

India's scientific community: A cultural crisis?

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Over the last 15 years, the state of science in the country has been under increasing scrutiny at major academic fora – the Indian National Science Academy¹, Indian Academy of Sciences², the Indian Science Congress sessions³, periodic DST status reports⁴ and Seminars in the Society for Scientific Values⁵. The theme has almost invariably been the same: There is little qualitative impact of Indian Science on the international field despite proliferation in the number of papers published in various journals. This, in turn, is a direct reflection on the state of 'University education in science' in the country. The preamble for such discussions has always been predictable: What has gone wrong since Independence in a country which can rightly boast of the pioneering achievements of Bose, Raman and Saha, all done indigenously in this very atmosphere? And let there be no mistaking the extreme poverty and the consequent non-existence of the so-called 'facilities for scientific research' prevailing in those times, and which the modern generation of academics and professional workers never tires of complaining about. Indeed, the great achievements of these giants in the pre-independence days, sitting in this very soil, as distinct from the equally impressive successes of their 'provasi' counterparts (Bhabha, Chandrasekhar), would even tempt one to wonder if there is any other 'mystery' apart from 'funds' which lies at the root of 'success' in a scientific endeavour. Ramanujan was of course a 'class' by himself, and cannot be understood in 'rational' terms. One must, of course, hasten to make a prior allowance for a fortuitous circumstance which existed 70 years ago, viz., the state of flux that science, especially physics, was undergoing in those days when it was perhaps easier for a single individual to make a decisive impact on the international map than it is today. Yet a closer scrutiny of the 'nature' and 'thrust' of their investigations strongly suggests the influence of an 'indigenous' culture that is quite independent of its western counterpart,

despite the general background of Western Science, in which these investigations had been carried out. This is especially true of Bose's great discovery which one may venture to guess would not have been easy to make in the then prevailing atmosphere of Western Science which had not (and still has not) recovered from the strongly 'deterministic philosophy' of the nineteenth century, and was very much 'ill at ease' with the new paradigm that had been thrust on it by half a dozen western minds in quick succession (Planck, Einstein², Rutherford, Bohr and de Broglie). (In this connection I am reminded of a remark by Abdus Salam in 1970 (ref. 6), in the context of a discussion on 'symmetries', namely, it is often easier and more natural for an easterner to appreciate the significance of concepts based on apparently 'conflicting' ideas such as particle-wave duality than his western counterpart, and indeed went on to cite Bose's great discovery of the very concept of indistinguishability as an example).

Apparently there are vital ingredients (other than funds and facilities) in the indigenous cultures and traditions of a given community that go to make up its scientific ethos and values.

Pre-independence scenario

Now to come back to the question which has been bothering our academics¹⁻⁵, it is necessary that one must not fight shy of looking back to the pre-independence scenario for comparison. As long as the country was under the foreign yoke, the political atmosphere was such as to keep the academics and intellectuals confined to the portals of the modest university system for all it was worth. The foreign government was simply not interested in making use of our scientific talent for genuine developmental purposes (except perhaps for occasionally hiring some scientists for help in their war efforts). Nor were the members of the scientific community

anxious on their own in offering their services to the then government against the emotional tide of the freedom movement. The safest abodes for their intellectual pursuits under the circumstances were thus necessarily the educational institutions which also 'housed' the sciences in a modest way in the absence of alternative, exclusive, abodes of scientific pursuits (with rare exceptions like the Indian Association for the Cultivation of Science, the Bose Institute in Calcutta and the Indian Institute of Science in Bangalore). The result: whatever little (?) output came out of this system was truly indigenous and this included the signal contributions of the giants noted above.

