

## NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C.

## REPORT FOR 1954-55

THE fifth annual report of the National Science Foundation, Washington, D.C.\*, covering the year ended June 30, 1955, includes a brief review of the operation of the Foundation during its first quinquennium, but otherwise follows the pattern of the fourth report. The report of the director, Dr. A. T. Waterman, is in two parts: the first discusses some current aspects of American science, such as the loyalty and security considerations which determine the Foundation's grants for non-classified scientific research, the forthcoming International Geophysical Year, synthetic rubber research and development and the indirect costs of research supported by Federal grant or contract at educational institutions; the second reviews the work of the Foundation itself during the year. A foreword by Chester I. Barnard emphasizes the importance of leadership by the Federal Government not only in the financial sphere, but also in developing an adequate supply of scientists if science is to make its full contribution to the public welfare. Such leadership rather than direction is the Government's function, and the need for co-ordination can be met best by fostering the collection of facts regarding all aspects of the scientific situation and facilitating communication between scientists and scientific institutions. Appendixes occupying almost half the report list the personnel of the Foundation's Board and its advisory panels and committees, the basic research grants and fellowships awarded during the year, publications of the Foundation and the financial report.

During the year ended June 30, 1955, the Foundation made 588 grants, totalling 7,857,395 dollars, to 184 institutions for the support of basic research in the natural sciences. Of these, 275 (totalling 3,542,495 dollars) were in the biological and medical sciences and 313 in the mathematical, physical and engineering sciences. During the period 1952-55 the Foundation has made 1,232 grants totalling 14,316,140 dollars in support of basic research in the natural sciences, and the present report stresses the special efforts of the Foundation to foster co-operative research with nuclear emulsions (for which purpose a second conference was sponsored at De Pauw University on March 30, 1955), research on the solid state, on high-speed computation and in geochemistry. Grants have been made for the assistance of biological field stations, and a limited programme of support of the social sciences was approved in August 1954. The programme is being administered within the framework of the Foundation's three scientific divisions, using the criteria of science (that is, the identification, within the social disciplines, of those areas characterized by the application of the methods and logic of science), national interest, convergence of the natural sciences and social sciences, and basic research. The Foundation has also established a continuing programme for providing funds to medical schools for research stipends to medical students.

In March 1955 the Foundation announced the award of 715 fellowships and 70 post-doctoral fellow-

ships for advanced study in the natural sciences for the year 1955-56. Of these, 225 were in the biological sciences, 183 in chemistry, 108 in engineering, 31 in the terrestrial sciences, 63 in mathematics and 175 in physics and astronomy. A research programme on techniques for fellowship selection over the past three years has led to some modifications and simplifications in the methods used in selecting. Three further conferences on the role of physics in engineering education were held during the year under review, dealing with mechanics, with thermodynamics and with electricity and magnetism. The Foundation continued to sponsor a series of summer institutes for science teachers and instituted a survey of the educational and vocational attitudes of high-school leavers in an attempt to discover why talented youths often fail to continue education. The survey was able to arrive at an estimate of the numbers of those who wished to proceed to college but would be prevented from doing so.

The Foundation is also extending its interest in the exchange of scientific information and is urging scientific societies to seek some permanent solution of their publishing difficulties and to undertake studies that will lead to a clearer understanding of the facts and problems of scientific publication. The Foundation is supporting the publication by the Science Division of the Library of Congress of comprehensive lists of United States and Russian scientific serial publications as well as a list of the world's biological serial publications, and also a study in the Technical Information Division of the Library of Congress to determine the extent to which information first available in unclassified government reports is afterwards published. Funds have been provided for bringing up to date the indexes for *Biological Abstracts* and for a thorough study of biological abstracting, and the Foundation is also attempting to promote fundamental research on methods of organizing information and on the feasibility of translation by machines. Continuing support was given to the translation and publication of an English edition of the Russian *Journal of Experimental and Theoretical Physics* and to the Scientific Translations Centre of the Library of Congress, and 132 scientists were given grants enabling them to attend twenty-nine different international scientific meetings.

Including those already noted, the National Science Foundation sponsored, alone or jointly with other bodies, twenty-one conferences convened during the year to examine special areas of science, chiefly where adequate support was not available from industrial or other sources. They included an international symposium on problems relating to arid lands, sponsored jointly with the American Association for the Advancement of Science, the United Nations Educational, Scientific and Cultural Organization, and the University of New Mexico; conferences on the crust of the Earth, the anomalous magnetization of rocks, man's role in changing the face of the Earth, the cosmic distance scale, and on genetic, psychological and hormonal factors in the regulation of patterns of sexual behaviour in mammals; mathematical tables; research in the history,

\* National Science Foundation. Fifth Annual Report for the Fiscal Year ending June 30, 1955. Pp. 159 + 1x plates. (Washington, D.C.: Government Printing Office, 1955.) 50 cents.

philosophy and sociology of science, the mechanics of sediment transport, radiocarbon dating, the evolution of behaviour, the theory of numbers, mathematical statistics and probability, problems of nuclear structure, molecular quantum mechanics and high-energy nuclear physics; the twentieth Cold Spring Harbor Symposium on Quantitative Biology, at which special emphasis was given on population genetics; and the fourteenth Growth Symposium of the Society for the Study of Development and Growth. Some 137 scientists from the United States and abroad were assisted to attend the Garden Research Conferences.

