Science, Education, and Research: Problems and Prospects[1]

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One of the few scientists in modern India who was quite happy to wear his political beliefs on his sleeve was the mathematician and historian, D D Kosambi [1,2]. Polymath and polyglot, Kosambi was a towering intellect and a lifelong iconoclast who was often at loggerheads with all sorts of establishments (including the Communist Party!). During his working life which was from 1930 to mid 1966 he held positions at the Banaras Hindu University, the Aligarh Muslim University, Fergusson College in Pune, the newly founded Tata Institute of Fundamental Research in Mumbai, and finally an emeritus professorship at the Maharashtra Vidnyanvardhini in Pune. He thus had a view of various aspects of Indian academics from the inside, and this often resulted in an uneasy relationship with his colleagues at many of the institutions he worked in.

Among his unpublished essays [3] is one that is titled "A Chapter in the History of Indian Science" which is a fairly strongly worded critique of the Indian scientific establishment. Although not dated, it was probably written in the late 1950's , and it begins:

"Development of philosophy, mysticism, or linguistics could easily have been expected in India, seeing the history and structure of the country. Nevertheless, in the rapid changes that mark both the intellectual and the economic progress of India, it will be seen that these subjects are very poorly developed and often studied abroad by the Indians themselves. Even the remarkable political philosophy and method of ahimsa (non-violence) may be traced back from Mahatma Gandhi to Tolstoy and to Silvio Pellico's *Le mie prigioni*. On the other hand, Indian scientists have already made substantial contributions to the world's culture. The science is not specifically Indian except in its exponents. In the study of its developments it may be seen that at least two factors have each acted first as a stimulant and then with a growth of quantity as hindrances. The first of these is the foreign type and language [English] of instruction, the second is the change from an economy of colonial exploitation to one dominated by a new indigenous bourgeoisie. For the illustration of these two trends it is necessary to give examples which do not always make pleasant reading."

Much of the article is highly critical of the science establishment in general, and specific scientists in particular, but he attempts a class analysis as he ends:

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“The same facile character which enabled them to please Government officials helps them placate anyone in power, and then there is the claim to have put India upon the map of world science. Besides, the painfully achieved newspaper publicity impresses not only the British but the Indian readers. Less obvious has been the change in class character. The Indian professor belonged to the class that looked forward to retirement as a small pensioner. Only one of our scientists named above was born to share-capital, which paid for his education and gave him the capitalist friends who created an institute for him. The rest, however, have become shareholders on a considerable scale merely because of the rapid capitalist expansion of India during World War II. […] The same class for which modern science was a necessity has assimilated the top scientists. Neither the science nor for that matter the idea of capitalist production are in any way Indian.”

Regrettably, much of what he says in this somewhat bitter and acerbic essay remains essentially true even to this day.

There have been many analyses of the state of science, education, and research in India [4] both in absolute as well as relative terms. The situation is not satisfactory on either count: benefits that have accrued to society at large do not seem to have been commensurate with the scale of investments made, and further, comparison with other nations (China, mainly) can be very unfavourable.

The structure of the science establishment in India today had its roots in the post-independence decision of Jawaharlal Nehru to effectively separate teaching and research when bodies such as the Defense Research Organization and the Department of Atomic Energy (DAE) were established in the late 1940’s and early 1950’s [5]. (The Council of Scientific and Industrial Research (CSIR) which was established in 1940, prior to Indian independence, also saw a significant expansion in the number of laboratories in the early 1950’s.) Much has been written about the nature of this choice that seems to have been motivated largely by a need to accelerate the pace of research in the country, especially in strategic sectors such as atomic energy as well as in a host of other areas in both the fundamental and the applied sciences. The commitment to making independent India a scientific society was strong, but the manner of its implementation has had long-lasting repercussions.

The necessity for establishments where high-quality research is carried out in a project-mode is one thing, but the consequent separation between teaching and research has not served the academic body of the country well. As a result of this dichotomy, teaching has gradually become the responsibility of colleges, universities and other similar establishments, and research is largely seen as the preserve of specialized institutes. Further, since the system has the inbuilt tendency to perpetuate itself, there has been a gradual proliferation of these highly specialized “boutique” institutes, all of which are characterized by a focus on a limited range of academic subjects, a small and highly privileged faculty, students at the Ph. D. level if at all, and very large barriers to entry. The majority of the scientists in such institutions train very few people: there is essentially no multiplier effect, and thus they do not contribute to manpower generation or human resource development to any significant extent. Furthermore, the high privilege also makes the organization largely self-referential, and the overall developmental needs of science and teaching in the country are ignored.