The 'culture' of these educational institutions in the pre-independence days was also quite different from what it is today. The 'ambitions' of the teachers were confined to their modest academic pursuits which included offering their best attention to their students, as if they were their own children, and not from any sinecure motives. (I have seen my late father (Jatindranath Mitra) spending hours together with his students at home, over and above the limited hours spent with them at his Ramjas College, with the sole incentive if any being one of 'competition' with sister institutions for his students' performance at the University examinations, as if their successes were his own! Any other motive, especially the 'tuition' motive which is so prevalent today, was simply unthinkable then). No wonder, the students got their academic dues without ever asking for them, but more importantly, this kind of gurukul atmosphere had a profoundly salutary effect on their moral fabric which they were to propagate later to their progeny. The seminal researches of Bose-Raman-Saha were already ample evidence of the modest but indigenous research atmosphere present in the then University educational system pioneered by great visionaries like Asutosh Mukherjee (Calcutta), Madan Mohan Malviya (Banaras) and the Maharaja of Mysore, all of whom took great personal interest in bringing together

bright young workers and encouraging them in their efforts.

Post-independence: Decline of university system

This 'garden atmosphere' was however too Utopian to survive the economic challenges of the post-war era which also happened to coincide with the post-Independence era. With the dawn of Independence, our founding fathers rightly stressed the need for rapid industrial development, seeking to compress as it were the two centuries of Industrial Revolution in the West to at most a few decades. This new emphasis called for fresh priorities with its inevitable impact on the society. In this review, we are however concerned with only some aspects of this impact on a small but vital section of the society which is supposed to nurture science through a sound educational system. In the new dispensation of the then government, the universities found themselves suddenly reduced to the status of 'second class' institutions, as if to contradict the very noble sentiments of no less an authority than Jawaharlal Nehru on the true role of a university in a free society as the symbol 'for compassion, for reason, for the adventure of ideas and generally for the onward march of the nation towards still higher objectives'⁷. Not that there was any deliberate attempt to downgrade the universities, but in the then nascent atmosphere, their social status registered a sharp decline in the face of a new 'cultural revolution' caused by the creation of a chain of government-sponsored organizations such as the CSIR, ICAR, ICMR, AEC and the various national laboratories under their respective jurisdictions on the pattern of their British counterparts. The external symptom of this development was a sudden imbalance caused by the outflow of talent towards these new pastures at the immediate cost to the educational institutions which had hitherto been their traditional abodes, as well as fountainheads for the supply of intellectual and scientific talent in any country, but the negative effect penetrated much deeper (see below).

Now the growth of government-sponsored scientific organizations is inevitable in any developing society and

their creation on the British pattern cannot be faulted on intrinsic grounds. Indeed in the post-war era, a similar development was also noticeable in the French System under the CNRS and like organizations⁸. However, unlike in Britain or France where the firm tradition of liberal intellectual values has always ensured a steady supply of a sizeable fraction of the intellectual cream of the society within their university systems without fear of any major depletion of talent, a phenomenon of this nature proved much too harsh for the delicate educational structure of this country in the nascent atmosphere prevailing in the post-independence period. And to make things worse, there was no evidence of a corresponding degree of concern in this country for countering the impact of this new culture through suitable checks and balances. Instead there was just a one-way development: The discovery of new form of 'glamour' in these prestigious institutions in the Indian context tended to attract the scientific manpower to the new environment by way of better economic and social prospects, while on the psychological plane, it had a negative effect which should have been anticipated: A 'devaluation' of the University system through the implied perception of a sort of 'poor cousin' status for the latter in the eyes of the society at large. Unfortunately the government made no effort to introduce any corrective measures against such an obvious imbalance which was to have a long-term detrimental effect on their healthy growth in the new scenario. For on the one hand the University system now found a major rival claimant for the modest state support that it had hitherto been used to, with the greater part of the available funds for development being diverted to National Institutions now manned by people identified as the 'top scientists' in the country many by whom had little actual contact with teaching at the brass tack levels. On the other hand, the visible indifference of these new 'managers of science' towards the problems of their 'poor cousins' (presumably for lack of any direct experience with the working of these institutions) generated a psychological feeling of social inferiority within the university community, to such an extent as to generate a genuine desire among its smarter members to

