A Historical Account of Dow's Environmental Stewardship

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INTRODUCTION

Industry is often accused of doing nothing to protect the public from the hazards of its products unless required by law to do so. While a few companies may be guilty as charged, this is simply not true of the great majority. The people who downgrade the conscience of industry have little conception of the comprehensive and continuing testing and evaluation programs—often begun decades ago—which many companies carry out to ascertain the health and environmental effects of their products and to meet their moral responsibilities. Indeed much of the data on which safety laws are based was first developed by private industry, and industry scientists have often served on committees drawing up laws and regulations.

Dow's own program of testing and evaluating the safety of its products began a half-century ago. As our knowledge grew, our arsenal of safety tests increased, many of the additions being special tests for special situations. These early toxicological discoveries were paralleled by new developments in industrial hygiene, plant engineering and operational procedures, occupational medicine, analytical chemistry, and other disciplines supporting environmental evaluation. Collectively, a philosophy of responsibility toward the well-being of employees, customers, and the general public has evolved and grown stronger.

This paper summarizes some of Dow's more noteworthy pioneering achievements in the field of product safety and identifies the individuals responsible for them. The contributions of these individuals and others like them extend far beyond the examples cited. They have, for example, exerted an important influence upon public policy regarding health and the environment, upon industrial and university researchers, and upon government scientists and regulators. In addition, many of these same people have held key posts in a variety of professional organizations concerned with environmental and product safety, often contributing significantly to the development by these organizations of test methods for product evaluation. Dow scientists and administrators take pride in the fact that responsible people in a stimulating environment can accomplish a great deal—and without government intervention.

The dates in this paper usually indicate when each effort was first undertaken rather than when it was described in a report. A study of the Dow reports provides an interesting insight into the dedication of the early workers. Reports are preceded by months of work and in some cases by as much as 10 years of effort.

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THE 1920's

1927. Dow had been selling inorganic insecticides for years, but now, at the instigation of President Herbert H. Dow, established quality control in insecticide packaging.

THE 1930's

1933. A Biochemical Research Laboratory headed by Dr. Don D. Irish was established at the instigation of President Willard H. Dow to investigate the potential effects of chemicals on human beings and organisms.

1934. Dow and the United States Public Health Service signed an agreement concerning the use of toxicity warning labels for carbon disulfide and aniline. Leland I. Doan represented the company in this matter. During the same year, the company formed a Safety Department to implement improved engineering and work practices resulting in greater safety. Department members included Clarence E. Rice and Samuel R. MacCutcheon.

1934-1935. A mammalian toxicity laboratory was established to study the possible deleterious effects of chemicals and chemical intermediates. The laboratory carried out skin absorption, skin irritation, and acute oral toxicity studies. It likewise conducted industrial hygiene investigations aimed at recognizing, evaluating, and controlling industrial hazards, and at anticipating hazards related to chemical handling and exposures.

1935. George E. Lynn and Thomas J. Powers began to investigate ways of reducing the discharge of toxic effluents into the Tittabawassee River in Midland. The first industrial use of bacteria to degrade phenolic wastes was begun, and fish were first used for bioassay purposes. Effluent samples from chemical waste lines were collected and analyzed in an attempt to locate the sources of effluents and to define methods of waste treatment.

1935. Coded experimental chemicals were submitted to J. Franklin Kagy, a graduate student at Iowa State University, who evaluated them as insecticides. The samples were designated as K-1, K-2, etc. This system, developed by Edgar C. Britton, D. D. Irish, and William W. Allen, is still utilized as a simplified method of indexing chemicals.

1936. The company hired its first medical doctor, Harold H. Gay, and began studying the clinical symptoms caused by exposure to lead.

1937. E. M. Adams, Howard C. Spencer, and Verald K. Rowe began studying the effects of chlorinated hydrocarbons and insect fumigants upon mammals in order to set early threshold levels for safe human exposures.

