

## SCIENTIFIC PROBLEMS OF POST-WAR INDIA.

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### (A) *The need for the establishment of statutory scientific organisations.*

In matters of application of science for the promotion of human welfare and defence against aggression, and of scientific education, training and research India has so much leeway to make up that many of the scientific problems of post-war India will be a carry-over from pre-war times. In addition, the experience of the present war will certainly confirm to a greater degree the dangers and helplessness arising out of our backwardness in science and reveal new problems and the need for reorientation and renovation of the structure of scientific research in India. With a teeming population which is increasing at a fair rate, with the low standard of nutrition and living obtaining in the country on the one hand, and insufficient knowledge of our material resources, the undeveloped state of agriculture and possible industries and the consequent unpreparedness in matters of defence on the other hand, the need for a planned application of science, not through paper schemes but through intensive action, backed by the authority of the State is also obvious. Modern wars have been rightly termed to be 'total' wars, and as a part of the totalitarian programme, a 'total' utilisation of science in the form of the country's resources in scientific talent, appliances, and material resources has been planned and effected in the leading belligerent countries. And the experience thus gained and the effectiveness of planned application of science will make their effects fully felt in the post-war economics of nations. But it cannot be said that the utilisation of our scientific talent and material resources has yet been conceived in India on that scale which can stand comparison with the pre-war practice of the advanced countries far less stand competition with the post-war situation.

2. The incentive in this regard is essentially a matter concerning the State and its policy and we scientific men can only draw the attention of the Government of India to the need for an authoritative and effective organisation of scientific talent constituted by the State with statutory powers to act as its advisor in all matters scientific and to promote, supervise and co-ordinate the development and application of science for the welfare of the community and the discharge of the duties of the State in the sphere of utilisation of material resources.

3. It does not require any great foresight to be able to say that the position in India during the present war could have been incomparably better if at the start of the war we had such organisations both at the Centre and in the Provinces. There is a feeling of frustration among scientific men in India in that their legitimate expectations of being fully associated with the efforts for defence and for improvements of sanitation, agriculture and industry do not seem to have materialised. Let us hope that in the post-war reconstruction there would be no reasonable ground for such feeling.

4. This then is our first requirement and the most important problem in post-war India, namely, that the State must have a planned programme and a policy whose sole object is to encourage the progress of science and its application for the development of material resources; and set up statutory organisations for the expression of authoritative scientific opinion, for the co-ordination of the activities of its scientific departments and for planning and encouraging scientific research and a sound and rapid utilisation of our material resources. The organisations and the scientific departments we have at present are either few in number or inadequately supported and the idea of a central co-ordination is just beginning to take shape. It is therefore desirable that the scientific men of India should formulate specific proposals regarding action to be taken by the State and this is perhaps the main purpose of this symposium.

5. I have been requested to discuss the scientific problems which confront (a) land utilisation and its more important branches such as agriculture, irrigation, forestry and fisheries and (b) the universities. The object being to pool our experiences I shall only mention in brief those aspects which should have a place in any plan for scientific research and training in post-war India.