migrate from the university system to 'new pastures', e.g., 'abroad'. Thus, far from strengthening the fabric of the educational structure, the new policy of the government seemed to be tantamount to 'allowing' the traditional educational institutions to 'decay with time, when its long-term concern should have quite the opposite, viz., a continuous generation of scientific talent which only the latter could provide for a steady flow of scientific manpower for the expanding organizational activities in science and technology. Incidentally, this 'decay' has been strictly at the qualitative level, for with the passage of time there has been a steady proliferation of the number of universities in the country, almost in tandem with the increase of U. N. membership during the same period (while the FIVE permanent members of the Security Council dictate the deliberations and decisions). This fact, together with the utter frustration of the teaching community due to the lack of basic amenities for work, as well as of incentives for promotional avenues over the last three decades, has probably been the biggest single factor responsible for the parlous state that the university system finds itself today. The peculiar form of 'trade-unionism' now witnessed in the educational institutions is hardly distinguishable from what one is normally accustomed to in the industrial sector, and is a far cry from their 'cloistered atmosphere' of half a century earlier. In the public perception, the university system has now acquired the dubious distinction of a 'second-class citizen', what with the so-called 'promotional farce' (especially in the professorship category) which has merely served to erode its credentials further. In all fairness though, the question of 'which came first, the hen or the egg?' remains at best a speculation.

Degeneration of scientific manpower

The above is only one side of the story, one accruing to a vital sector of the society, the university system, to the decline of the scientific enterprise in the country. The other side of the coin, the state of the scientific community which forms the bulk of the scientific manpower of the government-run institu-

tion, is no more rosy, if one has to go by the frequent concerns expressed by various Academic bodies¹⁻⁵, case studies by professional experts⁹, as well as numerous expressions of public concern reported in various magazines and newspapers in recent times under titles like 'tragic gap' [ed. Indian Express 3.2.95], 'plight of scientists' [Times of India, 11.3.95], to mention a few samples. (This is hardly surprising, since after all, the 'timber' of scientific manpower in the country comes from the same stock as can be supplied by the educational system itself, irrespective of whether the initial advantage of the former was at the cost of the latter). The laments expressed in these media columns, including some¹⁰ from members of the general public, are mere variants of a common theme: 'a moribund state of science in the country'. The symptoms span a whole range of factors, both specific and non-specific. Some items are¹⁰:

(1) A lack of sensitivity (of authorities?) in identifying and encouraging scientists;

(2) Failure of senior scientists to champion the cause of their junior colleagues;

(3) Public unawareness of the research-funding policies. As a result, huge grant sanctions are often based on political clout of the scientist in an atmosphere of corruption and sycophancy at the bureaucratic level;

(4) Lack of peer support of upcoming young scientists due to the reluctance of the top rung of scientists to encourage talented and ambitious youngsters (barring some genuine cases). This stems from a sense of insecurity (born out of their own inadequacies, lack of commitment and complacency). The resulting effect is a gradual extinction of the 'flames of scientific temper'¹⁰ in the young minds through a denial of access to facilities, and/or only short-term support to their research.

(5) Callous attitude of officials in the Alma Maters of young scientists, resulting in delay of sanctions, bills settlements, etc, so that the finance and purchase sections decide the time table.

The common refrain of most of these complaints is a pitiful lack of 'funds and facilities', together with a very unjust form of distribution which leaves this meagre resource in the hands of a small but influential group which would resist

any sharing of scientific power down the line. Underlying this refrain is an implicit belief that the amount of any worthwhile research output is directly proportional to the available *funds and facilities*, as if to suggest an exclusion of all other factors! This is certainly an oversimplification but it goes to show how deeply the malaise has penetrated the psyche of the average scientific worker. The kind of research that is directly proportional to the 'fund available' is still quite substantial in this country, as a recent discussion in one of the premier Academies¹ would suggest, but how much qualitative impact it makes on the international scene, is anybody's guess, despite our claims to the possession of the fourth largest scientific manpower in the world. Apparently some other vital element/elements conducive to the growth of a healthy science are also involved.

