THE EXCITEMENT OF DOING SCIENCE

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At a time when purely commercial attitude prevails in education it has become necessary to state the obvious, that pure science, motivated as it is by the thirst for knowledge, provides the foundation for the superstructure of science and technology which has become the mainstay of our present civilization. But even more than that it needs to be emphasized that pure science today is a natural extension of the age old and continuing efforts of intellectuals to understand the mysteries of Nature. The ancient sages searching for enlightenment went through extended periods of agony which only made the attainment of goal a matter of great ecstasy. Scientists have experienced similar moments of agony and ecstasy in their search for truth. Agony that you go through when you are searching for the elusive solution to a problem – a solution that you feel it in your bones, must exist. Ecstasy that you experience when you find it. Let us begin with an episode from the life of Issac Newton, the founder of physics as we know it today.

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Now more than 350 years have passed since the birth of Isaac Newton. The following account illustrates how his contemporaries saw Newton. This was in 1696, at a time when Newton had ceased to be a professional scientist and had become the Master of the Mint. However, a true scientist never ceases to be one. For, someone brought to his attention a mathematical problem posed as a challenge by a famous European mathematician, called Johann Bernoulli. The solution to this challenge problem had defied all scientists for over six months.

The problem may be briefly described thus. Imagine two points A and B in a vertical plane, with A at a greater height than B. Connect the points by a smooth write of any shape. Let a bead slide in a frictionless way from A down to B. Bernoulli's question was to find the shape of the wire so that the time taken by the bead to go from A to B is the least. If you think that the straight line being the shortest path connecting A and B is the correct answer, you have to think again. Indeed the answer is not so straightforward (no pun intended!) and as mentioned above the best brains in Europe had failed to crack the question.

It is said that Newton saw the question on his return from work one evening. He was intrigued by it and tried to solve it. It took him several hours but by early morning he had solved it. The curve that the wire should be shaped as is called the brachistochrone. To obtain the answer, one needs to use variational methods in calculus, a branch of mathematics Newton himself had invented. Having solved the problem, Newton sent the solution to the Royal Society, asking the President to publish and forward it to Bernoulli without revealing his authorship. When Bernoulli saw the solution, he however immediately saw that it could not have come from anyone else but Newton. His remark reportedly was: "I know the lion from his paw".

This episode illustrates the agony and ecstasy a problem can bring to a scientist. Even though he was out of touch with regular scientific pursuits, the scientist in Newton was aroused by the challenge posed and he did not rest till he had solved the problem. Let us look at an episode from the life of another great scientist.

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In his early life Lord Kelvin was known by his family name Thomson. This story refers to Thomson and another young man Parkinson both of whom were competing for the top rank in their Cambridge examination of the Mathematical Tripos. In the end Parkinson topped the list and Thomson stood second with the rest of the pack far behind.

There was one particularly difficult question which only the two had answered correctly. What struck the examiner most was the similarity of their answers; so much so that he suspected malpractice. Did one boy copy the other's answer? He called Parkinson for an interview.

"Tell me, how did you manage to solve such a difficult question?" he asked Parkinson.

"Sir, I occasionally read research journals. I had come across a paper wherein the author had solved this problem. So I knew the solution beforehand." He gave the reference to the paper.

The examiner, who himself had taken the problem from that very same paper, was impressed. He complimented the boy for going beyond the teaching syllabus and reading new articles. Dismissing him with a pat on the back he called Thomson and asked him somewhat aggressively: "I would like to know how you solved this problem. Parkinson who solved it saw the solution in a research paper. Don't tell me that you also saw it there."

"No Sir!" replied the future Lord Kelvin. "I wrote that paper."

In scientific research it is the originality that matters. Today we do not hear about Parkinson who topped the examination. But Thomson's work is part of our textbooks.

Examples of great scientists like these inspire us in our own humble efforts. Let me come down to Earth and share with you my own experiences that led me to opt for a career in science. These are experiences of my formative years, which students from schools and colleges can very well appreciate.

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That I liked maths and science was noticed by my father who made me acquainted with the recreational aspects of mathematics, with its wealth of anecdotes, puzzles and paradoxes. He did this either directly or by giving me books of this nature. He also encouraged me and my brother to do experiments. Our house in the university campus was spacious enough for him to provide a chemistry lab for myself and my brother to play with.

In those days it was customary for visiting faculty from other universities to stay with their local host and so we had mathematicians like N.R. Sen, Ram Behari, A.C. Banerjee or Vaidyanathaswamy staying with us on such visits. Even if I did not understand what they were talking about, the overall ambience did help in creating an aura about mathematics.

However, a crucial development, which helped foster a competitive spirit in me took place when I was in the VIII standard. My maternal uncle Moreshwar Huzurbazar, or Morumama as I used to address him, came to live with us in order to do an M.Sc. in mathematics. He was a brilliant scholar, having done very well at the B.Sc. examination of Bombay University. [Later in his life he was a mathematics professor and finally became Director of the Institute of Science, Bombay.]

