A Chemical History of 3M

1933 - 1990

Neil MacKay

A Chemical History of 3M MacKay

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Enclosed is a copy of the newly published hardcover book "A Chemical History of 3M 1933 - 1990".

This book is authored by Neil MacKay, a former 3Mer. It offers an intriguing journey back in time introducing the people who lived through the early years of this Division.

This story offers not just some "dry history", but instead, some great insight into why and how things happened when they did. It includes some extraordinary memories and recollections by those who built the firm foundations of the PCPD.

Gil Foster

Gil Foster

Division Vice President

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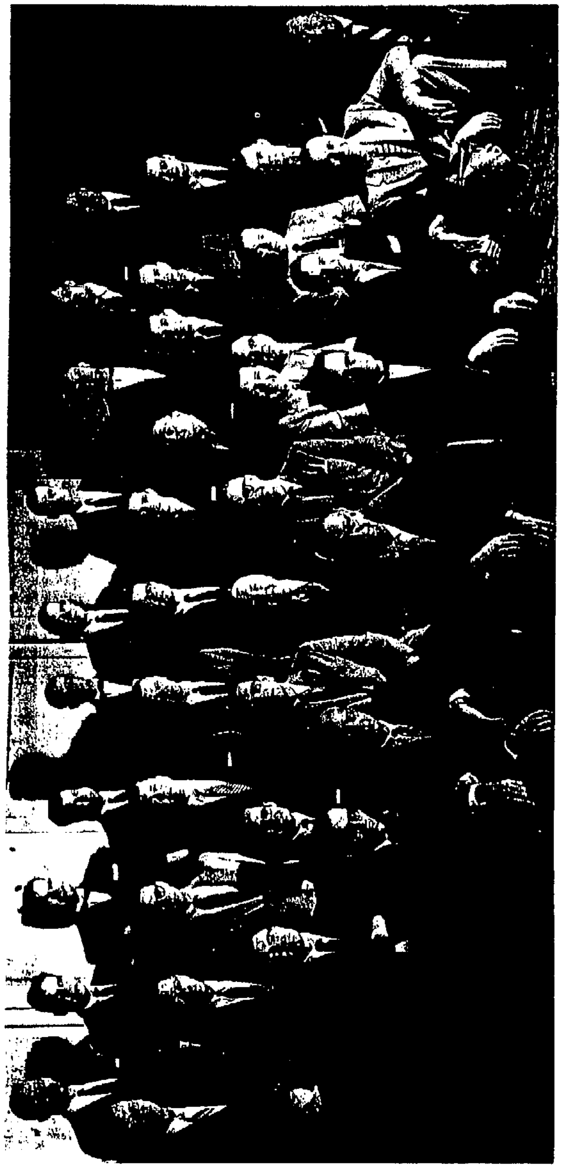

Sales and marketing group in early 1960s. First row, from left: Herb Julian, Bill Skown, Fran Ruggles, Jack Burrell, Bob Adams, Ed Rasmussen, Roy Weik. Second row, Jim Rogers, Doug Hall, Joe Selden, Joe Duke, Frank Woznak, Edmond Tyne, Ed Gill, Roy Mordaunt, Jim McFadden. Third row, C. E. Smith, Sam Baumen, Bob Peiffer, Bill Sillcox, Eliel Fritz, John Ernlund, Ray Brown, Art Telfer, Abe Zoss, Lyle Hals, Stan Prater. Fourth row, Frank Miner, Bob Small, Dave Shryer, Tony Genovese, Cliff Travis, Fred Troester, Bob Curtis, Dave Towler, Jack Thompson, Al Reynolds.

Preface

You should know why this book was written.

First, it is the story of a good 3M business developed over fifty years. During that time, a great many smart people lived with the risk, aggravation, uncertainly and hard work which bought the business to its current condition. Those people deserve credit for their contributions.

One purpose of this book is to record that small amount of history that written records, old photos and memory will allow. Undoubtedly, many of the most important contributions and contributors have gone unremembered and unrecorded, but not unappreciated—to all of those pioneers who built the first fifty years of 3M's chemical business, this book is meant to be a remembrance and a sincere public recognition of their efforts.

It is particularly unfortunate that for practical reasons of time and cost, this story could not be expanded to include the contributions of those who built the business outside the United States. Many of the names would be the same, but there would certainly be many new ones as well. 3M's chemical business today derives half of its revenue from OUS markets, so the efforts and successes of those involved in Asia, Europe, Canada, Africa and Latin America are unrecorded here, but certainly not unrecognized or unappreciated.

The second purpose of this book is to serve as an enabler for the future of the business. Make no mistake, a clear understanding of the past is a significant enabler for the future.

It is no accident that this is not a story of chemistry. It is clearly not a story of molecules, compounds, good science or technology. It is a story of people. This business was built by human beings who more often than not had to rely on and invest their faith, vision and personal judgment. The opportunity for failure may have been the single most powerful driving force behind the development of the business. Mistakes were made and failures were abundant, but there is no evidence here of fear of failure or mistakes. Those setbacks and difficulties seem to have been accepted and integrated as part of the education of the business.

William L. McKnight, who provided the foundation for 3M's business principles, was one of the early sponsors of the chemical opportunity at 3M. His early stated vision of empowerment may very well have been written with this business in mind:

"As our business grows, it becomes increasingly necessary to delegate responsibility and to encourage people to exercise their initiative. This requires considerable tolerance.

"Those people to whom we delegate authority and responsibility, if we use good people, are going to want to do their jobs in their own way. These are characteristics we want, and people should be encouraged as long as their way conforms to our general pattern of operations.

"Mistakes will be made, but if a person is essentially right, the mistakes made are not as serious in the long run as the mistakes management will make if it is dictatorial and undertakes to tell those under its authority exactly how they must do their job.

"Management that is destructively critical when mistakes are made kills initiative, and it is essential that we have many people with initiative if we are to continue to grow."

-- William L. McKnight

To all of those people involved today in this enterprise, who have the opportunity and responsibility to shape its next fifty years, there are some very valuable lessons here.

This book has two audiences—those who wrote the past and those who will write the future. The former will read it with a sense of pride in accomplishment. The latter will read it with a sense of question about 3M luck, about the personality of the business, about plain hard work, about determination to succeed and permission to fail. Mr. McKnight would likely have agreed that these things are the root of the business.

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Introduction

A few words of background might be of value to some readers.

Chemicals fall into two broad classes—commodity and specialty chemicals.

Commodity chemicals—acids, sodas, solvents and the like—are produced in mountainous quantities by many companies all over the world. They are economically priced at a few cents to five dollars a pound and are sold by the truckload and carload. Most carry no brand name because they are so much alike. Most are raw materials or intermediates used to manufacture an endless variety of products.

Despite the low prices per pound the sheer volume of commodity chemicals results in a multi-billion-dollar-a-year industry.

Specialty chemicals are very different.

They are produced in relatively low volumes and sell at higher prices, as much as twenty to fifty dollars a pound or more. Many are designated by brand names and are manufactured for specific uses.

Fluorochemistry is a broad science within the spectrum of specialty chemicals. In turn, 3M's specialty chemical business consists of only a narrow band within the science of fluorochemistry.

3M's best known specialty chemical product is Scotchgard™ protector, an anti-stain, anti-soiling treatment for carpets, furniture fabrics and other materials. Other 3M fluorochemical products are not as widely known because they are not consumer items and are sold chiefly to industry and government.

3M entered the fluorochemical business when the technology was new and exciting. In the decades that followed, 3M developed its fluorochemistry from a laboratory phenomenon to a broad range of products sold throughout the world. This book recounts the history of that development and the development of other chemicals which are sold as products or used by 3M divisions to produce many products.

Dedication

Without the contributions of the men and women who lived it, this history could not have been written. The anecdotes and other information they provided were not available from any other sources.

Many of those contributors also read sections and chapters in progress or the completed manuscript to verify accuracy and readability. That does not mean, however, that the author can be absolved from the responsibility for the credibility or readability of what is printed on these pages.

When recollections of two or more people were in conflict, the author chose what appeared to be the most plausible version or melded two or more versions into one. Memories become tarnished after thirty or forty years, so parts of this report may conflict with your own recollections.