Role of 'national ethos' in the growth of science

What is this vital element/elements? Perhaps a single phrase in which it/they can be summarized is a sense of 'national ethos' which binds a great nation together in terms of its different components, scientists included. Indeed it does not take too much scrutiny of the scientific achievements from any great country which has made a sizeable impact on international science (UK, USA, USSR, France, Germany, Italy and Japan) to convince oneself of the 'sense of belonging' of its scientists as its nationals trying to project the work of their colleagues as if it were their own. And this stance is visible quite naturally and spontaneously, without the slightest effort at any 'pretence'. Any member of our scientific community who has interacted with his/her 'foreign' counterpart will not fail to testify to this common characteristic which binds them together, transcending the international character of science. One would also discern a broad degree of 'cultural similarity' as well as a sense of national solidarity in their respective publications (as revealed by their referencing patterns, among other things). This is not to say that scientific pursuits in these countries are free from problems, but they are of other types (also present

in our system) and their identifications, and solutions are at least not hampered by the 'cultural identity' problem.

Let us now compare the corresponding scenario in our country. To keep the record straight, there is no question of a sense of national identity not existing at the socio-political level (in the face of any external threat, we are all one), but are we equally sure that the same degree of 'cultural solidarity' obtains within the subsystem of the scientific community (which after all is not threatened by an external enemy)? Despite possible protestations to the contrary, the answer seems to be an emphatic 'no'. And the evidence lies not just in the relatively innocuous fact of our scientists being more comfortable with their activities when they 'go abroad' with obvious attractions on both the economic and the 'fund-cum-facility' fronts (this is merely an external symptom, not a cause), but rather in their very attitude of indifference to a sense of cultural and ethnic togetherness compared to their more successful western counterparts. This attitude is more easily noticeable in the themes and referencing patterns of their publications which evince an unmistakable tendency to 'lean' towards western thoughts even for mundane and routine ideas, and often show a tendency to ignore similar work emanating from their compatriots, in favour of corresponding references from more 'visible' western colleagues. This may well be due to a feeling of insecurity born out of a lack of confidence in indigenous research output, but it has the effect of snowballing into a peculiar 'collective culture' in which the indigenous component becomes the victim. It may be argued that since basic science is international in character and there is only one accepted theory by and large, such an attitude is unexceptionable *vis a vis* the theme of a paper. While this is a priori a very powerful argument, it is not free from limitations, for the same logic should also apply to the various other nationalities in western science. Yet one invariably notices some distinct 'nationalistic' flavours (American, Russian, Italian, Japanese, etc.) in their respective publications, despite a common pursuit of international science. The only sensible answer to this paradox lies in the simple fact that within the broad framework of 'accepted sci-

ence', there is plenty of scope for diversification of ideas designed to address limited sectors of investigation, and it is through such possibilities that one often arrives at 'new' insights on an 'old' problem. There is good reason to believe that such 'insights' have a sort of 'regional character' reflecting the 'national ethos' of the investigators concerned. And in any case it is difficult otherwise to account for the fact that most original discoveries have emanated from one or more of these *individual* countries, with their clear imprints, and very rarely on a 'multinational' basis.

To illustrate the nature of these 'insights', one invariably finds an abstract (often mathematical) flavour in Russian and French research publications, in contrast to a more practical 'applicational' orientation in their British and American counterparts. German and Italian Physics which used to be oriented towards the abstract and applicational respectively in the pre-war days, have undergone drastic changes since then, with a certain degree of intermixing of the two, probably as a result of the traumatic effects of the War on their respective social structures. The Japanese ethos, on the other hand, shows an interesting transition from the Eastern abstractness of the pre-war physics (Yukawa, Tomonaga and especially the Nagoya Group) to an applicational (bordering on engineering) orientation, especially since the War, perhaps symbolizing a *collective national effort* for 'catching up' with the western nations on the technological front; yet the key element has been unmistakably a collective nationalistic ethos.

