hunting licenses find in their close association with the outdoors an esthetic value far above any monetary value they derive.

In times of international stress, the wild-life resources of the state become of increased value as a means of taking its citizens into the open and of preserving their mental balance and their collective sanity. In times of national emergency, the food resources of a country are its first line of defense. Protection of its agricultural crops from the ravages of insects and diseases is a primary objective in any effective defense program.

THE RESEARCH LABORATORY OF THE GENERAL ELECTRIC COMPANY[1]

By Dr. WILLIAM D. COOLIDGE
VICE-PRESIDENT OF THE COMPANY AND DIRECTOR OF THE LABORATORY

THE significance of our laboratory's work, in its three aspects—to our company, to the world of science and to industry—has been discussed by Mr. Wilson, Dr. Compton and Mr. Ferguson, respectively. They have been most generous in awarding us credit on all three counts, and those of us here, who are working, or have worked in the laboratory, have been heart-warmed and thrilled by their exceedingly kindly appreciation. We know each of them well enough to know his complete sincerity, so we accept their praise at its full value and acknowledge it with deeply sincere gratitude. Their mere presence here would be, were it needed, complete proof of their interest in our work, for, even in these busy and anxious days, it would be hard to select three men who are carrying heavier burdens and responsibilities than are, each in his own field, these three. For their taking time to come to this birthday party and for their most kindly contributions to it, we return our heartiest thanks.

We offer our thanks also to the civic leaders of cities where our plants are located, to the science editors and other representatives of the press, to the educational and industrial leaders of our own city and to our many friends in the General Electric Company who have graced this celebration by their welcome presence.

For me to add anything to what the preceding speakers have said about the laboratory's work would be in the nature of an anti-climax, but, since they have spoken, as it were, from the outside looking in, so perhaps I may say a few words from the inside looking out, in regard to the relations of the laboratory to science and industry, or rather perhaps on the aspect of the laboratory as a catalyzing agent which has helped to bring about a momentous reaction between the two.

Forty years ago the attitude of science toward industry was mostly one of aloofness, frequently tinged with contempt, while industry for the most part ignored the existence of science. To-day we find some 50,000 scientists contentedly domesticated in the 2,000 industrial research laboratories of this country, while industry, with considerable assiduity and often with generosity, caters to their peculiar needs.

In bringing about this startling change in four decades, I believe our laboratory, as a pioneer in industrial research, has been a contributing factor.

I think the hesitation which was manifested by both Dr. Whitney and myself on embarking on industrial research was symptomatic of the general attitude of scientific men. That hesitation in my case was caused not at all by any such feeling as was then entertained by many scientists that science would be soiled by close industrial contacts, but simply by my doubt that industry could present such fascinating problems as lay before me at M. I. T., or problems which would offer equal opportunity for worth-while work. The same was true with Dr. Whitney, I am sure. Indeed he had already made an application of his experimental work to profitable industrial ends. But he too evidently doubted if industry could offer enough problems of interest to occupy his full time to advantage, for he at first arranged to divide his time between Schenectady and Boston. It was not many months, however, before he realized that in the General Electric Company were enough interesting problems to keep himself and a growing staff of assistants busy for a lifetime and more, so he ended his connections with M. I. T. and devoted all his energies thereafter to building up the Research Laboratory here.

My own experience was similar. I was persuaded by Dr. Whitney to join him only by his invitation to bring with me the apparatus with which I was then working at M. I. T. and his assurance that I would be given all the time to devote to it that I desired. But I too soon found more engrossing problems here, so I shipped my apparatus back to Boston, leaving further experiments with it to other hands.

It was not long before the results of our laboratory's work began to appear in the products of the company, in new materials, more efficient processes and new devices, some of them opening up wholly new fields for electrical development. Other pioneer laboratories in their different fields were similarly demonstrating the utility of research in industrial problems,

[1] Address given on December 17 at a dinner on the occasion of the celebration of the fortieth anniversary of the founding of the laboratory.

and as papers were read at meetings of the scientific societies, presenting the problems that had been met, their solutions through applied research and the value of the outcome to the public, scientists in general came to realize that there was a tremendously worth-while job for science to do in promoting the nation's industrial progress.

At the same time, I think, the supercilious aversion on the part of some scientists to industrial contacts faded out. It was at one time a very real thing. Hardly a quarter century ago, thirteen or fourteen years after our laboratory was started, there was another General Electric laboratory in another city which was headed by a scientist obsessed with that aversion in extreme form. His laboratory had accumulated some data which might be helpful in a development of ours, so a letter was written asking for them. His reply was that he feared we contemplated making use of those data in some commercial development, and in that case he would be unwilling to give them to us. I don't know whether he had time to change his attitude toward commercialism, for his association with industry was rather brief.

If there is a scientist to-day who regards industry as barren of interesting problems or contaminating in its contacts, he must be a rare bird, for I do not know one of his species.

Meanwhile industry's attitude to science has been undergoing a change equally profound. During the first fifteen years of our laboratory's existence, the relatively few companies maintaining research laboratories were accumulating proof of their value, but it took the experience of the last war to bring home to American industry what industrial research really means. When the British fleet took its strangle-hold on German commerce, our industries were forced to realize how dependent they had become on the output of German laboratories. Dyes, anesthetics and other essential drugs, optical glass, chemical reagents, magnesium metal and powder and many special alloys were no longer obtainable. American research mobilized to supply the lacks, and, when the United States entered the war, made very important contributions to the national defense. Had it not been for the few industrial research laboratories then in existence, and the university scientists who volunteered or were drafted for the emergency, American industry would have been in worse straits and our Army and Navy would have lacked some of their most effective defense facilities.

While the lessons of the war were fresh in the American mind, the National Research Council undertook to drive home the implications of those lessons, to make industry research-conscious, and to advise in the organization of research, both by the larger individual companies and by industries when the companies composing them were small.

In consequence there are now nearly two thousand industrial research laboratories, and organized research has come to be accepted by industry as an essential activity, as necessary for progress and prosperity as financial control and accounting.

A comparison of conditions to-day with those of forty years ago reveals a change which is fairly revolutionary. The leaders in the revolution were those companies which pioneered in research. But their leadership would have been ineffective, if they had not been able to demonstrate to science and industry alike that industrial research could be a plentiful source of both scientific and industrial progress. The creation of the research era of American industry required more than the fiat—let there be industrial research. Laboratories had to be so organized and directed that the scientist would find in them opportunity for the full exercise of all his ability, and problems calculated to arouse his enthusiasm and inspire his best efforts, while at the same time the industrialists must be able to derive from them products which would increase business and profits. To accomplish such a fusion of the scientific spirit with the profit motive, to inspire enthusiastic team-work within the laboratory, while knitting the laboratory's work, through full cooperative effort, into the company's organization with its diverse activities of engineering, manufacture and sales, required leadership of a new and different kind. The success of an industrial research laboratory in its early years depends almost wholly on the quality of its leadership.

Those of us who have been long in the laboratory and can remember the difficulties under which we often labored in its early years, the frequent failures and disappointments, remember also the sympathetic encouragement, the infectious enthusiasm, the resourceful suggestions and the unflagging assistance we derived from our leader.

And so to-night, thrilled as we have been by the kindly tributes to our laboratory and its achievements, we realize with gratitude and affection how much of the credit should go to our laboratory's founder and builder, Dr. Whitney.

OBITUARY

RAYMOND PEARL

RAYMOND PEARL possessed, to an exceptionl degree, knowledge, originality and an intellectual drive which were a stimulus to all who had contact, either directly or indirectly, with the products of his mind. A pioneer in the application of quantitative methods in