The proposal for a National Science University—More comments

There is growing anxiety that our S & T standards have not attained the highest level(s). In a sense it is perhaps a 'Nobel Prize' syndrome like that of the 'Gold Medal' in the field of sports.

A closely related issue is: should we not devote most on applied sciences to address more urgent national needs/problems. One may also argue that as in other cultural activities (like music, literature and art) certain investment is necessary for the sake of exceptionally gifted and dedicated scientists in order to achieve excellence. Another question arising from the National Science University (NSU) proposal is whether 'pure sciences' could be done in total isolation in this age of holistic perspective[1].

Many recipes have been offered to reach the pinnacle. The NSU proposal[2] is the latest and its ingredients are: (i) link between research and undergraduate education, (ii) better inputs (of facilities and expertise), and (iii) a conducive ambience and value system. It seems that the proposal aims at growing certain 'exotic flowers' of 'research' in a 'greenhouse' termed 'NSU'. If the purpose is only to grow the hitherto unbloomed flowers then, perhaps, there may not be much argument except that: What makes it sure that the 'strategy' will succeed? Because, to some extent, the TIFR and IISc did have equivalent approaches, barring the undergraduate education programme. They had funds, vision, expert faculty, political (or governmental) support, and even the industrial back-up. However, the gains of some 40 years are 'what' has been described by the guest editor and others in the 10 October, 1994, issue of *Current Science*.

But, if S & T has to be meaningfully tied up with development, then it is perhaps debatable whether NSU is the best option. Because a sustained and environment-friendly socioeconomic growth of almost 1 billion people through S & T is a gigantic task requiring a much larger vision, different strategy and scale of operation. It needs not only 'flowers', but also, more importantly, the 'fruits' of research. The 'flowery' purpose of NSU may probably succeed in due course, bringing 'name' to the country, but it is not clear how it will integrate 'fundamental research' with the much essential and multifaceted applied aspects. For example, basic sciences like geology and astronomy are not included, the former because it is applied (e g. in assessing natural resources/hazards and environment), incidentally, there is no Nobel Prize in these branches.

If application is not the aim, some may plead that, when even the advanced countries find it difficult to plough resources into pure research, should our country – among the bottom ten of the world in many respects – venture only for 'name'-sake. Few other problems are: (i) it will further add to 'brain-drain'; (ii) its direction and purpose could be articulated by some of its outside 'leaders' who may have different perceptions; (iii) its output on joining the mainstream may get frustrated due to contrasts in the ambience.

An important aspect of NSU as elaborated earlier by Srivastava[3] is the need to bridge the existing gap between research and education. Such interfacing at the undergraduate level will understandably raise the quality. But, implicitly, it brings forth the closely related problem of the quality of primary (P) and secondary (S) education, to which more than 80% of the students belong but are unable to enter the undergraduate level. Hence, the creative potential of a very large percentage of young 'gene pool' remains untapped (or unearthed).

For example, those who qualify for IITs and are likely to enter the NSU mostly belong to middle and higher classes, as all of them have to bank upon costly and programmed 'coaching' and/or 'correspondence courses' – a phenomenon confined to urban middle and upper class. It is rare that students clear the entrance examinations only by studying the ten-plus-two course textbooks, even those prepared by the NCERT through eminent scientists. Is it not sad that over the last 30 years even the IIT faculty has not thought it necessary to provide sufficient and affordable material for the ten-plus-two students of remote rural areas who have no other means, facilities or resources to improve their insights, understanding and problem-solving capabilities in order to equally compete with their urban and privileged counterparts.

Probably the most important problem to be faced by proposals like NSU is to ensure a buoyant inflow of brilliant young boys/girls. And even when a combination of students, teachers, facilities and value system is able to produce 'great research potential', it may still be difficult to sustain it if a certain 'quality of life' is not assured. Normal motivations to strive hard are: fame, money, power, social status, etc., which explains why the best among our youth are taken away by the IAS, IPS, IIT, IIM streams and nowadays by the industry. In comparison, the S & T professions are not attractive and often even the common needs of life are difficult to fulfil. Under Indian conditions, the latter may take a heavy toll on the mental, physical and psychological energies. It might be argued that people devoted to 'intellectual curiosity', to 'deduce', 'discover' or 'invent' should not bother about material needs/comforts, but in any case some respite is indeed essential from the mundane problems of life, since a certain degree of inner freedom and peace are almost prerequisites for creativity to flourish.