To all those men and women and to all the rest who were involved in fluorochemicals at 3M, including researchers, sales and marketing personnel, administrators and staff, this book is dedicated. Special thanks to the following:

Bob Adams, Art Ahlbrecht, Charlie Bentz, Hugh Bryce, Bob Burford, Lou Cove, Gil Foster, Dick Guenthner, Doug Hall, Lyle Hals, Cliff Hanson, Mike Harnetty, Jim Hendricks, Wil Hirsch, Carlene Holt, Cliff Japs, Frank Kuettel, Les Krogh, Don LaZerte, Sid Leahy, Bill Leder, Ted Lucas, Bill Lundquist, Paul Novotny, Bill Paterson, Bill Pearlson, Bill Petersen, Dick Raths, Gayle Rengel, Jim Rogers, Duane Sanderson, Jack Sargent, Tom Savereide, Bill Skown, Joe Selden, Patsy Sherman, Dave Shryer, Al Smith, Sam Smith, Frank Vikingstad, Larry Wagner, Don Wardrop, Stan Zaluda, Lamar Zollinger.

Additional thanks to Bill Pearlson, technical editor for the author and Gayle Rengle, both of whom spent hours reading and correcting this manuscript.

Neil MacKay

NOTICE

Fluorocarbons are not harmful to our atmosphere.
The chemicals that attack our ozone layer are **chloro**fluorocarbons or CFCs.
3M does not produce chlorofluorocarbons.

CHAPTER 1

Joe Simons' Stuff

In the late 1930s and early 1940s a body of American scientists (knowingly or unknowingly, depending on their need to know) were working to create the first atom bomb. To accomplish that, they had to discover a method of separating uranium-235, which is the fissionable variety, from ordinary uranium-238. One suggestion was to handle the uranium as uranium hexafluoride vapor, a highly corrosive, poisonous material.

Easier said than done.

As a matter of fact, it was impossible. No one knew how to do it, but all agreed that if it could be done, the job not only would be Herculean, but extremely hazardous. And, if and when uranium hexafluoride vapor was produced, additional questions would have to be answered. How could fluorine be stored? What super materials would have to be invented to manufacture storage tanks, pipes, pumps, valves, gaskets and even lubricants that would not burst into flames, explode or corrode on contact with fluorine? How could they ship the vapor from one factory to another? How could they protect the people who would handle the vapor?

Those were just a few of many questions that had to be answered by scientists in the Manhattan Project, the code name for the A-bomb development program.

Columbia University in New York City, where an atom smasher had been installed in the basement of the Physics building, was headquarters, but thousands of scientists also were participating in universities and government installations across the United States. Scientists at the University of California, the University of Chicago, Duke, Johns Hopkins, Purdue and Cornell also were conducting theoretical studies. Company researchers who helped were employed by Hooker and the Harshaw chemical companies. Government supervised production and testing facilities were at Hanford, Washington, Los Alamos and Alamagordo, New Mexico, and Oak Ridge, Tennessee.

After the war, some of those researchers landed at 3M, including several who joined the Fluorochemical Project. Lyle Hals, a retired 3Mer, was enjoined from telling anyone, even close relatives, about his employment or employer during two years at Columbia, where he was one of several thousand men and women working for the Manhattan Project. Buildings on and near the Columbia campus comprised the hub of activity until the project was moved to the football stadium at the University of Chicago.

Although the Manhattan Project scientists were gingerly treading new ground, they did have some fluorine history to fall back on. The study of organic fluorine compounds dates almost from the beginning of organic chemistry.

Fluorochemicals are componds of fluorine and any of a number of other elements. Fluorine is one of nature's commonest elements, more abundant than copper, a hundred times more abundant than iodine. One of the places it is found is in fluorspar, a rock used before the founding of the Holy Roman Empire as a flux for smelting iron and the primary source of commercial fluorine today.

Fluorine, which can be liberated from the rock by using sulfuric acid, appears as a hydrogen fluoride gas. That is the form in which it usually is handled commercially before it is separated from its hydrogen and combined with something else.

As the Manhattan Project scientists well knew, handling fluorine is a major problem. In its pure, uncontrolled state—fortunately never found in nature—it is one of the most active, most dangerous elements known to man. The greenish-yellow gas will burn steel, water and even asbestos, which earned it a nickname—the wildest hellcat. Strangely, its wildness contributes to fluorine's unique stability when it is combined with certain compounds.

It was first isolated more than a hundred years ago, in 1886, by French chemist Henri Moissan, who reacted gaseous fluorine with carbon tetrachloride to make a reactive fluorocarbon. He was nearly killed for his effort, but lived to win a Nobel Prize.

There the matter stood until after the turn of the century when

methods of preparing organic fluorine compounds were advanced by the contributions of a Belgian chemist named Swarts. His work on the replacement of chlorine with fluorine laid the foundation for the commercialization of the compounds of carbon, chlorine and fluorine.

German scientist Otto Ruff made the first liquid fluorocarbons at room temperature. His published findings preceded more extensive efforts in this country by a number of academic groups.

The mid-1930s were exciting years for the development of fluorine chemistry as academic research and industrial development grew rapidly. A scientist named Al Henne, who had been Swarts' student in Belgium, developed the manufacturing process for a chlorofluorocarbon while working for General Motors in Detroit. GM arranged with DuPont to manufacture its product which was named Freon 12™. Later DuPont developed a similar product named Freon 22™. DuPont's product is widely used as a coolant for refrigerators, a blowing agent for foamed plastics, a degreasing solvent and more.

DuPont chemists also polymerized tetrafluoroethylene trade named Teflon™. Contemporaries at I. G. Farben in Germany did the same with chlorotrifluoroethylene.

Other scientists also were pursuing fluorine chemistry in industry and campus laboratories. Phillips Petroleum Corporation used it to develop a system that produced high octane gasoline. Farben patented several successful applications.

At Penn State College (now University), Professor Joseph A. Simons, working independently, produced liquid fluorocarbons, including high boiling point compounds.

Pre-war researchers knew that the more fluorine there was in an organic compound, the lower its boiling point. Because or that, highly fluorinated compounds tended to be gases at room temperature. Furthermore, all research on organo-fluorine compounds was by direct fluorination or exchange reaction.

Simons used direct fluorination of carbon in his laboratory, but believed that he could make more complex fluorocarbons by running fluorination under milder conditions. If nothing else, that would avoid the possibility of explosions and fires associated with direct fluorination.

With that in mind, the professor directed his students to study the effects of various heavy metals on the reaction. His supposition proved to be correct. Research showed that catalysts, particularly mercury, modified the reaction. Simons and his crew produced—in small amounts—liquids made only of carbon and fluorine that boiled at 100°C and higher.

Only an ounce or two of the colorless liquid fluorocarbon had been made in Simons' laboratory by the time Manhattan Project scientists found out about it. A minute quality was supplied for testing by the atomic scientists at Columbia University. It was enough to verify the Penn State professor's claims. The A-scientists were elated to have found what they referred to as "Joe's Stuff."

That enthusiastic reaction in the laboratory at Columbia can only be imagined more than 50 years later, but there was a tempering factor. Simons' output was a liquid and the atom scientists also needed solids and gases. However, they believed that problem could be solved. By the Spring of 1942 the work had gone so well it was taken from the Columbia laboratory and given to several industrial firms for production.

A major obstacle in producing an atom bomb had been overcome.

• • •

Joe Simons was a complex man. He has been described as brilliant, prejudiced, loyal, humorless, friendly, abrasive, stubborn, arrogant and egotistical. He also was a man of ideas and an extraordinary researcher, and the best teacher I ever met, one man attested. He was a good friend to the graduate students who worked for him, but outsiders were adversaries. Consequently, nearly everyone introduced to Simons had the same initial reaction—completely negative. Simons' personal problems included the fact that he was short in stature and concerned about it. In an effort to appear taller, he wore hats with high crowns and shoes with lifts.

It was Simons' personality, including a penchant for trying to control people, that worked against him in his attempts to sell his fluorochemical research achievements before 3M came into the picture. Simons' brashness also prevented him from participating in the Manhattan Project. After he had helped the war effort with his research, he was invited to join the fluorochemical research studies. He would on one condition: that the project be moved from Columbia to Penn State. His suggestion was rejected.

