

## Freeing science from the tyrannies of funding and peer review

The editorial entitled 'Purposeless research' by P. Balaram (*Curr. Sci.*, 1999, 77, 481–482) made an excellent case for 'amateur science' done for the love of it. The damage done to such by our present system of proposing and publishing is both more pervasive and more subtle than made out in the editorial.

First, in the interests of full disclosure, I should state that in my first science policy book *Lost at the Frontier* (with D. Shapley) I coined the terms 'telestic' and 'atelestic', i.e. 'with purpose' and 'without purpose', as the most significant and functional distinctions today among different categories of science; hence I liked title of the editorial. On the other hand, I am among the most vocal supporters of purposeful science as the central motif for all public funding.

My position, now slowly gaining ground worldwide, is that *public* funds must be given only for identifiable public purpose. How else can scientists distinguish themselves from what I called 'welfare queens in white coats' a term now fully installed in the debate; for are we any better than 'welfare queens' when we take huge sums from public coffers just for our own pleasure? This position most importantly restores the absolutely essential ingredients of honesty and integrity back into parts of the science community. I have been pained to see mental gymnastics and verbal torture, and even thoroughly bogus (recall Lederman's book title *The God Particle*) appeals to the religious sentiments of the decision-makers to justify public funds, by some colleagues working in esoteric fields such as *particle physics, astrophysics and cosmology*. These are all noble, worthy pursuits, but not with public funds.

But as I also argue, removing 'purposeless research' from public control can also improve the style and funding status of such research. Here is how it can be done. First, regarding funding – I refer the reader to the book by the Cambridge biochemist Terence Kealey *The Economic Laws of Scientific Research* (St. Martin's Press 1998) in which he makes the case in great quantitative detail of how public-funded research is debilitating to quality. Instead, privately-funded research is much more creative

and innovative. He uses data largely from England, Germany and France. India would have proved his case even more dramatically. Which CSIR lab funded J. C. Bose, C. V. Raman, Meghnad Saha, etc. My position goes on further. I argue that the entire mindset of science has been distorted by focusing not on doing research, but on getting money to do the research. Every American faculty member is psychologically distracted if not obsessed with the latter. The solutions I offer for 21st century science funding to the US, Europe and India are as follows:

(1) Go after private funding for atelestic (purposeless) science (and humanities). The estimate is that in the US some ten trillion dollars will change hands via inheritance from my generation  $\pm 10$  years to the next (i.e. in the next 20 years). The community of science has to make the case for funding such atelestic science to the wealthier citizens. It is *not* at all a hopeless case. Private sources have recently provided hundreds of millions of dollars for telescopes. In the US private appeals net annually \$ 100–300 million for cancer, heart or lung research. But scientists must make the case via the media and directly to individuals. The numbers are staggering. If the world's billionaires were to give half the increase of their wealth in one year to an International Foundation for Culture (including atelestic science) we would have an endowment turning out more money than the world's total for atelestic science (less big science's unlimited appetites). The national governments, under UN prodding, could give some tax breaks as incentives, thereby involving the public in paying a (small) share.

(2) Follow Alvin Weinberg's suggestion of the 1970s of making purposeless research an overhead on purposeful research. Thus a department that attracts \$ X million in purposeful research, gets say \$ 0.15X for purposeless (or whatever) research. The US Defense Department for many decades had exactly such a mandated internal tax on all its industrial contracts. Amazingly no other agency (to the best of my knowledge) has copied this obvious strategy. The argument is simple, surely a scientist doing something useful for her (or his) country

should be encouraged to exercise her other creativity on the side on, literally, any topic, telestic or atelestic.

(3) Bootleg all really new, including purposeless, research. My research career in the US goes back to the era before there was *any* public funding. Yes, Virginia, there was such an age. Professors had time for research, even time to think; the University provided some rudimentary pieces of equipment; in our field we often scrounged a few gifts or second-hand pieces of gear from industry, occasionally a new electron microscope or XRD was found possible. But by far the biggest, absolutely unsurpassable, value of this situation was that we were free to follow any idea, or whim; do a few quick and dirty experiments and generate some basis for a more thorough study. We were not constrained by any agency's requests for proposal. We were not at the mercy of that monstrosity of a so-called peer-review system (which Luis Alvarez, Nobelist in Physics, called the single most dangerous threat ever for the health of science). That thinking scientists (who have, by definition, then read the enormous literature on the topic) would have meekly tolerated this indefensible procedure pompously called 'peer review' speaks volumes of the degree of their obsession with money. In 1947–1948 I used this informal bootleg strategy under my professor, E. F. Osborn, to make the two most important contributions of my career: the sol gel process, now used in perhaps a quarter of all ceramic papers and hydrothermal (super-critical) processing. Fifty years later, 1996–1998, using bootlegging again, I believe we have found equally significant new processes using microwaves and simultaneous multiple pulsed lasers, respectively by exactly the same route. Over twenty companies have, after the most detailed, honest on-site visits and 'peer' review, chosen to support our work and put their money to back it. In three years all six peer-reviewed proposals have been rejected by our colleagues and agencies!

