shown to circulate in the blood and lymph up to the time of the death of an animal is indeed surprising when we recall the unanimous opinion of other workers in this field that the toxin is rapidly, and, to a very considerable degree, detoxified or bound by the animal tissues.

It will be seen from the above account of our investigations that my associates and I have come to the conclusion that the theory of carriage of tetanus toxin to the central nervous system by way of the peripheral nerves is no longer tenable. In so far as this poison reaches the central nervous system it can do so only by being brought to it by the arterial blood. The various aspects of the disease have been the subject of intensive investigation by clinicians, bacteriologists, immunologists, physiologists and pharmacologists during the past fifty years. A great body of frequently conflicting facts has been brought to light, but there is little agreement in respect to their explanation. Four different theories have been proposed to explain local tetanus and four more have been devised to show the pathways by which the toxin reaches the central nervous system. We have discussed three of the second quartet as variants of the neural transport theory. The fourth, which receives our hearty support, states that the toxin can reach the central nervous system only by way of the blood stream. In regard to the exact nature of the poison or poisons concerned, their possible alteration in the animal body and the manner in which they induce the formation of an anti-body, we are without definite knowledge. All these questions are of great significance and have an important bearing on the mode of action of bacterial toxins as a class. It will no doubt require the united efforts of many investigators for many years to find an adequate solution of these and other fundamental problems of this disease. We are continuing our work in the hope of throwing some light on one or another of these difficult questions.

ORGANIZED INDUSTRIAL RESEARCH[1]

By Dr. W. D. COOLIDGE

DIRECTOR OF RESEARCH LABORATORY, GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

THIRTY years ago an industrial research laboratory was still a novelty. Professor Elihu Thomson, Mr. Edison and Dr. Steinmetz had made many of their great individual contributions, and it was because of the traditions built up by them that Dr. E. W. Rice, then technical director of the company, had decided to embark on the new experiment—*organized* industrial research. The value of science to industry had not yet come to be generally recognized, nor had industry yet convinced science that a union of the two could be anything but a misalliance. Many scientists in that day felt, and some openly proclaimed, that to apply to industrial problems scientific brains and scientific methods was to debase them.

Let me say as emphatically as I can that I yield to none in my appreciation and admiration of those scientists who, in academic surroundings, with little thought of financial reward but with a passion for knowledge and an eye single to the truth, are pushing their researches even farther into the unknown, and broadening and deepening the foundation of science on which our civilization rests. For our civilization is an engineering civilization which could endure scarcely a day if all the products of engineering were suddenly swept away, and it is science which serves as the basis of engineering. So the most cloistered scientist, however remote from the marts of trade and however innocent of the least thought tinged with utilitarianism, is perhaps, all unknown to him, preparing the way for some new appliance for the service of mankind, some appliance perhaps that will bring new industries into being. When Professor J. J. Thomson, in his university laboratory, by a beautiful experiment first determined the charge of the electron, he certainly had no thought of any interest but that of pure science, of extending our insight into the fundamentals of things. He surely did not foresee the great new industry of radio broadcasting which was to bring employment to tens of thousands and entertainment and instruction to millions. But Professor Thomson's work helped to lay the foundations of that industry, just as truly as did the other beautiful experiments and keen analysis of Langmuir, when in our own laboratory, he discovered the space charge effect, the effect produced in vacuum by those very charges which Professor Thomson had measured, the effect which, when understood, made possible for the first time the design of high power vacuum tubes suitable for radio broadcasting.

And I venture to say this—and this is the point to which I have wished to lead—that Langmuir in his work, like Professor Thomson, was absorbed wholly in the pursuit of truth, and the attainment of new, fundamental facts was for him an all-sufficient goal.

[1] An address given at a meeting of the American Institute of the City of New York on February 1, 1934, when a gold medal was presented by the institute to the General Electric Company "for pioneering in industrial research."

