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"GIVE SCIENCE A CHANCE"*

INTRODUCTION

AFTER referring to the sad loss which the country has suffered by the death of Acharya Ray, Sir S. S. Bhatnagar described the visit of Prof. A. V. Hill as "Perhaps the most outstanding event in the scientific life of India during the past year". The invitation to Professor Hill extended by the Government of India has been generally taken as an indication of their interest in securing the aid of science to problems of national development to which they are committed during the post-war period. It was largely owing to the insistence of the Council of Scientific and Industrial Research that more financial aid should be given to science, that such an invitation could be conceived even during the war.

Proceeding, he said, "It is a happy augury that the report made by Professor Hill had an unusually short incubation period. Following his recommendations the Government of India have already created a Department of Planning and Development and the Council of Scientific and Industrial Research has been transferred to this portfolio. Other research activities under the Government are likely to follow suit. I am sure the scientists assembled here have special reason to be happy in the fact that the choice of the Viceroy for the care of this new

portfolio has fallen upon Sir Ardeshir Dalal who has been a past-President of the Indian Science Congress and who commands the confidence and respect of the scientists as well as of the business community of India. It is hoped that other far-reaching recommendations of Professor A. V. Hill will also be accepted by the Government of India. There is no better method of raising the standard of science and scientists in this country than that so ably developed and skilfully described in his address before the last session of the Indian Science Congress.

"Another direct outcome of Professor A. V. Hill's visit to India has been that a mission of scientific workers from our country has been touring the U.K. and has arranged to go over to the U.S.A. and Canada, to observe the scientific, industrial and agricultural developments which have come about in these countries during the war and then to make recommendations and suggest plans for a further interchange of information and knowledge for mutual help and co-operation. India has been cut off intellectually for more than five years from the rest of the world and that in itself is a disaster the magnitude of which is directly proportional to the vast strides science and research have made in the U.K. and the U.S.A.

"My present visit to England has been the greatest eye-opener to me and I have now seen with my own eyes the high levels to which scientific invention and ingenuity have risen during the war. Not only has science helped

* Extracts from the Presidential Address by Sir Shanti S. Bhatnagar, Kt., O.B.E., D.Sc., F.R.S., to the 32nd Annual Session of the Indian Science Congress, held at Nagpur, on 2nd January 1945.

in developing weapons and instruments which are essential for success in a mechanical warfare, but it has aided industry and agriculture in supplying the basic needs of humanity during a period of great difficulty. The results both in military and human terms have been most encouraging. The large-scale application of radio-location, the jet-propelled planes, the numerous types of jettison tanks and unbreakable containers, the automatic weapons of offence and defence and scores of new alloys and novel metallurgical processes have had far-reaching consequences on the course of the war. The technique of operational research, the use of scientific methods of determining tactics and developing a national food policy, the discovery of penicillin and D.D.T., all these have contributed much to the realisation by the common man and the Government that organised science is one of the most important factors in national development. It is a tragedy that a ruthless war and almost universal bloodshed should be necessary for this new awakening, for it should have been obvious without it that science can play and must play an essential part for human advancement. In fact, unless opportunities are provided for science to explore these possibilities for human betterment, a better world cannot be created.

"There is no doubt that England is sparing no effort to approach the Peace much better informed and equipped than after the last War and the signs of this new awakening are visible in the universities, the Government departments, in industry, the agricultural and medical institutions and in every other walk of life."