So, Simons stayed on at Penn State, devoting time and effort

to his concern that the process used to produce his fluorochemical for the government (a process the Manhattan Project continued to use) was very dangerous. It required reacting highly explosive fluorine gas directly or indirectly with a hydrocarbon or chlorinated hydrocarbon to produce fluorocarbons.

An alternative method required two steps, which made the process expensive when producing compounds consisting of more than two carbon atoms. (DuPont successfully produced Freon refrigerating/air conditioning gases containing one and two carbon atoms with the two step process.)

Simons was sure he could find a better way.

He began by reviewing an experiment carried out by one of his graduate students, Howard Frances, back in 1936. Frances had dissolved acetic acid in liquid hydrogen fluoride, then subjected the solution to an electric current. That electrolysis produced several products, but the most important achievement was that the hydrogen atoms attached to carbon had been replaced by fluorine.

So, in 1942, bolstered by Frances' results, Simons set out to perfect the electrofluorochemical process. Frances had proved that fluorocarbons could be made by applying direct current. The chore was to refine that proven concept.

Simons pursuit of a successful experiment which had lain dormant for seven years was another step that led to 3M's support of the professor's research.

Those experiments and the patents developed from them would link Simons' name with 3M for all time.

CHAPTER 2

The Second Ph.D.

To set the stage for the meeting of 3M and Simons, we return to St.Paul to a sunny Monday morning in June 1936 when Dr. James Hendricks arrived to begin his first job.

He had ridden a streetcar to the 3M location on the East Side after arriving from Chicago by train the previous afternoon. As the bright yellow streetcar rolled eastward, Hendricks paused on the sidewalk to take in the scene. A short block away protruding above the low store fronts on East Seventh Street were the tops of the buildings that housed 3M's offices, laboratories and manufacturing facilities.

Hendricks was the second man with a doctor's degree to be hired by 3M. His destiny was to be one of a handful of scientists and technicians who helped organize 3M's central research laboratory in 1937. That laboratory, the great-grandfather of today's 3M Corporate Research Laboratory, was vital to 3M's acquisition of Simons' patents eight years later.

But, on that sunny Monday morning more than half a century ago, Hendricks had no inkling of his future. He was content with the thought of beginning his first job after completing his graduate studies at the University of Illinois.

He walked the short block to Fauquier Avenue, crossed and turned left past a three-story white stucco office-laboratory building on the corner. In mid-block, he turned to enter a small one-story wooden structure that housed 3M's Rubber Cement and Tape Laboratories.

Employees called it the Sanitary Farm Dairy Building because 3M—then formally called Minnesota Mining and Manufacturing Company and informally "the Mining"—had purchased the structure seven years before from a St. Paul milk company. The building faced south, a stone's throw west of Forest Street. Opposite was a broom factory, which would be bought and razed by 3M a few years later to allow construction of a two-story administration building (Building 21) in 1939 plus the much larger office Building 42 in 1951. Those structures would house 3M offices and international headquarters until the Maplewood campus Building 220 was built and occupied in the early 1960s.

The white stucco building Hendricks had passed at the corner was Building 2 which faced Fauquier Avenue with Building 1 nestled behind it. The latter, two stories high and faced with yellow brick, was constructed in 1911, making it the oldest 3M building in St. Paul. Building 2 had followed in 1919. Both are still in use, occupied by departments of the 3M Industrial Abrasives Division.

Building 15, the dairy, was demolished in 1937 and Building 20, an abrasives factory, was built on that site that same year.

But, in 1936, Buildings 1, 2, 14 (built in 1929) and the dairy structure on the north side of Fauquier Avenue formed 3M's administrative and laboratory row. In those laboratories, men and women conducted tests and simple experiments on products and raw materials used to make tapes, rubber cement and other adhesives, coated abrasives and minerals.

3M had been operating laboratories of sorts since 1916 when Sales Manager William L. McKnight set up a facility to determine standards for 3M sandpaper. It was a testing facility more than a laboratory, but noteworthy as a distant forebear of 3M's specialty chemical businesses.

The first step forward from that point was taken in the abrasives test laboratory in 1921 when workers began developing a better varnish to bond minerals to backings in making sandpaper. Those efforts would result in a technological triumph in the coated abrasives industry—a varnish that could withstand soaking in water without softening. It was named 3M Wetordry™ sandpaper, then revolutionay, still important today to the Industrial Abrasives Division.

When Hendricks arrived in St. Paul, 3M was thirty-four years old. The company was founded in the summer of 1902 in Two Harbors, Minnesota, to mine corundum to be sold in bulk to manufacturers of abrasive grinding wheels. By 1905, 3M had moved from Two Harbors, a few miles south to Duluth. In January 1906, by then in the business of making sandpaper, 3M recorded its first sale, a two-

dollar order from the South Bend Toy Company.

The mining operation was abandoned after it was learned that the substance being dug from the earth near Two Harbors was not corundum, but low grade anorthosite unfit for abrasives. 3M not only lost sales and had to contend with returned goods, but had to buy mineral to make its own sandpaper as well.

In 1907, the fledgling firm hired as an assistant bookkeeper a young man named William Lester McKnight. Soon the new assistant was advanced to cost accountant, 3M's first. Two years later, an office manager was needed for the Chicago Sales Branch and he was given that job.

In 1910, 3M was relocated to St. Paul because the man who had the most money invested, Lucius P. Ordway (3M's President from 1906 until 1909), wanted the company to be nearby so he could keep an eye on it.

Eleven years later, in October 1921, Mr. McKnight, by then Vice-President of the company, hired a man who would become 3M's fifth president and who would have impact on the Flurochemical Project a quarter-century later. He was Richard P. Carlton, who before his early death in June 1953, became known as the father of 3M research. He began at 3M with the title Factory Engineer, but quickly moved toward directing the various laboratories. Another distinction was his engineering degree from the University of Minnesota which made him the first 3M technician with a degree from an accredited college.

When the waterproof sandpaper project got under way, Francis G. Okie, a Philadelphian who had invented and patented the process, came to St. Paul. Okie was an inventor, not a scientist, so in 1928 3M hired Dr. Barney Oakes from paint manufacturer Sherwin-Williams to work on new formulations. Oakes, who had the distinction of being 3M's first Ph.D., was involved with 3M's chemical industry, among other things, for many years until his retirement in 1959.

Opposite: Eastside St. Paul location shows (from right) Buildings 2, 14 and 20 along Fauquier Avenue and the back of Building 21 on east side of the street. Parking lot behind Building 21 was site for Building 42 in 1951. At left, across Mendota Street, tape plant Building 24 is under construction. East Seventh Street angles from left to right in foreground. Forest Street is at right.

Another pioneer in 3M specialty chemicals was Joseph Kugler who began in 1927 in the abrasives area where one of his first assignments was to design a mineral storage building. He got into chemicals by joining the waterproof sandpaper laboratory project in the early 1930s.

Barney Oakes

We can assume that 3M's first waterproof sandpaper was made with purchased resins, but we know that soon the company was making its own varnish. Oakes, in a letter dated February 2, 1933, referred to "the several weeks of January that we have been operating our new varnish plant." That would indicate that chemical manufacturing at 3M dates from that year.

Dr. William E. Lundquist (who joined 3M in 1942 and retired in 1977) recalled stories that in the 1920s 3M made varnish in pots over open fires in Building 11 at the Old East Side plant location*. As could be imagined, that process was dangerous and varnish fires flared up frequently.

William Lundquist

Another addition to the chemical business in the late 1920s or early 1930s was Walter Eilers, who was hired from Minnesota Paint Company (now Valspar) in Minneapolis to operate the varnish department.

In 1935, chemical manufacturing at 3M took another step forward into research distinct from varnish-making or similar compounding. It began with General Motors' interest in the development of a source for waterproof abrasive discs. GM needed to wet sand the lead filler used to patch gaps between fenders and bodies after the cars came off the assembly line. The excess lead needed to be sanded away for appearance sake, but dry sanding created clouds of toxic dust that flew everywhere.

GM issued an appeal to all abrasive manufacturers; at 3M Kugler was assigned to that problem. His first solution was what 3M called

*Much of the early history cited was recorded by Lundquist from discussions with Kugler in the mid-1940s.

