which had prevailed when paucity of information and tenacity of individual opinion retarded progress.

Nevertheless, the science was very weak in theory. Chamberlin when asked on one occasion what occupied his thought replied in miner's phrase: "Prospecting old drifts to see what, if anything, of value is left in them." He referred specifically to the Laplacian hypothesis of the genesis of the solar system (which he and Moulton proved fallacious) and its consequences in geology, the once molten, cooling globe; the once steaming, now congenial atmosphere, the once potent, now dying earth. These ideas had become suspect. Advanced students entertained the thought that the planet was much older than had been estimated, that its vast energies were still very effective, and that the changes they had wrought in its crust during the later geological periods were so great that they could not have been worked by gravity and residual heat. Yet no other forces were known and the framing of new hypotheses to replace the old proceeded doubtfully. In this day, 1942, it is known that those doubts were fully justified; however, thanks to Madame Curie the inexhaustible energies of the atoms of the globe, that is to say the energies of its entire mass, are potentially available to geological speculation. It is no longer a question of power, but one of its distribution and of the mechanisms through which heat, gravity and atomic forces work.

PHYSICS IN INDUSTRY[1]

By Dr. E. U. CONDON

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TO-DAY the nation's industries are working together as never before to do their part in the battle for freedom. It is fitting at such a time that we look over that part of civilized life for whose cultivation we as physicists are responsible, that we try to see how our science has been developing and in what direction we may cause it to grow in the future. We want to see clearly the job ahead so we can set about doing it earnestly and cheerfully; for we believe that, with effort, we can determine the future in peace as in war.

Although we can trace contributions to physics in America as far back as, say, Benjamin Franklin and his kite, the reasonably wide-spread organized research in physics that is now such an important feature of American academic and industrial life is a product of the last twenty-five years. Our professional group, the American Physical Society, is not yet fifty years old. For the first twenty years or so of its existence, very little was reported by its members which has affected the later development of our science in a basic way. The period was one of thoroughly sound beginnings marked by a few really outstanding contributions: Rowland discovered the magnetic effect of moving electric charge, and he perfected the diffraction grating for spectroscopy. Hall discovered the Hall effect, which is to-day a valuable tool in studying electrical conduction in metals and crystals. Michelson and Morley discovered the phenomena which laid the groundwork for the theory of relativity. Somewhat later Millikan measured the charge on the electron and the Planck constant.

It was a period in which very few of our physicists had the opportunity to contribute much to the advancement of science. Most of them were concerned with teaching, and the great industrial laboratories as we know them to-day simply did not exist.

A great change set in just after the first World War, although it is hard to see that that had much to do with it directly. Indirectly it did, for war acts as a stimulus to cooperative effort. The National Research Council was organized and soon after the war the Rockefeller Foundation established the National Research Council fellowships in physics, chemistry and mathematics. By this means some fifty young doctors of philosophy were each year enabled to continue their development as research men to such a degree of self-reliance that most of them could shoulder other burdens without losing their ability to carry on in research. I believe that these fellowships alone, supported at a cost that was absolutely trifling, have done more for the development of American research science than any other single thing. The fellowships reacted not only on the fellows but on the institutions and the faculties at the universities where the fellows worked.

In the 1920's research in fundamental physics expanded by leaps and bounds. The momentum carried by x-ray quanta was demonstrated by Arthur Compton. Davisson and Germer discovered electron diffraction; investigation of cosmic rays was inaugurated; atomic and molecular spectra were analyzed; and a group of young American theoretical physicists participated vigorously in the development of quantum mechanics.

It was also a period of rapid expansion of industrial physics in the electronic industries. From the birth

[1] Essential substance of an address delivered at the opening of the Charles Benedict Stuart Laboratory of Applied Physics, Purdue University.

of radio broadcasting in Pittsburgh in 1920 there was steady progress in the development of useful applications for phenomena associated with electric discharge in gases. The applied science of electronics was born to serve as a strong bond between physics and electrical engineering.