Unless the young ten-plus-two entrants are able to foresee a 'floodlight' at the end of the tunnel comparable to other professional options, it will be difficult to attract the most promising ones. An even greater problem is to retain them. Thus, any recipe to improve the S & T output will have to address this crucial issue.

Excellent science expresses itself both in 'individual' and 'group' modes. Certain activities, even in basic sciences, need large-scale experiments, field or laboratory work/tests (e.g. in accelerator or space research, human genome project, geoscientific field investigations, etc), while theoretical studies may often be based on individuals. Even in group research there are some who formulate and provide vital insights. Such individuals often act as the 'sources' (or 'charges') and create the desired 'research potential'. The presence of such leaders (the likes of Profs. Raman, Saha, Krishnan, to name a few) is an essential ingredient required for excellence, but one is forced to think that over the past 40 years the 'charge'

has perhaps reduced to less than the 'critical' needed to trigger an explosion of 'scientific creativity'.

As succinctly brought out by Srivastava in his presidential address at the 81st Science Congress, the country requires both excellence at the highest level and accountability (i.e. effective applications of S & T). Hence, while the NSU, by linking education and research, may achieve excellence in pure sciences, the 'accountability' part also deserves equal attention.

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There seems to be an ongoing debate between the non-resident Indian (NRI) scientists and the Indian scientific establishment, in the issues of *Current Science*, on the proposal of creating a National Science University (NSU) in India. Prof. Mahajan, one of the promoters of the NSU, is scathing in his indictment of the scientific establishment in this country, and has dismissed the quality of research in India as being poor. The resident scientists have pointed out that the contribution of the NRIs to science and technology at the international level is not at all impressive, and that the proposal is saturated with implicit arrogance. They have expressed misgivings that the NSU may turn out to be a haven for burnt-out NRI scientists. Perhaps the only point of agreement between the two lobbies is that, both of them are unanimous in proclaiming that the existing universities and colleges are dens of ignorance from which nothing good may be expected. Whereas Mahajan says that 'universities are saddled with teachers and professors whose intellectual level is shock- ingly low', Prof. Ramakrishnan states that 'we do not have even one university which can be compared to the best in the world overall'. In fact, scientists in our country miss no opportunity to declare that our universities have low standards and poor academic environment.

If the problem is regarding science education at the higher level, it is rather surprising that *Current Science* did not invite any of the eminent scientists from the universities to respond to the proposal. Considering that the entire undergraduate and most of the postgraduate education takes place in the universities and colleges, the major response should have been from these institutions. There are distinguished scientists who have spent all their productive years in the universities and have contributed to the growth of science in India both by their own research work and by training others to be researchers and teachers. I am sure that *Current Science* is aware of this. The proposal as well as most of the responses so far seem to be from scientists who have no serious responsibilities towards science teaching in the country.

It is well known that in the pre-independence days most research work used to be conducted in the universities. P. C. Ray, J. C. Bose, C. V. Raman, K. S. Krishnan, M. N. Saha and S. N. Bose, to name a few eminent researchers in the physical sciences, were all associated with the universities. All of them were remarkable teachers too. In the post-independence period too (especially in the fifties and sixties), many eminent scientists were from the universities; for example, T. R. Seshadri, G. N. Ramachandran, Neelratan Dhar, B. R. Seshachar and A. K. Raichaudhuri. It is however, true, that the overall quality of research in the universities has not been particularly satisfactory, and its impact at the international level is negligible. This is generally ascribed to the creation of research institutes outside the university sector.

While granting that research work done in the universities is not of a high order or of great relevance to the needs of the country, what is more shocking is that our elite institutes in science and technology, have hardly distinguished themselves, given the power, prestige and almost totally unquestioned access to funds that they enjoy. These institutions and their priorities have also played an unreasonably important role in shaping our S & T and higher-education policies.

As an instance of the total neglect that the universities are facing (and the unreasonably large percentage of the S & T budget that our research institutes obtain), we may take a look at the break-up of the more than 1432 projects amounting to nearly Rs 105 crores, sanctioned by the various S & T-related agencies of the Government of India in 1992–93. More than Rs 50 crores have been sanctioned to about 112 projects (above Rs 20 lakhs per project). But, of these, only 20 are from the universities and if we count out the central universities, the number comes down to 14. Of course, most of the minor research projects, with an average allocation of around Rs 15,000, are in the universities! The allocation of project funds is only one part of this inequitous pattern of funding. The annual budgets of most of our prestigious elite institutes are usually several times more than the budgets of any fairly big established university in the country, Even then some of the top scientists of the elite institutions clamour for more funds. They point out the low per-capita budget spent on scientists in their institutions compared to that incurred in Japan or in the US. Often, such comparisons are made to explain away the dismal performance of the Indian S & T centres.

