theory a wave of length much greater than the water depth would travel with a velocity c, determined by the relationship $c = \sqrt{gh}$, where g is the acceleration due to gravity and h is the depth of water. According to this formula a depth of 288 ft is required for a wave velocity of 66 mi/hr. Such a depth exists for a relatively long fetch almost exactly in the direction of squall movement between 240- and 300-ft depth contours. Also indicated in Fig. 1 are velocity contours for free gravity waves described by the $\sqrt{gh}$ law. The approximate area of generation is indicated by crosshatching. Since the wave was moving in an area of variable water depth, refraction effects introduced a deflection of the wave path toward shallower water, producing paths approximately like those shown by the heavy arrows, which indicate the incidence of the wave on the east coast and its reflection to the west coast.

The times of occurrence of the various events are compatible with this explanation. Eighty minutes for transit of the reflected wave from the vicinity of Michigan City to the Chicago shore exceeds the transit time of the squall and the associated direct wave westward across the lake, because the reflected wave was traveling in shallower water.

The uniqueness of this pressure-jump lies in its abnormally high velocity of propagation. The amplitude of the jump was not abnormal and was fairly typical of those that occur about 20 times per year in this vicinity.

Several points are suggested by the theory now proposed.

1) If our thesis is confirmed, several hours' advance warning may be possible on the basis of the position and unique velocity of a squall line such as this one.

2) A study based upon the explanation given here together with a history of the occurrence of similar waves in this and other parts of the Great Lakes, could facilitate the forecasting of future occurrences.

3) These results can be applied to continental shelf areas and would probably be of practical value in the North Sea, the Gulf of Mexico, and similar areas.

References and Notes

1. Lamont Geological Observatory Contribution No. 123. This study would have been impossible without the generous cooperation of the U.S. Weather Bureau and the Beach Erosion Board. The opinions expressed are our own.
2. P. Unna, "Thames floods," *Nature* **121**, 942 (1928).
3. J. Proudman, *Dynamical Oceanography* (Wiley, New York, 1953), pp. 295–300.
4. F. Press and M. Ewing, *J. Appl. Phys.* **22**, 892 (1951).
5. ———, *Geophys.* **16**, 416 (1951).

Saul Dushman, Unofficial "Dean of Men" of the General Electric Research Laboratory

THE death of Saul Dushman on 7 July ended a very unusual career. He was one of the most valuable and highly regarded scientists in the General Electric Research Laboratory. Yet he was not a prolific discoverer or inventor—he is credited with eight patents during his 40 years of service. Neither was he an outstanding pioneer in theoretical research, although he was a brilliant analyst and student of science, and his many publications show a remarkable grasp of fundamentals in both physics and chemistry. These publications were of such merit that they earned him a world-wide reputation.

But his greatest contributions, and those most valued in the Research Laboratory, were human ones, the dynamic influence of a sterling character, dedicated to the service of science and of his fellow men.

Dr. Dushman was born in Rostov, Russia, on 12 July 1883. When he was 9 years old his family migrated from West Russia (now Poland) to Canada, and settled in Toronto. Here he attended public schools, graduating from high school with the highest scholastic record ever achieved in the province of Ontario. This won him the Prince of Wales scholarship at the University of Toronto where he graduated in 1904 with an A.B. degree. After several years as lecturer and demonstrator, he received his Ph.D. in physical chemistry in 1912, and later in that year he joined the staff of the General Electric Research Laboratory.

Dr. Dushhman was married in 1907 to Amelia Gurofsky, who died in 1912, leaving a daughter, Beulah, now in government service in Washington, D.C. In 1914 he married Anna Leff, who survives him.

Upon his arrival at the Research Laboratory, Dr. Dushman was invited by Irving Langmuir to join in the study of electron emission and other high-vacuum problems. He continued to work in this field for most of his life, and he made many valuable contributions. It was this research that laid the foundation for the publications for which he is best known.

Perhaps it was his experience as a lecturer that led Dr. Dushman, early in his career, to undertake the task of correlating and interpreting new science in a series of publications. Two qualities made him well fitted for this task. The first was the ability to read and digest scientific literature with great rapidity. He became a compendium of information, to whom his colleagues in the laboratory often turned for help on a wide range of subjects.

The titles of a few of his early papers published in the *General Electric Review* will show the breadth of his interests:

Modern theories of light (1914)
Recent views on matter and energy (1914)
The absolute zero (1915)

A new device for rectifying high-tension alternating currents (his own work) (1915)
The periodic law (1915)
The kinetic theory of gases (1915)
Theories of magnetism (1916)
Structure of the atom (1917)

The second qualification that fitted him for the task of scientific interpreter was an unusual faculty for expressing things clearly in simple language.