SCIENCE IN THE BRITISH UNIVERSITIES

"We found most Universities denuded of their ablest workers. They were nearly all engaged in important war work and visited their departments only occasionally. They were busy with meetings and committees and in special scientific work related to the war-effort: but all the same they are all devoting their attention to the future of science in British Universities. The Association of Scientific Workers has submitted a memorandum to the University Grant Committee of the Treasury suggesting what reforms in teaching and research should be taken in hand immediately after the war and better provision for science should be made in the universities. Their report ends with the following strong plea:

"We reiterate, then, our plea for the utmost vision and flexibility in budgeting for the development of science in the Universities. Where the flowering of intellect is concerned, any accurate prediction is impossible. We are convinced, however, that peace can see at least as rapid a growth in all fields of science as war has brought about in some special applications. The only proper attitude for an enlightened community is to make available the financial and material resources appropriate to each stage of development. We are far from being in sight of either the limits of science or the end of our reserves of intelligence. Bold and flexi-

ble thinking is, therefore, the prime necessity in framing post-war policy for the universities."

"Out of the many important recommendations made by the Association of Scientific Workers for the expansion of scientific activities in the universities, the following are quoted so that the Indian universities may take a lesson from what is now the train of thought in Great Britain:

(1) Schools of fundamental research must be fostered in the universities, expansion proceeding as fast as talent appears.

(2) All graduates with an aptitude for research should be offered full maintenance while working for a higher degree.

(3) Research fellowships should be provided for those who have taken a Doctorate degree.

(4) When men are appointed mainly to do research they should have the same status and salary as those appointed mainly for teaching.

(5) Research committees should be set up in every university to watch over the development of research, especially in borderline subjects, and prepare an annual research budget.

(6) The education and training of laboratory technicians should be given immediate attention. Courses should be planned for general education and technical training.

(7) The wages of technicians must be revised upwards forthwith if the universities are to attract the right type of personnel.

(8) Centralised technical services and supplies for research should be established in each university. These should include facilities such as a typewriting pool and a statistical service.

(9) Departments of applied science should be brought into being, as they are bound to play an important part in the university.

(10) Industrial development work should be carried out in Research Association laboratories: but where these Research Associations do not exist the university laboratories may be employed.

(11) Academic scientists should be allowed to act as consultants or advisory directors of research to research associations and should be given leave to spend long vacations in industrial laboratories.

(12) Properly supervised research in selected Research Associations and Government laboratories should be allowed as part of or a full qualification for a higher degree.

"Some of these recommendations involve capital cost and the memorandum referred to above estimates this to be not less than £30 million over a period of ten to twenty years. The actual expenditure of the universities would rise to £15 million per annum within five years and to £20 million over ten years at 1939 values. It has been suggested that most of this money will come from the State. Further, it has been strongly recommended that the Treasury Grant to the Universities should be doubled in the first academic year after the war and increased to quadruple, that is, to £9 million, in the fifth year.

"The future of science in the British Universities would thus be assured. This must serve as an incentive to our Vice-Chancellors who should ask the nation and Government for more grants for technical education and developments of sciences in the Indian universities. I have been told that at least in two Universities in India, scientific research is now positively discouraged and (in the name of economy) admission to research students, in spite of the willingness of the professors concerned, is almost completely prohibited. I take this opportunity of drawing the attention of those who love their country and wish it well to see that the field of University education is kept as free from narrow communalism and politics as possible. Since politics has begun to play a part in the selection and election of Vice-Chancellors, the University standards in India have tended to deteriorate instead of showing an improvement and if these evils are not looked into by the Chancellors and the Courts of the Indian Universities, these institutions will cease to be real seats of learning and will turn into arenas for political ambitions."

