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THE TRAINING OF RESEARCH AND TECHNICAL PERSONNEL

SINCE the commencement of the year 1944, there have been notable utterances from the leading statesmen, industrial magnates, economists and scientific men regarding post-war reconstruction of our agriculture and industry. There is complete and wholehearted unanimity on the question of the utilisation of the immense natural resources of the country with the aid of tools offered by modern science and technology. In 1938, Lord Rutherford, in the course of his address to the Silver Jubilee Session of the Indian Science Congress, held at Calcutta, dealt at considerable length with the question of organisation of scientific research in India. He said, "This is in a sense a scientific age where there is an ever-increasing recognition throughout the world of the importance of science to national development. A number of great nations are now expending large sums in financing scientific and industrial research with a view to using their natural resources to the best advantage." The present war which has since intervened has brought into prominent relief the weaknesses in the agricultural and industrial economy of this country.

In the course of his Presidential Address to the Section of Engineering and Metallurgy Mr. Ghandy drew attention to the position of Indian industry as compared with those of the advanced countries. He said, "We are not able to manufacture aircraft or automobiles. A proper shipbuilding industry is still unknown. Our requirements of heavy machinery have to be supplied from abroad and we are content to utilise the great reservoir of scientific talent that exists in the country for the purpose of maintenance and operation of machines designed and constructed in foreign countries. What heightens the sense of tragedy is the fact that a country so unusually rich in natural resources as India should be so backward in industrial development."

Addressing the delegates of the Indian Science Congress held at Delhi, Prof. A. V. Hill spoke on the fundamental principles which guided the organisation and development of scientific and industrial research in England. In the course of this talk he referred to the four M's which are essential for the progress of science, men, money, material and machinery.

Of these, the last three could be mobilised; an enlightened and sympathetic government can enlist the enthusiastic co-operation of the public in finding the *money* and can arrange for the import of the necessary *machinery* to meet the urgent and immediate requirements of industrialisation. Nature has been exceptionally bountiful to us and can supply the raw *materials* needed for industry. The supply of *men*, however, offers difficulties.

The Government of India have constituted a Post-War Reconstruction Committee which has been entrusted with the task of planning the various nation-building activities during the post-war period. A few days ago, the leading industrialists of the country have published a memorandum outlining a Rs. 10,000 crores plan of economic development for India, which is to be given effect to in three stages.

Professor Sir J. C. Ghosh, in the course of his Presidential Address to the Annual Session of the National Institute of Sciences, has pleaded for the immediate inauguration of a National

Research Council with the following functions: (*a*) to plan the main lines of scientific work in accordance with national needs, to formulate schemes for the above purpose, to review and modify the same whenever necessary and to recommend ways and means for implementing the results of accomplished researches; (*b*) to ensure balanced development of all branches of science and minimise overlapping; and (*c*) to advise and help relevant authorities regarding the training and supply of scientific personnel for pure and applied research.

The speed of scientific and technological progress will be limited by the supply of scientific and technical personnel. The training of highly competent and skilled personnel takes a long period. The selection and rise of the specially gifted among these workers will follow as a matter of course. Adolph von Bayer, the celebrated German chemist, who gave synthetic indigo to the world, once said that it took three years to train an infantry man, five years for a cavalry man, seven years for a gunner and nine years for a chemist. Dr. Bhabha, in a contribution to the symposium on post-war organisation of scientific research in India, writes, "Even if money is found for equipment, a highly trained and gifted staff cannot be created in less than a decade". Professor Sir Bhatnagar is of the opinion that the National Research Council, when founded, should take upon itself the responsibility of not only planning scientific work in accordance with national needs but also help in the training and supply of scientific personnel for pure and applied research. Sir J. C. Ghosh has invited attention to the way in which Russia faced the problem of supply of men. "In the planning of the development of scientific research, the Soviets began with the finding and training of men and then built the Institute later. They did not start with paper plans of Institutes in which men were subsequently made to fit." Emphasis should be laid upon the finding and training of researchers who would be called upon to tackle problems of industrial advance.

Even in England, it has been admitted that the number of trained personnel is inadequate to meet the growing demands of post-war reconstruction. "Admitting that the pre-war provision for research in Great Britain compares favourably with that of the U.S.A. or of Soviet Russia, it must not be supposed that the position can be rectified immediately by the allocation of financial and material resources more commensurate with the effort required. The supply of personnel alone, as Sir Stafford Cripps observed, is an obstacle to rapid expansion."

At the commencement of the first five-year plan which Soviet Russia launched soon after the last Great War, she was faced with a similar problem. It is instructive to recall how the question was tackled by her since India is faced with a closely analogous situation. Mr. Ghandy, in his Presidential Address referred to above, has outlined the scheme adopted by Soviet Russia in mobilising their technical personnel. "The 'peoples' Commissariat of Education as the name signifies is in charge of education. It seems that a proper scientific bias is given to education. 'Pioneer palaces' or children's clubs, with their science laboratories and their exhibitions help the growth of a scientific outlook in the minds of young students, while science courses at the schools and the universities and the facilities for the conduct of research at the university laboratories in collaboration with the Science Research Institute of the Academy of Sciences, complete the scientific training of students and turn out a regular flow of scientific workers for the benefit on the community at large."

On the eve of Russia entering the present conflict "a decree signed by President Kalinin introduced a system for the replacement of schools under the control of individual factories and commissariats by the Government controlled schools organised on a national plan. It was not long before a network of industrial technical schools came into existence in Russia, Moscow alone having seventy such schools towards the end of the year 1942, each specialising in a particular branch of industry.