His first book, *Production and Measurement of High Vacuum* (*General Electric Review,* 1922), was written primarily for his fellow workers in the field of electron emission. Beginning with a review of the kinetic theory of gases as a basis, and comprising all the up-to-date vacuum experience of the General Electric Research Laboratory, it became a standard reference on this subject for many years.

The next two books were written for chemists. Being trained as a chemist, he always had their interests at heart, although his own work was chiefly in the realm of physics. His expressed purpose in writing these books was to make new physical science available to chemists in a form that they could read without elaborate background. These books were *Quantum Theory and Atomic Structure* (incorporated in Hugh Taylor's *Treatise on Physical Chemistry,* 1931) and *Elements of Quantum Mechanics* (Wiley, 1938).

Dr. Dushman's next and most important work, which earned him a world-wide reputation, was *Scientific Foundations of Vacuum Technique* (Wiley, 1949), which was published the year after his retirement. It is a comprehensive survey of all phases of achieving, maintaining, and measuring low gas pressures, and is the epitome of his long and rich experience in this field. It soon became, and still continues to be, the standard "bible" on this subject. He was engaged in writing a second volume of this work when he was stricken with his final illness.

His last book, published in 1951, entitled *Fundamentals of Atomic Physics,* is designed as a textbook, and it is described by him in the following language:

> In 1945 the General Electric Company established annual awards of fifty General Electric fellowships to be granted to high-school teachers of science throughout the northeastern states for the purpose of enlarging each fellow's grasp of new developments in the physical sciences. Courses in physics and chemistry were to be given during a six-weeks period in the summer at Union College, Schenectady, New York, by members of the college faculty, assisted by members of the General Electric Research Laboratory. From the very beginning, the author took the greatest interest in the courses at Union College, and, in cooperation with the staff in physics, prepared a series of notes which might be of assistance to the Science Fellows in connection with the lectures. These notes were gradually developed into a more systematic survey of the *Fundamentals of Atomic Physics.* It was thought that this review might prove useful, not only to other teachers of science outside the group of Fellows, but also to students in engineering.

These books, plus his more than 50 scientific papers, the material from many of which was later incorporated in his books, are the contributions for which Dr. Dushman was known and honored in the world at large.

But in the laboratory where he spent his life, Saul Dushman, the man, was even more highly regarded and loved than Dr. Dushman, the scientist. His colleagues often referred to him as the laboratory's "greatest morale builder," and his interest in young men, especially new employees, earned him the unofficial title of the laboratory's "dean of men." He considered it his personal responsibility to perpetuate the "spirit of the laboratory," a spirit of strict honesty, friendship and cooperation, which had been inculcated by its founder, Dr. Willis R. Whitney. As the laboratory grew, he recognized the need for better understanding between members of different departments. Observing the tendency for members of the same group to sit together in the laboratory cafeteria, he started a weekly luncheon, in a special section of the cafeteria, at which great care was taken to cut across departmental lines. The discussion period that followed each luncheon was personally supervised by Dr. Dushman and was confined to subjects of general interest. These weekly events, which were known as the "Dushman luncheons," became very popular.

Dr. Dushman's door, like Dr. Whitney's, was always open, "rain or shine," to anyone who was in trouble. But his interest in the personal problems of his colleagues was not the conventional sympathetic ear; rather it was hard-headed, though kindly, practical advice and help. Often he took the problems of his fellow workers home with him, and worked and worried over them as though they were his own.

Dr. Dushman's most outstanding quality, both in science and in life, was strict honesty. It was so much a part of him that his outspoken candidness, which was characteristic of him, never gave offense. His mild profanity, which never exceeded a "damn," was a lovable characteristic for which he is well remembered. It was not profanity with him, but an expression of his forthrightness of speech, as of thought.

The respect and love which his associates felt for him is well expressed in the following tribute by the director of the laboratory, C. G. Suits:

> Saul Dushman was a devoted friend of the Laboratory in which he spent most of his fruitful scientific career. But beyond the loyalty and devotion which he felt for his associates as a group, Saul was a personal friend and personal counsellor of a host of his associates. He took a particular interest in young people, and in helping them over the difficulties of launching their careers in science. His fairness, his understanding, his great warmth of personality, and a fundamental interest in his fellow man, made this role a natural one for Saul. The results of his counsel and advice have played a vital role in the lives of unnumbered people who were privileged to come in contact with him.

Scientists throughout the world know Saul Dushman for his science, but his associates in the Research Laboratory will forever remember him, first and foremost, as a beloved friend.

ALBERT W. HULL
General Electric Research Laboratory, Schenectady, New York