INDIAN INSTITUTE OF SCIENCE.

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In the few minutes given to me, I wish to deal with a certain aspect of the major problem raised by the President in the course of his address. They are my own personal views and, although I have discussed them with my Director, I do not wish to commit either my Institute or my colleagues to any proposal that I may make in the course of this talk.

The Indian Institute of Science has, as its object, advanced teaching and research in both pure and applied science. During recent years, increasing amount of emphasis has been placed on applied research and, especially after the commencement of the War, most of the work done in the chemical and engineering departments has been of an applied character bearing on specific requirements of the Defence Services.

We receive some of the best students from different universities and they usually stay with us for two to three years though some continue longer. The question which now arises is as to how best we can make the fullest use of the present organisation in post-war scientific development.

Most of our students are between 19 and 22 when they join us and they are usually temperamentally better fitted for pure rather than applied research. Some continue to be interested in pure research throughout their stay, while others develop interest in applied research if conditions are favourable.

Entry into applied research becomes attractive and, sometimes even easy, if it concerns the study of some small problem bearing on an already existing industry. Such problems are referred to us only occasionally, the industries preferring to keep them to themselves. This is unfortunate, because these problems are of much economic value and the industries continue to lose money over them for very long periods for want of adequate scientific advice.

There is also a certain amount of apathy to studying by-products and waste-products as general enquiries, because the individual capitalists would like them solved exclusively for their benefit. Although this is against the highest traditions of science, we have yet got to accommodate them, because, otherwise, there will be no development at all.

Enquiries bearing on the preparation of new products or machinery take the highest place in applied research. Next will come the standardisation of conditions for the cheap and efficient production of known materials of high value. This will also rank high. These two are the most difficult forms of applied research and the chances of practical failure in these lines are greater than that of success. One or two out of every ten may succeed and, even then, further large-scale development will be no easy matter.

In India, the average capitalist wishes to have ready-made industries and I may state, without fear of contradiction, that it requires a very high order of talent, including a good deal of organising power, to convert a laboratory success into a moderate-sized working unit. A good deal of alertness and patience are required together with a correct mental outlook for facing a succession of failures before attaining even a moderate success. After all this, foreign competition, including successful dumping, may knock out the whole venture.

It is because of this that there is every reason to fear that, unless adequate safeguards are provided and the scientists suitably encouraged and rewarded, applied research will not flourish after the War. The present conditions are unfavourable and unless there is a drastic change, there is not much to hope for in the future.

The first essential condition is that there should be key duties to protect industries which can be developed within the country. The second and a not less important one is that the scientists engaged on the development of processes should be well paid—even

better than those on pure research. The applied scientists have to make a big sacrifice because they have to remain largely unknown and their work will remain mostly unpublished. They also have to face the risk of practical failure. If capable workers have to be attracted to applied research they have to be treated well and given assurance of adequate reward if they succeed. They have a right to share in the returns from the processes they develop.

It is practically certain that things are going to be very difficult after the War. Even the little scope that we now have will disappear and I cannot see how we can keep scientific workers on applied research unless the line is made attractive and there is some kind of future for the workers. The authorities of my Institute have made a beginning in encouraging applied research, but I think they will have to go even farther to attract good students into the line after the War.

In Europe and America, the practical value of a laboratory observation or even the production of a small laboratory sample of a useful material will be readily appreciated and the already well-established industries will be only too ready to develop and to commercialise such findings. As the result of this, the laboratory worker can continue with his investigations on the creative and fundamental side without having to trouble about the practical demonstration of the value of his finding. In India such a condition does not prevail. The average capitalist is very conservative and requires ready-made industries with even some kind of proof that the product is marketable and will bring a good return. He expects everything from the scientist, so that if a process is to find some practical application, it will not do to stop in the laboratory. The scientific investigator will also have to do the semi-large scale production and work out the costs. He will have to demonstrate to the capitalist—who is not generally interested in science as such—that the product, as made by him, is saleable and will fetch a good margin of profit.

It has been suggested that in post-war India it may be possible to have some kind of expert organisation that will study the practical value of every scientific finding and will arrange for its being tried out on a big scale. In my opinion, such an organisation—even if one with sufficient number of well-balanced experts can be formed—will not work successfully. The only parties that will be really interested in the exploitation of any practical finding will be the scientific worker concerned and the institution to which he is attached. Only these can do something and in the case of an institution like ours, sufficient resources should be available and the necessary encouragement given by setting up small pilot plants which will themselves be moderate-sized production units. The authorities should be prepared to face losses because some of the ventures are bound to prove unsuccessful or offer unexpected practical difficulties. They should have confidence that even a single good success will more than compensate for dozens of failures.

There then comes the vexed question whether the same institution can do advanced teaching and, at the same time, provide scope for researches in pure and applied sciences. This should be possible if the institution is big and the staff fairly large and representative. No institution of any standing can afford to neglect pure research, because, without it, scientific thought will not progress; the institution will itself become a back-number and will be ignored by scientific institutions elsewhere.

An all-India institute like ours should definitely maintain active lines of pure research in all the branches. Applied research should also be fostered and developed in the manner that I have indicated. This will mean that we will have to maintain adequate specialist staff, some of whom will have to devote themselves to pure research and some to applied research. The scholarships will also have to be evenly divided so that neither side may receive over-weightage. Collaboration between the pure and applied groups of workers should be encouraged, so that they may benefit by mutual association.

It can be reasonably expected that, in spite of the above, some departments will develop into predominantly pure schools and some into essentially applied schools; some may not make a mark in either field. These are largely dependent on the inclinations and the abilities of the personnel and can be set right after periodical reviews of the progress in different fields.

It has often been asked whether the same person can do and direct both pure and applied research. This is theoretically possible and there are a few cases of outstanding successes even in India. Such instances are, however, very rare and the average person attempting such a thing is likely to fail in both. Apart from difference in technique, pure and applied researches require different types of mental outlook and one cannot develop both at the same time. So far as I am concerned, I would like to do only one at a time, though retaining a general interest in the other.