

create confusion, linguistic partiality among evaluators could not be ruled out altogether. Further, in such two-tier system it is always possible that some really bright students may not qualify in the hit-or-miss game of the first paper, but do extremely well in the majors papers which would not even be evaluated!

It was also feared that comprehending lectures delivered in English would be difficult for many students, thus necessitating a slackened pace of teaching. In the semester system where time schedule is very rigid, complete coverage of the courses would not be possible. The level and the standard of teaching are therefore likely to suffer.

To be fair, most of these eventualities cited are real problems, but they are not insurmountable. Also, difficulties of implementation should not be construed as academic unsoundness or weakness of the proposed system. Participation of external examiners cannot affect the confidentiality if the existing checks and balances—such as all examiners sitting in the same hall to perform their job of evaluating false-scripted, unidentifiable answerscripts under supervision of senior faculty members—are rigorously followed. Further, participation of external evaluators already exists in some of the IITs. Inaccurate translation of question papers is a distinct possibility, but the possibility can be minimized by careful editing and cross-checking. Chances of an evaluator in a regional language being partial to his own

linguistic group cannot be ruled out in these days of heightened regional chauvinism, but its effect would at the most be only marginal. Courses on remedial and functional English, already there in the 1st year curriculum for students weak in English, can be strengthened and emphasized to counter the problem of comprehension among those unaccustomed to English medium of instruction. After all, the problem already exists with about 15% of the existing students.

While the IIT-JEE system is being thus overhauled, some introspections are going on about other important features of the system. Some crucial questions have been raised about the objectives of the JEE. What exactly are the attributes sought to be assessed through this test? Is it the candidates' mental alertness, their knowledge, their mnemonic ability, their exposure beyond the horizon of the textbooks, or their aptitude for the engineering programs? Or is it simply their ability to read fast and write faster, an ability that does not necessarily reflect the quality of mind and is acquirable through rigorous mechanical drilling—a technique almost perfected by the coaching schools? It is suggested that a committee, comprising senior faculty members from all the IITs, should look into this question of refocusing the objectives of the JEE and analysing whether the desirable objectives of testing are being fulfilled by the existing system.

To set the record straight, the new pattern was introduced and finalized by

the previous government in response to a movement at Delhi IIT, spearheaded by the newly emerging 'Vernacular Elite'. Data are available for JEE-1990, the first year after implementation of the new system. In the very first year, as much as 22.4% of candidates answered their scripts in vernacular. While overall qualifying percentage is 2.9, that of English-medium candidates is 3.7 and that of vernacular-medium candidates is 0.3. In absolute numbers, about 80,000 appeared, nearly 62,000 answered in English and remaining 18,000 in vernacular; 2322 candidates from the first category and only 48 from the second category qualified! It would however be hasty and unwise to dismiss the entire exercise as futile on the basis of data from one year only. The data at least make the point that these 48 students of now-proven merit would never have made the grade, had the system not been changed. It would be necessary to monitor the progress of these students, and to enhance their capacity for comprehension of lectures in English through appropriate academic programmes. In all fairness, therefore, the new system should be given a chance.

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The real brain drain

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Estimates of the magnitude of the annual brain drain from India and results of studies which help in understanding the brain drain as a process are presented. A term called the 'real brain drain' is introduced and a systematic policy for mitigating its harmful consequences is described.

The term 'brain drain' refers to the permanent migration of highly qualified and talented manpower from a developing country, in which it has been trained at considerable expense, to a developed country. In India, the problem first became important in the sixties because

of changes in the US immigration laws. With these changes, it became possible for a large number of Indians to migrate to the US. Initially the issue of most concern was the large number of doctors leaving India. In recent years, as the need for Indian doctors in the US

has diminished, the focus has shifted to the large-scale migration of engineers and scientists.

Magnitude of the brain drain

In the Indian context, the phrase 'brain

drain' implies the migration of engineers, doctors, scientists, social scientists, etc. The persons migrating possess Bachelor's or Master's degrees or Doctorates in the respective fields. A large majority of those with Bachelor's or Master's degrees go abroad initially for higher studies and then stay on.