Are the scientists in our elite institutes pioneers in any field, or is there any distinctly Indian contribution in any branch of science in the recent times? They are generally swayed by every passing trend in the West, and they give little importance to work done in 'unfashionable' areas. This is a trait which they share with the NRIs. Any citation analysis of papers published from any of our elite institutions indicates no major achievements (at least as recognized by the world community). However, they are in the forefront for getting all the prestigious awards, fellowships of academies and positions of power in the S & T bureaucracy.

Many of these scientists have total contempt for the rest of the Indian scientific community, especially those working in the universities and colleges. But that does not prevent them from taking over most of the positions of power from where they can control the entire activity of the S & T community, that works in the universities and colleges. I recall the case of a leading mathematician from one of our elite institutes who declared that he would not go any where near the mathematics department of any university.

But he seemed to have had no second thoughts about accepting, when called upon to take, a leading role in one of our national bodies concerned with improvement of mathematics in the country.

Let the NRI scientists and the leaders of elite Indian institutions battle it out between themselves as to who is more marginal as far as contribution to science and technology of the modern era is concerned. The poor Indian universities are perhaps best left out of such discussions.

While I was preparing this letter, a very disturbing document came to my notice: a draft academy paper on university education in science published by the Indian Academy of Sciences in December 1994 [see page 255, this issue]. The document refers to a working group of the planning commission which proposes a three-tier system for science education in the country. The first tier is to cater to about 700 'highly talented' students to be trained in about 7 centres with an annual outlay of approximately Rs 70,000 per student. The second tier is aimed at about 24,000 students, presumably of lower calibre, to be trained in 20 colleges, with an annual expenditure of Rs 5000 per student. The third tier is designed for nearly 125,000 students, presumably worthless, to be trained in colleges with 'poor-quality faculty and inadequate infrastructure', through videotapes, with a magnanimous outlay of nearly Rs 480 per student, per year. The faculty for these is to be trained in the nearby universities.

The panel (constituted by the Indian Academy of Sciences), which has prepared the draft, endorses this recommendation with the proviso that the 7 centres mentioned earlier should be within the overall university system, but should be independent and autonomous. Nothing is said about how these 'highly talented' students, on whom so much money is proposed to be spent, would fulfil any national need, or of any commitment demanded of them. The proposal is downright insulting and humiliating to the university fraternity in this country.

Why, if the outlay for exceptionally talented students is doubled, or if the number of such students adopted be halved, they might as well be sent abroad for their undergraduate education, as the best education at that level is presumably available only in some western countries!

If our policy makers are serious about changing the scenario of education and research in our universities, they should not commit public funds to gimmicks such as the NRI-sponsored NSU. Nor should they be carried away by the various proposals and draft papers put forward by the top scientists of our elite science institutions, whose commitment to any national cause is somewhat unclear, but who wish to play a dominant role in all policy formulations.

The only way some of us in the universities can see the situation changing in the larger scientific community of India is by involving eminent people in the universities and colleges in deciding their own internal policies. Further, they should have a say in national policies, including the assessment of performance of our research institutions. Only in that way can some semblance of equity come in terms of correcting the totally skewed nature of funding as well as dispensing of power and status among scientists in the country. Introducing such a control may bring in more accountability and lessen the aloofness of the elite institutions, and make them more aware of the needs of the country.