35 Oil, which was a slightly reacted phenol-formaldehyde resin in water. Because there was no better equipment, 35 Oil was formulated in a small open glazed box referred to as the "horse trough." The mixture was stirred with a canoe paddle wielded mostly by Howard Brinker, who would become 3M's phenolic expert in later years.

Joe Kugler

Producing resins under those circumstances was disagreeable, to put it mildly, so Kugler passed a complaint along to management. In a letter dated June 12, 1935, on the subject of Mixing Equipment for No. 35 Oil, Kugler indicated that the complaint had been satisfied. The letter, addressed to a E. M. Johnson, who was in charge of the Engineering Department, with copies to Carlton, Oaks and Lloyd Hatch, is reproduced here:

"I would appreciate having you order the 200 gallon Pfaudler glass lined mixer for No. 35 Oil as soon as possible. With the coming warm weather the fume condition is becoming almost unbearable. The present horse trough and handling equipment affords little or no protection. To supply both Wausau and Copley* this equipment is being used to practically its full capacity. Mr. Carlton is favorable to this purchase.

"I would like to see the general layout plan for this installation before the auxiliary equipment is ordered.

J. H. Kugler"

That acquisition allowed the horse trough to be retired after about six months of duty.

Lundquist believes Kugler's mixer was a two hundred gallon glass-lined kettle which was in Building 11 when Lundquist arrived in 1942. "That two hundred-gallon kettle together with a forty-gallon glass-lined kettle were the only heated and cooled kettles at 3M when I joined the company," he said.

Lundquist also said that although No. 35 Oil might have been an original solution for General Motors' problem, "It was also necessary to develop a phenolic resin binder which was accomplished in short

*The resin also was being used as a primer on roofing granules at 3M manufacturing facilities in Wausau, Wisconsin, and Copley, Ohio.

order." Lundquist's notes also said that "For most of the compounding work, direct fired, open varnish kettles were used from perhaps 1923 until we moved to Chemolite in 1948, and even for a while thereafter."

The horse trough operation developed into a separate Resin Department around 1936. That marked the separation of chemicals from abrasives and planted the seed for the independent chemical operation of the 1950s.

• • •

The first thing Hendricks did when he walked into the Rubber Cement laboratory in 1936 was to seek out his new boss, Grant Merrill, who gave his new employee a tour of the facility. First stop was the room containing the cement and tape laboratories.

"I saw heavy steel tables stacked high with tin plate cans full of experimental adhesives," Hendricks recalled years later. "It was quite a departure from the lab that I was used to at the University of Illinois...At first I thought that the research in reclaimed rubber cements was just mixing things together and noting the results. However, I learned later, as I became more experienced, that there was an art to compounding. You had to know raw materials, their properties, physical properties, chemical properties, and so on, raw materials such as reclaimed rubber, resins, solvents and oxidants, dispersing agents and so forth."

In August 1936, six weeks after he began working, 3M's adhesive operations including the Rubber Cement Laboratory were moved to Detroit, Michigan, to be near the automotive industry. That move not only accomplished the obvious, but became a pilot study of how 3M business units could operate independently without day-to-day supervision by top management*. That experience might have influenced the formation of the Central Manufacturing Division (CMD) and seven other divisions in 1948, a structure 3M has followed ever since.

*In 1990, living in retirement in White Bear Lake, Minnesota, Hendricks recalled that in 1936-37, 3M management people including Mr. McKnight and Carlton visited Detroit regularly—usually monthly—to review the business and the product development work in the laboratory. The department heads also went to St. Paul for meetings.

CHAPTER 3

The Research Laboratory

In 1937, 3M established its first pure research laboratory. It would be the nursery where the fluorochemical research project would be placed and begin to grow eight years later.

The General Research Department, as it was named, was distinctly different from the product improvement laboratories which had been established by various divisions over the years. The new laboratory was dedicated to developing new technologies; division laboratories were dedicated to finding methods of improving existing products. An example was the Tape Division laboratory which was organized as a product improvement center for Scotch™ masking tape, developed in 1925 and Scotch cellophane tape, which was invented in 1930.

Harry Stephens

Dr. Harry N. Stephens, an organic chemist at the University of Minnesota, who had been a consultant to 3M, was hired to organize the General Research Department. He hired Hendricks from Detroit, then went outside to hire Dr. L. Wallace Cornell and Dr. William Sohl. Cornell and Sohl were the fourth and fifth Ph.Ds hired by 3M, joining Oakes, Hendricks and Stephens. By 1990, 3M would employ more than 1,000 men and women with doctorate degrees in the St. Paul area alone. Gilbert Gehrenbeck, a Chemical Engineer, completed Stephens' roster. Gehrenbeck, a UofM graduate and a 3M employee since 1928, had pursued research on electrical tapes with Stephens while the latter was at the UofM.

The vision of Mr. McKnight and Carlton was borne out when the research department began to shape the future of 3M. The Laboratory's impact on the new fluorochemical technology alone, when it arrived in the mid-forties, was outstanding.

The establishment of two other 3M departments within six years after the organization of General Research in 1937 not only was additional evidence that the company was determined to develop new technologies, but provided a system for developing 3M fluorochemicals into marketable products. A New Products Department (NPD) was formed in 1940 under the leadership of Joseph C. Duke, but a few months later, he turned the department over to Bert S. Cross, who would be 3M's President in the 1960s. NPD was responsible for turning General Research accomplishments into salable products. In 1943, a Product Fabrication Laboratory (the Profab lab) was set up to develop manufacturing processes for new products developed by NPD.

The Laboratory in 1937. Bill Sohl is at left, Hendricks holds file.

The General Research Department name, originated by Carlton, was accepted at 3M, but after Bill Lundquist and Cort Agre joined the organization they referred to it as Central Research. That was DuPont's name for its research laboratory, where Lundquist and Agre

had been employed. Dr. Stephens liked the sound of Central Research and adopted it for his laboratory in the 1940s.

The General Research Department's first home was a modest room fifty feet long and twenty feet wide in the basement of Building 2. Directly behind it, separated only by a partition of shelving, was the Tape Laboratory in the basement of Building 1. That proximity allowed General Research scientists to use the Tape Laboratory's equipment, which was a decided advantage. Off-setting that were the curtains of dust that streamed down on desks, files, floors and personnel whenever a jumbo roll of coated abrasives was accidentally dropped in the slitting department on the first floor.

"The laboratory," Hendricks said, "consisted primarily of heavy steel tables. We had some homemade mixing equipment, tape spreaders, coating equipment, a reaction vessel and drying and heating equipment. The tape lab had rubber mills, with Baker-Perkins experimental mixers, churns and other ordinary equipment that you find in a laboratory."

In 1938, its second year, General Research escaped to the basement of Building 14, which had been built west of Building 2 in 1929. There were no dust clouds, but another problem confronted the researchers. The drying ovens for No. 5 maker which manufactured abrasives was on the first floor. So, while the new quarters provided more space and better facilities, the atmosphere, even with air conditioning, was stifling. Almost every day the thermometer in the laboratory registered eighty to eighty five degrees because of the heat radiating through the ceiling.

Mr. McKnight

Projects pursued at that time in the Laboratory were hardly esoteric. Nor, were the scientists carrying out pure research. Hendricks developed a waterproof adhesive for beer bottle labels. Before mechanical refrigeration was wide-spread, bottled beer and soft drinks sold in taverns, drug stores and other retail spots were cooled with ice. Soaking in ice water caused labels to slip from beer bottles, so Hendricks formulated a water-resistant adhesive. The program flopped because he could not make the new adhesive compatible with the automatic labeling machines of the day. Other problems that kept the staff busy during those first years included improving adhesives for 3M's tape products, glass bead studies and searching for a coating to make it easier to unwind masking tape from rolls.

Two more moves were to be made before the Department found a permanent home. In 1939, after a year in Building 14, the Laboratory was moved to the third floor of Building 2. The research team occupied space vacated by Mr. McKnight and other management people who had moved down the block and across Fauquier Avenue to the new Building 21. The Laboratory remained in Building 2 until 1945.

After he arrived in 1942, Bill Lundquist contrasted 3M's research operation with DuPont's experimental station in Wilmington, Delaware. DuPont's staff had a preponderance of researchers with doctor's degrees. Division laboratories at 3M employed men with bachelor's degrees or with no advanced education. 3M also was more informal than DuPont, with Mr. McKnight and Carlton personally and constantly involved with the laboratory programs. Lundquist recalled meetings with management that ended with authorizations being signed before anyone left the room.

