

## SCIENTIFIC ORGANISATION IN THE UNITED STATES, CHINA AND JAPAN.

By DR. JOHN B. GRANT, M.D., M.P.H., F.A.P.H.A.

(Read at Symposium, September 27-28, 1943.)

The overall picture of organisation in the United States, China and Japan follows much the same pattern with certain differences in emphasis due to the stage of development reached. Research in the natural sciences is universally carried out in three different although inter-related spheres; Universities, Government Institutions and Industries. University research is primarily concerned with advancement of knowledge for knowledge's sake, and industry is concerned chiefly with the applied aspects, while Government Institutions are more or less between these two objects. The extent of governmental research institutions depends on the predominant economic framework of the nation in question. 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. Industry particularly since the last war has extensively established research laboratories relating to its individual fields of application. In these countries, special scientific societies of a voluntary nature have now been established for almost every differentiated field of scientific knowledge. These are generally associated through one or more national bodies for the advancement of science.

### UNITED STATES.

The American Association for the Advancement of Science, founded in 1848 and incorporated in 1874, marks the beginning of organised scientific research in the United States. Its 16 sections represent the main differentiated fields of knowledge including the natural sciences and its official journal *Science* corresponds in functions to *Nature* in England. 181 scientific societies and organisations with more than 21,000 members are affiliated with the Association.

The National Academy of Sciences was incorporated by Congress in 1863 to serve as an advisory body to Government. Its membership is restricted to 250 representing the accolade for distinguished work in the fields for which the 11 sections of the Academy is divided. The National Research Council was established in 1916 under the charter of the National Academy of Sciences primarily to co-ordinate research during war. It was however reorganised in 1918 as a permanent body to stimulate research particularly in the natural sciences and in their application to engineering, agriculture and medicine. The work of the Council is organised along two lines dealing with the general relations of the Council on the one hand and on the other with major branches of science and technology. The latter group has seven sections. The Council is the most important national clearing house of information regarding research work undertaken throughout the country in the fields represented by these seven technical divisions. An extremely fruitful function of the Council has been its research fellowships chiefly in chemistry and physics. The war has not only stimulated but also co-ordinated research in the United States with the creation of the Office of Scientific Advisory Council to which is attached the National Academy of Science and under which are the National Defence Research and Medical Research Committees.

It is estimated that university, government and industrial expenditures for research aggregate over 300 million dollars per annum.

*University.*—There are 516 universities and colleges in the United States, ranging from universities in the true sense to what in Europe would be about Gymnasia level, each of which is undertaking research that in the aggregate is considerable and much of it significant. It is, however, difficult to generalise or to analyse either the volume or results. One feature of university research to be noted is that while much is supported by special grants from outside most of the expenses constitute part of the routine budget of the

department in question. This is somewhat different from the practice prevalent in India where practically all funds for research must be sought from outside of the regular budget.

There are some 200 university laboratories undertaking industrial research work and commercial investigations under grants made by various firms. A unique and successful industrial experiment station is constituted by the Mellon Institute supported by associations of manufacturers and providing industrial scholarships. The Institute provides direct service not only to the industrial concerns supporting the scholarships but to a number of industrial concerns possessing the same problems for investigation.

*Government.*—In recent years Government supported research has become increasingly significant particularly from the laboratories of the Bureau of Chemistry and Soils and the Forest Products Laboratory of the Department of Agriculture; the Bureau of Mines of the Department of Commerce; and the National Health Institute of the Department of Treasury. The National Bureau of Standards of the United States is probably the most widely known of governmental research institutes. Industrial groups send representatives to the Bureau's laboratory which also includes small scale manufacturing plants in which mill processes can be studied. The Bureau undertakes researches and tests which cover not only the various fields of physics and chemistry but also metallurgy and ceramics. The Bureau is the national agency for standardisation.

The Smithsonian Institution is internationally known in the scientific fields of ethnology and astrophysics. It was founded by Act of Congress in 1846 and it is supported largely by the Government. It houses the headquarters of the American Association for the Advancement of Science.

*Industrial.*—The extent of industrial research is reflected by the statement of one authority that there are at least 16,000 scientists engaged on behalf of industry and spending before the war over a 100 million dollars annually. The major emphasis is chemical. Some of the laboratories have won international recognition as research centres such as the Bell Telephones, du Pont, International Harvester, General Electric, Thomas Edison, Westinghouse, Eastman, Kodak, National Carbon, to mention only a few. There are also some 300 commercial laboratories engaged in research on problems referred by concerns too small to maintain profitably their own laboratories.