Against this backdrop it is interesting to ask if any collective 'nationalistic ethos' is noticeable in the Indian context, even after half a century of the post-independence period. The characteristic imprint of 'Eastern Thought' was clearly visible in the pioneering researches of Bose, Raman and Saha, carried out in the 'splendid isolation' of their respective environments. It would be idle to ask if there was evidence of any 'national identity' under the shadow of a foreign ruler, but the themes of these papers were 'characteristically Indian' which did not prevent them from having a decisive bearing on the international frontiers of physics. True, it was a period of upheaval in Physics

when it was getting reshaped in tune with the new realities, and when the chances of making a significant impact due to individual efforts were a maximum. However, it is interesting to ask if a 'Bose' or a 'Raman' could have made a similar discovery in the present environment of science in the country after 50 years of independence when our 'Eastern' philosophy should in all fairness have crystallized into a well-defined 'national ethos in science', as in the more 'mature' countries of the west. One major problem he would face is the enormous growth of Physics since the consolidation of Quantum field theory (though the current state of this theory is again in a state of flux!). The more serious handicap for him would be cultural: he would find himself as a 'Rip Van Winkle' with no trace of the indigenous scientific culture that he had (perhaps inadvertently) *initiated* 70 years ago, in today's 'voo-doo' atmosphere which pervades every section of the society, science included, making it virtually impossible for any well-defined indigenous culture, scientific or otherwise, to evolve. True, in the new world order some degree of intermixing of cultures of the East and the West is inevitable, yet it is fair to say that by and large, the cultural identities of the major nations have not been lost in the process.

Decline of cultural values

So, where do we stand in this new scenario? More pertinently, how did this remarkable increase of entropy in our 'science culture' come about? While part of the reason must be attributed to the worldwide phenomenon of increased mobility in the post-war period which has led to a considerable intermixing of scientific and cultural values, one suspects that there must have been other important factors without which it would have been difficult to account for such a qualitative transformation in a country of India's size and diversity which has maintained its cultural identity over centuries. One major factor that may stand some repetition in retrospect is the government's (short-sighted?) perspective for 'development in a hurry' by indiscriminately drawing on the Nation's 'intellectual reservoir'

(the Universities) without a balancing concern for the long-term effect on the cultural health of the nation. This was done by declaring its dependence on the scientific community to be sure, but the actual implementation came about through a hurried 'patronage' to a few 'top scientists' (chosen arbitrarily) in a 'nascent' atmosphere where the Society's perception of a healthy balance between its scientific manpower and a sound educational base to generate it had not had time to crystallize. Now, while the choice of a 'Bhabha' to initiate the Nation's atomic energy programme would be deemed unexceptionable even after 50 years today, the arbitrary choice of many others as 'science managers' led to a visible imbalance in the educational and scientific community then at a crucial stage of evolution. Among various fallouts, a 'competitive' phenomenon was discernible, with some senior academicians leaving their natural habitats (*viz.*, the universities) for similar (lucrative?) placements with the government. From the long-term perspective of a healthy growth of the educational system in the country which is the fountainhead for the supply of sound scientific manpower on a continuing basis, such an episode, right at the dawn of independence, had a profoundly negative effect on the traditional image of an 'ideal society' normally associated with the pivotal role of the 'universities' in projecting this noble image. Indeed, in the eyes of the academic community, especially of the younger generation, this transformation which put the glamorous image of the Science Manager above the low-profile picture of the 'teacher' working in an educational institution was tantamount to a repudiation of its traditional value system, the long-term effect of which may be partly captured by the spirit of the following poem due to Robert Browning (?) on the occasion of William Wordsworth's appointment as Poet Laureate of England:

'Just for a handful of silver he left us;
Just for a riband to stick in his coat.
Got only one of which fortune bereft us;
Lost all others she lets us devote.

They who had gold to give doled him
out silver;

How all our copper had gone for his
service.'

In the Society's perception, such a lopsided perspective at the very dawn of

independence, without a corresponding corrective measure to ensure that no damage was caused to the long term health of the educational system, set the tone for *defining* the relative priorities for development of the universities *vis a vis* governmental organizations, and indeed repudiated in the process the lofty ideals set out by Jawaharlal Nehru himself⁷ on the role of the universities in building up the mental health of the Nation. Once the relative priorities were so defined, the subsequent evolution of the university system (*vis a vis* the scientific organizations under government charge) took its natural course where 'shortage of funds' for scientific education was but a symptom of the many consequences to follow. And if the then Society accepted this 'value system' without proper scrutiny of its long-term effect on itself, (since in the ultimate analysis the health of the scientific manpower would be determined by that of its basic source—the university system), it is merely the price of a costly mistake made half a century earlier that we are paying today in more ways than one.

