

devote their time to the solution of his problems. The fellowships are of different amounts, but average about \$3,500 a year. In the summer of 1917 the total number of fellowships was forty-two, the number of fellows employed on them being sixty-four. In some cases a bonus is attached to a fellowship, such bonus to be paid only in the event that a discovery of sufficient importance is made. Discoveries are patented, the patents becoming the property of the manufacturer who has donated the fellowship.

Numerous Investigations Being Made

Among the fellowships in successful operation at the time of the visit of the writer to the Mellon Institute may be mentioned the Bread Fellowship of an annual value of \$6,500. With this fellowship is associated a bonus of \$10,000, which has been paid three times over in the course of the past six years. As a result of investigations carried on in connection with the Gasoline Fellowship, several plants have already been erected. A million-dollar carbohydrogen concern operating in Pittsburgh was founded on the strength of discoveries made on a fellowship at the Institute in the years 1912-14. The Illuminating Gas Fellowship proved a godsend to its donor when, with the outbreak of war, the supply of potash was cut off.

There are fellowships which have for their respective objects recovery of the by-products of coffee roasting, utilization of the citrus waste of Florida, synthesis of drugs formerly imported from Germany. A number of fellows are studying processes for the reduction of iron, copper and aluminum ores. Others again are investigating methods for the production of acetylene and hydrogen. Several fellows on the same foundation are busied on problems connected with the petroleum industry. There are fellowships on phosphate, coke, fire brick, glass refractories, etc. To convey an adequate idea of the variety of the work of the Institute it would be necessary to reproduce a complete list of the fellowships.

It is not an easy matter to obtain reliable information with regard to manufacturers' profits, and where such information is furnished it is in general understood to be confidential. I have some interesting data relating to the financial returns from research, but for the reason just indicated, I am not at liberty to give much detail. In one case an industry founded with a capital of \$25,000 had accumulated \$200,000 of assets at the end of two years and was doing a business of \$1,000,000 annually.

In another case an industry started in a like small way was making a monthly profit of \$50,000 at the end of eighteen months, during the first six months of which the business was in the experimental stage.

Big Profits to Manufacturers

The third case which I will cite is one in which an initial investment of less than \$100,000, gradually increased to between \$300,000 and \$400,000, resulted in an industry which was disposed of for \$1,500,000 at the end of two years.

The fourth case is that of a plant which cost \$25,000. At the end of four months it had paid for itself and was making a profit of \$1,500 a day.

An instance which might be cited is that of an old-established firm which decided about three years before the war to see what there was for it in research, with a result that \$1,000,000 has been added to its annual profits. This was achieved at an average annual cost approximating \$12,000. The research work was done by three men who improved the processes and replaced important agents by cheaper and more effective substitutes. Another instance could be given of a firm which saved \$180,000 through the resourcefulness of a single research man in the first year after he had begun work on its problems.

The examples of the financial results just given cover four different kinds of industry. The profits represent actual values created by research. Certain of the firms in question, it may be noted, have adopted the bonus system, whereby the wages of the workmen increase as the profits of the company augment through improvements in the processes.

The benefits of research are, of course, not always as conspicuous as in the cases here cited. That the results to

be obtained are not, however, to be regarded as a matter of haphazard, is evidenced by the policy of those commercial concerns which, in the light of their experience, willingly spend hundreds of thousands of dollars annually for the maintenance of a research laboratory. The experience of the Mellon Institute, too, is that a very small proportion of the manufacturers endowing fellowships are out of pocket through their investment.

Canadian manufacturers should have within reach all the facilities for industrial research which are placed at the disposal of manufacturers in other countries. Within the not distant future there should be established at Ottawa an institution corresponding to the Bureau of Standards at Washington, D.C., and the National Physical Laboratory in England. The need of an establishment like the Mellon Institute to consider specific problems offered by individual manufacturers for solution is also pressing. The cost of building and general equipment might well be borne by the government, as also the cost of general maintenance. Ultimately the greater part of the expense would fall on the individual manufacturers for whom definite work was being done, for they would have to pay specific costs connected with that work, including the salaries of the scientific workers. The reward of the manufacturer would lie in the possession of patents taken out on the discoveries made. The government might stipulate that the results of investigation conducted in the laboratory should be published after the lapse of a certain number of years. It might also, by the collection of a small per cent. of the royalties on the patents, ultimately make the institution self-supporting.

Lack of Adequate Equipment

The scientific workers in the laboratories just referred to and in those laboratories which already exist or which in the natural course of events will develop within the plants of private corporations in Canada should, for the most part, be graduates of our Canadian universities. Much good industrial research work can be done under direction by men who have had an undergraduate course in a scientific department. The directive function should, however, belong to men who have had a more advanced training. This implies that in the leading universities of Canada the research ideal should be more in evidence, and that developments in graduate work should take place. Nowhere in Canada is there a university adequately equipped and manned for such work. This is a reproach which should not remain.

How can we tolerate the thought that in Germany provision is made for training men in advanced research which is not made in Canada; that positions exist for men so trained which do not exist in Canada! What excuse can we Canadians offer in extenuation of the fact that the leading universities of the United States have left our universities far behind in the matter of research? If the people of Canada realized the significance of the modern scientific movement, they would see to it that the necessary funds were forthcoming, and they would surely insist, as a matter of national pride, on our universities taking their place alongside the foremost in the world. This would mean on the one hand more time, and in some cases better equipment, at the disposal of the members of the staff in order that they might be scientifically more productive. On the other hand, it would mean adequate inducement held out to young men of requisite ability to prolong the period of their studies and prepare themselves more effectively for research work, either in pure science or in the application of science to industry.

The only unfinished section of the Trent Canal is that between Lake Simcoe and Georgian Bay. Construction of this section will proceed at once. It is expected that the work will be completed this year.

The new directors of the Canadian National Railways will soon present a report to the government, which, it is stated, will call for the completion of terminals at Montreal, Toronto, St. John, Vancouver and other cities, and for the construction or completion of certain western branch lines.