Morumama discovered that I enjoyed doing mathematics. He also noticed that my father had two blackboards built into the walls for myself and my brother to write or draw as we wished. He found a new use for the boards. Once in a while he would write a mathematical problem or puzzle, under the title "Challenge Problem for JVN". The problem would remain on the board till either I solved it or gave in and asked for the answer (which, I am glad to say, happened rather rarely).

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Morumama's problems were certainly outside my school syllabus: they called for analytical reasoning and 'trick solutions' which would light up for me some hidden aspect of mathematics. My lasting regret has been that no record has been kept of those problems. But so far as I was concerned, I developed an attitude of taking on the challenge posed by a difficult question. When doing research in pure science, it becomes a challenge to find answer to your question...in this case, nobody knows the answer! You have to be the first one to find it. Sometimes even the question is not properly phrased and you have to state it correctly. This is where the thrill of research lies.

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Let me narrate another experience I had in 1961, when beginning my research career. I was a student of Fred Hoyle, the famous Cambridge cosmologist and one of the originators of the steady state theory of the universe. This theory states that the universe had no beginning and will have no end. It was thus a rival to the more commonly accepted big bang theory, which states that the universe originated in a primordial explosion (big bang). In January 1961, the Cambridge radio astronomer Martin Ryle announced some results that, he claimed, disproved the steady state theory. This was a challenge to Hoyle, who felt that a reply to this challenge should be given at the time Ryle presented his results to the Royal Astronomical Society (RAS) in February. To this end he asked me to work on a mathematical model that demonstrated that Ryle's findings did not contradict the steady state theory. As time was short, we had to find such a model within two weeks.

I worked on the model and within ten days we had a workable theory to present. But there was a snag. Hoyle had to be elsewhere on the day of the RAS meeting: he had already committed to talk to some college students on the very afternoon that Ryle was going to present his results. So he asked me to reply to Ryle's criticism that day. At first I was very scared as to how I would stand up to a seasoned scientist like Ryle in a debate. But Hoyle assured me that so long as I believed in the correctness of my results, I should not be intimidated by any scientist, howsoever important. Considerably reassured, I gave my little talk that day and could convey our point of view successfully.

This experience conveyed to me a lot of confidence. Science is a game one plays with specified rules: facts to base one's argument on and logic to regulate those arguments. The objectivity of science is its strength. Despite controversies, facts eventually win out. I embarked on a career based on this game of science and have not regretted that decision. Indeed I have enjoyed playing the game. If you like doing science there is nothing like it...there one is paid for indulging in one's hobby. If you succeed in finding an important result, you have the added satisfaction of having contributed to the storehouse of knowledge steadily accumulated by the human race.

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Perhaps I should also mention that books like 'Men of Mathematics', 'The World of Mathematics', and 'Living Biographies of Great Scientists' played a key role in brining to my impressionable mind the excitement and frustrations of creative geniuses. The anecdotes given in the beginning of this article tell us that science is not a drab subject to be memorized, but an arena of adventures. It is revealing to know about the pride and prejudices of great scientists, and to learn that they too occasionally made mistakes. But science itself is objective and has a self-correcting tendency that leads ultimately to the right answer. This was one motivating reason behind my opting for a career in science.

Prof. J. V. Narlikar is internationally known for his work in cosmology, in championing models alternative to the popularly believed big bang model. He was President of the Cosmology Commission of the International Astronomical Union from 1994 to 1997. His work has been on the frontiers of gravity and Mach's Principle, quantum cosmology and action at distance physics. He has received several national and international awards and honorary doctorates. He is a Bhatnagar awardee, as well as recipient of the M.P. Birla award, the Prix Janssen of the French Astronomical Society and an Associate of the Royal Astronomical Society of London. He is Fellow of the three national science academies as well as of the Third World Academy of Sciences.

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Apart from his scientific research, Narlikar has been well known as a science communicator through his books, articles, and radio/TV programmes. For these efforts, he was honoured by the UNESCO in 1996 with the Kalinga Award.

Narlikar broke new grounds in space research, when during 1999-2003 he headed an international team in a pioneering experiment designed to sample air for microorganisms in the atmosphere at heights of up to 41 km. Biological studies of the samples collected led to the findings of live cells and bacteria, thus opening out the intriguing possibility that the Earth is being bombarded by microorganisms some of which might have seeded life itself here.

Narlikar was decorated Padmabhushan in 1965, at the young age of 26. In 2004 he was awarded Padmavibhushan.

It is a great honour for us that an internationally reputed Scientist of the stature of Prof. Narlikar spontaneously came forward to contribute an article for the Golden Jubilee Magazine of Shillong College. His article inviting the students to take more interest in basic science studies and research is particularly important under the present circumstances. The copy of the letter received from Prof. Narlikar, while accepting the invitation to contribute an article, is produced below. – Ed.

Dear Dr Bhattacharjee,

I have your invitation to write an article for your Golden Jubilee Magazine of Shillong College. I once wrote an article describing why I chose a career in science. Do you think an article like that would be OK for your magazine? Please let me know at this e-mail address.

Regards.
Jayant Narlikar

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