(4) Every University-lab has enormous reserves today: no one lacks equipment, they lack innovative ideas. How can I say this to the US and even for India without any fear of contradiction? First, because



obviously the most significant innovations, if they are going to be broadly applicable, cannot demand a super-specialized tool (again excepting big science). Hence, initial experiments can be conceived using what is at hand which is plenty. Second, there is today an enormous surplus of under-used high-powered expensive tools in every major University including one or two in India. Why should sophisticated TEM's or Crays, costing \$ 2 million each, not be

used 16–24 h/day? In the US using a few letters and phone calls, a really well-formulated experiment can be done on someone else's machine for the zero-cost expedient of putting a colleague's name on a paper. Cooperation and co-labouring is the name of the game.

The rewards for using such strategies to get purposeless science back into the picture are enormous. This kind of systems-judo, using the momentum of the system against itself, is most important to restore

the sense of autonomy of the scientist, and remove her/him from under the heels of the oppressing system including funding and peer review.

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## The condition of science in India – Further thoughts

I could not agree more with Vachaspati Pandey (*Curr. Sci.*, 1999, 77, 1007–1008) about the causes for the pathetic situation of science in India. With a Ph D, numerous research papers in national and international journals of repute (if papers are representative of one's capacities and efforts), and considerable postdoctoral experience acquired and currently being acquired, I am expecting to be on the road next year – unless I find another postdoctoral position elsewhere. A permanent position in the capacity of a research scientist in an Indian research/academic institution (even the poorest University department) is only a dream, as it is for hundreds of young scientists in my position. And, as postdoctoral fellowships in the Earth Sciences are not offered by any institution in India other than Physical Research Laboratory (PRL) Ahmedabad, where I am presently employed, next postdoc would have to be abroad. If I do not wish to go abroad, then I may have to compete with a hundred others for a University lecturer's post (if there is any open position notwithstanding reservations, etc.), or one of those positions called 'research associate-ships', with every possibility of helpless and rewardless exploitation.

We are victims of a vicious cycle. When we graduated, we were told that B Sc would not get us anywhere; we should do an M Sc. Still with no job prospects, we did a Ph D, thinking that it would be helpful. Many of us have done a Ph D due to a liking for science, not just to earn a living. Even after that we don't get a job anywhere (is it not suffi-

ciently ironical already?), so we do a postdoc, and even after our first postdoc there is no job, so we do a second postdoc, and so on. And when we have two or three postdoctoral experiences added to our CV, we *may* be considered for a regular position somewhere back in India (why would we come back?) We had rather sit at home after completing our Bachelor's and done something more useful (some like to say 'work is its own reward' – quite appropriate for Indian science, because in Indian science there is anyway no other reward).

If someone who has been doing postdocs abroad and is happy with both the science he has been doing and the materialistic benefits he has got abroad, does not return to India in the future, India has lost him forever and the science policy makers only are to blame. On the one hand, people talk about inculcating a love for science in school children and of the noble task of popularizing science. Whereas there are awards for science popularizers, there aren't jobs for you if you want to *do* science and are also competent enough. Small wonder therefore that many of us leave science after Ph D and join software companies. I am not suggesting a permanent job to every Ph D student that passes out of every science department in the country. Some are totally undeserving, incompetent and notorious, with chief interests not even remotely connected with scientific research or academics – but so are some of those enjoying permanent positions in various disciplines and departments.

While I was Ph D student at the IIT Bombay (1994–1998) I had several colleagues whose stipends were paid by the CSIR. Although Ph D stipends (like all salaries in India) should be monthly (and may be monthly as per the rules), I found my fellow-students receiving lumpsum amounts once in six months or once in ten months. Such inhuman treatment of promising young scientists and students, effectively a violation of human rights, speaks volumes about the way science is being 'encouraged' in this country. I would like to know if the top authorities in the CSIR also draw their salaries once in ten months.

Any kind of reservation for any scientific position needs be legally banned forever, as perhaps no other policy of the Indian Government has done as much harm to the quality of education in India and the quality of its graduates and postgraduates and doctorates than the reservation policy. It is not uncommon to find advertisements from major research institutions which announce available research associateships or regular permanent positions: 'Two positions available, one reserved for SC, one for ST'. Unless this ludicrous and criminal system is stopped, I foresee the country running out of good, creative, dedicated scientists in another decade or two, and Indian research institutions packed with mediocre scientists with little competence and liking for research, doing mediocre bread-and-butter work (or no work) and drawing handsome salaries.

I really wonder how the custodians of Indian science, far from confronting