Perhaps the biggest casualty of this lopsided value system was its failure to develop some well-defined 'schools of thought' with a characteristic Indian flavour, for which the best breeding ground is the university system itself. Of course, there had been attempts to develop such schools on a localized scale, but these pockets did not live long enough to grow into an all-embracing 'Indian ethos' of the type discernible in the more successful western societies noted above. With the 'individualistic ethos' that have characterized our scientific community (in company with the rest of our countrymen, as Gandhiji had recognized well enough to advocate basically small scale industries!), the more 'influential' among them merely took advantage of this lop-sided value system to promote their individual career interests through lobbying with the appropriate authorities in a well-defined hierarchy (Science managers for the middle level scientists; the political authorities for the top rung). Apparently, the sole criterion of scientific 'visibility' lay in some sort of State recognition (in the form of national awards, higher placements, etc). Others with more conservative forms of

ambition for visibility in science often chose to look for more suitable opportunities abroad. And all this transition occurred before the scientific community in the country had reached a critical size, not just in numbers but in quality, which is a standard bulwark against any major scientific injustice or aberration in any 'mature' nation. No wonder, the degeneration into such an 'opportunistic atmosphere' was not conducive to the evolution of a holistic scientific culture, and the same got progressively reflected in more ways than one. A major signature has been the publication pattern of our scientists which have shown a strong tendency to routinely follow western ideas howsoever trivial, even in mundane theoretical investigations, while in the experimental areas of applied science the themes have often no relevance to the needs of their local environments. In either field there is little sign of effort to develop an indigenous culture as is normally understood in a western science community. Instead one witnesses a hybrid 'value system' in which a desperate *cultural* dependence on 'Western' science for research ideas has come to be matched by an equally compulsive culture of sychophancy with which the members of the upper echelons of the scientific community 'look' to the 'authorities' for security of their own positions of power and influence, while those in the middle levels in turn, are only too eager to pay court to their 'superiors' for sheer survival. This typical scenario, which is reminiscent of the political culture in the country as a whole, has got perpetuated in the failure of a strong 'scientific constituency' to develop as a natural custodian of moral and scientific values in any country. Such a body which evolves gradually in a mature educational and cultural base, did not have enough time to crystallize in a healthy manner in the atmosphere prevailing in this country. We now have a 'Society for scientific values' which periodically 'assesses' the moral and cultural health of the scientific community, but it comes too late in the day (and with too little mandate to do anything but scratch the external surface of the malady) for a meaningful impact on the health of this community to day.

Strangely enough, the hazards of too much dependence on the western environment have lately started telling on

the more ambitious among Indian scientists who have been experimenting with a scientific career abroad. An interesting study by an eminent scientist and his colleague living abroad¹¹ reveals that after the first two stages (pre- and post-doctoral) in US universities and scientific institutions which the young Indian worker finds extremely satisfying for his knowledge, and rewarding for his career, there begins a long period of professional frustration for the more ambitious among them who have an urge to compete for professional recognition with their western counterparts. No wonder many of these NRIs, including scientists, are now anxious to come back to play an active role in the Indian scenario (including the setting up of an 'ideal' science university?), perhaps after tasting the limits of 'intellectual satisfaction' available from the West, *vis a vis* their personal ambitions. It is precisely in such situations that the true significance of a characteristic (national) ethos, something that is naturally present in the western system but has somehow got short-circuited within the Indian scenario in the process of 'evolution in a hurry', comes out in bold relief.