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This is in response to the articles published in *Current Science* (10 October 1994) about the proposed National Science University. We, the following, support the idea that a brainstorming and heart-searching session needs to be arranged to debate on this matter because this is a very important decision aiming at rejuvenating the scientific teaching and work in this country. In our opinion, the concept of the proposed National Science University is not in tune with upholding the scientific tempo in a global perspective. Science cannot develop in isolation. Whatever expertise we have so far developed in this country needs to be sustained. During the post-independence period, a chain of scientific institutions and universities was set up. This was further strengthened by the broader theme of opening up of a few IITs regionwise, ending with a smaller perspective of scientific or technological pursuit. As a result, the other institutions/universities have been continuously neglected and deprived. Despite that, they were allowed to admit more and more students in graduate and postgraduate classes, and teaching of science and scientific work became politicized and devoid of any uniform standard and fresh outlook. And now, once again, we are going to have a superstructure of a National Science University, which is bound to face the same fate in the present-day scenario of regional politics and disintegration. Thus, writing off the old institutions/universities and neglecting them further by undertaking new ventures on super-institutions such as NSU will definitely induce more heartburn. This will do more harm than good in sustainable progress of science. Already a few institutions and universities are showing remarkable success in maintaining scientific tempo. If anything meaningful is to be done at the present juncture, it is to extend help to those centres in the form of finance, collective leadership and management free from all sorts of bureaucracy. Many institutions/university centres could have delivered real good science, both in teaching and research, had all the rules and regulations envisaged thus far for the proposed NSU been applied. It is not the NRIs alone but scientists from all over the world who are to be attracted to collaborate. NRIs are only a fraction of those scientists and if NRIs feel that they have a certain obligation to repay the debt, there are several ways to do that but not by opening up another class of universities such as the proposed NSU. Collaboration or exchange of scientists is not non-existent at present but this should be provided at a very high and selective level. There is no dearth of good scientists in this country, but the management succumbing to no work culture already eats into the vital of the lives of those who wish to change the rule. Today, we do not find that nationalist spirit which once created a feeling that we are inferior to none; we talk only on collaboration but what collaboration we are not sure of. If the government and the people are sincere enough to remodel the management of scientific education and research, it is

necessary to apply step by step the thumb rule of 'hire and fire' to the existing universities/institutions as far as practicable and not by instituting the NSU as proposed. If such a university comes up, it will be a suicidal one, leading to more chaos in straightening up the management and in distribution conducive to better scientific pursuit. Is it possible to introduce the 'hire and fire' rule as well as work culture in this ill-conceived democratic set-up of politics and socioeconomic conditions? If this is made possible, rest assured the scientific pursuit in this country will take a new turn and this country can have innovative teaching and research in science and technology indigenously

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The proposal of creating a National Science University (NSU) in India by Mahajan[1] of the University of Texas, USA, has several plus points, enumerated and discussed by several distinguished scientists[2–6].

Plus points

An ideal university/institution that is involved in pursuing activities in science is supposed to have three important functions to perform: (a) dissemination of knowledge (teaching), (b) its creation (research), and (c) its transformation (extension/application). Our colleges, universities, IITs and other science institutes/laboratories seldom perform all the above functions. The proposed NSU appears to be different from the existing academic institutions in that the former envisages among its objectives optimal performance, taking into consideration all the three important functions. Furthermore, it has been proposed that the NSU would keep pace with up-to-date progress in the fields of science and technology, and eventually groom and produce world-class brilliant scientists. The proposal, in general, appears to be eminently good more so when the NSU proposes to provide each of its faculty a sum of US $50,000 as an annual research grant.

Critical consequences

However, I am of the view that there are certain points which make the NSU proposal practically unworkable. It has been proposed that the NSU would be of moderate size, consisting of 100–200 faculty members, 800–1500 undergraduate population and about 200–400 Ph D level students. The crucial point of concern here is the last figure (median value = 300). If one presumes that a Ph D student would take 4 years for the successful completion of his/her work, then every year following the fourth year of NSU establishment, we shall have around 300 doctorates in basic sciences (physics, mathematics, astronomy, chemistry, computer sciences and biology). This figure amounts to approximately 10% of the estimated turnout of doctorates in natural sciences alone in 1993 (refs. 7, 8). Where do they go after obtaining their Ph D degree? Do they go to USA (for example) or join our existing mediocre universities/institutes? If they go to USA, or to any other foreign country for that matter, then the proposed NSU would become yet another export house dealing with brains. The scientists churned out of the NSU would definitely feel dejected/frustrated if they join our existing academic centres, barring a couple of prime national institutes which are splendid by world-class standards. Ideal environment should be created in our science centres so that the products of the NSU when absorbed would continue to maintain the scientific temperament that might have been infixed into their mind during their tenure at the NSU. Would it not be worthwhile then to think of the outlets first before the NSU crystallizes?

Root cause

While reviewing the status of science education and research in India, Mahajan[1] has probably ignored, may be inadvertently, the root cause of deterioration of the standard of science education and, consequently, research. We have colleges with just a single microscope and makeshift laboratories, yet every year hundreds of tertiary-level degree holders (science graduates, B Sc's with biology as the core subject) pass out. Later they join the universities. Should we expect development of critical scientific faculty in them? A couple of steps down the ladder, we do find that the standard of science teaching at 10-plus-2 level is still worse. Should we not fortify our base first, before manoeuvring in the front? One single NSU located somewhere near New Delhi, I think, cannot transform the whole gloomy science scenario currently prevailing in the country.

Ombudsman or NSI?

