# THE RELATION OF PURE SCIENCE TO INDUSTRIAL RESEARCH.*

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THE writer traces the growing appreciation of the importance of industrial scientific research primarily to the events in Europe, and the recognition of the unpreparedness of the United States to defend itself against attack. Industrial research conducted in accordance with the principles of science is no new thing in America. The engineering department of the American Telephone and Telegraph Company, under the charge of the speaker, was founded nearly forty years ago to develop, with the aid of scientific men, the telephone art, and has grown from small beginnings to a great institution employing hundreds of scientists and engineers. It is generally acknowledged that to industrial research thus conducted we are largely indebted for the telephone achievements in America being so greatly above those of other countries.

The same applies to the development of electric light, electric power and electric traction. Vast sums are being spent annually upon industrial research by some of the larger electrical manufacturing concerns, but the speaker says with authority that these laboratories return to the industries each year improvements in the art which, taken altogether, have a value many times greater than the total cost of their production. Money expended in properly directed industrial research conducted on scientific principles is sure to bring to the industries a most generous return.

Industrial scientific research departments can reach their highest development in those concerns doing the largest amount of business, and small concerns without co-operation among themselves cannot have the full benefit of industrial research, for no one among them is sufficiently strong to maintain the necessary staff and laboratories. But once the vital importance of this subject is appreciated by the small manufacturers, many solutions of the problem will promptly appear. One of these is for the manufacturer to take his problem to one of the industrial research laboratories already established for the purpose of serving those who cannot afford a laboratory of their own. There are now under consideration many plans for the establishment of industrial laboratories to serve concerns which cannot afford laboratories of their own, and in some cases the possible relation of these laboratories to our technical and engineering schools is being earnestly studied.

But until the manufacturers themselves are aroused to the necessity of action in the matter of industrial research, no plan can be devised that will result in the general establishment of research laboratories for the industries.

In the present state of the world's development there is nothing which can do more to advance American industries than the adoption by our manufacturers generally of industrial research conducted on scientific principles. In the minds of many there is confusion between industrial scientific research and purely scientific research, particularly as the industrial research involves the use of advanced scientific methods and calls for the highest degree of scientific attainment. The distinction lies not in the subject-matter of the research but in the motive. Industrial research is always conducted with the purpose of accomplishing some utilitarian end. Pure scientific research is conducted with a philosophical purpose for the discovery of truth and for the advancement of the boundaries of human knowledge. At the same time, while a single discovery in pure science, when considered with reference to any particular branch of industry may not appear to be of appreciable benefit, yet when interpreted by the industrial scientist, with whom may be classed the engineer and the industrial chemist, and when adapted to practical uses by them, the contributions of pure science as a whole become of incalculable value to all the industries.

But who is to support the researches of the pure scientist, to furnish the laboratories and the funds for apparatus, travelling and foreign study? It has been suggested that perhaps the theatre of scientific research might be shifted from the university to the great industrial laboratories which have already grown up, or to the even greater ones which the future is bound to bring forth. The speaker does not agree with this. Organizations and institutions of all kinds engaged in pure scientific research should receive every encouragement, but the natural home of pure science and of pure scientific research is to be found in the universities, from which it cannot pass. Instead of abdicating in their favor, our universities, stimulated by the wonderful achievements of these industrial laboratories, should find a way to advance the conduct of their own pure scientific research.

The universities, however, are not money-making institutions. Well, there is much that can be done without money. The most important and most fundamental factor in scientific research is the mind of a man suitably endowed by nature, and responsible university authorities should apply their judgment so that when the man with the required mental attributes does appear he may be appreciated as early in his career as possible.

While, however, there are many things and most important things which the universities can do to aid pure science without the employment of large sums of money, there are, nevertheless, a great many things required in the conduct of pure scientific research which can be done only with the aid of money, and the first of these is to provide a master scientist, when he does appear, with all the resources and facilities and assistance, so as to afford a full freedom of development to the range of his genius.

Workers in pure science should be located not only in our great universities, but also at our technical schools, where the influence of a discoverer in science would serve as a balance to the practical curriculum and familiarize the student with the high ideals of the pure scientist and with his rigorous methods of investigation.

The engineering student should be taught to appreciate the ultimate great practical importance of the results of pure scientific investigation and to realize that pure science furnishes to engineering the raw material, so to speak, which must be worked into useful forms. A better understanding is required of the relation between the pure scientist and the applied scientist, and this understanding would be greatly helped by a closer association between the pure scientist and the student in the technical schools.

*Presidential address delivered before the American Institute of Electrical Engineers.

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In last week's issue reference was made to a producer gas plant built by the Nordberg Mfg. Co. for the Canadian Mining & Finance Co. at Gillies Lake, Ont. The item should have referred to this plant as a compressor plant instead of a producer gas plant. It contains two Nordberg compressors and one Fraser & Chalmers compressor, all three machines direct connected to electric motors.