A study of the literature available on the brain drain from India¹⁻³ shows that a number of papers have been written on the subject. These papers identify some of the principal causes of the brain drain and suggest measures for checking this flow of people. However, in spite of the large volume of writing available, reliable statistical data on the magnitude of the outflow are relatively scarce. At the national level, there is no ready data base from which one can come to know the total number of emigrants who leave on an annual basis and can be classified as constituting a brain drain. Reasonable inferences can however be drawn by using data available for the US because of the fact that much of the brain drain is to that country.

Burki and Swamy⁴ have given the following data on Indian immigrants to the US:

Year	Professional, technical and kindred workers
1973	4941
1974	4812
1975	6156
1976	6408
1977	5762
1978	4731
1979	3685

The average annual outflow from the data comes out to be 5214. A CSIR report⁵ indicates that in 1977, 4666 persons with a scientific, technological and professional background and 1386 students (making a total of 6052) of Indian origin were admitted as immigrants to US. This number agrees well with the data of Burki and Swamy.

Based on the above data, it would be reasonable to estimate that the annual brain drain to the US was between 5000 and 6000 in the seventies. This number may not have changed much in the eighties since the immigration quota is fixed by law and has not been altered until recently. Some changes have taken

place in the US immigration laws in 1990 and it is generally expected that these will lead to an increase in the brain drain. Assuming that the brain drain to the US is about 90 per cent of the total, the current annual brain drain from India to all countries of the world can be approximately estimated to lie in the range of 5500 to 6500. Of these, it is estimated that about 35 to 40% are engineers, 10 to 15% are doctors, 15 to 20% are scientists and the remaining are from other fields like humanities and social sciences, business management, etc.

It is worth noting that the brain drain is a small percentage of the annual national output. For example in the case of engineers, the annual output is around 30,000. If one takes the brain drain to be 2000, we get the percentage brain drain to be only about 7. The percentages in the case of the other professions (doctors, scientists, etc.) are even smaller.

Understanding the brain-drain process

In a recent study⁶, the brain drain as a process has been studied in detail with respect to BTech graduates of IIT Bombay. A fairly good understanding has been obtained by analysing the replies given by our alumni to a carefully formulated questionnaire. The questions were framed with the intention of developing two methods for understanding the brain drain. In the first method, an attempt was made to trace the professional career of the alumnus by analysing his initial decision to go abroad or not to go abroad, his decision to settle down abroad or return to India, and his views on life overseas and in India. In the second method, no personal questions were asked. Instead alumni were asked to comment on and rate certain features of life in western societies and in India that influence Indians in their decision to settle abroad or to return home. Both positive and negative features were considered in these questions. Some of the important findings were as follows:

i. Data on alumni settled abroad showed that most of them took the initial decision to go abroad with the purpose of undergoing further studies. The primary factor influencing this

decision was the desire to take advantage of wider and better opportunities abroad. The data also showed that most alumni had not planned on staying back overseas when they went from India initially. ii. Data on alumni settled in India showed that a number of them (about 25 per cent) had also wanted to go overseas for further studies. Of these, many had secured admission in the US universities but could not obtain financial aid. Thus it is evident that the real control on the number who migrate and their break-up professionwise is exercised by the receiving country and its needs.

iii. A large number of those who settle abroad do so without really having planned or made a conscious decision in this regard. They seem to slip gradually into an environment in which the salary and, very often, the working conditions are excellent and in which the initial opportunities for advancement are good.

iv. As perceived by alumni, the principal positive feature of a western society which encourages Indians to settle there is a 'comfortable standard of living'. 'A commitment to first rate science and technology' is perceived as the next most positive feature. This finding would appear to be a vindication of the statements often made that firstly 'brains go where money is' and secondly 'brains go where brains are'. These two positive features of a western society combined with the most dominating negative feature of Indian society as perceived by alumni, viz. the all pervading presence of a stifling, unresponsive bureaucracy, are the root causes of the brain drain.

