Defence Science Journal, Vol. 2, No. 2-3, April - July 1952, pp.83-87

DEFENCE AIDS SCIENTIFIC RESEARCH & INDUSTRIES*

By Dr. S. S. Bhatnagar, D.Sc., F.R.S., Secretary, Ministry of Natural Resources and Scientific Research

Defence requirements of a country have always been associated with its material resources and the manner in which these are put to practical use. In recent years this connection between defence and practical utilisation of resources, or in other words, industrial development, has come to be more intimately appreciated and nations which are not in a position to meet some of their essential needs have harnessed science to make good the deficiencies by evolution of new processes, utilisation of new raw materials and development of substitutes. Fixation of nitrogen to produce ammonia and nitric acid is now a classic example of a process developed with the object of doing away with dependence on imported Chile salt-petre, supplies of which were liable to be cut off in the event of war. It is even said that Kaiser Wilhelm postponed World War I for a whole year to have this dependable indigenous provision for basic raw materials for both explosives as well as chemical fertilisers in actual produtcion. Production of sulphuric acid from gypsum in Germany during World War I is an instance of using new materials to meet defence requirements of which another example is provided by Fisher Tropsch's and Bergius' processes for production of synthetic petroleum products from coal.

Defence also aids science and industry by accelerating the pace of industrial developments and thereby providing new sinews for the progress of science and its application to useful ends. Rapid developments in use of radar and sonar in many spheres like radio location, detection of hostile aircraft, guiding of bombers and bombing and location of submarines, have opened up innumerable possibilities for application of electronics and ultrasonics and also brought out the importance of these sciences in civil aviation and commercial navigation and several other similar fields. The availability of radioactive isotopes in relative abundance as a result of quick developments in the field of nuclear energy has provided new tools for scientific investigations in the field of agriculture, industry and public health. The rapidity with which penicillin, streptomycin, aureomycin, atabrin, DDT and several other insect repellents and insecticides were developed and produced under the stress of war time conditions has been an invaluable contribution of defence in prevention and avoidance of disease.

In India also defence has been giving a fillip to science and industry. The tempo of industrial development was stepped up during the two world wars and production of many new items was established mainly to meet defence demands and in some cases to meet shortages created by war conditions. One of the major contributions of World War II was the rationalisation of production in cotton, woollen and jute textiles. Leather and rubber are some

*Paper read on April 21, 1952 at the Second Defence Science Conference.

other industries which benefited similarly. The emphasis on industrial products coming upto certain specified standards has to a certain extent been responsible for introducing standard methods of production and raising the quality of some Indian products to bring them on a par with imported material.

Science was also influenced in several indirect ways. An analysis of the statistical data relating to education in scientific subjects shows that World War II inculcated an increased interest in science and the numbers taking the I.Sc. and B.Sc. examination began to show an appreciable increase from 1940-41 onwards. The establishment of Board of Scientific and Industrial Research in 1940 and Council of Scientific and Industrial Research in 1942 was primarily intended to utilise science in making India an efficient supply base. This is borne out by the resolution creating the Board in which emphasis was particularly laid on the development of industries whose importance or possibilities had been prominently brought to the forefront as a result of conditions created by the war. The expansion of these activities to cover the whole sphere of industrial development was a logical consequence of this step.

The scope of these influences has, however, been limited because of the nature of the 'basic' political set up obtaining till recently. Major defence requirements were obtained from U.K. and other foreign countries and only the barest minimum were met from indigenous resources. These conditions have been gradually changing and greater reliance on the ability of industrial concerns within the country to meet defence requirements is evident but the lack of an organisation in the Ministry of Defence which could look at problems from a scientific point of view retarded the healthy development of these impacts. The setting up of Defence Science Organisation three years ago is an indication of the change in outlook and now that this organisation has established itself firmly, it should assume a more active and prominent role in effectively influencing progressive developments in certain specified fields of scientific research and industry.

Apart from secret defence projects, there are a large majority of non-secret problems in the solution of which defence is profoundly interested and which also have major bearings on the national welfare in general. In seeking a solution of these, defence can and should obtain help of agencies outside its own organisation.

In America the expenditure of War and Navy Departments excluding A.E.C., on research and development totalled 500 million dollars in 1947. Of this only 20 per cent. or 100 million dollars was spent in governmental laboratories while 80 per cent. or 400 million dollars took the form of contracts with industrial and university laboratories. Not all this money was for applied research only; a portion, though a small one, 35 million dollars, also went to promote basic research. These figures are just illustrative of the extent to which defence organisation in U.S.A. supports research in universities and other industrial laboratories by contracts and are suggestive of the vital role which these research institutions have played in defence research and development even in advanced countries like

U.S.A. While it is not suggested that Defence Science Organisation in India should at the very start begin supporting educational and research institutions on the same scale, from selfish motives alone, a beginning in placing of research contracts with various research organisations is immediately called for. Besides promoting science in general, such a step will also assist in the training of technical personnel in specialised fields to meet defence requirements.