During its first eight years, the Central Research Department grew six-fold. Thirty people were employed there in 1942 when the Laboratory was moved upstairs in Building 2. By 1945, when the Laboratory was relocated to the Benz building, sixty-three names were on the payroll. Twelve were Ph.Ds, including Director Stephens, Hendricks, by then in charge of the Colloid Section, and Sohl, head of the Organic Section. (Two others on the original team, Gehrenbeck and Cornell, had moved to other jobs in the company.) The other fifty-one laboratory workers were a sixty-forty mix of men and women, technicians and secretaries.

The relocation of Central Research Department from Building 2 to the Benz building was a major step forward for the Laboratory. The Benz building, still occupied today by 3M laboratories, had six floors, so Laboratory employees finally had ample elbow room. The structure, a one-time liquor warehouse, stands several miles west of the original 3M plant site and east of St. Paul's downtown business

Opposite: Harold Scholberg holds the attention of visitors to an open house at the new CRL in the Benz building in 1945.

district. The facility has been modernized over the years and in 1990 housed the Protective Chemical Products Division Laboratory and several other 3M laboratories.

"In 1945," Jim Hendricks recalled decades later, "the top floor of the Benz building was the last word in laboratory facilities (at 3M). We had a big open house and Mr. McKnight took great pleasure in escorting the mayor of St. Paul through our new laboratory."

Hendrick's impression of the Laboratory as a grand facility must have been influenced by the time spent in the monastic basements of Buildings 2 and 14. Others who came to 3M in the late 1940s have different memories of the converted whiskey warehouse and candy factory.

Be that as it may, a program produced for an open house on May 4, 1945, made the Benz building seem almost palatial.

"The location (of Central Research) is on the top floor with high ceilings and easy access to vent hoods through the roof" the section on Outstanding Features of This Laboratory began. "The space is divided into areas for each section. Technical people of one kind are kept together. The facilities of the various areas are designed for the functions of that area."

Ventilation, incandescent lighting and "walls and ceilings (that) have been painted to lend a pleasant atmosphere and furnish adequate light" were noted. Asphalt tile floors described as "less tiring than concrete" were noted.

"The chemical benches are of the latest design. Experience dictated the drawer and compartment arrangements. The bench tops are, except for a few instances, impregnated fine sandstone in place of the conventional soapstones. Pipework in the benches is hidden. At present this is not important because the supply lines come in overhead. Later...all service pipes will be hidden. Utility outlets for gas, water, steam and electricity have been generously provided."

Tall vent hoods each vented to the outside and with its own blower, safety glass in the windows and other safety features such as a board between each bench to block flying glass in the event of an accident as well as to "foster concentration" were in the new building. Special rooms were provided for shop, constant temperature, optical, photographic and microplant work.

"The Central Library, which services the Central Research Laboratory and the Departmental Laboratories, is located on the fifth

floor. Many technical and trade periodicals are on display. Some important scientific journals have been bound."

The men who joined 3M in the late 1940s saw the building in a much different light. They had not only worked in modern college laboratories, but had toured other industrial research laboratories in the course of job interviews. Compared with those facilities, the Benz building definitely was not posh.

Dr. J. D. (Don) LaZerte, who came to 3M in 1949, recalled steam locomotives noisily shunting boxcars in the nearby railroad yard. The engines not only huffed and puffed and slammed and banged, but they emitted cinders and soot that billowed high into the air. The ash drifted through the open windows into the sixth floor fluorocarbon laboratory during warm weather. In colder months, closed windows blocked ash pollution, but there were no storm windows, so the laboratory was an icebox.

Dr. Lester C. Krogh, who retired in 1990 as Senior Vice-President for Research and Development, sometimes mentioned the Benz building in presentations. He was charmed that it began its career as a whiskey warehouse.

"(It) was built of poured concrete with factory-type windows..." he once said. "One thing you did have to say for it was that if you needed to set up a new piece of equipment, nobody complained about spoiling the appearance of the surroundings."

The sixth floor was one big space that held nine benches set in two wide rows running north and south. The Organic Section took up the southeast corner with the Colloid Section in the southwest. The Analytical Section was the first row. Two benches were used by the Iron Oxide Pigment Group, three by the Fluorochemical Project. Carl Miller's dry copier project, Harold Scholberg's surface chemistry and Nelson Taylor's glass bead project filled the rest of that row.

One level down, on the east side of the fifth floor, were the one hundred ampere electrochemical cells. A two thousand ampere cell for larger experiments was in the pilot plant behind the building in a garage that once house whiskey delivery trucks.

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When Charles (Charlie) Bentz joined 3M's Special Products Laboratory in 1943 it contained a Varnish Department and a Resin

Department. Bentz worked on monomers and polymers* in the Resin Department for about six months, then was transferred to a small 3M plant in Illinois. When he returned to St. Paul, he was assigned to a factory in Building 11 as its Process Engineer. That factory manufactured adhesives for tapes, phenolics and varnishes for abrasives, monomers for adhesives, polymers for magnetic tapes and a small line of furniture and automotive finishing compounds for outside sales.

Central Manufacturing Division (CMD) was formed and had built a factory near Hastings in 1948. Oakes was General Manager of the division which was responsible for producing resins and chemicals as manufacturing materials for other 3M divisions. Five years later, when Special Products Laboratory was transferred to CMD, there were four process buildings and a combination warehouse-office-laboratory at Chemolite.

Begun in 1945, Special Products Laboratory was located on the third floor rear of Building 2 in space vacated by Central Research when it moved to the Benz building. There were eight people in the Special Products Laboratory working with acrylate polymers and monomers trying to discover a replacement for synthetic rubber. That laboratory was an ancestor of the industrial chemical laboratory and similar laboratories that followed.

In 1953, Kugler replaced Oakes at CMD and chose Lundquist as his Technical Director. (Both Kugler and Lundquist were involved in early development of 3M's film-making technology and manufacturing, which began as a project in the Chemical Division.)

*The building units of many plastics and rubbers are carbon-and-hydrogen-containing-molecules known as monomers. With the help of catalysts, monomers can be connected into long molecular chains which are polymers. For example, ethylene is a monomer of polyethylene, a polymer. The shape of the molecular chain helps to determine a polymer's properties. In a fiber, the molecules might lie straight, giving strength and stiffness. In synthetic rubber they are tangled; stretch them straight and they try to curl up again like rubber bands, providing springness.

CHAPTER 4

The Simons Connection

3M became associated with Joe Simons through the company's support of another research project at Penn State.

In 1942, Central Research Director Stephens arranged with Dean Frank Whitmore of Penn State's College of Chemistry to undertake a project for 3M. The goal was to perfect organo silicone compounds; 3M was trying to develop a silicone rubber that would be impervious to heat as a material for making gaskets for military searchlights.

In that early war year, silicones were new and exciting. Today, a half-century later, silicones are used routinely in many homes as spray-on waterproofing treatments for shoes, boots, tents and other materials requiring protection from water or water stains. Modern silicones also are inexpensive and less effective competitors to 3M's fluorochemical protectors; less effective because while they seal against water, they offer no protection against oily stains.

Stephens met Dean Whitmore while pursuing a 3M management mandate to ferret out new technologies being developed on U.S. college campuses. Stephens' link to Penn State was his acquaintance with Dr. Nelson W. Taylor, who was a graduate student at the UofM during Stephens' tenure and by 1942 manager of Penn State's Ceramics Department. Coincidentally, Taylor also knew Simons from their graduate days at the University of California.

3M's Central Research Department, in operation five years, was a beehive of activity. However, in the main, 3M scientists were pursuing product development and not pure research. Clearly, the company needed something to fulfill the mission of the Central Research Laboratory. So, Stephens was an eager courier, running from campus to campus seeking at least one infant technology that 3M could possess and develop.

Besides 3M's interest in a silicone material for gaskets, the company was interested in finding a new or improved method of manufacturing silicone compounds and was making some progress on that in St. Paul. When Stephens mentioned the possibility of a joint study on that subject with Penn State, Whitmore referred him to Simons, who shared laboratory space with Whitmore on the top floor of the Physics building. Simmons had never worked with silicones, but agreed to with the financial support of 3M. He assigned a graduate student, Wilbur (Bill) Pearlson, to manage the project.

