



Figure XXIV
Sistersville Plant in 1981

The early interest was in pesticides. Research was carried on cooperatively with Boyce-Thompson Institute in Yonkers, New York, where Dr. Law had established a fellowship to screen chemicals for their biological activity. The driving force behind the Agricultural Chemicals program for Union Carbide became Dr. Richard H. Wellman, a plant pathologist, who was hired in 1939 to work with Boyce-Thompson. Boyce-Thompson is a research institute, now located at Cornell University in Ithaca, New York, which is dedicated to basic research in agriculture.

The Agricultural Chemicals business was an entirely different kind of business from the usual petrochemicals and plastics at Union Carbide. It needed special testing, government approvals, and marketing plus the education and servicing of end use consumers, as well as intensive research in discovery, product development, and toxicology. The products were neither commodity chemicals nor consumer products and a strange breed to most "Carbiders."

The first product made and sold, in the 1940s, was CRAG 6-12 Insect Repellent, chemically 2-ethyl-1,3-hexanediol. It was used widely by American troops in the field during World War II. The breakthrough in Agricultural Chemicals came about in the 1950s with the discovery, by Dr. Joseph Lambrech, of a broad spectrum insecticide with low mammalian toxicity trademarked CRAG SEVIN, and chemically named 1-naphthyl-N-methyl carbamate. It was a very effective insecticide and could be used safely by home gardeners and by peasant farmers in undeveloped countries without special training or precautions. It was first produced on a temporary basis in modified facilities at South Charleston and Institute, and then in 1960 in a 50 million pounds per year dedicated facility at Institute. SEVIN gained special notice in 1960 when several million pounds were airlifted to Egypt on an emergency basis to save the cotton crop there from an infestation of army worms. SEVIN became the most widely used pesticide in the world.

Molecular Sieves

In the late 1940s, Dr. Robert M. Milton of Linde began basic studies on zeolites at Tonawanda, New York, with an eye to using them as adsorbants for separating oxygen and nitrogen. Zeolites are natural products that are chemically similar to clay but which have some special structural properties. The structure consists of a three-dimensional lattice framework that permits molecules of differ-

ent sizes to be selectively adsorbed in the micropore interstices. Milton's idea was to make a synthetic zeolite inasmuch as natural zeolites are very rare. By 1950, Milton had succeeded in developing a process to make synthetic zeolites from silica and alumina. He also identified the three basic forms of zeolite, dubbed A, B, and C, and their structures. The term that was used to describe these synthetic zeolites was "molecular sieves."

Molecular sieves were first manufactured and sold by Linde in 1954—only five years after their discovery. Their uses proved to be widespread and significant. These uses included adsorption for physical separations and catalysis in catalytic cracking, isomerization, and hydroforming of petroleum. They were also used as an environmentally-friendly substitute for phosphates in detergents. Linde was awarded a KIRKPATRICK CHEMICAL ENGINEERING ACHIEVEMENT AWARD in 1961 for the development of synthetic zeolites. Milton was awarded CHEMICAL PIONEER AWARD of the American Institute of Chemists in 1980 for his work.

Further development on molecular sieves was picked up by Edith Flanigen, first at Tonawanda and then in the Company's Tarrytown laboratories. Under her direction, a whole new stable of synthetic zeolites was developed. These new zeolites included silicon, phosphorus, and various metals in their makeup. This new generation of molecular sieves is recognized as a landmark discovery in the field of inorganic chemistry. Flanigen was awarded the prestigious PERKIN MEDAL of the Society of Chemical Industry in 1992 for her contributions. She was the first woman to receive the PERKIN MEDAL.

The molecular sieve business developed and prospered and is a billion dollar industry today. Molecular sieves were first made and marketed by Linde and then as a separate group associated with Chemicals and Plastics. The first molecular sieve plant was in Mobile, Alabama. In 1988, the molecular sieves group was folded into UOP (formerly Universal Oil Products), a joint venture with Allied-Signal, and was Union Carbide's most important contribution to that venture.

DYNEL

Union Carbide developed a textile fiber in the late 1940s that was trade named DYNEL. It was made from a copolymer of vinyl chloride (60 percent) and acrylonitrile (40 percent). The fiber had a wool or fur-like texture and appearance

and found excellent application in wigs, simulated fur coats, carpets, and industrial filters and cloths. (The New York office at 270 Park Avenue was covered with 70,000 square yards of Dynel carpeting when it was built in 1959.) However, DYNEL was very heat sensitive and limited on that account. A DYNEL resin unit was built in 1950 in the VINYLITE area at the South Charleston Plant, and a spinning unit was built outside the plant, but also at South Charleston, to make DYNEL tow and staple fiber. The initial capacity of the system was six million pounds per year, which was increased in 1964 to ten million pounds per year.

