Indian Science and the University System

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Introduction

India is considered a developing country in the present context; yet, unlike most other countries, it can boast of a long tradition of learning, of great philosophers and mathematicians. From the Salbha-Sutras to Bhaskaracharya we have records of Indian contributions to sciences. However, for various reasons that should interest the student of history of science, the tradition did not continue. Indeed, the Nobel Laureate Abdus Salam has highlighted the fact by a striking example: the Taj Mahal in India and the St. Paul's Cathedral in England. Both these contemporary buildings illustrate the heights reached in the architecture of these two countries. Yet, as Salam points out, England of those times produced a Newton which India did not.

No branch of learning can prosper unless the social ambience encourages it. Science is no exception. After its decline it did not prosper in India until the British rulers replanted it and made the society aware of its importance. One may speculate what would have happened to science in India if it had not come under the Western influence through colonization. Would the descendants of the Peshwas and the Moghals done the replanting of science and technology ? Fortunately, the newly emerging science in India did not wither away when the British left our shores.

India's independence in 1947 saw the beginning of a rapid growth in the science and technology base in the nation. Thanks to the perception of Jawaharlal Nehru, and the visionary scientists like Shanti Swarup Bhatnagar, Homi Bhabha and Vikram Sarabhai, a number of national institutions, research centres and laboratories sprang up all over the country. Today the list of R&D organizations makes impressive reading. In addition, national agencies like the Department of Science and Technology – fund science and technology projects on short and long term basis.

There is a striking gap in this multipronged approach, a gap that did not exist in 1947 but which came about shortly thereafter and has widened steadily. The universities have missed out in the overall growth of S&T both quantitatively and qualitatively. And the serious repurcussions of this widening gap are now catching up with the overall system. The most serious of these is the manpower problem.

Universities in ideal situations provide an environment where a two-way interchange of ideas, question-answer etc. exists between the teacher and the taught. The teacher with his experience informs and motivates the student towards the challenging and exciting aspects of the field. The student, with his freshness and curiosity may ask questions that make the teacher think again. We see these idealized conditions in the successful universities in most of the developed nations. The authors of articles in scientific journals of repute come predominantly from the universities' environment where they are engaged in teaching as well as research.Unfortunately, these conditions no longer obtain in our universities. There are good departments, motivating teachers, successful research workers and bright students in the university sector... but one finds them more as exceptions than as a rule. Innumerable statistics can be quoted to say how higher education has prospered since independence, how the numbers and sizes of the universities have grown, etc. None of these can answer this question: 'If so much has been done for higher education, why is there a brain drain away from the universities?'

A Personal Experience

The fact is, that sometime during the 1950s or 1960s (–it would be worthwhile doing a sociology project on when exactly this happened) our intelligentsia and politicians agreed for once that the universities are a losing concern so far as the research in S&T was concerned. When I left India in 1957 for higher studies in Cambridge my dream was to return to some university in a job that combined teaching with research. When I returned in 1972, I could not realize that dream and had to settle for the second-best – a job at the Tata Institute of Fundamental Research.

Why should I label the premier research institution in the country 'second best'? This is beacuse, working there under the excellent environment one sadly misses students who have completed their undergraduate education. And so, the invigorating inputs received from student teaching are lacking.

This is the main reason for the present problem of manpower in our research institutions. These institutions with their better research facilities confine themselves at most to the Ph.D. programmes and as such have no direct contact with students who could be motivated to do Ph.D.s in science. On the other hand the universities, where students exist in abundance, are troubled by infrastructural problems and lack of a research atmosphere.

How can one find a way out of resolving the issue ?