To keep the perspective right, it will be a gross oversimplification to claim that Indian Science has scored no visibility at all since independence, for the Nobel recognition of Subramanian Chandrasekhar a few years ago stands out loud and clear, despite the technicality of the citizenship anomaly. Among other pioneering achievements in recent times which have helped put India on the world map are those of G. N. Ramachandran (Triple helix), S. Chandrasekhar (Liquid crystals), A. S. Paintal (Science of breathlessness) and C. N. R. Rao (Surface chemistry) to name a few. Again, in the area of the theoretical sciences (mainly physical) there are a few institutions of science, mostly outside the university system, where good quality work has attracted 'proper recognition' in the international scientific community, in the sense of a "Conformity with 'normal standards' prevailing today in the international field", but nothing more concrete can be claimed in this regard. These are indices of better 'funding and facilities' in improving the quality of work in a standard institution whose

'cultural base' continues to 'look west' for fresh ideas. However, considering the vast potential of the scientific manpower in the country, a growth of much bigger dimensions would have been expected. This brings back the bigger question of the possibility of cultivating a more indigenous scientific culture (for which the intellectual 'software' can come only from our own educational system) and which alone can hold out the prospects of generating 'fresh ideas' indigenously without the compulsion of 'looking west'.

Indigenous scientific 'hardware': AEC and ISRO

For a comparison of this scenario on 'cultural software', with the corresponding scenario on the technological front, it is useful to keep on record that at least one area in which a centralized command (under an ideal leader – Homi Bhabha) has paid off quite handsomely is a successful development of an indigenous culture in the atomic energy research programme which has grown from strength to strength over the decades since independence and has now developed a strong infrastructure which is not only largely self-contained but has been continuously expanding its activities in several dimensions to generate appropriate spin-offs without external support. The international stature of this organization today owes much to the single-minded devotion of Bhabha's able followers like Raja Ramanna and his colleagues who have put this country on a firm footing on the world map. In parallel with the AEC, the sister Organization of ISRO which has also indigenously developed an equally viable infrastructure to put this country on the world map on the space front, owes much to the original vision of Vikram Sarabhai and the sustained and dedicated efforts of Satish Dhawan and his able colleagues.

The AEC and ISRO are examples of what may be called typically 'Indian ethos' developed through truly indigenous efforts. Their infrastructures are sound examples of technological self-reliance which by their very nature could not have materialized without a highly organized structure, which in turn was possible only under a unitary command with direct government con-

trol, in company with corresponding structures in developed countries.

State of scientific 'software'

Vital as these organizations are for the health and security of the nation, they are nevertheless a modest fraction of the nation's scientific and technological 'agenda' which span a whole gamut of basic and applied sciences. It is also possible to argue that any worthwhile research efforts in today's state of the art in applied sciences requires a considerable degree of *organized* effort and planning. Moreover, since the infrastructural facilities for such activities cannot be duplicated at will (because of the high cost of installation) their use must also be centralized as far as possible, which explains the emergence of specialized centres like the NSC (with facilities like pelletrons). Similarly, major experimental laboratories for specialized researches in well-defined areas (such as the GMRT) are all 'hard science' activities which necessarily require a high degree of organized and dedicated effort.

The main concern in this review, on the other hand, is not so much an indigenous infrastructure of scientific 'hardware' (AEC, ISRO, etc), crucial as it is for the Nation, as is the development of an indigenous software in the basic sciences for which the traditional breeding ground has been the university system in any country, developed or developing. It is here that one does *not* need any high degree of organization which may well be counterproductive! On the other hand, its relatively informal atmosphere provides the best soil for a gradual and spontaneous evolution of a healthy scientific culture which can be truly claimed as our own. Unfortunately in this field, our performance has been dismal for, not to speak of generating an 'indigenous' flavour, as in most successful nations, it has not even produced a well-defined 'composite' flavour after fifty years of independence, and the blame for this must be laid at the door of our educational policy which simply failed to take off, and whose worst victims have been the university system. This in turn has affected all sectors of the scientific and industrial base, in both basic and applied

sciences, as a result of the 'poor software' produced at source! There is no dearth of quantity – about 4000 PhDs per annum – but this itself is more of a liability than an asset, in the absence of a 'sense of direction'. As found in a recent survey⁹, this community is beset with a sense of frustration due to loss of self-esteem, lack of intellectual stimulation due to erosion of knowledge base, and a general sense of inadequacy with the environment. All these (and more) are the bane of the typical average scientist of today who has been variously depicted as a 'holy cow' and a 'fall guy' with a poor image of himself, whose labour is unrecognized and his achievements ignored. An analogous picture is also discernable in the general public's perception¹⁰.