Appropriations for services and equipment for the International Geophysical Year totalled 1,914,957 dollars, and during the next fiscal year the Foundation plans to make a full evaluation of current basic research activities on synthetic rubber, the average annual expenditure on contract research, which at universities and other institutions during the quinquennium ending June 30, 1955, exceeded 1,118,000 dollars and at the government laboratory at Akron 1,094,000 dollars. The Foundation assumed responsibility on July 1, 1955, for administering the Federal programme for basic research on synthetic rubber. At the request of the Bureau of the Budget the Foundation has also given special attention to the indirect costs of research supported by Federal grant or contract at educational institutions and has recommended procedure for reimbursing such indirect costs where requested. Adoption of the policy is estimated to involve an additional cost to the Federal Government of not more than 8 million dollars, or 2.3 per cent of the present Federal expenditure on research in such institutions. As regards the loyalty and security considerations in making grants for non-classified scientific research, Dr. Waterman affirms that the Foundation will not knowingly support anyone who is, by admission or conviction, disloyal to the United States; its grants will be made on the judgment of outstanding scientists in his field and of persons possessing personal knowledge of his competence and integrity.

## RESEARCH IN SEMICONDUCTORS SYMPOSIUM AT OTTAWA

A SYMPOSIUM on semiconductors took place during February 13-14 at the National Research Council Laboratories, Ottawa, at the invitation of the Low Temperature and Solid State Physics Group of the Division of Pure Physics; the arrangements followed the lines of the symposium on melting reported in *Nature* of January 7. The chairmen were Dr. D. K. C. MacDonald and Dr. W. B. Lewis.

When opening the meeting, Dr. MacDonald said that the subject of semiconductors was chosen because of widespread interest throughout Canadian universities and laboratories. The Low Temperature and Solid State Physics Group is specifically interested in bulk properties, and is investigating magnetic susceptibility and the thermal and electrical conductivities, as well as the occurrence of semiconductivity in intermetallic compounds; but the scope of the meeting in general would be much wider. Later, Dr. Lewis said that quite apart from the revolution it has effected in electronics, research in semiconductors may well provide a basis for a new statistical treatment of processes whereby energy is

stored and dispersed. In nuclear reactors, energy is produced initially in a very intense form, and dispersed under conditions far from thermal equilibrium. The processes of dispersal and degradation of this energy, until it emerges as heat, seem to require a statistical approach which would be essentially different from the traditional equilibrium theories of thermodynamics and thermal fluctuations, and yet would to some extent take their place.

In the first of two papers, R. E. Burgess (University of British Columbia) outlined the theory of statistical fluctuations of both the spatial and temporal distributions of electrons among the energy-bands and -levels in a semiconductor; these give rise to 'patch' effects and noise, respectively, and the theory can be compared with experiment. In his second paper, mathematical analysis of the characteristics of germanium point-contact diodes (showing voltage turn-over) was shown to lead to severe restrictions on conjectural models: possible mechanisms were discussed, and in particular a model due originally to Gunn appeared to be consistent with these restrictions.

W. B. Pearson (National Research Council, Ottawa) described briefly the concept of the semiconducting valence bond, which has proved fruitful both in accounting for known semiconductors and in predicting new ones, and went on to discuss further aspects of bonding in semiconductors. G. F. Bolling and J. W. Rutter (University of Toronto) showed how both the grain structure and the distribution of impurities in solid germanium are affected by the way in which it is formed from the melt. This is important both for obtaining distributions required for electronic devices and for knowing how to avoid the formation of undesirable substructures in the solid. J. Sharma (National Research Council, Ottawa) described an experimental frequency analysis of the glow peaks obtained at different temperatures from luminescent alkali halides. The luminescence is caused by colour centres, and a provisional model was put forward to account for the spectra caused by different types of centre. Two chemists, D. M. J. Compton and T. C. Waddington (National Research Council, Ottawa), described experiments on the organic semiconductor anthracene, with various kinds of electrode, various impurities and under various conditions of illumination. Among properties measured have been the electrical conductivity, Hall effect and distribution of space-charge. Marked differences in behaviour from typical inorganic semiconductors require correspondingly different explanations.

Other papers were given by J. H. Simpson (National Research Council, Ottawa) on the calculation of the ground-state of an  $F$ -centre; by J. Rolfe (National Research Council, Ottawa) on the design of high-frequency transistors; by Z. Szepesi (Canadian Marconi Co.) on the similarity in electrical characteristics between condensed layers and single crystals of cadmium sulphide; by F. T. Hedgecock (National Research Council, Ottawa) on the magnetic properties of very dilute germanium alloys down to 8° K.; by R. P. Singh (National Research Council, Ottawa) on the functions developed by Wannier for use in the theory of a perturbed lattice; and by A. O. Barut (University of Montreal) on the conditions needed for a rigorous quantum statistical derivation of thermodynamics.

An informal report of the proceedings is being prepared, similar to that produced for the previous symposium on melting and diffusion.

T. H. K. BARRON