

[*The Science Advisory Committee to the Union Cabinet (SACC) has been very much concerned with the problem of excellence in science in the country. The Chairman of SACC is having in depth discussions on this important issue with the scientific community. In this context, he had invited several scientists to prepare papers on the topic. Two such papers are presented in this issue of Current Science. Correspondence from the readers is welcome. Ed.*]

ON EXCELLENCE IN INDIAN SCIENCE

P. K. KAW

Physical Research Laboratory, Ahmedabad 380 009, India.

INDIAN science has come of age. The very fact that it is going through the painful and uncomfortable process of self-assessment speaks for itself.

If I am asked the question "is there excellence in Indian Science to day?", my answer would be negative. It is not that I am counting the number of Nobel Laureates and international award winners that we have produced and am disappointed at this small number. No, that is not a good index of excellence. What concerns me *more* is that an *average* Indian scientist does inferior and less motivated work than an average scientist in a developed country. I think that it is this base of average scientists which needs to be pulled up in excellence. Nobel prizes cannot be ordered around. But if the average base of science and technology is superior, "spikes of excellence" will be automatically more frequent.

What is ailing our science and how can we remedy it? Good science needs good students, their proper training, appropriate motivation and facilities for creative work, and finally correct science management. In what follows, I shall make a few remarks on each of these topics.

1. STUDENTS:

In terms of inherent abilities Indian students are inferior to nobody in the whole world. Unfortunately, our best students do not take up science as a career. They do not see it as a lucrative profession economically, nor do they see it providing them with a great deal of fulfilment of any other kind. Lastly, compared to other careers like management, administrative servi-

ces etc., there is a greater sense of insecurity in a career based on science viz. "will I find a job? If so, as what?" etc., etc. It is true that the economic lot of Indian scientists has improved a great deal in the recent past. But to be able to attract the best students we have to keep up with our competitors viz. management, administrative services etc. So whatever can be done in this direction can only help. Perhaps a part of the problem lies in the *lack of awareness* among our students about the achievements of Indian science especially in the areas of atomic energy, space technology defence matters and various industries. Further more, the increasingly larger number of attractive opportunities which are available to Indian scientists to-day may not be widely known. If we can find a method by which information of this kind could be publicized and could permeate down to higher secondary school level, we are certain to attract a bigger crop of good students.

2. TRAINING:

There is an obvious need to provide our students with adequate formal training at institutions with reasons facilities such as a good teaching staff, library, fully equipped laboratories, a decent computer etc., etc. This is unfortunately being done only at very few universities and Institutes of Technology. There is a need to improve teaching facilities in our overall university system. However, apart from this obvious need there are several issues involved in scientific training which are almost completely ignored by our educational system. These are largely related

to our traditional moorings and we really need a conscious effort to free ourselves from some of these burdens.

- (i) A scientific approach to problem solving has to be developed in early childhood and at the grass roots level. One has to be able to overcome traditional superstitions and influence of illconceived explanations of natural phenomena. This means that we need a greater number of community science centres, science exhibitions involving active participation by the visitors, science programmes in radio, television, in children's magazines etc., visits of schools to science labs and working scientists to schools etc.
- (ii) In our society, unfortunately there is little respect for skilled workers who work with their own hands. This concept has permeated to our educational institutions whereby we often see scientists, engineers and doctors getting a lot of theoretical training and spending very little time for acquiring systematic field experience. Among research scientists also we find a much greater number of theoretical research workers, and little praise for the achievements of experimental scientists. This has to change; we must develop a respect for mechanical, electrical, electronic and other technical skills. And again this has to start in early childhood. For example, children can be encouraged to tinker with simple experiments, equipments, gadgets etc. at various community laboratories. Similarly, skilled persons from various fields like working electricians, mechanics, photographers, electronic technicians etc. can come and tell them about the work they do and how beautiful and challenging it can be.
- (iii) We have to encourage our students to question authority and pre-conceived notions; at the same time we have to convince the teachers that this is a natural part of training in science. Questioning pre-conceived notions is usually the heart of creative

thinking which is essential to science and scientific method. It is clearly important to emphasise this point because our cultural upbringing is exactly the opposite. We are taught right from our childhood to respect authority and not to question it. This leads to a lot of unscientific atmosphere. Thus we often find that an idea is followed not because it has any merit, but because it is being supported by some authority. Bad ideas get perpetuated and good ideas get squelched. Thus the natural scientific approach of worshipping and nurturing good ideas is replaced by the very unscientific approach of worshipping people in authority and encouraging the ideas originated from them. This whole approach has to change even if it needs a mini-revolution in our academic institutions.