1938. V. K. Rowe and H. C. Spencer obtained toxicology data on Dow products and then discussed the data with the Food and Drug Administration, even though the company was not required to do so. During this same year, Dow toxicologists first tested materials for their cancer-producing potential on susceptible mice over a period of six months, and likewise studied the effects of various compounds on the metabolism of the animals. H. C. Spencer and Dorsey R. Mussell were the individuals involved in the latter programs.

THE 1940's

1941. D. D. Irish, E. M. Adams, V. K. Rowe, and H. C. Spencer carried out the first metabolism studies with fumigants on animals.

1941-1942. Investigations were begun to ascertain the effect of chronic (6-month) industrial exposures to lead arsenate and other lead compounds. These investigations involved studies of blood and urine, including analyses of urine for its lead content. Investigators included H. H. Gay and D. R. Mussell.

1945. W. J. Hansen began soil residue studies with pesticides.

1946. The company replaced its "First Aid" department with a full-scale Medical Department staffed by Drs. H. H. Gay and H. R. Gordon. W. H. Beamer prepared the first ^{14}C-labeled pesticide ($^{14}CCl_4$) for use in animal metabolism studies, while V. K. Rowe and H. C. Spencer carried out the first Dow two-year feeding study. This study, on SARAN* film and SARAN molding powder, may have been one of the first two-year feeding studies anywhere.

During this same year, Dow built its first rotary kiln incinerator for wastes.

1948. Harold R. Hoyle, Dow's first full-time industrial hygienist, was hired to study the effects of exposing humans to chemicals under working conditions.

Late in the year, the company first began the continuous monitoring of air pollutants in a production plant by use of instrumentation. This instrumentation, developed by Ormond E. Barstow, H. R. Hoyle, R. E. Schneider, and Parke B. Brown, and used to monitor CCl_4 vapors in the aspirin plant, may have been the first continuous monitoring instrumentation employed anywhere.

Also in 1948, William C. Bauman informed Dow management that production work with chloromethyl ether should be carried out in a complete enclosure and by remote control. This recommendation predated by years the knowledge of the carcinogenic nature of this product.

* Trademark of The Dow Chemical Company abroad.

THE 1950's

1951. W. J. Hansen studied the persistence of pesticides in soil, and K. C. Barrons the persistence of herbicides in water. G. E. Lynn and W. J. Hansen conducted plant residue studies involving pesticides.

1951-1953. Arthur W. Winston, Jr., began to conduct LC_{50} acute fish toxicity studies involving effluent and pesticide chemicals.

1952. V. K. Rowe, D. D. McCollister, H. C. Spencer, C. M. Adams and D. D. Irish began carrying out the first inhalation toxicity studies on humans.

1954-1956. The company formed a hearing conservation committee, instituted an annual audiometric testing program for employees, and began monitoring the duration, intensity, and frequency of in-plant noise. These activities were carried out by E. J. Schneider, Howard E. Ode, and representatives of the Safety and Engineering Department.

1950-1957. Dow began monitoring the gases in the air breathed by individuals fumigating for soil, grain, and household pests. This program, conducted by H. R. Hoyle, J. E. Peterson, E. J. Schneider, and Larry Maxwell, affords an excellent illustration of the company's concern for the health and safety of customers using its products.

1957-1958. The company built a high-temperature, water-scrubbed incinerator to burn industrial wastes and plastics. Construction of the incinerator, the largest in the world, was under the direction of Charles Sercu. The unit made it possible to completely destroy highly toxic, stable materials otherwise difficult to dispose of.

1959. Human exposure studies were undertaken to determine the effects of solvent vapors at concentrations below the accepted threshold limits of toxicity. Exposed air and blood were chemically analyzed and the results utilized as indicators of the extent of exposure. Dow personnel responsible for the program included Ben B. Holder, Richard Stewart, Ted R. Torkelson, Duncan Early, H. H. Gay, Arnold W. Schaffer, and Carl L. Hake.

THE 1960's

1960. Milton E. Getzendaner conducted the company's first pesticide residue study on fish. D. Jack Kilian made the first vegetative chromosome mutagenic tests, while Wallace V. Seiler and A. W. Schaffer first monitored the air in a commercial drycleaning establishment for solvent vapors. The latter program provides another example of Dow's concern for the well-being of its customers.

