effort in instrumentation is exactly the opposite. If components are more easily available, then there would be greater efforts in value addition.

It is presumed that local industry will rise to the occasion and not offer shoddy products– this is a must. Assuming this is the case, there must be every effort to discourage the import of instruments that are locally made or assembled. There would of course be the tendency of users (supported by local agents of foreign companies) to play the 'specsmanship' game. This should be resisted.

To keep imports to a minimum, industries and R&D organizations seeking to import must first be asked to make matching purchases of local products. A formula could be evolved whereby, unless there is a purchase of Indian products to the value of Rs. X, say, import to the value of Rs. Y will not be permitted. In the case of imported instruments, there should be an additional levy towards a development fund, revenue from which must be available to the agency which co-ordinates and directs the overall national thrust in instrumentation. All this might sound draconian to the user, but national interest demands that we start paying the price.

Reference was made earlier to active interaction between users and manufacturers leading to a cycle of sustained development. This strongly suggests that technology parks as proposed above must be close to major R&D centres, for example the Indian Institute of Science and the Bhabha Atomic Research Centre. The laws of the land must be suitably modified (i) to facilitate professional contacts between scientists of the R&D establishment on the one hand and the engineers of the park on the other (this is so in many other countries), (ii) to gift surplus and unwanted equipment in the R&D establishment to park industries, (iii) to encourage the purchase of products made in the park, and (iv) to encourage the subcontracting of various fabrication tasks to the park. In addition, a golden handshake scheme must be introduced to enable scientists in R&D establishments to quit the lab and turn into entrepreneurs. As a gesture, the R&D establishments should permit such scientists to take out, free of cost, know-how available in the lab, and perhaps also surplus equipment, upto a certain value. In the long run, all this would help in trimming the sizes of some of our labs, which have grown rather unwieldy in the process of trying to build up all kinds of infrastructure.

Simplification of rules as proposed might appear shocking, conditioned as we are to an excessively suspicious and bureaucratic system, but other countries already have such schemes (at least the more important ones); no wonder such technology parks are successful there.

As yet another daring gesture, the government could offer free, say for a period of five years, know-how generated in its laboratories to small-and medium-scale industries. So far the idea has been that the expenditure on R&D must be at least partially recovered through the sale of know-how. The report of the comptroller and auditor-general clearly shows that performance in this respect has been pathetic. If anything, there have been endless disputes between the seller of the know-how and the buyer. If offered free to all and without any guarantees, such disputes will not occur. Moreover, there might be many entrants to the field and thus a healthy competition.

One specific area which definitely needs active promotion is very-large-scale integrated circuit (VLSI) design. Today the trend is toward application-specific integrated circuits (ASIC). Many institutions (e.g. the Indian Institute of Science) train students in this vital area but the training goes waste owing to the absence of a strong instrumentation industry. In fact many migrate, unable to use their skills locally. This trend can definitely be arrested, at least to some extent.

Concluding remarks

There may be other solutions to the problem, different from what has been sketched above. There is obviously no unique solution, but whatever it be, it will surely have to address the questions of how to galvanize our industry, how to stimulate slumbering talent, how to help more scientists and engineers to turn entrepreneurs, how to promote active interaction between designer and user, how to streamline the flow of ideas from lab to industry, how to open up latent markets, and how to overcome prejudices and mutual distrust.

The failure of the past has not been the lack of resources as much as the lack of will on all sides. In a sense, the government is a key player and the ball is really in its court. Both industry and the scientific community have made numerous suggestions in the past but the government (meaning really bureaucracy) has done precious little. Bureaucracy has nothing to lose but science does and so does the country. Will those concerned pay heed?

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BOOK REVIEW

Physics Instrumentation in India. In two parts, as special issues of *Indian Journal of Pure and Applied Physics*, Part I, July–August 1989; Part II, September–October 1989. Publications & Information Directorate, CSIR, New Delhi. 220+xviii pp. (Part I) and 224 pp. (Part II). Rs. 100 each part.

My late learned colleague Prof. R. Srinivasan, an accomplished experimentalist, once made the observation that experimental physicists could be categorized in the class of endangered species. Srinivasan would have been delighted to see these two excellent volumes. As a member of the community of experimental scientists in this country, I welcome the book as a positive effort to save our community. Both parts of the book are professionally done in form and content. The excellent articles do provide a good impression of the state of the art available in the leading laboratories of the country.

The lead article by G. Venkataraman is a must for all, in particular for policy-makers. Venkataraman has made a serious effort to analyse the current situation and has suggested certain solutions. Though I beg to differ from him on some of his solutions (like government involvement a *la* C-DoT), he has done an excellent job. The book provides a blend of small-scale (individualistic but cheaper) condensed matter physics instrumentation with industrial-scale (collective but costlier) instrumentation of large telescopes, neutron spectrometers, pelletron and tokamak. The articles, while clearly bringing out the current state of preparedness in some of the laboratories of national importance, also provide a clear view of the

'systems' approach to modern-day instrumentation. The book is particularly useful for people involved in large - or medium-scale instrumentation starting from small subsystems. It is also a good reference book for any modern instrumentation course.

A large section of Part II is devoted to nuclear reactor-based research. A number of articles on neutron spectrometers have done a good job of demystifying the *Dhruva* research reactor for neutron beam research. This clear exposition was overdue as a service to potential users. The articles on optical and radiotelescopes are excellent. They inform us of the level of sophistication and precision achievable in the country and renew our faith in the old saying 'where there is a will there is a way'.

Certain key and modern areas of signal-to-noise enhancement using digital signal processing have been ignored. The book also does not give proper attention to other important areas: cryogenics, magnet technology and optical instrumentation (other than telescopes). It would have been a good idea to provide an epilogue of a technical nature in which certain recurring themes of instrumentation that are common to all fields could have been pointed out. Certain projects that are largely on drawing tables, even if they originate from laboratories of national reputation, could have been omitted.

Thirty-five out of 47 articles are from laboratories belonging to the Department of Atomic Energy (DAE); other institutions contribute the rest. Is it then a good representation of physics instrumentation in India? Given the trained manpower and the scale of financial inputs it is expected that DAE laboratories will do first grade R&D work and no one doubts their competence. But it certainly does not imply that other laboratories have not made any creative contribution in this field. I do hope that the book does not create the false impression that megaprojects are both a necessary and sufficient condition for innovative instrumentation. Still, it is a must for all libraries and groups involved in serious instrumentation.

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