3. MOTIVATIONS:

What motivates an individual to do scientific work? How does he choose the topics and decide the depth at which the enquiry is carried out? Ideally you do certain scientific work because you are good at it, you know that you can contribute to the field by developing a method/technique, bringing a new insight and you get tremendous joy and satisfaction by pushing the frontier a little further. At the next level, you do work to seek peer recognition *i.e.* recognition by other scientists whom you respect; this also provides you with some ego gratification. At an even more down to earth level, you do certain work out of necessity *e.g.* you promised something to a funding agency or you feel the need to publish to survive or improve your position.

In India, a very peculiar situation has developed. Most of us seek peer recognition outside India. This is partly because we are spread out thin and have not really developed a 'critical mass' in any field within the country. But a major part of the problem is elsewhere. We refuse to develop peer groups within the country. We do not talk to each other and we do not respect each other's abilities/opinions. Even when we know the problem and limitations of each other's

work, we do not freely discuss them. A policy of live and let live seems to be present—you scratch my back and I will scratch yours. We are letting mediocrity flourish ourselves. The major yardstick of accomplishment used by funding agencies, interviewing committees etc., is the number of 'foreign publications'. This is what has replaced an honest peer evaluation. The premium is therefore on publishing papers, finding obscure foreign journals which will accept anything for publication and swindling everybody around you. The result is that a great deal of ill-motivated work is getting done in the country. In some fields we can generate a 'critical mass' of people. In others, scientists in related fields have to spend time to evaluate each other's work. We have to organize more symposia, meetings, workshops etc., involving small group of scientists whereby a detailed in-depth discussion of various scientific works can take place. With honest peer evaluation, funding agencies can also play an important role in motivating the right kind of work.

4. MANAGEMENT:

The present procedures of science management and policy planning in the country also leave much to be desired:

- (i) Firstly, there is a certain amount of feudalism and lack of democracy in science policy making. This may be due to historical reasons but obviously needs to be changed. Thus the inputs to science policy planning must come from a much broader base of scientists than seems to be happening today. The various science academies, congresses and scientific journals can take a leading role in generating inputs to science policy planning from the rank and file of Indian scientists.
- (ii) Secondly, no distinction is made between scientists and science managers. By and large our best scientists gravitate towards managerial positions early in their career and the country loses the service of a brilliant scientist. It may be necessary to develop a class of science managers who need not be the best scientists but who can take

up a lot of routine work from the hands of practising scientists and leave them only with the task of broad decision making, policy planning etc. In this way a scientist can continue to devote a good part of his time towards science. This will also change the present system in which the science managers enjoy a much greater degree of respect than practising scientists.

- (iii) The science policy planning should be crisp and clear and once certain decisions are taken, they should be known to all. For example, basic science in which one puts very little limitation on the area of enquiry of the scientists should be funded at a limited percentage level; moreover, this support should by and large be given to the brightest people in their field who are making contributions at the international level. On the other hand, majority of funds should be directed to relatively less basic research, research which has direct applications and research which should in general be tied to some experiments within the country. As mentioned in (3) above, the science managers have to evolve new procedures for evaluating scientific work which needs funding. One has also to evolve a system of rewards and punishments by which only 'good scientific work' continues and the bad groups with poor performance are actually weeded out. There should be no financial support available for inferior and unmotivated work. This has to be done by scientific peer reviews with a great deal of honesty and integrity. Each one of us has to regard this as an important part of our job as practising scientists who use governmental support. Similarly among areas of high investment research one must have very clear policy decisions (based on a broad discussion of scientific issues involved) on what areas should be developed and at what rate. One must decide how one should develop a critical mass of physicists in these areas so that they may make a viable contribution to the research effort in the country.

(iv) To attract some of our talented scientists who are settled abroad, the idea of providing them with a challenging opportunity to develop independent groups with a 'new culture' is an excellent one. However, there are a number of problems related to rehabilitation of returning scientists which need to be carefully looked at. These are related to mundane hassles of everyday life like housing, schooling for children, difficulties of

acquiring common-conveniences like gas, telephone, scooter etc.—but they do drain away a lot of nervous energy and enthusiasm. Anything which can be done to make the transition smooth is well worth the effort.

In conclusion, the discussion above is far from complete but does reflect some of the thoughts which immediately come to mind on scanning the present scene in Indian Science.

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