(B) *Land Utilisation.*

6. Problems concerning various aspects of land utilisation are now being tackled by different departments of the provincial and central governments including the Imperial Council of Agricultural Research. An intensification of efforts and the question of co-ordination of the work of various agencies and governmental organisation should receive the serious attention of government. There is no machinery for the visualisation of the problems of land utilisation as a whole. Agriculture; survey and control of erosion; maintenance, distribution and recreation of forests, woodlots and trees for conservation of soil and moisture, for shade and for increasing material resources of plant origin including cheap fuel and those beneficial to the peasant; control of floods, drainage, irrigation, water transport and fisheries; roads, railways and village communications; supply of potable water of reliable quality and of water for industrial purposes; town and village planning, and locations of industrial sites; these constitute the more important aspects of land utilisation. There should be some statutory body whose duty would be to take stock of the present position; to keep in touch with current developments and tendencies; to reconcile the various demands on land and ensure the conservation and development of our heritage of soil and water resources, and to advise government and formulate policies; and initiate action on them and supervise their execution. We are in urgent need of an erosion survey; a soil survey with a view to evolve rational systems of correlated soil and crop management based on modern science for increasing yields of crops, improving their quality and increasing their variety and to ascertain the factors which have prevented the utilisation of culturable waste and current fallows amounting to about 200 million acres as against 230 millions under crops; a survey of water resources including underground and surface waters suitable for human consumption with or without treatment, as reliable potable water is not available to the vast majority of the population and for the purposes of industries and irrigation. Many of these problems confront more than one province and even within the sphere of provincial governments there is no statutory machinery for co-ordinated actions by different scientific departments. A systematic and complete survey of our resources of vegetable and animal origin, the possibilities of their exploitation by intensive investigation and research requires to be tackled with determination by a central agency to give direction and lead to and co-ordinate the activities of the Provinces and States. These are mostly administrative questions but it is often very little realised that proper use of science can only be made if an organisation is set up which enables scientific workers representing the different branches of science to draw up plans and schemes and to give effect to them in mutual consultation and supervise their successful execution. The scientist therefore must have a greater share in formulating plans and policies and on the supervision and execution of such schemes. The main scientific problems have to be formulated categorically in their order of importance and a time-schedule worked out for achieving specific objectives. Taking for instance the essential questions of the adequate nutrition of the people, of clothing, housing, provision of potable water and sanitary surroundings, the requirements of the population have to be worked out both for the whole country and also on a regional basis. The amounts of manures and fertilisers have also to be worked out both for the country as a whole and as regards regional requirements. Each of these aspects ultimately some problems for scientific research. Government must have organisations capable of avoiding maladjustments and the dangers of unco-ordinated activities affecting the physical wellbeing and economic life of the people. Many of the existing organisations unfortunately are not conceived in this spirit or not functioning as they should. Drainage of larger tracts, irrigation, control of floods and water transport and in many cases land

reclamation are interrelated and their problems should not be treated and often do not admit of being treated piecemeal or by sporadic efforts attempting to nibble at various points on the periphery of the problem.

7. The existing resources in trained men and facilities for research are not adequate. Judging from standards maintained in advanced countries we require a multifold increase in the number of agricultural experimental research stations for research in soils, crops and animal husbandry; in facilities for research in the way of laboratory equipment and libraries; and in trained personnel. As yet we have practically speaking no effective provision for advisory work in agricultural matters as this expression is understood in Europe and America. Even in the matter of text-books most of the illustrations on the yields of crops, effect of manures and fertilisers, classifications of soils and systems of soil and crop management are drawn from Europe and America. While the latter must form a part of the material for imparting instruction as most of the relevant scientific work has so far been done outside India, for teaching applied aspects of agricultural sciences we must have suitable text-books dealing with our own soils and crops, etc. There are many provinces in which there are no experimental stations nor institutions devoted to teaching, training and research in the basic agricultural sciences. I think I have said enough to support my thesis that in post-war India we must have a survey of the extent of scientific effort and of facilities for training and research which are needed in order that even the most ordinary needs of the community can be met in a reasonable interval of time.