However, it was rather characteristic of that period that industry and physics were not closely associated. Academic physicists were a little inclined to be mistrustful of industry. In some vague way it was felt by many that the interests of engineering and of physics were best served by keeping them far apart after the engineering student had finished his sophomore course in general physics! Many a bright young man, turned physics instructor, felt he was casting pearls before swine when he had to expound the beauties of his subject to the sophomore engineers. Oddly enough, the engineering students could detect this air of condescension in their physics instructors and did not react to it with humility. I am often surprised at the vehemence with which leading engineers whom I meet will denounce the physicists who taught them in college. It was a most unhealthy situation. Happily it is now almost completely changed.

Then came the 1930's, largely a shameful decade in which people lived in insecurity, with much unemployment, little hope of professional advancement and in which there was a totally inadequate development of our natural resources in scientific talent and inventiveness. Like fools we watched while our present enemies bent every effort toward the mobilization of their universities and their industries to prepare the means that would crush us as a free people. In 1934 when Hitler started to rearm, many of our physicists were unemployed, and our young people could see little opportunity for a career in science. By 1936 the armament program had progressed so far in Germany as to require speed-up in the universities, such as we now have, in an attempt to supply the vast numbers of technical men which modern warfare requires. But we slept on, seeing in this not a marvelously coordinated effort to conquer us, but simply viewing it as a distant anti-intellectual attack on their universities. As late as 1940, even in 1941, there were those who argued against taking steps to resist these murderers of Lidice—because to do so would call for disturbing our way of life, and upsetting the calm, detached pursuit of knowledge in our universities!

On top of all this blindness to the international scene, we had to hear attacks on the scientific method as anti-social. Economic and social ills of society culminating in the depression were somehow blamed on science—as if all our troubles arose from too much of that calm analysis of carefully checked observations that is characteristic of scientific method! Somehow it just couldn't be admitted that there were some unsolved problems in applied social science. Somehow the fault lay with the physicists, for having taught us too well to understand the forms of matter and energy and how to use this knowledge to improve man's physical conditions of life.

Silly as such talk sounds now, it had quite a following in the 1930's. Support of scientific research was unduly curtailed except toward the very end of the decade. This situation might have been much worse if it were not for the fact that those physicists who had jobs, in spite of depression conditions, were having such a gloriously good time.

Heavy hydrogen was discovered, the neutron, the positron, artificial disintegration of the elements, artificial radioactivity, isotopic masses were measured with precision, new means for producing high voltage were developed, and finally there came the application of the new knowledge, while not yet five years old, to give medicine and biochemistry new tools of investigation that were soon to make vast changes in their approach to basic problems. With all this going on, is it any wonder that physicists did not find time even to answer the charge that they were responsible for the depression!

To be sure, some of them would have felt better to have had decent jobs; others would have liked, or at least their wives wished for, a little raise. And lots of fine young minds who would be most welcome in the profession to-day looked elsewhere for work, seeing how limited were the opportunities in science.

But the outlook was not entirely as dark as I have painted it. Toward the end of the 1930's there developed in America a new realization of the fruitfulness of bringing the newest results of physics into industry. Industrial research, already strongly established in the chemical field, began to expand in the direction of applied physics. The more progressive engineering schools established courses in applied physics. More physicists began to find their places in industry. Physicists began to see that their science, far from being restricted or polluted by an association with technical processes, could derive a new stimulus and a new significance that it could never possess so long as it was the private intellectual pursuit of a cloistered few.

For a time it looked as if there might be a separatist's movement whereby the industrial physicists would have professional societies of their own and would have little to do with the academic or "pure" physicists. Fortunately all such tendencies have been eliminated.