Dr. Harry Stephens, Director, Central Research Laboratory, with Mrs. Stephens in 1945.

A graduate chemist from the University of California at Berkeley in 1938, Pearlson eventually journeyed east hoping to earn an advanced degree under Whitmore. Upon his arrival at Penn State, he found that the dean did not have a fellowship to offer him. Whitmore steered the eager student to Simons, who held three fellowships for a National Defense Research Council (NDRC) project on radioactive gases as counter measures to chemical warfare. Each fellowship was for eighteen months at one hundred and twenty five dollars a month. Pearlson began with Simons in late winter of 1941 and stayed

until 1947.

In the NDRC project, Pearlson was introduced to fluorine chemistry.

He retired from 3M's Commercial Chemicals Division Laboratory in 1985 after 38 years with the company, retaining clear recollections of Harry Stephens, including a conversation during a dinner meeting one evening near the campus. It began with Pearlson reviewing the laboratory efforts for the previous six months. Nothing had worked, Pearlson said, and added that he and the four other graduate students involved were running out of ideas.

Before the two men left the restaurant, Stephens came up with twenty ideas which he generated in a process that unnerved Pearlson. First, Stephens uttered a few words on the subject, then lapsed into silence that lasted four or five minutes. Then he offered an idea and enlarged on it briefly, then sat thinking in silence again. That long process continued until Pearlson had nervously jotted down the final idea. He was, he recalled, impressed with their quality and by the fact that Stephens was so well-informed about a wide variety of existing industrial processes.

The irony is that by the summer of 1944 one of the ideas on the graduate students' original list bore fruit, so Stephens' ideas were never pursued. A patent for the new process was signed and sent back to 3M. Almost simultaneously, the Journal of the Chemical Society published a six-page report on General Electric's silicone production accomplishments. "It set down in detail exactly what we had done," Pearlson remembered.

3M continued its silicone contract* with Dean Whitemore for several years, but with GE's revelation it was clear that any valuable patent coverage was no longer possible.

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Is there such a thing as 3M luck? Or, are business opportunities so generously scattered that every wide awake company gets its share? In any event, luck played a role in what transpired. The facts were that before 3M became aware of Simons and eventually his electrofluorochemical research, the professor had tried to sell his technology to several other companies. DuPont and Westinghouse

* A retired 3M executive estimated the value of the silicone contract to Penn State at $5,000 to $10,000 a year.

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turned him down, partly because of the professor's personality.

"He wouldn't release his patents," Bill Pearlson said years afterwards, "unless DuPont (or Westinghouse) would hire him and give him complete control of the product development."

Hugh Bryce, another retired 3M scientist, recalled that DuPont was well acquainted with Simons' superdeveloped ego. "He was a consultant for DuPont for about two years," Bryce said, "during which time he tried to run their lives. Not just their business lives, but their personal lives as well."

Lyle Hals, who also knew Simons, did not remember negative traits. Hals was, however, impressed with Simons' ability to figure columns of numbers in his head. He also recalled that Simons was a glass blower and a proficient plumber. "He scoffed at lab coats," Hals said, "and never removed his suit coat. He believed a good researcher never spilled anything. And, **he** didn't."

So, by 1944, the year after 3M became involved with Simons in the silicone project, the professor's fluorochemical achievements still were bridesmaids. Because of GE's findings, the 3M-financed silicone research project was to be terminated, but Simons, not one to let corporate funds slip through his fingers, convinced 3M to transfer the balance of its grant to his electrofluorochemical project.

Simons and graduate student Frances had applied for their first patent on the preparation of organic fluorine compounds by electrochemical fluorination in 1941. By 1944, Simons, working with Walter Harland, had the research to the point that it attracted 3M's interest. The following year, 3M acquired Simons' patents.

"Dr. Stephens," Jim Hendricks said, "really deserves the major credit for getting 3M into the Fluorochemical Project and pushing it through to agreements with Simons and getting it into the commercial phase."

At that time, Central Research Department was busy with several major projects. Magnetic audio recording tape was under development. 3M's copying project, which would result in the invention of the first dry copying machine, was under way. So was a project to develop reflective glass beads, the raw material for reflective sheeting still popular today for traffic signs on streets, highways and freeways. Another important project, which didn't have the pizzaz of recording tape, copying machines or reflective signs, led to further perfection of 3M's acrylic polymer tape. Into that arena, fluorochemical

technology—3M's first pure research project—was drawn.

Soon after Simons' patents were transferred to St. Paul, 3M researchers projected that they could have a pilot plant cell in operation within two years. To that end, three Chemical Engineers, Ed Kauck, Al Diesslin and Lloyd Picard, were dispatched to Penn State to learn how to operate one. Diesslin and Picard stayed in Pennsylvania six months. Kauck stayed an entire year.

There they learned the fundamentals of operating a cell plus advanced techniques from Pearlson and other graduate students in Simons' laboratory.

Dr. Fred Steele of 3M's iron oxide research program was assigned by Stephens to be 3M's contact with Penn State.

Nelson Taylor, the ceramicist who left the UofM for Penn State, had in 1944 accepted a 3M offer to manage 3M's glass bead chemistry project. By 1947, he was in charge of the new fluorochemical development program. That change came about—at least to some extent—because Stephens wanted to hire Pearlson and transfer the laboratory work from Penn State to St. Paul. As part of the hiring process, Stephens invited Pearlson to recommend the man who would be his boss in the new Project. Pearlson talked with Jim Hendricks, head of the Colloid Section, Bill Sohl, head of the Organic Section, and Taylor, who was in the Physical Chemistry Section*, then told Stephens he would like to work with Taylor.

In 1950, Tom Brice left Penn State and joined the Project at Pearlson's invitation. Both made large contributions to the technology that became Scotchgard™ protector and other 3M fluorochemical products.

The first cell run at 3M was conducted in the Benz building laboratory in November 1946 using a 50 ampere cell built by 3M based on a design obtained from Penn State.

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When 3M began working with Simons early in the 1940s, Simons' laboratory was equipped with two three-to-six ampere cells. Each was an iron pipe three inches in diameter and ten inches high with a steel rod through the center and a nickel electrode around the rod. The bottoms were sealed and the top caps could be bolted down.

* William Wetzel of the Inorganic Section, who was immersed in iron oxide research, was not considered. He was too busy helping to develop America's first audio tape.

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The cells were operated by a generator which converted alternating current to direct current. A four-ton refrigerator was used to condense the gases which were produced and also to cool the cells to retard the evaporation of the anhydrous hydrofluoric acid or HF.

Tom Brice

In 1945, three one-hundred-ampere cells designed in Simons' laboratory and fabricated at 3M replaced the original cells at Penn State. Each new cell consisted of a twelve-by-twelve-inch jacket with a six-by-six-by-ten-inch electrode pack inside. That design and those types of materials were used for years to make new cells.

In essence, a cell is a steel pot with a cover which can be tightened to make it a pressure vessel. The electrode pack inside can be compared roughly with the anode and cathode plates of a storage battery. At the bottom of the cell is a valve where fluorocarbons, which are not soluble and settle to the bottom, can be drawn out as clear, colorless liquids. Some of the fluorocarbons produced are vented with the hydrogen as gases.

The cell process begins with organic carbon-hydrogen compounds. The hydrogen atoms are replaced by fluorine atoms in a simple relatively safe, one-step process, during which the product is completely fluorinated. No chlorine is involved and all the hydrogen atoms are replaced.

Complete fluorination gives 3M products vastly different properties compared with their organic counterparts. They also are vastly different from chlorofluorocarbons (which are frequently and erroneously referred to as fluorocarbons.) In a final step, the product is purified, usually by distillation. Inert fluids are complete in themselves. Reactive organic products are mixed with other chemicals to make a variety of products.

The process is versatile, too. With only minor adjustments a cell can be used to make a wide range of fluorochemicals simply by changing the organic feed stock, which is the raw material. In most other methods, each product needs its own processor or at the very least, major adjustments are necessary. Capacity of the Simons cell can be expanded easily by adding cells. That versatility is vital when a

number of products are produced in relatively small quantities.