In this respect the various national laboratories of the Council of Scientific and Industrial Research offer a unique opportunity for active collaboration. The suggestion is not for participation in all spheres of activity. It is a forceful plea for active collaboration between national laboratories and Defence Science Organisation in investigations intended to find a solution of specific and well-defined problems, many of which are of vital interest to defence and industry both. In spite of liberal treatment by Government, the financial resources of national laboratories are not so adequate that they can take up problems of defence to a sufficiently advanced pilot plant stage on their own. Of course, one possible solution is more liberal financial grants by government through Ministry of Natural Resources and Scientific Research, but for problems bearing on Defence funds are more easily obtainable through the Defence Ministry. This is the only practical way of making the best use of the immense facilities available at these laboratories for the benefit of defence. If this collaboration produces satisfactory solution of even few problems which face defence, my plea will have been more than amply justified.

The field for this active collaboration is so wide that all the eleven laboratories could participate in some activity or the other. For instance, Central Food Technological Research Institute, Mysore, could take up investigation on canned rations of various types and their behaviour on storage under different conditions. This will provide defence forces with standard and highly nutritive rations for their sustenance in the field. The institute has already developed a canned vegetable curry which is highly nutritious and will, I am sure, be appreciated by the armed forces.

Similar collaboration in ultrasonics and electronics particularly with National Physical Laboratory can lead to very useful results. India has a long coast line extending over nearly 2,500 miles, yet no detailed coastal map of India has so far been prepared. One of the major undertakings awaiting Defence Science Organisation is a regular survey of the coast line and the surrounding seas and in the execution of this project ultrasonics can play a major role. A permanent recording device based on ultrasonics can give a record of the profile of the bottom of the ocean. Such a survey will be of infinite benefit not only to the Indian Navy; it will be useful for commercial navigation and will also help in locating shoals of fish and development of fisheries. Provision of a depth sounder and automatic registering of depths beneath a ship can be of assistance in avoiding ships running aground thereby adding to the safety of general navigation. Testing of heavy ordnance castings like guns and rubber tyres are some other instances where ultrasonics can be usefully employed.

Extension in practical applications of electronics is also possible in various fields and by subsidising research in this subject, defence will be laying the foundations for the establishment of an electronics industry within the country. The importance of electronics in the context of modern life does not need any elaboration. As is well known, there is practically no walk of life, industry, transport, communications, education, entertainment, in which electronics does not figure prominently. Electronics is also the life blood of modern defence. For instance, electronic fuses are now commonly employed in projectiles. Gunfire and bombardment is guided by mechanical electronic devices which can compute the various factors in no time and give an exact indication of the direction in which shells should be fired. In the designing of many similar items of equipment for defence, National Physical Laboratory can be of considerable assistance.

The same applies to other national laboratories. National Chemical Laboratory could, for instance, assist in evolution of simple devices for desalting of water. It could also undertake on behalf of Defence basic studies of new explosives. Fuel Research Institute could help in study of improved methods of coking and carbonisation to obtain better yields of benzene, toluene, phenol and other similar essential chemicals. It should also be possible to consider jointly how far establishment of petrochemical industries in meeting some of these requirements is feasible.

In the field of industry also there are several items which defence should either take up on its own or subsidise directly with a view to establishment of industrial production of some essential raw materials. The priorities which defence requirements command carry the added advantage of ruling out ordinary economic considerations. In many cases establishment of indigenous production is essential although it is obvious that to start with, costs will be higher, appreciably higher, in many cases. An example that readily comes to mind is that of phosphorus, initiation of manufacture of which under present conditions would be uneconomic without direct support from defence.

Besides engineering industries, the ordnance factories of defence include a number of chemical industries which have now been running for a long period. In this connection, reference may be made to the manufacture of acetone from alcohol and oxidation of ammonia to produce nitric acid. The affairs of these factories are at present defence secrets, but I do believe that a stage has now been reached when it should be possible to reveal the economics of manufacture so that the experience gained may prove useful in arranging production of these materials for ordinary industrial purposes. Such information cannot be withheld for long and an acceptance of the concept of these factories being also regarded as prototypes for industrial development, will be a distinct contribution of defence in stepping up the tempo of industry.

Subjects which will receive prominent attention during this week's conference are ballistics, operational research, personnel

research and environmental physiology. I am glad a whole afternoon is being devoted to the study of 'ballistics in universities' and I have every hope that in the contributions to the discussion, the significant need of support, both moral and material, to the development of this subject in the universities will be fully brought out. My personal view in the matter is that the defence should make generous grants to two or three universities so that they can organise regular schools and make a start in intensive teaching and research in this important subject. The same remarks apply more or less to the other subjects, operational and personnel research. Operational research demands a regular supply of well trained statisticians and although a beginning has already been made, there is considerable scope for stimulating the application of statistical methods in several other spheres of activity.

Personnel research and environmental physiology have important bearings on industrial production and lead to more rational methods of production as well as an increase in efficiency of industrial labour.

As one of the largest employers in the country, the defence organisation has indeed a unique opportunity of making substantial contributions to promoting the general welfare of the nation. Armed Forces have under constant study various problems connected with the welfare of their personnel such as checking and avoidance of various diseases, causes of nutritional deficiency and ways and means of making these good, etc. These studies are at present restricted to particular areas and conditions obtaining in defence establishments and camps. Provision of facilities to state and social workers in extending these investigations and preventive measures to other areas in collaboration with defence personnel offers a unique opportunity of collaboration with defence in making effective contributions in promotion of general national welfare. This association can have far reaching educative effects and will enable the masses of India to raise their general standard of living. After all the nation as a whole is the back bone of the armed forces and any improvements in its general conditions will be reflected in improved conditions of recruits for the armed forces also.