

SCIENTIFIC RESEARCH AND THE CARNEGIE TRUST.

THE seventh annual report, that for the year 1907-8, of the executive committee to the trustees of the Carnegie Trust for the Universities of Scotland, was submitted at a meeting held in London on February 24. The report contains a review of the activities of the trust during the seven years of its existence. In the first place, the committee directs special attention to the scheme of endowment of post-graduate study and research, which completed its first lustrum on September 30, 1908. The committee submitted the results of the scheme over the five years to independent authorities for examination and report. For this purpose the services were obtained, in the physical and chemical sciences, of Dr. J. J. Dobbie, director of the Royal Scottish Museum, and formerly professor of chemistry in the University College of North Wales; in the biological and medical sciences, of Dr. J. Ritchie, superintendent of the Royal College of Physicians' Laboratory, and formerly professor of pathology in the University of Oxford; and in the historical, economic, and linguistic sciences, of Prof. P. Hume Brown, Historiographer-Royal for Scotland.

The assistance offered by the scheme was of three kinds—scholarships, fellowships, and grants—in order, so far as possible, to reach all classes of workers. Selection was made, not by competitive examination, but for fellowships on the merits of original work already published, and for scholarships on the evidence of experts regarding the applicant's special fitness for the work proposed. No fixed number of foundations, nor even a definite total sum, was assigned to any one year. The aim of the scheme was within the limits of the trust deed, to discover and supply the demand for assistance in higher study and research throughout Scotland. The actual expenditure upon the scheme for the first quinquennial period was 27,755*l.*

Two points in connection with the reports of the experts referred to above are mentioned. The first is that the reports must be taken as representing only part of the output of the universities of Scotland in higher study and research; for in many departments, and not merely in those outside the scope of the trust, much independent work of the kind is being done. The second is that in providing the scheme with so many able workers, as well as in affording laboratory accommodation and supervision, the universities deserve much of the credit due to its success.

In summarising the grants to universities and extramural colleges, the report states that, of the total grants during the past six years, amounting to 246,374*l.*, 23,000*l.* has been allocated to libraries, 131,644*l.* to buildings and permanent equipment, and 91,730*l.* to teaching. In this allocation the committee was guided by the special needs of each institution as set forth by its governing body. It is gratifying to find, in the statements received from the universities and other institutions regarding their claims under the second quinquennial distribution, their general recognition of the great benefits that have accrued.

The second quinquennial scheme of distribution, besides making contributions of 65,250*l.* to buildings and permanent equipment and 20,500*l.* to libraries, will at the close of the period of five years have increased the resources of teaching in the four university centres by permanent endowments amounting to 87,500*l.*, and have afforded during the five years an annual income of about 4150*l.* to meet ordinary expenditure.

During the period of seven academic years in which the scheme of payment of class fees has been in operation, the individual students whose fees have been paid by the trust number 8263, and the fees paid reach the total of 298,687*l.* Fifty-five beneficiaries under the scheme have made voluntary repayment of fees paid on their behalf, amounting in all to 881*l.*

With regard to school education of applicants, the committee has been able since the year 1907-8 to demand of all applicants a standard equivalent to that of the universities arts and science preliminary examination, or of the leaving certificate of the Scotch Education Department.

The expenditure for 1907-8 upon the research scheme and upon the laboratory was respectively 6340*l.* and 2185*l.*,

towards the latter of which the Colleges of Physicians and of Surgeons have together contributed 950*l.* Under the head of grants to university centres a sum of 73,998*l.* 5*s.* 9*d.* was available for distribution during 1907-8. The statistics of the payment of class fees for the academic year 1907-8 give the total number of beneficiaries as 3269, the total amount of fees paid as 43,256*l.*, and the average amount in fees paid per beneficiary as 13*l.* 4*s.* 8*d.*, an increase as compared with the preceding academic year of 107, 2154*l.*, 16*s.*, and 4*s.* 8*d.* respectively.