SCIENCE IN BRITISH INDUSTRY

"British industry in the past relied too much on tradition. It is now realised that the prosperity of Britain after the war will depend as never before upon the efficiency and progressiveness of her industries. Happily, for it is a most healthy indication of things to come, industrial and scientific research, is on almost everyone's lips now-a-days and it is certain that this will be one of the major features in post-war industry. In certain industries, such as the chemical industry, the application of science and research has reached such high levels already that even the Department of Scientific and Industrial Research has not considered it an imperative necessity on their part to equip and maintain their Chemical Research Laboratory to the same level of efficiency as their National Physical Laboratory. They maintain that the Imperial Chemical Industries conduct research on such a large and liberal scale that the Government Laboratories need not compete with them. The Directors of the Company are progressive in their views on scientific development and at a luncheon which the I.C.I. gave to the Indian scientists at Clarges, Lord McGowan, the Chairman, reported that the Directors of the Company had offered to provide at nine Universities of Great Britain, eighty fellowships of the average value of £600 per annum to be held by senior workers in certain sciences. The research organisation of the Company itself consists of nearly nine hundred fully qualified chemists, physicists, biologists, engineers and other scientific men and more than a thousand skilled assistants. During 1943 its expenditure on research and development in its own work was approximately £2,200,000; and in addition, £12,500,000 became due from the Company to the British and Overseas Governments under the heading of Excess Profits Tax, National Defence Contribution and income-tax. We had the good fortune to see their vast factories and research organisations at Bellingham, Blackly and Hudders-

field, and our distinguished industrialists who are visiting England should go and see these signs of research-mindedness of the British Industries.

"When I replied to the toast proposed by Lord McGowan at the luncheon, I spoke of the I.C.I.'s partiality to their own country. They had at least two big factories in India and I pleaded for grants on a generous scale for scholarships for scientific research in India by the I.C.I. I urged that no feast given to the Indian Brahmins is complete without a gift, and that all scientists are Brahmins by profession. The plea went home to Lord McGowan and he promised to consider in a friendly way the question of endowing research fellowships in Indian Universities. He also assured us that the eighty fellowships in the British Universities were open to Indian scientists in free competition.

"Besides the I.C.I., there are other industries in Britain which have large research departments, and we were particularly impressed by the efforts which had been made by such firms as Metropolitan Vickers at Trafford Park, Manchester, by the General Electric Company at Wembley, by Burroughs Wellcome, by Brown Firth & Co., by the B.T.H. at Rugby and by the Anglo-Iranian and Shell group organisation. In addition to the many private investigations carried out by individual firms, the interests of research by industry are safeguarded by investigations carried out in twenty-four Industrial Research Associations, which are maintained jointly by Industry and the Department of Scientific and Industrial Research."

"We are aware of even more outstanding organisations of this kind in the U.S.A. and Canada and look forward with eagerness to visiting the Bell Telephone Laboratories in New York in which the American Telegraph and Telephone Company employ over 4,000 scientific workers and technical men. The General Electric Company at Schenectady, N.Y., the Eastman Kodak Company at Rochester, N.Y., the Mellon Research Institute, Pittsburgh, and the various Petroleum Companies in the U.S.A. have fully equipped laboratories which work day and night on problems of fundamental and applied interests.

"If Indian industry has to rise, and rise it must to its proper stature in time, it must begin to devote more attention to expenditure on research. There is hardly any industrial organisation in India except Tatas which provides even reasonable facilities for scientific and industrial research. Lately Mr. G. D. Birla and Sir Shri Ram have shown some interest in scientific research, but much has yet to be done by science to save the existing industries in India from extinction by outside competition after the war.

"The newly started industrial units of India should join together and form Industrial Research Associations and the Council of Scientific and Industrial Research and the Government should subsidise the organisations so that they may blossom forth into hopeful industries of the future India.

"Now that expenditure on research, both

capital and recurring, is likely to be free from the Excess Profits Tax, Indian industry should give a real impetus to science. Nothing will help industry and science more than if our firms in India become research-minded. Even before my visit to England I strongly advocated the formation of Research Associations in India and I am glad to hear that the chemical and pharmaceutical industries of India are about to give a lead in this matter and have apprised the Council of Scientific and Industrial Research of their intention to form a research association. After seeing the work of Research Association Laboratories here, I have become convinced that we must work hard to get our small and big industries in India research-minded so that they may gain knowledge and strength to produce goods of the best quality and performance."