It has been unequivocally accepted that most of the Indian universities suffer from shortage of funds and present a gloomy picture as far as research activities are concerned[9–11]. Several fundamental problems relating to library, laboratory and management collectively create an atmosphere which is not conducive to conducting of good science. Interestingly, our teacher-cum-scientists in the universities are usually carried away by the fads of the day. For example, in each and every remote place we try to start courses on biotechnology, molecular biology, etc., with extreme disregard to adequate infrastructural support requirements. We tend to reject taxonomy as a subject of research (fortunately, gaining ground as everybody is now becoming alert to maintaining biodiversity), yet we end up teaching molecular biology at M Sc levels, with how to prepare acetocarmine stains, etc, as impudently unsuitable laboratory exercises. Should we or should we not practice this type of science activity? If the latter is acceptable, then do we need a science ombudsman or a National Science Inspector (NSI)?

In a nutshell, in India, we need not just one but several NSUs. However, it should be our concern to identify the root cause of the nadir in science activities relating to education, research and extension. A globally healthy body is desirable as against a body with well-developed head but crippled limbs. Should we not improve our science colleges, where scientific inquisitiveness could be inducted into the young mind. The law of averages could only bring out our scientific brilliance in submultiples of what has been proposed to be achieved through

single NSU to be created and located
New Delhi suburb

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The economics of sharing scientific and social information

In a recent article in *Current Science*, Kale *et al*[1] make a case for sharing of information between the industry, government, and the general public. They also emphasize the need for such sharing of information, specifically in connection with introducing new legislations or in enforcing the regulations under the existing legislations. The point that is quite central to the issues raised by Kale *et al.*[1] is the economics of information. There are private and social costs of gathering information, and there are also private and social benefits of using that information[2]. It is not fair to demand a private firm which incurs private cost in collecting information to make such information available free of cost either to the government or to the public, unless such sharing of information freely or at very low cost can enhance its own private benefits. The main point these authors make is that there is, in fact, a possibility that sharing of information can enhance the private benefits to the industry A case in point is that it helps the industry to make such information available for a wider academic audience for a careful scrutiny Such a scrutiny will improve the credibility of the information as scientific evidence to support the industry's case in dealing with the government and the courts

There are some other types of information, such as information on scientific R & D, the cost of generating which is very high, and sharing it with others will entail giving away enormous benefits to others and even possibly reducing the benefits to the persons collecting the original scientific R & D information. Sharing of such information must be done only subject to recovering the cost as well as a major part of the benefits that can accrue to the others Otherwise, where is the incentive for generating scientific R & D? R & D investment is a risky investment. The private corporations in capital-scarce developing countries such as India do not spend, for fairly good reasons, much on R & D in science and technology[3]. However, there are optimistic expectations that in spite of the significant difference between the developed and the developing countries with respect to investment in R & D, the latter can improve their technological capabilities in the near future[4].

If industry protects its own information from public domain, should it not pay for the information it uses from the public domain? Here one is referring to national databases, which impose enormous costs to the exchequer. There is a great potential in them, if only they are properly visualized and utilized! But it is difficult for the government to price its information differently for different users, some receiving much more benefits than the others. One must find alternate ways of recovering costs from potential beneficiaries. A part of the justification for corporate taxes lies in such services the government renders to the corporate sector.

In economic theory there is an extensive discussion on the issue of asymmetry of information and the associated welfare losses[5]. Some simple illustrations will be useful to highlight the issues. Information on a product's adverse quality is available to the firm and not to the consumer. Suppression of such information is advantageous to the producers and disadvantageous to the consumer. Insider's information known to a company executive, and not to a general purchaser of company stocks, can give rise to enormous profits to the company executive Owner of a used car has adverse information on the car, which he suppresses, thus causing losses to the potential purchaser. It is argued in the literature that the welfare losses can be minimized by either reducing the asymmetry of information or through legislations controlling the undue profits people might make, as in the case of insider's information Transparency in the information the government collects and uses as advocated by Kale *et al.*[1] is an attempt to reduce asymmetry in information and thus to improve welfare. This point made by Kale *et al.*[1] is also supported by the theoretical literature on economics of information, and in particular on the welfare loss implications of asymmetric information[6,7].

There is one more mechanism through which scientific and technological information can be made accessible to all. This is through private and public interest litigations on the damage caused to the individuals and to the society by products and services produced using scientific and technological R & D While processing such litigations the judicial system should call experts in the subject as expert witnesses to testify regarding the scientific credibility of the evidence produced by