Dr. William A. Zisman: a retrospective

Saul Oresky
Supply and Information Services Division, Code 3431

This year marks the 70th anniversary of **Dr. William Zisman**'s arrival at NRL. It also marks the 40th anniversary of his appointment to the Chair of Science for Chemical Physics at the Lab. From 1939 until his retirement from the Lab in 1975, Zisman's achievements in chemistry, especially surface chemistry, particularly in the invention of synthetic lubricants, earned him many awards and, even more significantly, contributed greatly to the Nation's defense. After Drs. Jerome and Isabella Karle, Zisman was the best-known NRL chemist and widely acclaimed as one of the Lab's strongest scientists. He died in 1986 in Silver Spring, MD, at the age of 80.

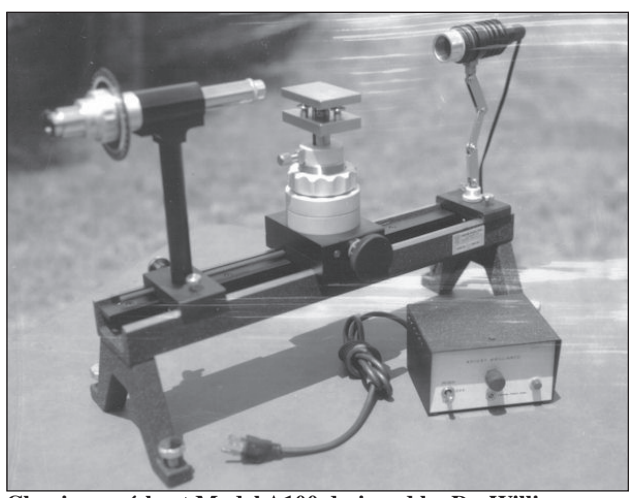
The balance between pure science and applicability was always evident in Zisman's work. He and his colleagues investigated and found solutions for many varied problems concerning military equipment during Word War II. In 1947, Zisman and his colleagues answered the U.S. military's call for better lubricants that would maximize the performance of their gas turbine-powered aircraft, especially in combat, by conducting fundamental studies relating molecular structure to lubrication and temperature/viscosity. This research resulted in the development of the first hydrocarbon ester lubricants. By the early 1950s, NRL-developed lubricants were used in Navy turbine engine aircraft and, soon after, in virtually all military and civilian gas turbine-powered aircraft.

The synthetic lubricants were also used to keep the motors of jet aircraft running in freezing weather. He also contributed to the Korean War effort by directing the development of a lubrication system for aircraft machine guns and cannon that enabled their use in the cold (-65 °F) of newly reachable high altitudes. His work on synthetic lubricants was also applied to cameras, gun sights, periscopes, electric motors, computing equipment, ship ventilating motors, aircraft control bearings, gyroscopes, and other equipment. Synthetic lubricants were to become a necessary part of the space program as well.

Zisman's contributions to the field of surface chemistry and physics at the solid-liquid interface that had solved numerous complex and critical problems in lubrication of military equipment used in temperature extremes also led to numerous manufacturing and industrial advances. These include the techniques that made Teflon-coated pans and stainproof and waterproof fabric finishes possible. It was Zisman who pointed out to DuPont's director of research that Teflon's unique non-wettability, not its chemical inertness, was its most important attribute. This led to Teflon's application as a nonstick surface on frying pans.

Born in Albany, NY, in 1905, Zisman grew up in Providence, RI, until the family moved to Washington, DC, when he was 14. After high school, he earned B.S. and M.S. degrees in physics from the Massachusetts Institute of Technology, beginning there his career-long record of winning awards and honors for his research. He became a research assistant for Nobel Prize winner P.W. Bridgman at Harvard University involved in high-pressure physics experiments, and he resumed his own studies there in 1931. After earning his Ph.D. from Harvard in 1932,

Pencil portrait of Dr. William A. Zisman by Dr. Robert Fox, who was a section head in the Chemistry Division.



(photo courtesy of ramé-hart instrument co.)

Classic ramé-hart Model A100 designed by Dr. William Zisman.

Zisman stayed on as a post-doc to study high pressure problems related to the Earth's core. This resulted in three papers in the Proceedings of the National Academy of Sciences. It was at that time that he became interested in the electrical properties of monolayers of oil on water and on metals. He decided to further his research on the surface properties of matter, being particularly drawn to the research of Langmuir, Harkins, Rideal, and others.

Unable for a time to find funding for his research because of the Depression, Zisman returned to Washington, DC, where he worked in administrative and clerical jobs for Federal New Deal agencies. Among these were stints with the Public Works Administration and the Resettlement Administration. At PWA, he was put in charge of groups of housing "experts" and social workers and was involved in the planning of the "greenbelt" planned cities. This gave him valuable management experience, which he was able to apply later at the Lab. Of his work during this time, he was most proud of his involvement in designing the first planned community, Greenbelt, MD.

He was happily able to return to science as a guest scientist at the Carnegie Institution's Geophysical Laboratory, for no pay, however, but the papers he coauthored there with Dr. Roy Goranson on the electrical properties of Langmuir-Blodgett multilayers caught the eye of some of NRL's scientific leaders. At NRL, he found not only support for his research but career advancement as well, first organizing and then rising to Section Head of the Surface Chemistry section, then Branch Head (originally called the Lubrication branch), then Superintendent of the Chemistry Division in 1956, while earning several important awards along the way.

At NRL, Zisman was known for his encouragement of looking for the unexpected and for his mentorship of the team of scientists in his charge. "Surface chemistry was his abiding interest and everyone in the division was trained to be aware of the various interactions that can be involved in diverse natural systems," said Patrick J. Hannan, who worked in Chemistry Division under Zisman. Hannan also noted how Zisman's work in surface chemistry influenced a great number of areas outside of the more obvious military and industrial purposes. For instance, the Journal of Dental Research (JDR) database contains 15 references to Zisman's work because of the applicability of his research to dental bonding.

Teamwork and communication among scientists of different research fields were the keys of Zisman's management philosophy, setting the standard for NRL's interdisciplinary ethos. Although driven by what were often near-term needs of the Navy and DoD, Zisman's underlying and consistent motivation was to pursue "long-term research" to prove over time whether that research was basic.

He earned substantial Government recognition for his service to the Nation, including the Distinguished Civilian Service Award from the Secretary of the Navy in 1954, the Department of Defense Distinguished Civilian Service Award from the Secretary of Defense in 1964, and the Office of Naval Research's Captain Robert Conrad Dexter Award in 1968. His many non-Governmental awards included the American Chemical Society's Carbon and Carbide Award in 1955, the Kendall Award in colloid chemistry in 1962, and the Borden Award in 1976. Clarkson College of Technology bestowed on him the Honorary Doctor of Science degree in 1965. The many awards he won from professional societies attested to the widespread impact of his research: the 1961 National Award from the American Society of Lubrication Engineers, the 1969 Mayo D. Hersey Award of the American Society of Mechanical Engineers, and the 1971 Joseph J. Mattiello Award of the Federation of Societies of Paint Technology.

Zisman held 39 patents, 10 of which are assigned to the Navy, and one of which is a German patent. One of his inventions, the NRL Contact Angle Goniometer, which has been manufactured by ramé-hart, Netcong, NJ, for over 40 years, is used to quantify surface energy. He devised the Zisman Plot, which is used to characterize the surface energy of a solid, and which appears in most surface chemistry textbooks. This method has had significant impact in the areas of lubrication and adhesion. He is credited with more than 150 publications in refereed journals, several book chapters, and more than 100 NRL reports and publications. ◆