INDUSTRIAL DEVELOPMENT THROUGH INDUSTRIAL RESEARCH.

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1. It must be recognised that some honest disinclination exists among energetic workers 'against contributing to symposiums as they generally result in nothing concrete'. We are now concerned with a Symposium on the Post-War Organisation of Scientific Research in India and the objective is the formation of a National Research Council. This National Research Council to be constituted under the statutory authority of the Government of India and organised by the Council of the National Institute of Sciences of India, which is the Indian equivalent of the Royal Society. As the word Symposium, which originally meant a convivial meeting for drinking, conversation and intellectual entertainment, now implies a meeting for discussion of some subject, and is therefore a collection of opinions delivered or a series of articles contributed by a number of persons on some special topic, I think the use of the word Symposium has been correctly employed. As regards the very serious opinions that are being contributed to this Symposium on Post-War Organisation of Scientific Research in India there can be no doubt at all, but the definite objective to be attained by means of a National Research Council or equivalent body has not been made clear in the functions of this controlling organisation. The objective is quite simply industrial development through industrial and/or scientific research to provide better conditions for work and food and homes for the people in India.

2. There are already many contributions to this Symposium on Post-War Organisation of Scientific Research in India which give the opinions of the leading scientists in this country from different points of view. These range from a consideration of a plea for the establishment of a Fishery Research Institute, the Post-War Research in Meteorology and the Post-War Organisation of Agricultural Research in India to the existing organisation of Medical Research under the Indian Research Fund Association and the position of scientific research in the United States of America, the Union of Socialistic Soviet Republics in Russia, etc. Among the opinions expressed are the following: (1) 'Past experience shows that at times of economic depression scientific departments suffer the most and the first victim of retrenchment is research'; (2) 'Until recently there was relatively little Government scientific research in the United States with the exception of agriculture, while research in Japan is entirely Government supported'; (3) 'The Academy of Sciences is the centre of scientific activity which synthesises the co-ordination of work going on in the Soviet institutions, laboratories, experimental stations, commissions and museums'; (4) 'Organised medical research in India is carried out under the Indian Research Fund Association constituted and financed by the Government of India'; (5) 'Nothing worth while can be done to commercially organised research but to abolish it'; (6) 'In an industrially developing country framework of all kinds continues to require maintenance and amplification'; and (7) 'The Institute must make the country see that scientific research must be generously subsidised and collectively organised by the State if it is to serve as a tool of human progress, which it must be made clear again means the progress of the masses and not of a few individuals as such'.

3. The probability is that most scientists will agree that scientific research must be encouraged as well as controlled by some central co-ordinating organisation. Also that with this body (the proposed National Research Council) there should be some kind of affiliation which will connect all existing technological institutions and experimental stations in India. It is conjectured that the exercise of control or guidance will be through special committees of experts, and that each committee, with perhaps sub-committees, will attend to a particular subject or group of substances which are inter-related. While the objective of the research is directed to industrial development the interests of each province or regional area must never be lost sight of. It is believed that these primary objectives can be best secured if the State takes upon itself the general

control and underwrites the whole of the expenditure likely to be involved. In his opening address for this Symposium on Post-War Organisation of Scientific Research in India Sir J. C. Ghosh estimated the national income in India at Rs.65 per head per year (roughly £5 or $22 per person) and calculated at 0·1% a national income for research at about Rs.2·6 crores which is roughly half the sum, Rs.5 crores, which has been agreed upon as necessary for the work which the proposed Council for National Research (or National Research Council) will require to carry out the projected Post-War Organisation of Scientific Research in India. This figure of Rs.5 crores is about 5% of the sum, roughly $300,000,000, expended annually in the United States on research by Universities, Government and industries, employing about 16,000 scientists. More than $100,000,000 are contributed by industry, but it is not clear whether this large expenditure is in commercially organised research which under (5) in paragraph 2 above is not regarded as towards the best interests of national welfare in India.

4. In my opinion there is some danger in using the expression 'Post-War' when many regard the present war as a continuation of that which was supposed to have ended when the Armistice terms to end the war were finally accepted by defeated Germany in the middle of 1919. Peace on earth and good-will among men is a Christmas wish and hope, actually life is a most serious struggle against conditions or circumstances or weakness in ourselves and the best motto we have perhaps is that of the Boy Scout and Girl Guide organisations, 'Be Prepared'. In his opening address to the Symposium on 'Post-War Organisation of Scientific Research in India' to which I have already referred, Sir J. C. Ghosh quoted Sir Robert Cassels, Commander-in-Chief in India in 1939-40, as broadcasting at the beginning of this war that 'India's greatest asset is a large supply of the finest type of fighting men. Her great weaknesses are a low national income and a limited industrial development incapable as yet of supplying the technical equipment of a modern army'. He added that 'history has amply shown that victory is not the prerogative of a large organisation swollen with ill-armed soldiery but rather of small well-equipped armies modern for their period'. This is even more true today than at any time before, and nowadays ill-equipped armies are nothing more than sheep for slaughter.

