institutions that have all maladies like bad bureaucracy and reduced dedication and sincerity among scientists. These factors prevent the effective utilization and distribution of meagre resources. In these places scientists start to build empires and monuments duplicating expensive equipments. Quite a few of our laboratories in India are more posh than several Japanese laboratories. In the affluent America, a large number of research laboratories are still using counters, spectrophotometers and ultra centrifuges bought quarter century ago. But what we do here—we scientists need a lot of introspection. Padmanaban in his article attributes the phenomenal progress in the West to 'corporate research where 40 post docs work round the clock for a single scientist'. While this may be true in some cases, in some other cases small groups consisting of a single Indian scientist and four post-doctorals and two technicians are doing wonders in USA. Each such small group publishes papers every year in top ten journals. No doubt we have the same calibre Indian scientists in India in a few institutions that are equipped even better. But can we compare the productivity of the two types of highly talented Indian brains? What is going wrong? Is it the competition and pressure for getting grants and accountability that make the comparable Indian brains to perform better? Can we shift all blame to bureaucracy which prevents doing fast science?

Indian science shows signs of distress in all directions. The academies and scientists should discuss these problems and evolve ways to solve these. The most important is introspection and scientists should remember that they are also obliged to the people. As Vijayan asks in his article whether there is 'a case for sustained effort to improve our credibility among ourselves and among others', the answer is, yes. Scientists should be dedicated, realistic, inspire students and create a world of high aspirations.

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S&T scenario

I wish to comment on the following on S&T scenario

(a) All nations enjoy or suffer from their own normalized levels of 'limits of growth/efficiency' and, naturally, India is no exception. We seem to be uniquely caught up with a situation where all development activities and also policies are essentially dictated by the 'limits of efficiency' set out by the generalist-permissive administrative structures and practices, yet seeking 'limits of growth' typical of technological societies. No wonder that the S&T sector also is affected by this inherent incongruency.

(b) Excepting for agencies such as DAE, ISRO and lately DRDO, Indian *civil* science has all along been a neglected sector, save some occasional bouts of governmental benevolence for selected narrow areas or institutions. Our declarations of intent for using S&T as 'engines of growth' have by and large been more rhetorical, if not theatrical, when taken from self-reliance point of view. In short, the cardinal trend for the past several decades has been to import all required knowledge (by way of technology, expert advices, and what not) from abroad, partly tied with strings and the rest for short-time commercial terms. And, unlike in many other LDCs, of course, the native science was always encouraged to co-exist and fulfil a marginal/advisory role. Be it in the public sector or the private one, import has been and continues to be the rule of the day, notwithstanding marginally greater component of self-reliance in the PSU's based on half-hearted technology absorption/adaptation practices.

(c) Having said so, it is crucial to realize the dangers from further marginalization of the indigenous science arising out of, may be, increased financial constraints of the Government on the one hand and free technology import on the other. I do not for one believe that Indian S&T at its *present* level can very significantly contribute to industrial development *as needed* today, thanks to decades of neglect. But this is the time, perhaps the last, to strengthen it very consciously and systematically so that along with 'imported modernization' our native S&T capabilities, at least in select sectors, will be augmented and such that by the turn of the century or so the two sectors would find the partnership more 'matching'. The S&T community shall take upon themselves the onerous task of convincing the political leadership, both ruling and the opposition, on the inevitability of such a strategy, failing which both would let down our future generations.

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Enzymatic activity of ribosomal RNA

This is with reference to the comments by D. Chatterji[1] in *Curr. Sci.*, 1992, **63**, 535. To set the record straight he has made some statements which need clarification. There is some confusion about Noller's work[2] and our work[3]. We demonstrated complete protein synthesis (polyphenylalanine synthesis) in *E. coli* but Noller demonstrated in a thermophilic organism, only the so-called fragment reaction which is an assay system for peptidyl transfer. Further, a limited number of proteins had to be added to our system not for structural purposes (as stated by Chatterji) but for translocation without which polyphenylalanine synthesis cannot take place. In our system two different conditions (high salt-high Mg^{++} and ethanol) were used to maintain the structure of ribosomal RNAs. It should also be remembered that Noller and his coworkers had about 5% protein left in their system.

It is also wrongly mentioned by Chatterji that we had *predicted* (italics mine) the biological activity of ribosomal RNA. Actually we had *demonstrated* that. Further, it is wrong to say that the ribosomal RNA *fragments* (italics mine) form a stoichiometric complex; actually intact ribosomal RNAs form the complex. It is gratifying to note that our work was widely quoted, (for example, Maniatis and Reed[4], Watson *et al.*[5], Cech and Bass[6]) long before Noller's achievement.

It is also interesting to quote from a personal letter to the author from A. R. Subrahmanian, a non-resident Indian and expert in ribosomology: 'It was very striking the big reception for the Noller paper. In contrast, I recall no comments at all regarding the earlier *Proc. Natl. Acad. Sci. USA* and *Arch. Biochem. Biophys.* papers of yours which in retrospect, were seminal to this development'. This was obviously regarding the *comments of Waldrop*[7] on the paper of Noller in the issue of *Science* carrying the Noller report. No mention about *our earlier work* was made in this write up.

It may not be out of place to mention here that a ribosomal RNA-based model of translocation was suggested quite sometime ago from our laboratory[8], which is also gaining ground (for example, Gross and Jaenicke[9]). This model has been discussed in the review article 'RNA world and ribosomes' in the same issue of *Current Science*[10]. We are still working on the model and strongly feel that this will be one of the best evidences in favour of biological activity of ribosomal RNA.

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Biology research in India

Current Science (1992, **63**) has justifiably focused the attention of scientific community on the status of basic science in India. Being a biological researcher, I was particularly fascinated by G. Padmanaban's article on 'Indian biology research at cross roads'. It is true that this is an age of biological sciences where understanding life forms can contribute for betterment of mankind with the enigmatic living cells where the more one works the less he seems to understand.

I am rather disappointed that the article lays all stress on molecular biology as the frontier area of biology probably due to the specific bias of the author. True that molecular structure is the very basis of life but what about the vast area of other subjects in biology which are equally important like energy production, effluent treatment, cleaner environment which are never stressed. Present biologists seem to think that molecular biology is the thing either for getting funds or recognition by way of awards than all other branches of biology which have been relegated to the background, and look naive and out of tune to work. A kind of psychosis has been set in India that biology should involve molecular biology in some way however remotely it is related to the subject. Why should our scarce financial resources be frittered away by funding 50-odd groups to work on recombinant DNA as the author claims. We have to introspect and see the outcome of centres that are heavily funded for molecular biology by DBT and their contributions before more money is given to newer groups. What will be the real benefit our country will derive by working on the stupendous task of the human genome project? Will it ultimately help in the improvement of traits?

If we look at the biology syllabus of most universities at the postgraduate level, molecular biology and genetic engineering are included with great pride and fancy. There is no harm in making such ambitious modern topics in curricula if only there are competent teachers who understand the subject in the first place. Mostly these subjects are taught by teachers who do not have much knowledge of the subject. Then how can we expect such students to come out with background knowledge to take research work later. In most cases they have to unlearn many things which is a waste of time and effort. We can do better and be internationally competitive in biological research only if the foundation of our promising post-graduates is laid well. It is not only true of building sophisticated infrastructural facilities on a weak foundation without basic amenities like water and electricity as the author has rightly mentioned but also the human force which has to carry out the work. A lot needs to be done to tone up our education system in the area of life sciences. I have found this with great dismay and anguish at the UGC reorientation courses for university teachers held at various universities. Let us start a change from the foundation to improve biological research.

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