#### CHINA.

Modern scientific organisations in China may be said to have begun with the establishment by Government in 1927 of the Academia Sinica, and today may be divided into two major groups: Government Institutes and Universities, although so closely correlated and interrelated as to be almost indistinguishable. Private industrial research, as such, may be said to be non-existent chiefly because that Chinese industry was at its beginning when the war with Japan began and also that most heavy industry is government controlled. The Academia Sinica corresponds to a combination of the Royal Society of Great Britain and the Kaiser Wilhelm of Germany. It is composed of 10 Institutes and the National Research Council which publishes 'Science Record' and 'Bulletin of Academic Research', the former being published in English, French and German and the latter in Chinese. The functions of the Council which was organised in 1933, are to promote and co-ordinate scientific research. Membership consists of the President, the Directors of the 10 Institutes and 30 members elected by Professors of National Universities. The function of the Institutes is research in the various fields of the natural sciences as well as in psychology, history, philology and social sciences. Institutes of mathematics and experimental medicine are under contemplation. The separate and parallel National Academy of Peiping was established in 1929 by the Sino-French Boxer Indemnity Funds Commission with three divisions of physical, biological and anthropo-geological sciences each having one or more research institutes. It is now entirely governmental.

The National Institute of Industrial Research conducts 16 laboratories covering fields of pertinent application in Free China today. It corresponds in scope to the activities of the D.S.I.R. and the Trades Research Associations of England combined.

The National Research Commission is an organisation of the Ministry of Economics, employing some 5,000 university graduates and 400 scientists to open up the national resources throughout Free China, and is engaged on a 5-year plan for developing the western part of the country. It subsidises research in universities as well as two of the Institutes of the Academia Sinica and also the Geological Survey.

The National Geological Survey of the Ministry of Industries has three divisions of Palaeontology, Mineralogy and Petrology; Geophysics and Seismograph and three laboratories, Caenozoic, Cartography and Soil Science. The discovery of Peking Man has been one of the outstanding scientific results of the Survey.

Less important Government organisations undertaking research are the National Agricultural Research Institute and the National Health Administration Research Institute.

The National Bureau of Compilation and Translation conducts standardisation of scientific terminology and publishes standard dictionaries in the different sciences. It also examines the text-books used in preliminary and secondary education, compiles Encyclopaedias and translates classics as well as produces booklets of popular education for the masses.

Government in 1934 inaugurated a programme of establishment of Research Institutes associated with Government universities and which have come into existence largely after the opening of hostilities in 1937. The most important are the seven Institutes connected with the National Associated South-Western University formed by a coalescence of Peiping, Tsing Hua and Nankai Universities. They function independently of the teaching departments of the universities. A second important group of university research activities comes under the National Central University. Now in Chungking the research institutes of the Academia Sinica following Canton have largely been suspended.

Three non-government institutions of importance are the Science Society of China with its work in biology and for many years publishing the Chinese equivalent of *Nature* and *Science* but now suspended by the war; the All-China Institute of Geography is supported by the Sino-British Boxer Indemnity Committee; and the private Fudan University which has made some important contributions in biology.

Three general comments offer with respect to Science Organisations in Free China. First as might be expected the major emphasis is with respect to applied rather than purely experimental work and particularly in solving the problems of a Government refugeeing in a previously entirely undeveloped part of China. A typical example is the Physics Section of the Peiping Academy which is now given over almost entirely to producing microscopes, or the motor fuel division of the National Institute of Industrial Research whose work after the closing of the Burma Road was directed towards cracking vegetable oils and purifying the resultant petrol. Such experimental work as is being undertaken is chiefly theoretical rather than experimental. Reference already has been made to the Sino-French Boxer Indemnity Fund Commission. Similar Commissions came into existence with the return to China by the U.S. and British Governments of their indemnity funds. These important organs of educational and cultural enterprise are known respectively as the China Foundation for the Promotion of Education and Culture, and the Board of Trustees for the Administration of the Boxer Indemnity Fund both of which are administered by the National Government. The two organs were the most important source of financial support to research in China during the decade previous to the war with Japan. A third generalisation is that tribute must be paid to the Chinese scientists, who despite refugeeing over hundreds if not thousands of miles, in many instances with scarcity of literature and equipment and living under adverse economic and social conditions, are nevertheless the backbone of China's present resistance and the promise of her post-war future.

#### JAPAN.

The last war led to the establishment of a national laboratory for scientific investigation and research with an annual budget of 250,000 dollars.

Industrial and government laboratories and institutes are probably larger, better financed and better organised in relation to the wealth of the community than in any

other part of the world with the possible exception of the U.S.S.R., although the level of work coming from some of these institutes may be open to doubt.

The bulk of research in the natural sciences is undertaken through Government supported institutions particularly the larger universities and institutes established for specific fields. 46 universities are listed for Japan proper although many have only one faculty. However, a faculty of the university cannot be registered unless it provides post-graduate instruction and research. The 6 imperial universities and 3 of the 24 private universities constitute the bulk of university research in the true sense of the word. It should be borne in mind that the first government university, the Tokyo Imperial, was founded only in 1887.

The Imperial Academy corresponding to the Royal Society of England and the National Academy of Sciences of the United States was established in 1897. This body sponsored the establishment of the National Research Council in 1920 under the Ministry of Education with the object to encourage and co-ordinate scientific and technical research. There are 9 divisions covering the fields of natural sciences, each of which publishes at least one foreign language journal. In addition, the National Research Council publishes its own annual report. The National Research Council, in 1925, itself sponsored the Japanese Association for the Advancement of Science corresponding to similar associations in other countries.

A Foundation for the promotion of scientific and industrial research was established in 1931 with an initial endowment from the Imperial Household and an annual subsidy from the Government.