DYNEL was a good product, but as it turned out, a niche product. In the early 1950s, the Company contemplated getting into the fibers business in a big way, and indeed, bought a large site near Spray, North Carolina, for that purpose. However, such a venture required a huge infusion of capital, and the idea was ultimately abandoned. DYNEL operations were continued at South Charleston until 1975, at which time they were shut down, because substantial new investment was required to keep operating.

Coal Hydrogenation

In the late 1930s, Dr. George O. Curme was concerned about the availability of feedstocks in the long term for the Company's operations. Quantities of natural gas in the Eastern United States were declining and an end to the supply was being projected. Indeed, the federal government was forecasting that the Country would run out of natural gas in ten to twenty years. At that time, no one foresaw the huge discoveries of gas and oil in the Middle East, in Africa, in Alaska, and in the North Sea. While Union Carbide's immediate future was secure with an ample supply of refinery off gases, the oil companies were showing an interest in using those materials for their own operations. Union Carbide already had experimented with running its own oil refinery (the "Gyro" unit at South Charleston) to make feedstocks for olefins plants. However, Dr. Curme felt that, ultimately, abundantly available coal would be the resource that would provide the most secure supply of feedstocks. Coal, of course, can be used to make synthesis gas, which in turn can be used to make aliphatic chemicals. However, this is not what Dr. Curme had in mind inasmuch as coal, in effect, has to be burned to make synthesis gas. What he hoped to do was make an array of chemicals directly, or nearly so, by coal hydrogenation.

To that end a pilot unit was built in 1937 at the South Charleston Plant to explore the hydrogenation of coal at temperatures up to 500°C and at pressures up to 6000 psi. Similar studies were going on in Germany and England and also by the U. S. Bureau of Mines in this country. However, those studies were directed more toward producing liquid and gaseous fuels rather than chemicals.

Coal hydrogenation studies continued in the pilot unit until 1949. At that time it was decided to build a 300 tons per day (of coal) demonstration plant at Institute, West Virginia. Dr. George T. Felbeck, who had superbly managed Union Carbide's wartime ventures, was placed in charge of the whole effort—concept, design, construction, and operation. Felbeck visualized a multifaceted, integrated approach that included the automated mining of coal, the generation of power, the gasification of coal to make synthesis gas and hydrogen, a Fischer-Tropsch process to make feedstocks for olefins, the hydrogenation of coal to produce aromatic chemicals, and the production of coke for carbon electrodes and activated carbon. Work on the demonstration plant, and its supporting facilities, started in 1948. The plant was finished in 1951 and operated until 1956. Many of the people involved came from the Oak Ridge operation and from the Methanol Plant in Niagara Falls, which had been shut down about that time.

The problems were horrendous—handling and processing hot erosive coal slurries and hydrogen at high pressures. Operation was very erratic. The plant achieved a modicum of success from a technical standpoint—the Company received a KIRKPATRICK AWARD FOR CHEMICAL ENGINEERING ACHIEVEMENT in 1953 for the project. However, it was kind of an “A” for effort. In the end Curme's hopes were neither feasible nor economic, and the venture could not stand on its own. A major factor affecting the economics was the increasing availability of natural gas and petroleum supplies. However, the concept did not die immediately. Proposals to make phenols and cresols by coal hydrogenation were continued until 1963 when the whole thing was finally put to rest. The concept of making chemicals directly from coal by way of coal hydrogenation may one day be a valid one, but it will not be so until petroleum is in much shorter supply. A record of Union Carbide's technology has been preserved for that day.

Nuclear Programs

The Atomic Energy Commission (AEC) was formed in 1946 to put nuclear energy under civilian control, and the AEC continued Union Carbide's contract to run the K-25 Gaseous Diffusion Plant at Oak Ridge. Carbide also assumed responsibility at that time for the Oak Ridge National Laboratory and then a year later for the Y-12 Electromagnetic Separation Plant. Thus, in 1947, Union Carbide was responsible for the whole complex at Oak Ridge. However, the Y-12 Plant was shutdown in 1947 for separating uranium isotopes and was converted to the manufacture of nuclear weapons parts. In the early 1950s, Carbide also assumed responsibility for a new gaseous diffusion plant that was built at Paducah, Kentucky. All of the nuclear facilities were managed on a cost basis and a fee was charged to cover only the cost of administration. The Company contributed to both management and technology. In 1969, Union Carbide received a KIRKPATRICK AWARD FOR CHEMICAL ENGINEERING ACHIEVEMENT for improvements in the gaseous diffusion process for enriching uranium.