In his report on the scheme of endowment of post-graduate study and research, Dr. J. J. Dobbie, dealing with the physical and chemical sciences, remarks that a careful examination of the papers relating to the work of the Carnegie fellows, scholars, and grantees in the mathematical and experimental sciences has confirmed and strengthened the conclusions expressed in the report of January 19, 1905, as to the satisfactory working of the scheme for the encouragement of post-graduate study and research. The high standard set in the appointment of the first fellows and scholars has been well maintained in subsequent appointments. With few exceptions, the beneficiaries have fully justified their selection by the trustees. They have carried out successfully a large amount of research work. During the past five years thirty-seven individuals have been appointed to fellowships or scholarships, and twenty-five, not including fellows, have received grants. The detailed numbers, excluding grantees, are:—mathematics, 2; physics, 8; engineering, 4; chemistry, 23. It is a noteworthy circumstance that the fellows and scholars in chemistry outnumber the total of all the other branches of the mathematical and physical sciences. This may, perhaps, be accounted for to some extent, but not altogether, by the fact that the comparatively fresh field of physical chemistry offers certain attractions to students who formerly would have devoted themselves to purely physical research. Some students are thus classed with the chemists, who might with equal reason be reckoned amongst the physicists.

The fellows and scholars have contributed together one hundred and seventeen, and the grantees twenty-two, papers to the scientific journals. The papers in every case embody the results of original investigations conducted by their authors, and in the aggregate contain a very large number of new observations, some of which have proved of real value in furthering the development of the branch of science to which they relate. Nearly all the papers of the beneficiaries have been published in the journals of one or other of the great societies. It is well known that since the inauguration of the trustees' scheme the output of experimental work by the Scottish universities has greatly increased. In chemistry alone, in the course of the last two years, the number of papers dated from the laboratories of the Scottish universities which have been published in the *Journal of the Chemical Society* is twice as great as the number appearing in the two years immediately preceding that in which the scheme came into operation; and a still more important result is to be found in the opportunity which the scheme has afforded for co-operation within our laboratories. Although Scotland has in the past produced many eminent investigators, they have, with a few notable exceptions, been solitary workers. It is only within the last few years that "schools" of research, such as have long been the strength of the scientific departments of the German universities, have come into existence there, and the encouragement which the Carnegie scheme has given to this movement is not the least of its claims upon the gratitude of the scientific world.

Dr. James Ritchie, in reporting on the biological and medical sciences, states that during the period under review eighteen fellows have been at work. Of the total number, ten had previous to election to fellowships been beneficiaries of the trust, either as scholars or grantees. The distribution of the fellowships as regards the different branches of science were as follows:—agriculture, two; zoology, two (including one in protozoology); anatomy, three (including one in embryology and one in anthropology); physiology, six (including one in experimental psychology); pathology, five (including one in neurology). Of those appointed to scholarships, numbering in all forty-

nine, eight have been promoted to fellowships. Of the others, eight resigned before the beginning of the academic year, and nine during the academic year in question. The departments of science in which the scholars proposed to work, or in which they have worked, are as follows, the numbers indicating the applicants in each branch:—geology, one; palæontology, one; botany, seven; agriculture, five; zoology, five; anatomy, two; embryology, two; physiology, three; pharmacology, two; pathology, eleven; surgery, two. The distribution of ninety-one grantees, according to their subjects, was as follows:—meteorology, one; geology, six; palæontology, two; botany, three; agriculture, four; zoology, ten; anatomy, seven; embryology, four; anthropology, one; physiology, sixteen; pharmacology, four; pathology, twenty-eight; therapeutics, five. The grantees fall into three groups:—(a) cases where grants have been made to persons holding responsible positions as heads of scientific departments or to assistants in such departments; (b) cases where grants have been made to persons in other positions, and who are engaged in research work in leisure time; (c) cases where grants have been made to young workers often in lieu of scholarships for which they have applied.

In concluding his report, Dr. Ritchie remarks that it is not difficult, in reading between the lines of the papers relating to the beneficiaries, to see that in very many cases the work which has been done would never have been undertaken unless the assistance of the trust had been given, and that in no corresponding period in the history of the universities of Scotland has so much research work of such uniformly high character been successfully carried on.

As regards historical, economic, and linguistic subjects, Dr. Hume Brown reports that, out of eighteen scholars and fellows, there are only four who have failed in greater or lesser degree to fulfil the conditions of the trust. What is noteworthy is that the work done has been original work, which really advances the various subjects undertaken by the beneficiaries. There appear to be three chief causes of the few failures that have occurred. Some candidates were recommended on the strength of their record of study in the universities, but it may happen that students who have distinguished themselves under the pressure of competition may show a lack of concentration when that pressure is removed. Such cases will occur, and can hardly be prevented. Another cause of failure is that the scholar had no clear conception of the work he undertook, with the result that time and labour were lost before he found his way to the essentials of his subject. The majority of the applicants for scholarships have had little or no previous experience in research, and it is important that they should be carefully supervised. The beneficiaries who have received grants are seventeen in all, of whom only one or two have proved more or less unsatisfactory.