"Offering the attraction of a free education, free uniforms, and three free meals a day and guaranteeing decent employment at the end in a diploma is obtained, these schools have drawn hundreds and thousands of youths, including girls, in their middle teens, and have already provided tens of thousands of qualified workers for war industries." Here is an illustrious example of how the talent of a whole people could be harnessed by a national government for the promotion of its industry.

Two classes of workers are needed for reconstruction, the research worker and the technician. It is generally agreed that the universities should take the responsibility of producing the researcher while trade schools and polytechnic institutes should turn out the technicians. At the moment, the universities in India are not adequately staffed and equipped, to take up the additional responsibility of producing a larger number of scientific workers; admissions to the science and technical courses are restricted due to limited accommodation and poor facilities that exist. The trade schools and polytechnic institutes are few and far between considering the size of the country and the magnitude of the work that lies ahead. Given the necessary funds there should be little difficulty in expanding the teaching and research activities of the universities and increase the flow of trained research personnel. Large sums of money should be expended for the promotion of technical schools and for the establishment of a chain of polytechnic institutes throughout the country. These schools and institutes will provide the technicians needed for the advancement of industries during the post-war period.

We must take stock of our present scientific and technical personnel. A national register enrolling all the personnel available in the country may immediately be opened either by the Department of Education or by the Department of Labour. When the war terminates an appreciable number of scientific workers and technicians will be released and the question of their absorption by science and industry

should be carefully planned. These questions are best considered by a special committee which may be set up by the Central Government. Large capital grants both for university and technical education and research should be allotted; Sir J. C. Ghosh has suggested that a sum of Rs. 2·5 crores per annum should be expended for this purpose. The conditions of service should be rendered sufficiently attractive to induce the best of our young men to adopt a career of research or technology. The Government should consider the inauguration of a State Scientific Service on a parallel with the administrative Civil Service. It is earnestly to be hoped that the Government of India will give its immediate attention to this fundamental question of organising a steady supply of scientific and technical personnel for post-war reconstruction.

BEQUEST OF PAVLOV TO THE ACADEMIC YOUTH OF HIS COUNTRY

WHAT can I wish to the youth of my country who devote themselves to science?

Firstly, gradualness. About this most important condition of fruitful scientific work I never can speak without emotion. Gradualness, gradualness and gradualness. From the very beginning of your work, school yourself to severe gradualness in the accumulation of knowledge.

Learn the ABC of science before you try to ascend to its summit. Never begin the subsequent without mastering the preceding. Never attempt to screen an insufficiency of knowledge even by the most audacious surmise and hypothesis. Howsoever this soap-bubble will rejoice your eyes by its play it inevitably will burst and you will have nothing except shame.

School yourselves to demureness and patience. Learn to inure yourselves to drudgery in science. Learn, compare, collect the facts!

Perfect as is the wing of a bird, it never could raise the bird up without resting on air. Facts are the air of a scientist. Without them you never can fly. Without them your "theories" are vain efforts.

But learning, experimenting, observing, try not to stay on the surface of the facts Do not become the archivists of facts. Try to penetrate to the secret of their occurrence, persistently search for the laws which govern them.

Secondly, modesty Never think that you already know all. However highly you are appraised always have the courage to say of yourself—I am ignorant.

Do not allow haughtiness to take you in possession. Due to that you will be obstinate where it is necessary to agree, you will refuse useful advice and friendly help, you will lose the standard of objectiveness.

Thirdly, passion. Remember that science demands from a man all his life. If you had two lives that would be not enough for you. Be passionate in your work and your searchings.

H. E. LORD WAVELL ON INDIAN SCIENCE

INAUGURATING the Thirty-first Session of the Indian Science Congress, His Excellency Lord Wavell said:—

"India, one of the oldest civilisations, has perhaps felt the impact of modern science later and less than any other great people. A large proportion of her population still lives the old life untouched by the vast changes of the century. Her realm has been of the spirit rather than of the earth. It may be said of the West hereafter that we took too much from India materially and too little spiritually.

But if India is to play the part in the world to which her size, her population, her history and her position entitle her, she too must make every possible use of scientific advancement.

She has already produced many great scientists, she bears many more in her fertile womb. Her contributions to science have always been on the side of peace and progress. She has everything to gain by combining modern science with her old culture indeed her traditional outlook should enable her to make an increasingly fine and characteristic contribution to natural knowledge. Indian science has made in fact a very remarkable stride forward during the last twenty-five years, as is shown by the foundation of many new societies, new journals and new departments of science in universities and under Government.

In this war science has played a great role in India as elsewhere. It has made a splendid contribution to maintaining the health of the fighting men, through the activities of such bodies as the Malaria Institute, the Indian Research Fund Association, the Nutrition Laboratories at Coonoor, and others. It has also played an important part in munitions production and in solving problems of supply. As an ex-Commander-in-Chief, I should like to thank Indian science for the invaluable assistance it has given to the armies in the field.

It must play a great part also in post-war development. The coming years will be vital to India. She must learn to make use of her abundant resources with the aid of science. Science is the most international of all human interests.

Professor Hill has himself said in an address elsewhere: 'I believe that the pursuit of knowledge for the welfare of mankind is one of the greatest agents for goodwill between men in every land.' It is in that belief that he is here to-day.

This Session of the Indian Science Congress has a momentous task to perform; to discover how best to bring the aid of science to the development of India's great resources in agriculture and industry, to the improvement of health and to social advancement and prosperity."