's equations that led Einstein to his special theory of relativity. Einstein started thinking about the problem when he was 15; he was 25 when he formulated the special relativity equations.

RA Mashelkar

Linus Pauling worked on a problem for 10 years too before finding the solution. It is interesting to hear a story from Linus Pauling himself.

Often my original ideas have come as the result of training my unconscious mind to think about a problem. I gave as an example the one on the theory of general anesthesia. I was in Boston as a member of the scientific advisory board of Massachusetts General Hospital in 1952, and this board was lectured by the professor of anesthesiology at Harvard-Henry K Beecher. Beecher said something that I hadn't knownâ€"that the noble gas xenon can act as a general anesthetic agent. So I said to my son (who was studying medicine). "How do you think xenon can serve as a general anesthetic agent, since xenon doesn't form any compounds in the human body? It must be some sort of a physical action. I don't understand it." I thought about it day after day for several days. In the evening when I would go to bed, I would lie there and think about the problem â€¦ After a while I stopped that. Then, seven years later, I was reading a scientific paper on crystal structure, and I said to myself, I understand anesthesia. I worked for about a year gathering data, and then I published my paper on "A molecular theory of general anesthesia." So I had trained my unconscious mind to keep

this problem in view, and whenever any new thought entered my head, any new piece of information, I would connect it up with that problem to see if there was any connection â€¦

Risk taking rewards

Let me explain that risk taking is the key and therefore, in scientific research, there should be no place for those who preserve the systems in a pre-fabricated and unaltered way. A friend of mine, who is a CEO of a company from abroad, once said, "We do not shoot people, who make mistakes. We shoot people who do not take risks. What do you do?" I said, "In India, we shoot people, who take risks!" I believe this is true. The most risk-averse are government laboratories. In fact, it is more often than not that such institutions are run by rules and regulations than by objectives. The system of S&T audit in our laboratories needs an urgent relook.

When we fund "futuristic research" we are funding risks too. But many times, the view of the future is taken by extrapolating the present. This does not always work out. Indeed the ability to speculate on the future is more difficult now than ever before. Even when the pace of change was nowhere near what it is today, the forecasts made by some of the brightest minds went so wrong. Let me recall one such effort. In 1937, the National Academy of Science (USA) organized a study aimed at predicting breakthroughs of the future. Several wise statements about agriculture, synthetic rubber etc. were made. They were essentially based on an imaginative extrapolation of the present. But it missed all the things that happened. It was amusing that in their predication, there was no mention of nuclear energy, no antibiotic (although it was just eight years after Fleming), no jet aircraft, no rocketry, nor any use of space! And these are precisely the technologies that have dominated our lives in the last few decades. I, therefore, feel that we must respect judgments of those, who are capable of exceptional flights of fancy, rather than only relying on those, who are experts in narrow areas of specialization.

There is so much to learn from the innovative firms around the world as far as supporting risky research is concerned. Some firms set up goals that stretch your mind. For example, Du Pont has defined a set of "unreachable goals" like immortal polymers, zero waste processes, elastic coatings as hard as diamonds, elastomers as strong as steel, materials that repair themselves, chemical plants that are run by a single chip and coatings that change color on demand. These may sound unrealistic but they are publicized widely and enthusiastically supported. Intel motivates its innovations by saying "double machine performance at every price point every year". Unfortunately, I have to cite only these examples from the western world, since I am not aware of an Indian firm, who supports risks in the way these companies do.

We must also understand that the challenge is not only that of funding risky ideas, but also spotting and funding mavericks, who have the potential to create breakthroughs. Such unusual innovators refuse to preserve status quo. Whereas standard science management practices tend to avoid conflicts, such people create conflicts. They bring in unusual spontaneity and exceptionality to the table. Their incentives are personal and emotional. They are not institutional or financial. Such innovators are sometimes extremely intense. Greet innovators like Carother, who developed the world's first synthetic fiber nylon, committed suicide. Diesel, who invented diesel engine, also committed suicide. Managing such intense and creative people requires a subtle understanding of the pain of creation that such people undergo day in and day out.

Finally, science is an exploration of the nature of reality, both inside and outside us. The emphasis here is on things, which are quantifiable and measurable and on theories, which can be tested and demonstrated and facts, which can be observed and verified by others. Imagination plays a vital part in both science and art, but in science it has certain constraints. As Feynman said, "whatever we are allowed to imagine in science has to be consistent with everything else that we know. The problem of creating something which is new, but which is consistent with everything which has been seen before, is one of extreme difficulty".

At the same time, the difficulty with science is often not with the new ideas, but in escaping the old ones. A certain amount of "irreverence" is essential for creative pursuit in science. I believe that if we promote that irreverence in Indian science, by change of personal attitudes, change of funding patterns, creating new organizational values, creating that extra space for risk taking, respecting the occasional mavericks and rewarding the risk takers, then not only will the fun and joy of doing science will increase, but also Indian science will make that difference, that "much awaited" difference.

RA Mashelkar