The implications of findings (ii) and (iv) given above are obvious. One arrives at the conclusion that so long as the country remains economically poor and so long as its citizens are free to migrate, there is little prospect of influencing the magnitude of the brain drain by introducing any domestic policy measures. One has to accept the fact that the magnitude of the present outflow is determined by the immigration laws of the developed countries. Even the break-up in terms of professions is determined by the needs of the receiving countries.

Recognizing these facts, what does one do in terms of a policy? Does one continue to do nothing, as has been the case so far, because there seems to be no way to reduce the magnitude of the

migration? Does one say that 6000 is not an alarming number worth worrying about in comparison to the total annual output of the country?

The real brain drain

The contention which I wish to present here is that we need to worry and do something about this permanent migration, not on account of the fact that it is about 6000 a year but because amongst these 6000 migrants, there are every year a few hundred outstanding individuals.

My personal experience of teaching at an IIT for 25 years shows that although about 150 of our alumni settle down abroad every year and they are in general of a good calibre, there are very wide variations in their abilities and only about 20 or 25 can be classified as being brilliant. Similarly, of the total number of 6000 persons who migrate, only a few hundred (perhaps three or four hundred) are really brilliant individuals. The permanent loss of these few hundred gifted persons should be a matter of serious concern to the nation and constitutes what may be termed as the 'real' brain drain. Any policy measures which can help to get back some out of this small group of persons would obviously be worth pursuing.

Developing a policy for the real brain drain

The question which one needs to answer first is 'Can these highly talented individuals who constitute the real brain drain be identified?' The answer is that this can almost certainly be done on a fairly objective basis. A data base of such persons can be constructed and continuously updated. An appropriate time to enter such persons in the data base is when they first go abroad, usually for further studies or for post-doctoral work. The attributes which one looks for in selecting the persons are a uniformly brilliant academic career in India from school level to graduation and beyond, the standing of the university abroad which he or she joins, the area of work, etc.

The first step in ensuring that a person in the above category may return is to stay in touch with him when he is abroad and prevent him from getting alienated from the Indian environment. This is particularly important in view of findings (i) and (iii) given earlier. Newsletters giving information on the science and technology policies in the country, technological breakthroughs achieved, job opportunities, etc. can be most useful in this regard.

Secondly it is very necessary to adopt a very flexible policy for hiring. By this one means the offering of a reasonable job suited to the individual around the time the person is thinking of returning. The job offer should be made without the person having to wait for an advertisement, coming back to India and appearing for an interview in India. A flexible approach would also involve giving some help in regard to accommodation and perhaps even paying the air fare for the person and his dependents for returning. Flexibility should not mean offering a higher designation than what the person is entitled to by virtue of his qualifications and experience.

The above-mentioned measures of flexibility are not novel ideas and have been tried out occasionally on an individual basis by some universities and institutes in India. What is now being suggested is a more concerted effort conducted in a systematic manner on a national basis. CSIR would probably be the proper forum for coordinating such an effort. CSIR has experience of handling schemes of a similar nature. For example, it has administered the pool officer's scheme. Many thousands of scientists and engineers have availed of the benefits of this scheme over the years. Once a gifted individual has been identified and entered in the data base, the organization in India in charge of this scheme would stay in continuous touch with the individual when he is abroad and would take the initiative in finding a suitable placement commensurate with the person's qualifications and experience when he is likely to return. Thus instead of waiting for the person to contact various organizations, the coordinating organization in India would take the lead in making a suitable job offer.

Concluding remarks

For too long has the nation been under the illusion that having one of the largest pools of manpower in science and technology is adequate for maintaining our position in science and technology vis-a-vis other countries. It is now apparent that side-by-side with the numbers, we need to consciously encourage the growth of quality. The adverse influence of the 'real' brain drain on our scientific and technological research has been decidedly alarming and it would not be wrong to say that over the last two decades we have almost completely lost one generation of our most talented young scientists and engineers. We really cannot afford to continue this way.

The programme of action suggested here could help to some extent. We should not be under any illusions of attaining total success with such a programme. Indeed, we would be lucky to get back perhaps a third or a fourth of the persons constituting the 'real' brain drain. But even this would be a tremendous success, because every one of the returnees would be a brilliant individual, a Raman or a Visvesvaraya in the making.

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