

New Ideas in Science Brakes on New Breakthroughs

By J V NARLIKAR

ONCE God applied to a Science Funding Agency for financial support for further research in creation, citing His previous work in the field. The SFA turned down His proposal after getting it peer-reviewed. The reviewers cited three reasons for rejection. Firstly, the purposer had not worked in the field for a long time. Secondly, no scientist had been able to repeat His earlier experiment. Thirdly, none of His work had been published in refereed journals but had only appeared in a Book.

This story, going round scientific circles, is guaranteed to evoke a laugh. But it also causes introspection. With scientific research getting increasingly costlier and funding resources getting scantier, research proposals inevitably have to go through a series of vetting and shortlisting processes. The review of a proposal by peers is expected to take into consideration the credentials of the purposer, how productive and original he/she has been of late, has his/her work been relevant to contemporary thinking and has it been published in recognised refereed journals. These criteria do help to pick out solid proposals that seek to advance the current thinking one step further — proposals which are safe and sound. But the peer review system, by erring on the safe side, may miss out on the daring new ideas that bring out revolutions in science.

Island Universe

Taking examples from the oldest of all sciences, astronomy, whether it is the heliocentric theory of Copernicus, the island universe hypothesis of Immanuel Kant or the concept of relativistic degeneracy of Subrahmanyan Chandrasekhar, new insights into science have more often than not come through discontinuous steps in thinking: steps that run counter to the current dogma. And the peer review system will reject such proposals as 'outlandish'.

In the 1920s, astrophysicists were grappling with the problem of how a star can maintain its equilibrium after it has burnt out all its fuel. Because of its own gravity, any massive object has a tendency to contract and collapse under its own weight. While it is generating energy through thermonuclear fusion, a star like the Sun has sufficient internal pressures to resist this compression. But what happens to a star which has no nuclear fuel left? Such a star will contract and will get increasingly dense, unless some new effect comes in to halt the process of collapse.

The newly emerging science of quantum mechanics had provided such an effect. Known as the exclusion principle of Wolfgang Pauli, this effect essentially says that no two identical particles like electrons can be together in the same state. It, therefore, resists compression of electronic matter beyond a certain limit. When that limit is reached the matter becomes 'degenerate' and produces its own strong pressure. And so it was believed that a star, howsoever massive it may be, finds a new state of equilibrium under this pressure and in that state it is seen as a white dwarf star.

Newton Guilty

In the early 1930s, Chandrasekhar found a crucial defect in this argument: it had ignored the relevance of special relativity to very energetic electrons. As electrons are packed more and more tightly, they begin to acquire higher and higher energies. To study the pressure produced by such fast moving electrons, the theory of relativity is a must. So he argued; and as he corrected this defect, Chandrasekhar found that degeneracy sets in only for those stars whose mass is not more than about 40 per cent above the Sun's mass. So no white dwarf more massive than this limit could possibly exist.

This result of Chandrasekhar, however, ran foul of the then current dogma. Sir Arthur Stanley Eddington, who had done pioneering research on the internal constitution of the stars, poured ridicule on Chandrasekhar's idea of relativistic degeneracy. And such was Eddington's influence on the establishment that the idea remained blocked for several years. Eventually, of course, Chandrasekhar was vindicated and the mass limit for white dwarfs became known as the Chandrasekhar limit.

History of science is full of examples where leading scientists and intellectuals blocked emerging ideas that did not conform with their pet beliefs. No less a person than Isaac Newton was guilty of holding up progress of the wave theory of light.

Today, six decades on, with much greater emphasis on objectivity, academic freedom, etc. are we better off? Hardly. For, a new element has now entered the equation. Scientific research has become a big money proposition.

This nourishes existing dogma and discourages new ideas. Even experienced and distinguished scientists find themselves in a catch 22 situa-

tion when submitting proposals not favoured by the establishment. One peer report said: "Such research should not be published in any reputed journal", while another said: "Since no reputed journal has published any work on these lines, it is no good". Likewise, one peer commented: "No research student or post-doc should be encouraged to work in this field" while another argued, "Since there are no young scientists working in this field, it has no future." How can new ideas surface in such a dogmatic environment?

Had such a system prevailed five centuries ago, Copernicus would have found all his research funds turned off while Galileo would have found it hard to work in an observatory or a laboratory. I am sure the peer review system, outwardly more humane and just, would have been just as effective as the Inquisition.

There is a way out of this impasse, but it requires a courageous step. I feel that the various research institutes and SFAs should keep aside, say, ten per cent of their budget for venture research where they will support scientists of established credentials for their well thought out but out-of-the-mainstream ideas. It is a risk well worth it. But unless this practice is universally accepted, it won't work as I discovered recently.

Academic Freedom

While drafting the project report of my new centre at Pune, I had been careful to make provision for supporting new ideas alongside the conventional mainstream research. Here, I felt was an institution where fresh thinking would be encouraged. However, a student who had shown great enthusiasm to work on one such idea approached me recently wishing to switch to a more conventional field. "The other students ridicule me: they warn me not to work in such an area as it would harm my future career," he said. Sadly, I let him make the change, for I could see his point of view. Here was peer pressure at work even at the student level. But shouldn't an institution that prides itself on academic freedom, have shown tolerance of alternative views? Otherwise, what hope is there for new breakthroughs?

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