

THE UTILIZATION OF SCIENTIFIC RESEARCH

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1. The Importance of Applied Research

In recent years, research has had a tremendous impact on industrial development in the world as a whole, and the interrelation between pure research and applied research has been brought very much into the limelight. This balance is particularly important for a country like ours, where on the one hand we must press forward with industrial development, and on the other hand we face considerable difficulties in producing enough people with scientific attainments for research. Although we may continue for some years to pick the brains of other countries and to develop our industry on the basis of their 'know how,' the stage is rapidly approaching when we have to discover new processes and to modify existing ones to suit the special conditions of our country. There is thus an imperative need for what can be called "Directed Research," i.e., research directed towards the definite aim of using a certain available raw-material or of developing a substitute for some product or of improving the quality of a given manufacture.

The fact of the matter is that in the good old days scientific pursuits were largely a matter of inner urge and inclination and could not for that reason be equated with material proceeds and prospects. With the passage of time and the phenomenal achievements of science in the service of man, the requirements of scientific personnel have assumed colossal proportions, and made co-operative team work an imperative necessity. The result is that scientific pursuits cannot any more be treated as a love affair of peculiarly constituted individuals, and the society has got to take cognizance of this changed situation, and offer conditions of work and service to scientific men which would not only attract the hermits and romantics of the community, but also the wordly wise career men who form the bulk of any populace.

2. Background of Scientific Development in Pakistan

For a proper assessment of the present situation regarding scientific training, research, and development in Pakistan, it is necessary to keep two

important points in mind. Firstly, that it is barely 14 years now that Pakistan came into existence under conditions which gravely dislocated the entire educational system of the country and placed a colossal strain on the newly constituted administrative machinery of the State, which severely handicapped nation building activities. Secondly, that the areas now constituting Pakistan were grossly neglected until partition in all the schemes of higher education, scientific research and development. Thus, except for the Punjab and Dacca universities, the comparatively more recently established University of Sind, and a few subsidiary research stations like the Irrigation and Industrial Research Laboratories in Lahore, the Agricultural College and Research Laboratory in Lyallpur, all the other universities and the whole ring of governmental research institutions beside the Government subsidised research centres like the Indian Institute of Science, Bangalore, formed part of the present Indian Republic. However, the problem on the inception of Pakistan was not one of starting every thing entirely from scratch but rather of cutting one's losses at one place and opening up business at another. In fact, the colossal dimensions of the progress, which has been made during this brief period with the industrial development of the country under the aegis of the Pakistan Industrial Development Corporation, and the organisation of scientific effort on a wide and varied front, cannot find its explanation on any other thesis. A true appreciation of this basic fact is necessary for an objective assessment of our failings and achievements on the one hand, and the cultivation of that mature confidence in our capacities and competence on the other, which is essential for a realistic approach to all future planning.

3. Relationship between Pure and Applied Research

At present the situation is that nearly three crores of rupees are being spent annually on research in Pakistan, of which nearly one-half is being spent in the C.S.I.R. and other governmental organizations. At the back of all the applied research and technological activity of a country,

there must be the scholars and the dreamers, whose probings into the secrets of nature form a basis for all future scientific advancement. In the past, most of them have worked in the universities, and this must continue to be so, although it is becoming increasingly apparent that in the modern world both university scientists and those working in industry and governmental laboratories can derive very considerable mutual stimulation and benefit from a close association. No measures directed towards such an association must therefore be neglected, and there have been serious suggestions in many Western countries for short-term exchange programmes between university staff and industrial research scientists.

It often happens that along the route to the solution of a practical problem the research worker formulates and partially solves associated problems, some of which turn out to have fundamental importance in pure science. These subsidiary problems in their turn may lead to results of great industrial utility, so that what is now fundamental research will turn into an applied field in two or three decades. One is reminded here of a famous scientist's remark that the sole difference between pure and applied research is just twenty-five years.

Recognizing the importance and value of the closest association between the university and the Government research laboratories, the C.S.I.R. have already set up the North Regional Laboratories at Peshawar near the University campus, and a similar pattern is being followed for the Central Laboratories at Karachi. The resulting cooperation may have far-reaching effects on the development of the scientific effort in the country as a whole.

The functions of the Council especially embrace this feature and cover a wide range of activities, generally directed towards the promotion and fostering of scientific research, having a bearing on the industrial development of the country and the utilization of its natural resources to the best economic advantage. While the scope of its activities has been kept broad and comprehensive, priority has to be given to problems of importance to the country's immediate needs, without however implying a narrow approach to problems or a neglect of broad-based research involving both pure and applied aspects of scientific investigations.