Globalization, the widespread availability of the Internet, and the access to high quality journals has also resulted in our academic goals and academic targets becoming more international. Thus much of work done in institutes---where the bulk of the national research funding is invested---tends to be used to address problems of a global nature in preference to issues that are local and own concerns and issues that relate to the environment around us. One can be more explicit: in all disciplines the leading journals tend to be published in the west, and both for reasons of prestige as well as of exposure, the urge to publish in these journals in high. It becomes necessary, therefore, to work in those areas that would enhance the probability of success in this objective, often accompanied by the neglect of more pressing but less fashionable areas.

There have been notable exceptions. Amulya Reddy set up the Centre for Application of Science and Technology to Rural Areas (ASTRA) at the IISc, Bangalore, with the explicit mandate that S&T must focus on local developmental needs. C V Seshadri at the MCRC (Murugappa Chettiar Research Centre) or M S Swaminathan at the MSSRF (M S Swaminathan Research Foundation) have all developed some programmes that are relevant to the local context. However, these efforts remain to be mainstreamed into our S&T education and research agenda [6].

Given the nature of scientific progress, it may be inevitable that areas of wider global interest and broader participation are also intellectually more challenging, but it is striking that most of the better-known institutions in India have more in common with similar entities across the globe and draw few references from within the country. In a sense, this is a perpetuation of the well-known ideological divide between Bhabha and Saha [7]: the former was unabashed in his promotion of “big science” and the organization that that would entail, whereas the latter was more supportive of a science policy that would change rural conditions. The anxiety to keep up has also resulted in there being low investment in research infrastructure in the sense that very few instruments that are used to carry out this research are built in India. Dr. Gopalakrishnan [8] talked of the 1960’s and ‘70’s when an elite corps of scientists and engineers was trained to build nuclear reactors. There is hardly a set of people who can reliably make even commonly used sophisticated machines such as MRI equipment or any number of similar machines in the country today.

One of the reasons for this can be attributed to the change to the 10+2 pattern of secondary education. While this brought a uniform standard to schooling in the country, it also had the unfortunate consequence of effectively devaluing trade learning. The intended track of 10 years of schooling followed by training at ITIs has not found many takers, and today the training provided by polytechnics and ITIs is fairly limited and dated. Arguably, it is more difficult to find a well-trained technician than it is to find an engineer.

Over the years the good intentions of improving the quality of our science has had the unfortunate effect of reducing the quality of teaching in the universities. On balance it has to be admitted that the average level of instruction in most colleges and universities is indeed quite poor, and possibly poorer than the level of secondary education. And there are plans to “reform” this sector too. As it happens, we are currently on the threshold of another change in the structure of tertiary education, as Delhi University that is both large and very influential has announced a change from a three-year to a four-year undergraduate degree. Restructuring undergraduate

education is in itself not such a bad thing if done with seriousness and done uniformly across the country, but it appears that there is no real curriculum change, merely one in duration. Delhi University, being the size that it is, the rest of country will have to confront this change, if not follow. To give a sense of scale, the University of Hyderabad has 5000 students while DU has 4.5 lakh students. It is not clear that these so-called reforms will produce graduates that are any better trained or more employable since there are many issues at stake here- the poorly conceived curriculum, the increased cost to students, the lack of infrastructure being primary among them.

The entire university system is in urgent need of reform in many ways. For a country of our size, there are far too few institutions of higher education. The University Grants Commission lists some 600 or so, the majority being funded either through the UGC or through the different states. Other than Central and State Universities (and the few institutions that are deemed to be Universities), there have been, in recent years, a number of new universities that are privately promoted and funded. While it may be necessary for entities outside the government to enter the higher education scenario [9], it is also a fact that few instances of interventions have been successful. Neither, for that matter, have public private partnerships. Philanthropy, particularly in the area of higher education, has also not been forthcoming. Indian industries, by and large, do not collaborate in the creation of knowledge, and in the few instances of when there is an attempted partnership with universities, the main motivation of industry seems to originate from the point of view of cost cutting. There seems to be no sustainable model of non-governmental support of science, education, and research.