INDUSTRIALISATION OF INDIA ESSENTIAL FOR WORLD PROGRESS

"Perhaps the most important factor which will have world-wide implications will be our attempt to raise the standard of living in India. Politics does play an important part in all events. It is obvious that the best and quickest way of bringing about national development is for India to have a National Government representative of the people. The present absence, however, of such a government does not justify that the thinking men and women of India should not devise ways and means of bettering the lot of their fellow-beings to the best of their ability under present circumstances and in view of the future. I am not convinced that the rich and the wise in the land have done all they can for agricultural and industrial development of India.

"It has been urged by some that the problem of India is largely biological: that health, food and population are our real bottle-necks. Those who know India intimately are fully aware of the facts that attention to agriculture alone cannot solve the problem of India's poverty. Biology must be helped by physics, chemistry and engineering, even by mathematics. India cannot be healthy, prosperous and self-respecting, and education, medicine, and agriculture cannot play their important role, unless a good bit of India's population is devoted to pursuits other than agricultural.

"In a previous paper I have described the orders of priority for some of the industries essential to India's development. In that paper the first place was given by me to the development of power and there seems to be now a general consensus of opinion that India must develop her hydraulic and other power resources as her coal resources are already severely strained. This project will have to be largely financed by the State, as it is far too big for any private enterprise in India. The State will also have to help big basic industries and heavy engineering. We should, by all methods of persuasion and even threats, appeal to the existing industries in India to develop the bye-products industries associated with them. For example, the great jute industry in India should take immediate steps to

manufacture such things as jute-boards, Brattice cloth, jute felt from jute waste, jute containers and jute cloth for wearing purposes. The State and the public should insist upon these industries being developed by the jute industry itself. Similarly it should be the duty of the sugar industry that their bye-products such as molasses and bagasse should not be used wastefully as at present. Power alcohol, furfural and its derivatives, acetic acid and all sorts of plastics and solvents can be made from these bye-products and these should occupy the immediate attention of the promoters of our sugar industry. They have sufficient money to invest in these ventures which may not start paying dividends all at once, but they will eventually be all very worthwhile in national planning and development. If I would not be misunderstood, I would make a suggestion to those European and Indian friends who are interested in the industrialisation of India not to fight for less or more to either side, but to come to terms honourable for both and do something to help Indian industry. It is obvious that European friends in India will have to yield to the natural aspirations of India, namely, that industry in India should be largely managed by Indians themselves. Indian businessmen should see that co-operation with the allied powers is the quickest method of developing India. The energy spent in fighting may be better spent in co-operative development. If the bye-product industries of coal-distillation, the petroleum industry, the textile industry, the woollen, cotton, sugar and jute industries and the metallurgical and chemical industries are developed, the country will have a different complexion altogether and a co-ordinated programme of development in all directions will become a possibility. This plea I am entitled to make as President of the Indian Science Congress, as I am convinced that science has no future in India unless our agriculture and our industries are fully developed; more food and more health are dependent upon these factors. Scientific and industrial research thrives best when it is applied to material benefit to human kind and to existing industries and existing agricultural enterprises."

TRAINING OF PERSONNEL

"As a result of our visit it may be possible to persuade the Government to have scientific liaison officers in Washington and London, and possibly in Moscow, so that the Indian scientists and the Indian Government departments may be in touch with the rapid strides which Science and Technology are making in these countries. These offices will have to be staffed by scientific men of some standing in India. It is also likely that we may be able to get admission for a large number of scholars and technicians from India both in the Universities and industries. We found many Universities eager to have good students for post-graduate studies. Lord Eustace Percy was particularly anxious that good-class Indian students should take advantage of medical and dental studies in their well-equipped faculty of medicine at Newcastle. Similar assurances were given to us by the authorities of Cambridge, Oxford,

London, Sheffield, Leeds, Glasgow and Manchester Universities. There will be a great paucity of space immediately after the war in these places of learning, but they hope to have a great deal more space later on. We should increase the availability of technical talent in India by sending our young and brilliant students to England and America. India needs not only scientific researchers but also technicians—persons of the foreman type who can help in the running and repairs of machinery so essential for industrialisation. Such firms as the Imperial Chemical Industries, Metropolitan Vickers and the non-ferrous metal industries in England are quite willing to train young men from India and even pay them as apprentices; we need a very large number of men with these qualifications, and we shall have to look for such training in Canada and the U.S.A. as well."