#### (C) *Universities.*

8. In the post-war scheme of organisation of scientific research and in view of the development of research laboratories in government departments and technological institutions other than universities we should form a clear picture of the part to be played by the latter in their departments of pure and applied sciences and of technology. There has been a tendency for some time past to emphasise that universities should foster training and research in technological sciences. The universities have also been criticised for devoting their main attention to the academic sciences. On the other hand, co-operation between industries and the universities has until recently been mostly conspicuous by its absence. The principle of associating universities with industrial and technological research has been accepted in a few instances and worked out in various degrees by some government organisations and industries. These tendencies are welcome and have obviously to be accentuated and accelerated. The main functions of our universities should however continue to be 'academic' or 'fundamental research' and the training of men in science and in research methods for purposes of making new discoveries or inventing new industrial processes and developing new techniques. The universities have to perform the very important function of supplying adequately trained personnel for educational institutions and also for technological institutions and for research in pure and applied sciences. Science alone has made all the difference between the older methods based on empiricism followed by preceding phases of civilisation and the scientific methods which are now being followed by its present phase. In our eagerness to apply science for the attainment of practical ends we cannot afford to neglect the fountain source and allow it to dry up or run down to a trickle. Our attitude should not be pure *versus* applied sciences and technological research but pure *and* applied sciences and technological research. They must go hand in hand and indeed it is often very difficult to separate the fundamental and applied aspects of a research problem even when it is strictly intended to serve an immediate 'practical' need. It is for this reason that the foremost industrial organisations which by utilising science are making millions have got first class laboratories, libraries and the best available scientific talent. And they are also producing increasingly larger volumes of most fundamental or 'academic' types of scientific research. But most of the men who are doing this fundamental and applied research had their first training in research methods in the universities and very often the top men had their training only in pure science. Our universities suffer to a degree

almost impossible to believe from lack of financial help, from grossly inadequate facilities including technical equipment and libraries. Also, the number of universities is very small considering the potential demands in trained personnel which would crop up if planned utilisation of science is ventured upon.

9. The question of adequate training in science and the methods of modern scientific research have developed into a vicious circle, the elements of which are lack of adequate elementary scientific training including the absence of 'nature study' in the school stage, insufficient and make believe laboratory, museum and library facilities in the stages of scientific education leading to the final university degrees. The teachers get very little facilities, leisure and incentive to keep up their scientific knowledge abreast of current developments. The combined result is an average low standard of the alumni of our universities. The man with natural gifts, however, can sometimes develop himself in spite of shortage in facilities but the average is not as good as it should be and there is a great deal of avoidable wastage. If, therefore, we intend to keep the level of our scientific effort equal to that in the advanced countries of Europe and America we must tackle the question of the preliminary training of men entering the universities and the facilities and standards obtaining in our universities for basic training in science and scientific research. The avenues of employment of our trained men and the scope that is offered to them for keeping up their knowledge and for developing it by further work either in our colleges, technological institutions, government departments or industries are equally matters of importance. On the one hand, we see the vast expanse of the problems requiring solution by the services of scientific men and, on the other, the very restricted scope for their employment. Even our best trained students have to yield to a feeling of frustration for want of adequate openings for them in scientific pursuits.

10. In order to break this vicious circle we should be able to formulate our requirements in scientific talent and of facilities required by universities for strengthening their education and research activities and for expanding them. We should make much greater use of our existing universities and their technological and research activities should be linked with the industries to a much greater extent than at present. The faculties of engineering, agriculture and medicine require great expansion. The universities and educational institutions could also be associated with great advantage in the collection of information and research concerning many scientific problems of a regional character. The universities can co-operate with industries by supplying them with men trained in research methods suited for their specific purposes and by providing for extension lectures and for supplementary training of their technical staff. For this purpose it is necessary that the universities and industries should be associated with one another and jointly ascertain how best they can supplement or develop their facilities for mutual benefit. Another aspect that is relevant to these considerations is the need for a greater diversification of the courses of studies offered by universities and in general of the activities of the universities as centres of research.

11. The universities must continue to possess the privilege of pursuing knowledge 'in its universal aspects' in the realms of the sciences and arts and in addition they must develop their activities in association with industries. The great desideratum for this purpose is the development of the general and technical equipments of the universities. Most universities in Europe and America as a result of the experience of the last war were enabled to rebuild their institutions and equip them technically anticipating as far as possible future developments in science. The modern states fully understand the need for such reconstruction and reorientation. The men guiding their destinies have a general knowledge of science and of its rôle in war and peace.

12. It is a very hopeful sign that the Government of India have in recent years taken steps showing its appreciation of the need for establishing central scientific organisations and it is hoped that this matter will receive further prompt attention by them.