It is also not as if the government does not realize that as a nation we are falling short, operating as it does in a policy background. Starting with the Science Policy Resolution in 1958, there has been increasing sophistication in the governmental stand, evolving to the Technology Policy Statement of 1983, the S&T Policy of 2003, and eventually to the Science, Technology and Innovation Policy of 2013 [10]. Other agencies such as the NCAER and the National Knowledge Commission have also produced very respectable and detailed reports [9]. But it really does not require very deep research to realize that in most fields, Indian investment is inadequate, and there are fewer Indians in any list of people who are contributing at the front. The fact that countries like China that were significantly behind in key indicators a couple of decades earlier are so significantly ahead at this point in time only indicate a chronic shortsightedness of policy. Both nations faced several decades of relative isolation, but we seem not to have addressed issues such as primary education, public health, and essential infrastructure as effectively as might have been possible, and indeed as effectively as was necessary.

The situation that obtains in India today of the state of science, education, and research may seem suboptimal, but there is some area of hope. Many of the problems that plague us as a nation---poor public health, the high cost of energy, or the poor flow of information for instance---are now becoming of wider interest, and as the rest of the world turns its gaze to these problems, they also become more solvable. Technologies that are being developed today can help to solve long-standing problems, a good illustration of which is provided by the recent initiatives of the government as well as private players in the area of solar power.

Kosambi, with whose quote I started my essay, famously fell out with the atomic energy establishment due to his advocacy of solar over atomic power. However, he was frank in his assessment [11], that "Solar energy is not something that any villager can convert for use with his own unaided efforts, at a negligible personal expenditure, *charkha* style. It means good science and first-rate technology whose results must be made available to the individual user." The differences that Kosambi had with the DAE were focused on the relative merits of nuclear and solar energy, and Kosambi failed to convince his colleagues then. It is ironic that fifty years later what he had envisaged has come to pass, although much of the necessary research has been done outside India, and we have, regrettably, not learned to develop the necessary "first-rate technology" at home.

There is a lesson in this, and one that is simple enough. If we are to bring about lasting change there really is no alternative to slow and sustained effort. The race, such as it is, is not always to the swift.

References:

1. M. Kosambi (Ed.), *Unsettling the Past: Unknown Aspects and Scholarly Assessments of D. D. Kosambi*, (Permanent Black, New Delhi, 2012).

2. R Ramaswamy, "*Integrating Mathematics and History: The scholarship of D D Kosambi*" , Economic & Political Weekly (2012) 47: 58–62 . Also reprinted in [1], pp, 377–389.

3. D. D. Kosambi, "*A Chapter in the History of Indian Science*", unpublished. Excerpts quoted here with the kind permission of M. Kosambi.

4. See, e. g. G. R. Desiraju, "*Science Education and Research in India*", Economic & Political Weekly (2008) 47: 37—43. There is an extensive (and growing) bibliography on this subject, and given my limited focus in this essay, the citation of references is selective, and indicative rather than exhaustive.

5. R. S. Anderson, "*Nucleus and Nation: Scientists, International Networks and Power in India*", (University of Chicago Press, Chicago, 2010).

6. Examples can be drawn from other fields of enquiry as well, but it does not serve any purpose to single out more specific instances. This remains a point of concern at the present time, both in India as well as in other nations, as a recent editorial in Nature (**497,** 536 (30 May 2013)) points out: "Increasing scientific globalization is welcome, but [it] could compromise national efforts."

7. R. S. Anderson, "*Building scientific institutions in India: Saha and Bhabha*", (Occasional papers, Centre for Developing-Area Studies, McGill University, Montreal, 1975).

8. Dr. A. Gopalakrishnan, this conference.

9. *India Science Report*, National Council of Applied Economic Research, 2005; *Report to the Nation 2006-2009*, National Knowledge Commission, 2010.

10. *Science, Technology, and Innovation Policy*, Ministry of Science and Technology 2013; *Science and Technology Policy*, Ministry of Science and Technology 2003; *Technology Policy Statement*, Ministry of Science and Technology 1983; *Science Policy resolution*, 1958.

11. D. D. Kosambi, "*Atomic Energy for India*", reprinted in *Science, Society and Peace*", (The Academy of Political and Social Studies, Pune, 1986).