The biggest advantage, of course is that the electrolytic cell process does not involve free fluorine. Using anhydrous hydrofluoric acid (HF) as the raw material eliminates the difficult and dangerous use of free fluorine. Consequently, ordinary materials can be used to build cells and other equipment because HF, while corrosive, can in the absence of water be contained in steel and other metals.

If the process as explained here appears simple and easy, be assured that it is not. Operating a cell is an art more than a science and what 3M has learned about that art over the decades is a closely guarded secret. During the last half of this century, other companies—Phillips Petroleum and Shell Chemical Company to name two—and the U.S. government have tried and failed. The exception is Rimar Chemicals of Italy, which operates a few cells to produce a limited range of products.

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While Simons was refining his electrofluorochemical research, in 1942, 3M noted its fortieth anniversary. The company, which started with one product (the annual report stated) "now manufactures many diversified products used throughout the world daily in virtually every phase of everyday life." That hyperbole was exposed immediately by a list of those products and product lines: Scotch tapes, sandblast stencil, No-Mar™ tape for protecting surfaces, rubber and resin cements, colored roofing granules, color pigments, flint mineral for abrasives, silica sand, Scotchlite™ reflective materials ("for safety marking of highways and railroad crossings and for commercial advertising signs"), polishing and rubbing compounds, oil sheet packing and gaskets, protective material for shoes "and many others." Diversification was attributed to research "on a constantly growing scale" beginning with waterproof sandpaper.

3M was operating its headquarters, four factories, thirteen branches and warehouses with three thousand seven hundred employees, including two hundred and eighty salesmen. Twenty-seven hundred stockholders shared the dividends, which increased from twenty cents a share in 1923 to two dollars and forty cents in 1941.

As a contribution to the war effort, 3M built a sulfuric acid plant in 1942 on an old roofing granules plant site in Copley, Ohio, to supply gun powder manufacturers. 3M also joined four other companies to form the National Synthetic Rubber Corporation to operate a government-owned synthetic rubber factory in Louisville, Kentucky. That venture was not very profitable because the cost of raw materials and the selling price of the product were controlled by the federal government. Operating the plant, however, allowed 3M "to acquire technical information regarding the manufacture and use of synthetic rubber which may be valuable should synthetic rubber play an important part in the post-war economy." Inland Rubber Corporation was acquired by 3M in 1941. Later, that subsidiary's name was changed to Midland Rubber Corporation. Subsequently some of the firm's assets were disposed of by 3M.

3M and many other U.S companies suffered from raw material and manpower shortages during the war, but that situation was reversed in the post-war boom years. By 1948, 3M could report that manpower in Central Research and division laboratories had increased about twenty percent that year. 3M also was operating sixteen factories (compared with four in 1942) in fifteen cities and warehouses or sales offices in eighteen cities. The 1948 report also stated that 3M was in the middle of a twenty million dollar expansion program.

In 1949 two new corporate positions were created. Mr. McKnight became Chairman of the Board, Archibald G. Bush Chairman of the Executive Committee, and Richard P. Carlton replaced Mr. McKnight as 3M President. In the previous year, Carlton had been appointed Executive Vice-President of Production, Engineering and Research.

Sales in 1949 totaled $114,925,274 compared with $63,548,337 in 1945. Profits were $15,398,176 or nearly five times larger than the profits reported in 1945. During that same period, the number of employees grew from 6,795 to 8,759.

That was the atmosphere at 3M when the fluorochemical technology was placed in Central Research in 1945.

When Diesslin returned from training at Penn State, he was appointed manager of the Pilot Plant. Don Wardrop, a Chemical Engineer who had joined 3M and the Project in 1946, became Diesslin's assistant.

Wardrop and Roy McKenzie, the Project Engineer, designed and supervised the construction of the two-thousand-ampere cell which was placed in operation in the Pilot Plant in the spring of 1947. Building a cell that size was a decided gamble because Simons had made only grams of a number of different substances and produced only pounds of the CF gases (CF_4, C_2F_6, C_3F_8) that the pilot plant

was designed to produce in larger quantities.

Simons' technology also could only produce inert fluorocarbons, so 3M's goal was to develop reactive materials while also coming up with new, profitable uses for inert fluids. No one knew how to produce reactive fluorochemicals, but they were certain that it could be done. Even during the early research at Penn State, Simons believed that by their very nature reactive fluorochemicals would be superior repellents of water, oil and other staining liquids.

"We knew," Jim Hendricks said, "that if you replaced the hydrogen with fluorine atoms in organic materials, you were going to get very unusual properties. And, surely something of value would come out of those unusual properties." Furthermore, 3M management often "preached that we want something unique and novel."

The work to develop an inert refrigerant fluid was obvious because 3M's laboratory cells were producing materials which were biologically inert and stable. That program failed, however, because 3M's selling price was too high. Another reason was that 3M's product did not perform as well as those of competitors.

3M also pursued the use of inert fluids as dielectric coolants for transformers and electronic equipment. A small quantity of the liquid could be pumped from a sump in a transformer housing and sprayed over the windings to cool by evaporation. Westinghouse Electric Corporation built two large tranformers which used 3M's inert liquid successfully, but 3M still could not produce and sell its fluids at an attractive price.

Inert fluids were ahead of their time. Nearly two decades later, in the late 1960s, they became popular as coolants for electronic devices and equipment.

A major obstacle to the reactive fluorocarbon research was the laboratory staff's inability to analyze the solids and gases produced in the cells. The problem was caused in part by the newness of the technology. Another factor was that testing equipment of the type found in laboratories in later years simply did not exist in the 1940s and 1950s. Some help was obtained from Professor Alfred O. Nier* at the UofM who ran 3M tests on the university's new mass spec-

* Nier supported the Manhattan Project through uranium studies and tests in his laboratory before the war and later worked fulltime at Oak Ridge, Tennessee, developing spectrometer separations of uranium isotopes.

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trometer, but that could not be done on a regular basis. Adding to the analysis problem was the fact that 3M scientists continually broke new ground in chemistry so that available test methods soon became obsolete.

"Almost every day we made a new molecule which had never been on the face of the earth before," one participant remarked years afterward. "We made new compounds, tried to identify what we had and filed patent applications."

Still there were no signs that indicated the research to develop a reactive fluorochemical was getting anywhere.

"It was pretty clear," Bill Pearlson said not long ago, "that we weren't going to go very far with the kind of materials we could make. They showed all the characteristics of the fluorocarbons—incompatibility with oil and water, thermostability—but there was no good way of converting those stable compounds into the kind of organic molecules that could be commercial. We needed a "hook" so we could transform the material into polymerizable molecules, the raw materials for organic syntheses.

"That's the job I was assigned when I came up from Penn State to St. Paul."

Luck intervened again in 1948 to end the search for reactive fluorochemicals. Acidic impurities had to be removed from the gases produced in the pilot plant cell, so an ammonia scrubber was rigged to the cell's output system to remove CO_2 and excess HF. The standard charge used for that was butyric acid, but Ed Kauck suggested substituting butyric anhydride, which would minimize the water and therefore decrease production of toxic reactive oxygen fluorine (OF_2). After Kauck's suggestion was adopted, the scrubber—six inches in diameter and ten feet high—became plugged with pounds of a soft, greasy mash of white particles. When allowed to dry, the strange substance became a greasy powder.

Some of it was sent to Wetzel's Analytical Section where infrared analyst Donald Weiblen learned that it did not match any conventional pattern or scale. During a discussion with Pearlson, Weiblen mentioned that the powder seemed to sublime, that is change from a solid to gas without going through an intermediate liquid state when placed under high vapor pressure. That directed Pearlson onto another track. Could the powder be an amide?

Experiments were run to convert the substance to a nitrate and an

acid. Both proved out, which established the compound's identity. The cell's production of perfluorsacyl fluorides had been converted to perfluorosacyl amides in the scrubber. Weiblen's experiments also provided him with new patterns in infra-red spectra for future analysis.

The material was turned over to the Organic Section to develop its chemistry. Researchers in that department headed by Dr. Matthew W. Miller began testing and studying it. Dr. Thomas S. Reid, Dr. Don Husted and Arthur H. Ahlbrecht learned that they could esterify the greasy powder. They could reduce it to alcohol and make acrylates.

And, they also discovered, what had come from the scrubber was a fluorinated carboxylic acid. At last, with luck, 3M scientists had produced reactive fluorochemicals.