FACTORY AND FARM

"In England great emphasis is being laid on equalising the standard of life in the cities and the villages. Agriculture still retains in England too much of its primitive character. Modern methods of application of energy on the farms, conditioned transport and proper storage of agricultural produce are still in their infancy. Canada and the United States are ahead in this field and the tractor, the motor vehicle and electric power have contributed a great deal in those countries for a better standard of life on the farm. On a value basis at present about 88 per cent. of the world's agricultural produce is used as food, 8 per cent. as textiles and 4 per cent. for other industrial purposes. The last two together form roughly one-third of the raw materials of industry. There is an increasing tendency to look to agriculture for a larger proportion of these raw materials, but these materials can only be used profitably if the factory becomes an adjunct of the farm. Industry is moving towards that ideal particularly in the U.S.A., and this may be a lesson which we in India may learn in our planning for the future. We are so primitive in our farming that this would be an idle dream unless we first improved our transport and communications and provided better methods of storage and marketing, power-driven machinery and the use of proved fertilisers."

Concluding the President described the Tennessee Valley enterprise as "the romance of a wandering and inconstant river, now become a chain of charming and lovely lakes which have contributed much to the enjoyment of life of the people, on which move, without any dangers of accidents, barges of commerce which nourish American industries. It is a fairy story of wild waters controlled by human ingenuity creating electrical energy which has been America's Alladin's lamp. I dream of the Tennessee Valley, but not without hope: for all this may happen to any river valley in India to the Damodar, to the Ganges, to the Sutlej, to the Narbada, to the Sone, if the people and the Government just give science a chance."

THE NEW OIL COMMITTEE AND FUNDAMENTAL RESEARCH

IT is a matter for sincere gratification and happy augury for the future welfare of the millions of this country that the Government of India Member for Health, Lands and Education should have recently declared his firm conviction before an assembly of the representatives of trade and commerce at Madras, that the promotion of the health and education of the people and the development of the resources of the country are of "greater importance than political problems". This advice and the appeal made by Sir Jogendra Singh, himself a producer, to an assembly of commercial magnates is none too early at the present juncture of our national economy. In any self-governing country, the merchant class should consider themselves not only as the privileged distributors and trade agents of the national produce but should also act reciprocally as the enlightened patrons promoting the cause of the producers. Production requires not only the capital of the business-man but also the wholehearted co-operation and contribution of the skilled technician and of the research scientist.

The idea of creating commodity committees and making them self-supporting to carry on research and have their own services throughout the country is an extremely useful and creditable suggestion. Among such commodities, the position of oil-seeds is a very high one indeed.

Not long ago *Current Science* had an editorial on this important subject putting in a strong plea for the scientific utilisation of Indian oil seeds. After a period of nearly two years it is encouraging to find that publicists have paid attention to the points urged therein. It is well known that oil seeds form a valuable part of the annually recurring agricultural wealth of this country. Out of a total area of 300 million acres under actual cultivation about 60 million acres are under oil-seed crops. Further the 90 million acres of Indian forests also yield as minor forest produce, commercial quantities of important oil seeds. The more abundant of these are listed below for convenience of reference.

Oil seed	Area in millions of acres	Output in millions of tons
Cotton	25.0	2.0
Groundnut	10.0	3.3
Mustard and rape group	7.0	1.0
Linseed	5.0	0.5
Gingerly	5.0	0.6
Castor	2.0	0.2
Coccolnut	1.4	1.4
Peppy	0.5	0.2

The less abundant but nonetheless valuable commercial oil seeds comprising mowra, nigerseed, safflower, kokum, domba, dhupa, chaul-