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The Inter-University Centres

What attracts talent to an academic institution? The ingredients include good salary and living conditions, a low bureaucratic profile, autonomy of operations and last, but not the least: good facilities both in terms of 'man' and the 'machine'. With the recent revision of pay scales the universities have not done badly. The scales in the university system no longer compare unfavourably with those in the national laboratories. So far as bureaucracy is concerned the universities have a long way to go to evolve a working system that involves as few babus as possible. Even more difficult is autonomy. Sadly the university constitutions have brought in numerous outside checks. The original intention may have been a pious one, that the academics in the university should be accountable to the tax payer and hence there should be outside representatives on the various bodies of the university. In practice it has meant a steady erosion of academic autonomy – a system in which the deans and the registrar are VIPs who must be kept in a good mood. A fundamental change is needed to reverse this trend.

What about facilities? A scientist needs good working conditions and a healthy interaction with like-minded colleagues. The exchange of ideas with others is as important as having good equipment to work with. With sufficient funds both the problems can be solved.

However, it is clearly not possible to provide top class facilities in all subjects in all departments of all universities. Take an example from astronomy. The difficulties of maintaining a good quality telescope at Rangapur by the Osmania Univesity are well known. A university department needs to be given far greater support than is usually possible, if it is to maintain a top class facility. And the bureaucracy and lack of autonomy of the university system make it difficult for the facility to be used optimally. So there is lack of use, lack of maintenance and eventual frustration and brain drain.

There are two ways of dealing with the situation. The first is to be unashamedly undemocratic by identifying selected groups in selected universities for special treatment. Special treatment means extra funds to be able to provide and run facilities above threshold and a guarantee of autonomy of operations. Considerable political will is needed to make this option work. The success would go a long way towards boosting confidence in the university system.

The second, softer option is through the creation of centralized facilities in the university sector which are managed by autonomous institutions specially created for the purpose. These 'inter-university centres' are thus meant as national coordinating agencies in specific fields. The first such IUC was created by the University Grants Commission in 1984 in Delhi. Known as the Nuclear Science Centre, this IUC now has a top class facility in nuclear physics – the pelletron. Another IUC to be created next was in astronomy and astrophysics at Pune. The third one at Indore is for atomic research with the facilities already existing under the umbrella of the Department of Atomic Energy. An IUC in instrumentation (at Bombay) is in the pipeline.

An IUC is a registered society with a Council and a Governing Body, the latter being a subset of the former. To start off the registered society there have to be a set of rules and a memorandum of association to be approved by the Government of India. After registration the society works within the framework of these rules and the bye laws that it approves. The IUC is thus provided with an autonomous structure that allows it to function much more freely and flexibly than university can. How does an IUC function? The example of IUCAA, the Inter-University Centre for Astronomy and Astrophysics will illustrate the answer.

The Importance of Astronomy and Astrophysics

Astronomy and Astrophysics (A&A) have received considerable thrust worldwide and are regarded as rapidly growing parts of physics.

Although the dividing line of interest between these two subjects is never very sharp, we may broadly identify astronomy with the observation of the cosmos and astrophysics with the physical interpretation of what is observed. Advanced countries like those in Western Europe, the United States, the Soviet Union, Canada, Australia, Japan etc. have astronomical programmes of a kind that would have been considered highly ambitious a generation ago but which are becoming realities thanks to the rapid developments in technology. Most facilities are either national or multinational, the latter applying to the more advanced facilities. Nowhere is the usage confined to a single institution or a university.

The physical interpretation of data also has advanced dramatically. On the theoretical front astrophysical models demand sophisticated ideas from physics, advanced techniques of mathematics and highly developed computing software. Although human ingenuity and intuition are still at a premium the back-of-the envelope calculations have to be followed up by detailed analyses.

Why this burst of enthusiasm for astronomy and astrophysics ? Historically, these subjects used to be the primary fields of interest in science. Newton's law of gravitation was inspired by astronomical observations. The explanation of Kepler's laws by the force of gravity was a triumph of astrophysics. Subsequently, however, developments in electricity and magnetism made laboratory science much more productive and popular than astronomy. The ability to make controlled experiments and precise predictions attracted scientists to laboratories and away from observing the cosmos. Thus it was by the first quarter of this century that A & A were relegated to the status of poor relations in the scientific household.