As against this plight of the average scientific worker, the scientific culture of the higher echelons among them presents a different kind of scenario, as succinctly described by P. K. Das, Editor, *Society for Scientific Values*, in some recent issues of its bimonthly newsletter^{12,13}. In a candid though satirical exposition, the distinguished meteorologist¹² expresses the view that Indian Science is badly afflicted with the so-called 'publicity disease' among its senior and 'high profile' practitioners. In his view, this disease has considerably eroded the real scientific base of the country by sending the wrong signals to the upcoming scientists. Without going into specific examples (several of which are of recent origin), it is perhaps fair to comment that there is nothing intrinsically wrong in wanting quick publicity – this phenomenon is quite universal the world over, provided the claim for priority is endorsed by the scientific community of the worker through a journal publication and/or exposure through a conference presentation. Indeed it is precisely in such situations that the advantages of a 'national ethos' become quite crucial since the projection of such results before the wider world becomes the primary responsibility and initiative of our own scientific community itself. However, if the work is of a secondary nature, which is more often the case, he must accept the initial disadvantage of 'missing the primary bus' and forgo any claims to instant glamour/kudos before doing a more substantial (yet secondary)

investigation, which usually is a time-consuming process with little chance of instant success. Indeed it is up to the senior members of the scientific community to ensure such conformity to the accepted norms of a mature scientific society so as not to send the wrong signals to the younger members of the community as to the correct scientific perspective.

P. K. Das's second article¹³ discusses the 'glamour'-oriented high profile behaviour of the higher echelons of our scientific community at the taxpayer's expense, such as (i) travelling from airport to airport to inaugurate symposia in five-star hotels (with speeches written by someone else); (ii) running down the work of others in their regional networks; (iii) and even indulging in subtle forms of plagiarism. An intriguing form of the last type shows up as 'an unduly servile attitude towards scientists from countries other than one's own'—quote from ref. 13. On the other hand, from the higher ups one often hears the oft repeated phrases like 'Scientific temper' and 'Excellence in science', as if to bring out rather tellingly a sort of inverse relationship between preaching and practising, much like two canonically conjugate (complementary?) variables in physics! One hardly hears of such phrases in the western societies where the 'scientific temper' is a routine matter for practice, not for publicity. Why is it the other way round in this country of ours? Otherwise it is again difficult to understand why a 'John Maddox' has to be periodically imported into this country every ten years (roughly coinciding with the Golden and Diamond Jubilees of our premier Academies) just to give a pat on the

back of our 'scientists', or a 'certificate of merit' through the columns of *Nature*. In no other country with a mature tradition of science would such self-appointed angels be allowed to exercise such uncalled-for patronage. On the other hand, it is surprising how much can still be done in this very country by purely Indian efforts, if only the right kind of encouragement were provided.

Summary and outlook

This somewhat repetitive analysis was designed for a panoramic view as to the nature of the disease which the scientific community suffers from today, one that is intimately linked with (i) the educational system which simply failed to inculcate the proper sense of values in the initial stages of development, and (ii) with the work culture of the scientific and technological institutions at the later stages of development of the scientific worker. On both fronts he finds himself completely lost in today's scientific labyrinth which seems to be going in tandem with the political atmosphere in the country. The scientific community is merely a part of our bigger society which has been witnessing a steady deterioration of our basic value system – a sort of 'systems failure' from which no part of the society can remain immune. The only difference is that greater maturity and self-restraint would have been expected of the upper echelons of the scientific community which after all represents the 'cream' of the society. One hopes that all is not lost yet, for there are definite indications of renaissance in the major disciplines of science through the coming up of a new

generation of workers with the right credentials, with good prospects of their numbers exceeding the critical size, so as to serve as the Conscience of the Scientific community of the future, as well as a watchdog against the kind of aberrations that have been witnessed during the 'transition decades' since Independence.

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