4. Pilot Scale Development of Applied Researches

Although the laboratory scale solution to an applied research problem is the most important step, yet it is only half the story as far as it

concerns the discovery of a new usable product or process. The other half lies in the development of the process on a "pilot plant" scale so that the economic and engineering factors involved can be studied on a semi-industrial level. Moreover, it often happens that the very chemistry of a process becomes radically different in going from a laboratory scale experiment to the full industrial scale. Certain reactions that work very well on the laboratory scale just will not go on the factory level, and vice-versa. In such cases, particularly, the pilot plant experiments are the scientist's and the industrialist's greatest safe-guard against mistaken or superficial assessments of the possibilities of a process, because pilot plant experiments usually envisage small-scale production of the actual usable and saleable article. Of course, the technical and economic data obtained can be used with confidence for full-scale industrial production.

When pilot plant experiments have established the industrial feasibility of a process and have indicated its basic economic "break up," the applied research may be said to have reached its goal. This principle has been consistently followed by the Council for the development of its processes from the laboratory to the pilot plant stage. Thus, the process for the manufacture of Jutoid matting was tried out on a semi-commercial pilot plant designed and fabricated at the Central Laboratories. In order to expedite the establishment of this industry, the pilot plant has now been given on a rental basis to the firm who have been leased out the process by the Council. Another process relates to the manufacture of a 60-burner laboratory gas plant according to a design patented by the Council. Nearly 40 of these plants have been fabricated in the workshop of the Central Laboratories over a period of 2 years and supplied to various institutions and laboratories all over the country. This patent has also been recently leased out to a local industrialist for commercial exploitation. A third instance in point is that of the manufacture of 'Cemto,' an integral water-proofing agent for use in cement. The laboratory process was tried out on a pilot scale and a plant was then designed for its manufacture. A local firm has recently gone into production of this product, using a large proportion of equipment designed in the Engineering Section of the Central Laboratories. There are several other processes which have been started along similar lines in the laboratory and are being brought up to a pilot plant level, so that the product can be manufactured on a small scale and sold to consumers in order to study the marketability of the product and win the confidence of the prospective industrialists.

5. Commercial Utilization

In the industrially developed countries, entrepreneurs of industry take them up at this stage or even earlier for further development into a regular commercial venture. However, in our country, the application of these results to the setting up of a full-fledged industry is hindered by several bottlenecks, chief among which is the difficulty of inducing our industrialists to risk a considerable investment on new processes, when they would much rather take up old and well tried industries. There appear to be two distinct ways of overcoming this obstacle. Firstly, by setting up an industrial liaison service, the research organization must take the results of applied research to the industrialists and perhaps on a personal level "sell" the ideas to them, because very often an industrialist does not know the great advantages that can accrue to him from taking up a certain process. A first step in this direction has been the publication of "Non-technical Notes," giving the advantages of the process developed, and setting out in detail the estimated economics of the manufacture and sale of the product. It is certain that the publication of such notes on new processes will create a lively interest among industrialists. In certain cases, where the response from industry is not adequate, another approach to this ultimate problem of the utilization of applied research would need to be made. This envisages the institution of a Research Utilization Board with adequate funds under its control for the development of specific industries based on the results of industrial research. Such boards have already been formed in the U. K. and India, and in our overall plans for the application of science to industry, due attention should be given to their development in Pakistan as well.

6. Funds for Scientific Research

Scientific research, particularly in the applied field, is an expensive undertaking, and with ever new developments in techniques and appliances, the costs on research have an onward trend.

Available figures show that in the U.K. expenditure in the various sectors of scientific and industrial research has increased from a million pounds in 1900 to 150 million pounds at the present day, excluding the annual grants to the universities amounting to about 21 million pounds. In the U.S.A., expenditure on fundamental and applied fields of research is of the order of 3,000 million dollars. Taking leave of these astronomical figures and coming nearer home, the annual expenditure of the Indian C. S. I. R., which started in 1942-43 with a modest annual budget of about 7 lakhs of rupees, now stands at about 2 crores of rupees, the total recurring and capital expenditure in the course of about a decade of its developments amounting to over 10 crores of rupees, out of which $2\frac{1}{2}$ crores have come in the form of donations, mainly from philanthropic industrialists. A more detailed reference to the statistical material in this connection goes to show that, once a start is made with the organisation of research, the figures of expenditure take a steep ascent, which Governments and industries should wholeheartedly welcome, because of the harvest of rich dividends coming with it.

In this context, the Government of Pakistan has already given effective recognition to the vital role of research in the country's economy by accepting most of the recommendations of the Scientific Commission, and liberal funds are to be allocated for the promotion of research in both pure and applied fields. One of the recommendations relates to the levy of a certain percentage of cess on the industrial production within the country, which is to be utilized for the execution of research having a direct bearing on industrial problems. It is to be hoped that, with the progressive development of industries in the country, a major portion of the load of day-to-day applied research will shift from Governmental organizations to Research Associations directly financed and operated by the industries concerned, as is the practice in the Western countries like the U. K. Such a change would enable the other research organizations to concentrate their efforts on the more vital long-term research projects.