Nevertheless the limitations of laboratory science vis-a-vis A & A could not be forgotten. The cosmic phenomena cover a far wider range of physical parameters than possible in the

laboratory. For example, a cosmic radio source can have energy 10^{40} times that released in a megaton bomb. Thus to test the validity of physical laws to the widest possible extent one has no alternative but to have recourse to A & A. This is why A & A have been brought back to a position of honour in modern times. Bigger and better telescopes are coming up and some of the best physicists are interesting themselves in the problems of A & A.

With most student manpower residing in the universities which as a whole have a very low profile of A & A in the form of teaching and R & D, it may well happen that good facilities will go unused for lack of astronomers !

This is where IUCAA steps in with an eightfold objective. To begin with, the Centre will have a core faculty, postdoctoral fellows and research students of its own engaged in basic research and



IUCAA's Eight-fold way

These exciting developments have found echos (albeit modest ones) in India too. The 2.3 m Vainu Bappu Telescope that was set up recently at Kavalur is probably the biggest optical telescope on Asian soil. The 1 m infra red telescope to be launched at Gurushikhar has the benefit of a very good astronomical site. The 10 m dish at Bangalore is equipped for state of the art work in millimetre wave astronomy. And perhaps the most ambitious project is the 35 crore Giant Meterwave Radio Telescope being erected at Narayangaon, near Pune.

Significantly, none of these facilities fall within the university sector. Although university users could in principle have access to some of these as guest observers, the existing framework does not make it easy for them to do so. Moreover, the more glaring question is 'Where are the users of tomorrow?'

participating in teaching and developmental activities. This is essential if IUCAA is to have credibility as a national coordinating centre. As a major research centre in A & A, IUCAA will organise schools and workshops in frontier research areas where national and international scientists will participate as resource persons. But growth of activities at IUCAA must be matched by on-campus nucleation and growth of A & A in the universities. To this end IUCAA's next objective will be to establish a dialogue with university departments through regional meetings wherein the problems faced by them in implementing a vigorous A & A programme are discussed. For example, what should an ideal M.Sc. Physics syllabus with specialization in A & A contain? How can the courses be supplemented by experimental aids and projects? Can A & A be introduced as a compulsory ingredient of the B.Sc. Physics curriculum so that students at least get introduced to these areas? IUCAA will help find practical answers to such questions.

This leads to IUCAA's third and fourth objectives...the training of manpower in A & A and growing the culture of astronomical instrumentation. Thus teachers need to be trained or reoriented for the teaching of A & A. So IUCAA needs to plan introductory or refresher courses for university and college teachers at various levels. And, it is equally necessary to organise elementary schools for undergraduates to acquaint them with exciting developments in A & A. To encourage development of astronomical instruments like detectors, cameras, photometers etc. IUCAA proposes to have an Instrumentation Laboratory where faculty and research students from the universities can participate in specific projects.

To some extent IUCAA is patterned on the International Centre for Theoretical Physics at Trieste, with a small core group and a large flux of visitors. As its fifth objective IUCAA has an Associateship Programme like that in the ICTP. An associate of IUCAA can visit the centre for long or short duration to take advantage of its centralized facilities or visiting resource persons. The travel and living expenses for such trips are borne by IUCAA. Directed at the university and college teachers, this programme is expected to improve mobility amongst the associates, increase contacts and promote interactions between scientists who might otherwise feel isolated.

IUCAA's sixth and seventh objectives are geared towards facilitating the use of major astronomical facilities by the staff and students of universities for research projects. The siting of IUCAA in Pune was dictated to a large extent by the location of GMRT at Narayangaon. By a happy turn of events both the IUCAA and GMRT office complexes are side by side in the congenial campus of Poona University which itself has a healthy and outward looking Physics Department. Thus IUCAA's sixth objective is to involve the university com-

munity more closely with the GMRT, both during its construction phase and as its users thereafter. And, to encourage the use of the guest observer programmes at other major facilities in the country and abroad by the university community, IUCAA will act as a catalyst for potential astronomers in the universities.