A six-month inhalation study on vinyl chloride, conducted by T. R. Torkelson, V. K. Rowe and H. R. Hoyle, caused Dow to lower its industrial hygiene guideline for the product to 50 ppm and to control vapors in production plants.

1963. Dow became the first company to store activated waste sludge in underground formations of porous rock. These formations — 3800 feet below the surface — served as sites for the anaerobic digestion of organic compounds. James L. Teal and Edwin S. Shannon developed and instituted the procedure.

1964. T. R. Torkelson studied animals to determine the effects of exposure to vapors of known mutagenic agents. E. E. Kenaga and A. E. Doty conducted the company's first simulated-premise studies, measuring the effects, upon the cholinesterase levels in rats, of vapors from insecticide-treated surfaces simulating house treatments. E. E. Kenaga, John L. Hardy, and John C. Ramsey carried out the first fish and *Daphnia* reproduction tests and the first picloram bioconcentration test with fish and *Daphnia* in water.

1965. B. Madsen and W. B. Crummett determined the *n*-octanal-water partition coefficients of various pesticides and compared the results with the biomagnification of pesticides in the fatty tissues of exposed animals. The results indicated that partition coefficients proved a valid indication of the extent to which biomagnification occurred with stable organochlorine compounds. Virgil B. Robinson and Joseph Molello conducted mammalian teratology and reproduction studies with COYDEN* coccidiostat. These were the first such tests carried out within Dow.

1966. This year marked the assignment in Dow of the first full-time fish, wildlife, and environmental ecologist. E. E. Kenaga developed an integrated approach to matching the toxicology, environmental residues, and physical and chemical properties of pesticides, while Ronald F. Wukasch, Allen Prince, Don Graham, and Stacy Daniels developed an efficient phosphate- and nitrate-removal process for reconstituting waste water and decreasing algae growth and eutrophication in natural waters.

1967. Charles J. Kramer and John Mutchler correlated the health data of plant employees with air-exposure levels of vinyl chloride. E. S. Shannon and Rudy G. Novak were responsible for the first chlorinated liquid organic waste burner built to meet all current applicable air-pollution standards.

1968. Gerald M. Ott, H. L. Gordon, and B. B. Holder instituted a program of computerizing data

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on employee death certificates in order to determine possible correlations between causes of death and exposure to specific chemicals. This work led to the discovery of the carcinogenic potential of arsenic.

1969. Dow's Board of Directors voted to form a corporate Ecology Council under the direction of Chester E. Otis. This Council was charged with accelerating and expanding the company's environmental efforts, establishing corporate policies and guidelines, and communicating matters of environmental importance to all parts of the Company, worldwide. 1969 also saw construction of the first liquid-tar furnace for phenolic-styrene waste disposal. This furnace, constructed under the direction of Charles Sercu, made it possible to burn such wastes instead of burying them. It had a Venturi scrubber and produced no ashes.

THE 1970's

1968-1971. F. A. Farber, D. A. Rausch, W. L. Dilling, and J. C. Safranski carried out studies on the photodecomposition, hydrolysis, and evaporation from water of trichloroethylene.

1969-1970. Under the direction of Frank Brower, Dow developed a phenolic-brine treatment process using carbon adsorption to remove organic materials from sodium chloride brine. The first unit utilizing the process was built as a demonstration model for, and in cooperation with, the Environmental Protection Agency.

1970. During 1970, D. J. Kilian conducted the first dominant-lethal mutagenic test carried out in Dow, an analytical method for mercury was developed and made public, and C. E. Otis compiled a two-volume literature index-bibliography designed to improve understanding of the environmental hazards posed by mercury. Also in 1970, the company announced a goal of designing industrial plants so that air and water contamination would be contained in a closed cycle. This concept—originated by Earle Barnes—was first put into practice in 1971, when a plant utilizing closed-cycle containment of water went on stream in Dalton, Georgia.

1970-1976. G. M. Ott, R. R. Holder, and Ralph M. Langner carried out a cohort mortality study of persons employed by Dow's Midland Division as of 1954, investigating possible correlations between mortality and chemical exposure or socioeconomic factors. Their work was the first of this nature published under industry auspices.