It was sufficient goal for our laboratory, too. That was the first source of my pride in our company—that in our laboratory, under the directorship of Dr. Whitney, fully supported by the authority of Dr. Rice—research in pure science was not only permitted but encouraged, with no demand for immediate practical results. The criterion for such work was not whether it promised direct financial returns, but whether it was likely to be productive of new facts to broaden the base of the scientific knowledge on which our industry rests.

To-day, industrial research has repeatedly and amply proved its financial value, so that the research laboratory has become a practically indispensable part of any large manufacturing organization; but, in retrospect, it seems to me that the recognition more than thirty years ago of the potential ultimate value, to an industry, of research in pure science showed extraordinary clearness and depth of vision.

From the beginning, along with our work on the various practical problems arising from engineering and manufacture, we have carried on much work in pure science—in physics, in chemistry, in metallurgy and in mechanics; we have been free to publish our results and have been encouraged to do so; we have had the satisfaction of knowing that we were making real contributions to the sum total of fundamental scientific knowledge and were gaining the respect and confidence of fellow scientists in academic circles. That such conditions have always prevailed in our company is, I think, ground for pride in our laboratory.

And later I discovered another source of pride. I can best illustrate it by an example. In the early days of our laboratory we made a series of discoveries—first on the metallization of carbon, then on the metallurgy of tungsten, and, finally, on the heat conductivity of gases and on the effect of gas pressure on the vaporization of tungsten—which enabled the General Electric Company to play a major rôle in increasing the efficiency of incandescent lighting to more than six times what it was when our laboratory was first started. For this our laboratory claims by no means all the credit. Much is due to the engineers and factory men, for the development of improved designs, new factory processes and marvelously efficient automatic machines. (This is why the presentation of a medal to a company rather than to an individual seems fitting.) As a result of this conjoint effort, the cost to the public of electric light has been reduced to a small fraction of what it was thirty years ago, for the benefit of each improvement has been promptly passed on to the public in the form of better and more efficient lamps at a price representing only a fair profit. Thus, for each dollar of profit the company has made on its lamps, the public has enjoyed savings amounting to hundreds of dollars—as can easily be shown by figures.

Many similar examples could be given. I soon realized that while employment in the Research Laboratory of the General Electric Company placed a worker in science at no disadvantage as compared with his academic confrères (in respect to freedom to pursue new knowledge), it gave him the advantage arising from satisfaction in seeing his scientific discoveries promptly and effectively applied, not only for advancing the industry, but also truly serving the public.

So to-day we see the results of past researches in metastable atoms and plasmas being progressively embodied in new and more efficient lamps having sodium vapor as the illuminant, just as in the past our investigation of heat conduction and tungsten evaporation in gases gave us the gas-filled incandescent lamp; we see our studies of cold cathode effects (field currents) in high vacuum leading to higher voltage tubes for x-ray production and other purposes; researches in surface chemistry have given us better photoelectric tubes and perhaps are about to give us better lubrication; studies in mechanical balancing has given us better and quieter rotating machines; and from fundamental studies in chemistry are coming new and better synthetic resins.

Sometimes a new fact remains long sterile until the stimulus comes which vitalizes it to produce some new practical result. For instance, our observation of the dissociation of hydrogen in contact with a hot tungsten filament was made nearly ten years before another observation, at the Johns Hopkins University, suggested the utilization of our phenomenon in a new form of welding, now known as the atomic hydrogen welding process.

Investigation often reveals relationships between phenomena in seemingly widely separated fields. For instance, who but the scientist would ever have suspected the close relationship now known to exist between the structure of oil films on water and that of the electron-emitting surface of the highly efficient thoriated filament of radio tubes?

So, along with our work on diverse practical problems, we are vigorously continuing researches in fundamentals—in electronics, in magnetics, in high pressure electrical discharge phenomena, in metallurgy and in mechanics. Even through the most severe part of the depression, although all activities were somewhat curtailed, our researches in pure science were permitted to continue with only slight diminution. We continue in full faith, based on past experience, that each new fact will sooner or later find its useful application, if not in the field of interest of the General Electric Company, then somewhere else. Our investigations of high frequency fields have already been of value to the medical profession. Our studies of the effect of x-rays on plants may yet be of assistance in horticulture or agriculture.