This war has completed the job of bringing all American physicists to a clear understanding of how much their science can contribute to the welfare of the people. At the moment their energies are devoted to applying their knowledge to winning the victory with a minimum of human suffering and material waste. Many university men are learning for the first time that there is a thrill and a deep satisfaction not only in discovering a new principle in science, but also in putting principles into application in new ways. When this war is over they will not forget this experience. Returning to the pure science laboratories in the universities they will have a sympathetic understanding of the problems of industry which will broaden and enrich the relationships of physics and engineering. I think they will even be more friendly and more tolerant of the sophomore engineers.

We must resolve not to neglect the cultivation of the basic science which we hope some day to apply. More and more, industry in America is recognizing the debt it owes to fundamental science—a debt it can hope to repay by fostering more basic research in its own research laboratories and by working in close cooperation with the universities.

I feel sure that those who are entrusted with furthering scientific research at colleges see this problem of applied physics in all its broad implications. They recognize, as we do in industry, that all physics is applied physics—so-called pure physics being simply that part whose application is to satisfy the curiosity of the physicists.

SCIENTIFIC EVENTS

RECENT DEATHS

DR. JACOB GOULD SCHURMAN, formerly professor of philosophy and president of Cornell University, later Ambassador to Germany, died on August 12, at the age of eighty-eight years.

MILTON THEODORE THOMPSON, retired civil and electrical engineer, who had assisted in the construction of some of the largest power dams, died on August 9. He was seventy-two years old.

DR. MARTIN EZRA KLECKNER, professor emeritus of chemistry and geology in Heidelberg College, died on July 13, at the age of eighty-one years. He had been connected with the college since 1886 when he was appointed an assistant.

ADDISON L. GREEN, since 1926 chairman of the board of trustees of the American School of Prehistoric Research, Yale University, died on June 24.

ARTHUR LAIDLAW SELBY, until 1926 when he retired with the title of emeritus professor of physics of University College, Cardiff, died on July 22, at the age of eighty-one years.

THE NUTRITION FOUNDATION

IT is announced by George A. Sloan, president of the Nutrition Foundation, that at a meeting of the executive committee held on August 12, there had been received new subscriptions amounting to $75,000 from six new member organizations. These, with subscriptions previously announced, bring the fund for the support of nutrition research to the sum of $923,500.

At the same time, Dr. Charles Glen King, scientific director of the foundation, announced the founding of *Nutrition Reviews,* a monthly journal of interpreted progress in the science of nutrition. Its purpose, he explained, is "to bridge the gap between basic research findings and their acceptance with confidence, on the part of those who deal with the public, to enable them to keep abreast of current progress and to have available an unbiased, authoritative review of current research literature."

Dr. Fredrick J. Stare, assistant professor of nutrition and biochemistry at Harvard University, was named editor of the new publication. It will be supervised by an editorial committee representing nutrition research and medicine. Members of the editorial advisory committee are:

Reginald M. Atwater, American Public Health Association.
Samuel W. Clausen, University of Rochester.
George R. Cowgill, Yale University.
Conrad A. Elvehjem, University of Wisconsin.
J. Murray Luck, Stanford University.
James S. McLester, University of Alabama.
Henry C. Sherman, Columbia University.
Russell M. Wilder, University of Minnesota.
John B. Youmans, Vanderbilt University.

The following assistant editors have been appointed:

Esther Batchelder, Bureau of Home Economics, Washington, D. C.
Franklin C. Bing, Council on Foods and Nutrition, American Medical Association.
R. Adams Dutcher, Pennsylvania State College.
Robert S. Goodhart, Nutrition Division, Office of Defense, Health and Welfare.
Carl V. Moore, Washington University.
Elmer J. Stotz, Harvard University.

A patent policy, adopted on the recommendation of Dr. Karl T. Compton, chairman of the board, provides for making research findings available to industry with full protection of the public's interest. Mr. Sloan's statement of the patent policy of the foundation follows:

If patentable inventions should be made in the course of research work supported by the Nutrition Foundation,