1971. Dow President C. B. Branch committed the Company to a "product stewardship" role which involves assessing the environmental impact of products and then taking appropriate steps to protect employee and public health and the environment as a whole. This commitment was formalized by the Dow Ecology Council on May 2, 1972, and included specific product stewardship goals (see page 144). Further instructions to research and development, manufacturing and marketing personnel were enunciated March 1, 1973.

1971. R. W. Meikle, J. W. Hamaker, C. R. Youngson, R. T. Hedlund, D. A. Laskowski, and N. H. Kurihara reported the first interrelated set of experimental designs for determining the environmental fate and impact of chemicals in soil and water.

1971 (April 21). A corporate Dow Environmental Testing Advisory Board (ETAB) was formed by J. E. Johnson to advise all company functions and management levels of the possible environmental effects of products and of new or changed processes. ETAB collected standard test procedures, analyzed data for possible gaps, and trained product department personnel to evaluate the environmental effects of their chemicals. Charles W. Hinman, Ray A. Gaska, Charles G. Kramer, W. B. Crummett, and E. E. Kenaga served on the first executive committee.

1971 (September 3). C. E. Otis, Dan R. MacDougall, W. R. Crummett, Richard J. Kociba, Perry J. Gehring, and Donald R. Peterson issued a written statement entitled "Possible Environmental Contamination from Chlorinated Organic Waste Products," warning industry and government of the potential hazards of hexachlorobenzene and hexachlorobutadiene.

1971-1972. John Zillich and Howard Alexander made the first Dow use of chronic fish toxicity tests in dynamic systems, studying toxicity of Dow effluents before they entered the river. P. J. Gehring, V. K. Rowe, B. A. Schwetz, and D. A. Rausch carried out inhalation teratology studies on CHLOROTHENE*.

1972. Dow issued a comprehensive compilation of Global Pollution Control Guidelines and Goals for internal usage. C. E. Otis had charge of this project.

1972-1975. Dow was the first industry to conduct an extensive human health study as part of a product-stewardship program carried out with a customer, Burlington Industries. Two matched groups of 150 people, one exposed and one not exposed to CHLOROTHENE, were given medical health exams, and air samples taken from industrial areas were analyzed in order to evaluate human safety. This program was carried out by Charles M. Kramer, G. M. Ott, Jed E. Fulkerson, and Nancy Hicks.

1973. The Health and Environmental Research

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Department was formed October 22, 1973, under Eteyl H. Blair to investigate industrial and other hazards to man and the environment from Dow's chemicals. This was another step in implementing strong product stewardship. P. J. Gehring and D. A. Rausch began metabolism studies which indicated vinyl chloride has a threshold level in causing cancer.

1974. At the fifth annual Environmental Honor Award Program for U.S. corporations, a jury of professional environmentalists awarded Dow top honors for making product stewardship an environmental way of life.

1974. The company built the country's first supplementary energy system for powerhouses. The computer-controlled system allows coal-burning powerhouses to switch to oil whenever meteorological conditions would otherwise result in excessive stack emissions. With this system, stack emissions meet ambient air standards at all times. The switching is controlled automatically by computer (coal to oil). Edgar (Ted) M. Ilgenfritz and Jack M. Brown devised the system.

1974. Dow became the first company to use tertiary-stage waste stabilization for water. This computer-controlled operation, designed by S. Douglas Hall and E. S. Shannon, features upstream and downstream monitoring of water pollutant levels. It eliminates residual BOD, TOC, thermal load, and fish toxicity, producing water that exceeds the treatment standards set by the 1977 EPA guidelines and those for NPES permits.

1974 (January 1). Dow broke ground for a two million dollar expansion of its toxicology laboratory in Midland. This expansion was completed in 1975.

1975 (May 5). Dow participated in formation of the Chemical Industry Institute of Toxicology (CIIT) to expedite testing of chemicals, complementing other toxicology studies. Malcolm E. Pruitt represented Dow in these activities.