The eighth and final objective strikes at the root of it all: to participate in science popularisation through the interaction with amateur astronomers, young students and the general public. At present there is hardly any exposure to A & A at the school level while even amongst the general public a desire to know about the scientific discoveries in astronomy is coupled with superstitious beliefs in astrology. IUCAA can play a vital role in this area through information dissemination, practical demonstrations, astronomical slide shows etc.

From Objectives to Action

IUCAA has already begun construction of buildings on its 7.75 hectare plot with provision of office rooms, lecture halls, laboratory and computer blocks, library, canteen, hostel, visitor flats and staff housing as well as an auditorium and a visitor recreation centre to follow. A SUN-4 server and workstations, SPARK Workstations, electronic mail for rapid communication with astronomers worldwide, a rapidly growing library have been set up partly in a temporary shed called **ADITI** and partly in the adjoining building of the GMRT Project. The Instrumentation Laboratory is expected to be set up within a few months.

At present IUCAA has six faculty members, three post-docs and eight Ph.D students. Twenty associates have been selected for a three year period from July 1, 1990. Already several schools, minischools, workshops and regional meetings have been organized under its auspices. Distinguished visitors from India and abroad have given lectures at Pune while on a visit to IUCAA. These activities will grow considerably within two years as IUCAA's buildings get ready and its academic infrastructure grows. A quarterly bulletin Khagol was launched this year and has already become well known in the A & A community in India and abroad. Its frequency will no doubt increase as IUCAA's activities grow.

The UGC has set up the IUCs with high expectations in the hope of arresting and reversing the alarming trends in higher education mentioned in the beginning. The success of the experiment depends on the users themselves. Thus, to make the associateship programme work, the universities must come to look on IUCAA as their own field station so that a staff member who has come to use its facilities is treated as on duty. IUCAA's overtures to university departments for strengthening the A & A will need to be reciprocated and taken advantage of.

To summarize, IUCAA is like the hub of a wheel, with the universities lying on the rim. Both the hub and the rim need to be connected in order that the wheel rolls along. □

FACTS AND FIGURES

A review of the developments in higher education during the Seventh Plan in Karnataka indicates certain problems in perspective which must receive the attention of the planners while formulating the Eighth plan. The same situation exists in the rest of the country.

(i) Unplanned and erratic growth of colleges in the State has taken place.

(ii) The quality of education has not been improved correspondingly with the growth of colleges.

(iii) Higher percentage of failures in the examinations resulting in wastage of public resources. Increase of malpractices in university examinations causing serious public concern necessitating an ordinance on malpractices.

(iv) Inadequate and dismal performance of students in All-India Services and other competitive Higher Education.

(v) Tardy Progress of research in the Universities which are to some extent irrelevant to the needs of the state.

(vi) Contents of courses and methods of teaching several subjects are obsolete and call for immediate change.

(vii) The state of buildings, library, equipment and furniture in most of the Colleges and Universities are below the standards prescribed by the University Grants Commission.

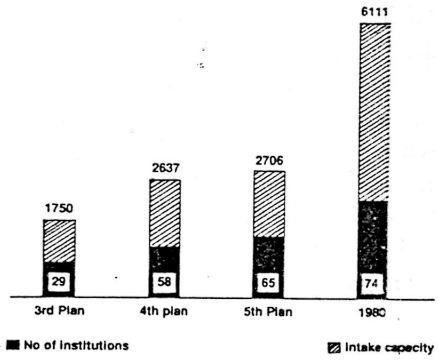
(viii) Performance of the State in the field of Sports and Games, extra curricular activities, with the exception of NCC, is below the par at the national level.

Source:

(1) Perspective for Education Sector Policy Paper for VIII Five Year Plan — Government of Karnataka Publication — August 1989.

(2) Report of Review Committee on PG Education and Research in Engineering and Technology, Ministry of Education and Culture — Government of India Publication 1990.

POST GRADUATE EDUCATION AND RESEARCH IN ENGINEERING AND TECHNOLOGY



GRADUATE INTAKE CAPACITIES