At the annual meeting of the trustees on February 24 Lord Elgin moved the adoption of the report, Mr. Balfour seconded, and the motion was adopted unanimously.

In the course of his remarks, Mr. Balfour said:—This is a special occasion in the history of the trust. It is the first time that anything in the nature of a complete survey of the work that has been done under certain sections of the trust has been possible to us. It is the first time that the public can be really put in possession of information which will enable them to judge of the value of the great benefaction which the founder established for his countrymen and for the world. There is one department of the trust of which, since I am not a member of the executive, I may speak with a freedom of praise which would be quite impossible were any of the credit or any of the responsibility due to me. I refer to that portion of the work with which this great report is chiefly occupied—the portion of the work which consists in encouraging original research.

It is evident that this great object is partially ministered to by that portion of our endowment which is given to equipping libraries, laboratories, and providing our universities with all the modern appliances which seem ever more costly as the progress of science advances, and without which it is quite impossible for a modern university to do its proper work. But it is not on that portion of

our labours on which I should like, specially at the moment, to congratulate Mr. Andrew Carnegie and the executive. It is rather upon the portion of the work which deals with the encouragement of those competent to carry on original work—an encouragement over and above that of merely supplying universities with the necessary equipment of books and apparatus. It is obvious that the task of selecting people who can do this work is very difficult and very delicate. It is surrounded with puzzling questions of administration, but the way it has been solved by the executive committee of the universities concerned, and the success which has attended their efforts, raises even the highest hopes of even the most optimistic and hopeful in connection with the movement. There is no greater waste in the world, and no more serious waste in the world, than waste of brains and intellect, of originality, and of scientific imagination, which may be used to further the knowledge of mankind of the history of the world, if men who are capable of carrying on investigations of this sort are given the opportunity of doing so. Competitive examinations are literally no test whatever of ability for original research. What is wanted is something much higher, much rarer, than the mere capacity for absorbing knowledge, and reproducing it rapidly when the time for examination comes round. What is required is some spark of that divine genius which shows itself in many ways, but which is, after all, a great element to which we must look for the progress of our race and the improvement of our civilisation.

What is it we want to do? We want to catch the man immediately after he has gone through his academic course, before he has become absorbed in professional life. At the moment when ideas spring most easily to the mind, when originality comes most naturally to the happily endowed individual, we want to catch him and turn him on to some inquiry which he is fully qualified to pursue with success. It is not an easy task to catch the man, and the number of men worth catching is not very large. The report speaks of a certain number of failures; there are not many among those who have been selected. It is amazing that the number is not much larger. No intuition will ever enable us to discover whether the man has anything beyond the ambition to do good work in original research. We have only to look at the reports of the experts who have dealt with the papers to consider the growth in the number of original papers accepted by scientific magazines which have issued from Scotland to see how much has been done to further this great cause of original research. We may divide the persons who are competent to carry on original research roughly into two classes, those who have the gift and ambition, but not one of those rare and overmastering ambitions which forces a man into this particular career for all his life. We have to catch them before they get absorbed in the necessary occupations of life and extract from them all we can in the way of invention and originality. Then there is a rare and higher class, those who seem born for research, to whom the penetration into the secrets of nature or into the secrets of history is an absorbing and overmastering passion, from which they will not be diverted or arrested except by absolute overmastering necessity of earning their daily bread and supporting themselves and their families. To these men it is all important, not for the sake of the men, but for the sake of the community, that they should have a chance of devoting their talents—rare talents—to that great work for which God undoubtedly intended them.

Work of the kind being done will never be able to be estimated by tables of statistics or measurement of output, but, in spite of that, will count, and count largely, among the affairs to which we shall owe the progress of knowledge, of invention, and of civilisation. Mr. Carnegie has, by this endowment of research, done a work which not only adds lustre to the history of his native country, but also has no provincial or national aspect about it, and will add to that stock of knowledge and invention which, when once made, is the common heritage of civilised mankind. In so doing Mr. Carnegie deserves not merely the thanks of those to whom he has entrusted the administration of his magnificent benefaction, but the thanks of the whole civilised world.