It is true that the field of interest of the General Electric Company is so broad that the chance that a new fact will find application in that field is good, and our company for that reason is more likely to benefit directly from research in pure science than would a company occupying a narrower field. But that is only a matter of degree, and, to my mind, detracts not at all from the credit due to the vision that foresaw the potential value of broad industrial research and to the courage that assumed the risks of pioneering.

While our laboratory, as I have said, was organized definitely for the purpose of industrial research and has always been known as the Research Laboratory of the company, it has had, by no means, a monopoly of the research work of the company. Important and fruitful researches have been conducted in the Thomson Laboratory at Lynn and in several of our so-called works laboratories, as well as in the lamp laboratories at Cleveland and the General Engineering Laboratory at Schenectady. Therefore, in speaking of the company's research, the contributions of all these laboratories must be included.

I have thus far spoken only of those company policies which have most directly concerned our laboratory, but I feel pride in our company on other grounds.

Mr. Owen D. Young has often spoken of the threefold obligation of a manufacturing corporation—to its customers, to its stockholders and to its employees—giving to its customers a product of high quality and reliability at a fair price; to its stockholders an adequate and assured return on their investments, and to its employes safe, pleasant and healthful working conditions, fair wages, assured employment and assistance in safeguarding themselves against the disabilities of injury, sickness and old age. I know of no company that has striven more earnestly than ours to fulfil those duties scrupulously. Other companies also have made a fine record in quality of product and in continuity of dividends, but in connection with the third duty—that of human relations—I feel that our company has again pioneered and deserves special credit. Under the leadership of Mr. Swope and Mr. Young, great effort has been made to improve working conditions, to pay as high wages as competition would permit, and to insure, as far as a single corporation could, continuity of employment. Equal effort has been made to provide (with assistance to self-help rather than through paternalism) relief against unemployment and retirement from either disability or old age, through unemployment relief and pension funds, built up by contributions from employe and company alike on a dollar for dollar basis. And employes have been encouraged and assisted to own their own homes and to make safe and profitable investments.

It is therefore both with a keen sense of the signal honor conferred, and with a reassuring conviction that the honor is fairly merited, that I gladly and gratefully accept, in behalf of the General Electric Company, this gracious award by the American Institute.

OBITUARY

MEMORIAL TO THE LATE THOMAS WILLIAM SALMON

A BAS-RELIEF portrait of the late Dr. Thomas William Salmon, first medical director of the National Committee for Mental Hygiene, was presented to the New York Psychiatric Institute and Hospital, Columbia-Presbyterian Medical Center, by the Thomas William Salmon Memorial Committee on the afternoon of January 26.

The presentation was made by Dr. William L. Russell, professor of psychiatry at Cornell University Medical School, for the Salmon Memorial Committee, and the tablet was accepted by Dr. Frederick W. Parsons, commissioner of the State Department of Mental Hygiene. Dr. William Darrach, dean emeritus of the Columbia University School of Medicine, delivered the memorial address. Dr. Clarence O. Cheney, director of the institute, presided. After the ceremony an informal tea was given at the institute in honor of Mrs. Salmon.

The tablet, executed by Charles Keck, of New York City, represents a figure of Dr. Salmon in profile, with the following inscription:

Professor of Psychiatry Columbia University 1921–1927
Beloved Physician Teacher Mental Hygiene Leader Whose
Vision Guided the State and the University in Placing
Here This Psychiatric Institute and Hospital

Dr. Salmon, who died on August 13, 1927, was professor of psychiatry in the Columbia School of Medicine and first proposed the cooperation of New York State with Columbia University and the Presbyterian Hospital in establishing a State Psychiatric Institute and Hospital as part of the Columbia-Presbyterian Medical Center. It is particularly in recognition of this service that the presentation of a memorial tablet to the New York State Psychiatric Institute and Hospital is being made.

Following Dr. Salmon's death, his friends and former associates organized and incorporated the