In 1955, the Corporation formed a Nuclear Division to integrate and manage its whole nuclear effort. A further objective was to carry on extensive research and development work in the field of commercial and industrial applications of atomic energy. At its peak in 1975, the Nuclear Division had 15,000 employees—mostly associated with the government programs. The commercial part of the Nuclear Division included the mining and milling of uranium ores in Colorado and Utah. It also included a venture in 1960 into a five megawatt nuclear “swimming pool” reactor at the Sterling Forest Research Center near Tuxedo, New York. The intention was to use the reactor for research and radioisotope production, particularly for medical purposes. However, the field was crowded, competitive, and not very attractive. As a result, the reactor was sold in 1980 to Hoffman-La Roche, a pharmaceutical manufacturer. They shut it down in 1982 and converted it to a greenfield site.

Computer Automation

In 1957, Union Carbide set out in concert with Ramo Wooldridge to effect computer control of a complex process. The process selected was the ethylene oxide process—actually the unit at Seadrift, Texas. Work already had been done

on data collection and off-line optimization. Full closed-loop, optimizing, computer control was achieved in 1959—a world's first. Other processes followed, especially Olefins Units. (Texaco brought a computer controlled process online a year-and-a-half later and received credit for being the world's first, because Carbide kept its accomplishment under wraps for competitive reasons.)

Environment, Safety, And Health

Personnel safety has always been a matter of importance at Union Carbide. Company safety records go back to the mid-1920s, and these safety records over the years tend to be about four times as good on average as industry as a whole. This is in spite of the fact that many of the Company's operations and materials are potentially hazardous. Indeed, the very fact that there is possible exposure to hazard has driven the Company's safety programs from early on. However, in the early days, safety was mostly a local matter and the role of the Corporation was mainly encouragement through policy. Nonetheless, many national safety awards were received, and the Company's safety record remains exemplary to this day.

Concern for health has also been a long-term priority at Carbide. In 1937, a Chemical Hygiene Fellowship was established at the Mellon Institute to test all Carbide products and their intermediates to determine toxic effects and limits based on breathing, ingesting, and skin exposure. The results of the tests were made available to employees and customers as "Toxicity Information Sheets", forerunners of the federally mandated "Material Data Safety Sheets". Routine physical examinations have also long been a part of the industrial health program. Industrial hygienists have routinely monitored plants since 1960.

In the 1930s, however, it became apparent that formal attention was needed for process safety as much as for personnel safety. Efforts were put forth in the areas of fire prevention, fire protection, pressure relief, and fail-safe shutdowns. In the mid-1940s, a Fire Research Laboratory was established at the Institute Plant to study the behavior of chemicals exposed to fire. Although no one was seriously injured, an explosion of a railroad tank car in 1954 at the Institute Plant (caused by a reaction initiated by filling the car through a contaminated pipe) triggered an intensive effort to assure safety in design and operations. The first step was to document potentially reactive chemical hazards plus fire safety and health hazards. This resulted in the publication of a three-volume "Reactive and Hazardous

Chemicals Manual”, which became another predecessor of the “Material Data Safety Sheets”. The tank car explosion also triggered the institution of formal, exhaustive Safety Reviews and Safety Considerations Reports for all process designs.

The environmental program got off to a slower start. Consistent with the rest of society, typical environmental devices in the 1920s and 1930s were rudimentary ash collectors for boilers and flares to burn flammable exhaust gases. Many people burned soft coal in their home furnaces or fireplaces and the smoke from an industrial stack wasn't much noticed. With the post-war growth of industry, the problems were exacerbated—from the standpoints of both air and water pollution, and it was obvious that something needed to be done. Prior to 1945, many rivers were open sewers, receiving untreated municipal wastes as well as taking the outfall of industrial plants. The first steps were taken to correct the problem in the 1950s. These included waste abatement (that is, the avoidance of waste) and segregating and collecting waste streams and treating them. The older plants were more difficult to deal with. Efforts were put forth on municipal wastes as well as industrial.

The first objective was generally to reduce the 5-day BOD (Biological Oxygen Demand) of the water, a measure of oxygen content and indirectly of the level of pollution. Linde devised a system, called UNOX, for treating wastes with oxygen, which was particularly successful in Japan. The South Charleston Plant and the City of South Charleston joined together in 1956 to design and construct a plant to handle their combined wastes. (It's still in operation today.) The Torrance Plant was built to meet newly established air and water pollution standards of Los Angeles County. The Texas City Plant constructed a series of lagoons in the late 1950s for treating their wastes. The Seadrift Plant also had a series of large waste treatment ponds. Standards were state or regional and varied from place to place. The Ohio River Basin came under the jurisdiction of the Ohio River Valley Sanitary Commission (ORSANCO), an eight state compact authorized by federal legislation to help clean up the water. The problems were enormous. Ready solutions were not readily available, and when solutions were available, they were generally expensive. There was much left to do.