5. It is probably forgotten that the Indian Munitions Board was established during the last war as a result of an enquiry from Sir Charles Munro, Commander-in-Chief in India in 1916-17, whether more could not be done to develop Indian resources for war purposes, so as to relieve the Ministry of Munitions in the United Kingdom as far as possible from the necessity of meeting extraneous demands. Afterwards, in 1919, Sir Thomas Holland wrote: 'India, with its wealth of raw materials, has found it in the past easier to buy than to manufacture the articles required for its amenities of life. The war has shown, however, that it is desirable to be less dependent on European countries for manufactured goods, and India, like other countries, has been compelled during the last four years to improvise for the time being, while laying plans for industrial development in the future.' In the same contribution Holland wrote also: 'Munitions for a modern army cover practically all the wants of a civil community, *plus* the special arms or lethal munitions employed by the soldier in actual fighting operations. The scale of operations in a modern campaign is such that the wants of the army in the field necessarily compete with the requirements of the residual community which, in India, far outnumbers those on "active service".'

6. After the recent experiences, twice in twenty-five years, it is agreed that this unpreparedness must not be experienced again, and yet while thinking or saying this we begin to consider something indefinite—the post-war period—when action is necessary now and is demanded at once to establish all that may be required for the military machine. This means, as already mentioned, practically everything wanted by the civil community plus the special arms used in military fighting operations. It seems to me that an immediate stock-taking is essential to obtain a clear understanding of what we require and what our resources in raw materials are to meet our requirements. Industrial research comes into play at once to discover how with available materials we may prepare those articles required for the amenities of life. If we are deficient in our resources of petroleum it is necessary to investigate whether the distillation of Indian coal cannot supply the difference between our wants and what we have. Similarly with regard to our great need of sulphur for preparing basic chemicals, such as sulphuric acid, no steps

should be omitted in an endeavour to recover sulphur or sulphuric acid from substances capable of yielding these products in the quantities desirable for satisfactory industrial development. On the minerals side of the question of industrialisation there are many items for consideration where focussed industrial research can be of immediate effect. Who can say how soon this result might be obtained and when the war will be over?

7. For the reasons given in the previous paragraphs it would seem essential that this proposed National Research Council should be brought into being immediately and that the stock-taking be carried out at once so that the position may be reviewed at an early date for the National Research Council to launch the industrial research which can be most effectively carried out now and to draw up a programme of those investigations which may follow as soon as possible. In an address on 'Some Aspects of Scientific and Industrial Research' (*Science and Culture*, Vol. IX, No. 3, September 1943, page 109) I drew attention to the work of the Imperial Institute in London and also to the gigantic stature of the Department of Scientific and Industrial Research in the United Kingdom compared with that of the Indian Board of Scientific and Industrial Research. It is impossible to find words serious enough to stress the need for sound, exhaustive scientific and industrial research as quite distinct from a series of quick, so-to-say qualitative, tests which include some quantitative data and which, because of the size and other factors in the research, may give misleading information for large-scale operations. A first consideration is the compilation of data on the raw material resources of the country—animal, mineral and vegetable. In the case of minerals a considerable amount of exploration is necessary and which should be pressed forward, not slowed down.

8. The enormous industrial development which was in progress in the U.S.S.R. in 1937 was unbelievable and my note on 'The Mineral Development in Soviet Russia' (*Transactions Mining, Geological and Metallurgical Institute of India*, Vol. 34, part 2, 1938, pages 98 to 201) was an endeavour to draw attention to what I myself saw in that country, which with its recent epic of Stalingrad has the homage of the British people. We owe a greater homage to those leaders of the Soviet Union who, in the face of foreign criticism regarding the unsatisfactoriness of some of the Russian raw materials (according to the conservative specifications of standard processes), continued mineral exploration, industrial research and development, often having to devise new processes to utilise the domestic raw materials at their disposal, and in this and in other ways had built up an industrialisation for the benefit of their peoples which has proved robust enough to meet the most violent and treacherous of military assaults. There should be no talk of a post-war period except for countries which have been overrun by the enemy or are under enemy control. In India the chief problem is that of a priority consideration with regard to using the very limited amount of equipment and power that is available for manufacturing those articles which are more urgently required for military purposes. There should be no question of slowing down or stopping any, especially mineral, operations which are directed at proving our national resources.

9. The industrial research to which I desire to draw particular attention relates to the testing of processes and products which have not so far been tried in India. Among these have been the production of sulphur from gypsum; the preparation of ammonium sulphate from gypsum with ammonium carbonate; the manufacture of alumina and aluminate (calcium) cements; the recovery of by-products from the high and low temperature distillation of coal; the extraction of ferro-manganese (low in phosphorus); the erection of iron and steel smelters in the Central Provinces and Hyderabad (Deccan); the conversion of good quality non-coking coals into coal of caking quality; the utilisation of brines for obtaining other sodium salts than the chloride, etc., including the problems of aluminium and magnesium reduction from their ores in India. In nearly all these cases some work has been done, but the fullest details should be made available so that the National Research Council may examine each in detail to make sure that nothing has been overlooked and that no case has been put aside without an actual trial, if this has been reasonably possible. I would add in conclusion that, in my opinion, it will be to the best interests of the industrial development, which seems to be the only hope for safety in the future, to reorganise the National Institute of Sciences of India by making it the Royal Society of India and to erect in it the National Research Council for encouraging industrial development through industrial research.