There still were many obstacles to hurdle before success was achieved, but at least the race was underway.

CHAPTER 5

A Critical Year

Nineteen forty-nine was a critical year.

Four years had elapsed since 3M had acquired Simons' process. A considerable amount of money had been spent, an array of chemical compounds had been developed, but still there were no products—or sales—to show for all that.

The strain on the exchequer was demonstrated the previous year when Taylor, in a letter to a scientist he wished to hire, wrote that money was not available to allow him to make a salary offer.

The Project also had become a target of sniping by 3M management people whose careers were tied to other, less favored product lines.

Two occurrences in 1949 helped change that gloomy picture. A government contract was obtained, providing outside money for continued research. And, an internal meeting cleared the air and breathed new life into the Project. Both the Air Force contract and the meeting were very important to 3M.

The meeting held on April 21 was called by President Carlton, who had been close to the Project from its inception while he was Vice-President of Research and Manufacturing. Now as President*, he was approaching another important decision point. He could recommend that the company allocate enough money to maintain the current level of research. He could reduce his funding request, which would force a cutback. He could request no money at all and kill the Project, the latter an unlikely choice given Carlton's, Stephens' and Mr. McKnight's intense interest in fluorocarbon technology.

*In 1949, Lloyd A. Hatch, a 3M Vice-President, replaced President Carlton as coordinator of research and new product development. Hatch had been in charge of the Roofing Granules Division.

Their support was as strong in 1949 as it had been in 1945.

There may have been another reason that contributed to the selection of the meeting date. The grumbling among the non-fluorochemical management people representing other groups and divisions had increased with each passing year. Those men had their own research and development programs that could use more corporate funding. Each was aware that his value to 3M was measured by his achievements and that R&D turned ideas into profitable products sooner if more manpower was applied. They looked enviously at a research venture that didn't appear to be product oriented, that did not appear to be going anywhere, but which was allowed to continue with an abundance of manpower supported by company profits.

Richard Carlton

3M's annual stockholders meeting was approaching. Those other management people would expect Carlton to provide evidence then that the Project deserved funding for another—its sixth—year.

Carlton took a novel approach—and it turned out an ultra-important step—to help him make his decision. He polled key people in the Project to find out whether they were fervid, lukewarm or in between. He asked them to defend their stands. Why did they feel the way they did? He extracted a consensus by letting the participants express what they felt had been accomplished and what they still expected to achieve.

Everyone in the room, from the oldest veteran to those whose employment could be measured in weeks or months, was asked to speak. At the end, each was asked to submit written answers to three questions: Is this project commercially sound? What will be the determining factors of success or failure? How should 3M proceed to determine as rapidly as possible the likelihood of the Fluorocarbon Project becoming a financially successful proposition?

"The meeting wasn't to decide whether to continue the Project or to kill it," Hugh Bryce said many years later, "but if the people at that meeting hadn't been willing to stake their own careers on their decision, Carlton might have been less supportive than he was."

Thirty men, including twenty-seven connected with the Project, attended the meeting in the New Products Department conference room in the Benz building. Their accomplishments are preserved in the meeting minutes and their reports drafted and submitted to Carlton afterward.

At one point in the meeting it was noted that, "It is not known with certainty at the present time whether 3M has a commercially valuable fluorocarbon program or not." That observation was overwhelmed by a wave of enthusiasm and bullishness from Project participants.

Dr. Charles Walton, General Manager of the New Products Department, opened the discussion. "3M Management has asked for an expression of faith in the project on the part of those closest to it," he said.

Chuck Walton

President Carlton said that management was "firmly behind the project," but anxious to "bring along specific products which could be sold." Walton mentioned that at that time there was no proof that any one compound was ready for sale. "Results have not indicated that we are past the research stage," he concluded.

Dr. H. M. Scholberg, head of the Electrochemical Section, led the defense. He expressed belief in the anticipated size of the fluorocarbon market and confidence in the Project. Others concurred and enlarged on the long-range possibilities.

A question was raised. Was 3M right or wrong in putting "all of its eggs in one basket, depending on the Simons process when several other methods of making fluorocarbons are known?" Pearlson, whose experience with fluorocarbons dated back more than half a decade, fielded that question.

He defined two competing processes he felt had some merit: fluorides and halogen exchange. Metal fluoride, he said, involves using elemental fluorine, which not only is more expensive than the HF used in the Simons process, but also is extremely hazardous. Both it and the halogen exchange process also are multi-step processes, compared with the one-step Simons process. Summing up, he said the "Simons process with its one-step operation thus appears to be inherently the most efficient."

"Is the project fundamentally sound for 3M?" Carlton asked. Dr. J. F. Dowdall, head of the New Products Division Laboratory, replied that most Central Research work had been concerned with patent coverage for the process and products. He said that from now on more consideration would be given to the fundamentals of cell operation and the commercial aspects of the program.

Mr. Carlton then asked (the minutes stated) what we would do if a customer requested the production of fluorocarbons in large volume. Dr. Walton replied that we would use our present knowledge of the production of the requested product, figure a selling cost and erect the plant to produce it on a contract basis. Such a policy would naturally presume we know how to produce the product requested.

Mr. Carlton asked whether the group has enough confidence in the process to recommend the building of a plant...which might cost as much as a million dollars should (that) reliable prospective customer (be found).

Everyone except Dr. W. E. Sohl and C. L. Jewett voted yes on that question. The two dissenters urged caution before making such a large capital investment "where so little is known of the process, the products and their uses (the minutes noted)."

Those who voted 'yes' did so with the understanding that the specific compound or compounds involved would greatly affect their decision.

Walton inquired about the advisability of making a small scale installation at Hastings (not the previously considered five hundred thousand dollar semi-works unit) in a large "shell" capable of containing further expansion. Erwin Brown of the Engineering Department suggested that it would be better to add fractionating and other recovery equipment to the present pilot plant rather than build a new half-a-million dollar semi-works plant at Hastings.

Such a plant (the minutes said, indirectly quoting Brown) would give the flexibility necessary to conduct very much needed basic chemical engineering studies of the process and equipment at the two-thousand-ampere-cell level before trying to design a semi-works unit at the ten-thousand-ampere-cell level.

The minutes concluded with a five-point summary:

1. That we have no current established market for any fluorocarbon material which has been released so far.

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2. That the construction of a semi-works plant on even a moderate scale is not advisable until a specific market is developed.
3. That the project is still in the research phase in both the laboratory and in market development.
4. That is it not known with certainty at the present time whether 3M has a commercially valuable fluorocarbon program or not.
5. That customers hungry for specific salable products are sorely needed.

Those negative statements notwithstanding, the Project gained new

Marshall Hague (left) and Joe Hoettinger run ZST heat strength tests on an early Kel-F™ polymer in the Benz building laboratory in 1961.

vigor from that meeting. The enthusiasm of the overwhelming majority of the men in that room carried the day.

Pearlson's recollection was that Carlton said near the end of the meeting, "Look, I'm going to have to make a recommendation for next year and I'm going to have to sign my name to it. I would like each of you to project the future of this program. Make your recommendation and sign your name to it." And, they did.

"There were two votes for dropping back to perhaps a two-or three-man program until we could find a product that could be sold and from the profits we could build up the research—the standard 3M pattern," Pearlson said. "The rest of us felt we had a bear by the tail and the only way we were going to survive was going full bore until we could develop the thing to where it would stand on its own feet."

Hugh Bryce had been employed only two weeks when he made his remarks.

"I was impressed with the enthusiasm shown by almost everyone," Bryce recalled forty years later. "And, I was struck by the fact that there wasn't a businessman in the bunch. I simply said that I was a new employee who was interested in fluorochemistry, so when Dr. Pearlson offered me a job, I took it. I said I hadn't been here long enough to do much myself, but that in that short period of time I've been very impressed with the people in the program. Because of that, I said, it's bound to be successful."

I believe, Bryce added, that "Mr. McKnight wanted to find out if we were genuine." And, Bryce noted, the Fluorochemical Project was the first pure research project in the history of 3M. "In every other case (Wetordry sandpaper and dry photo copying for example) there was a product involved. In the fluorochemical project we didn't have a product at that time."

Mr. McKnight's stance, Pearlson remembers, was that "if any technical man was willing to bet his career on a project, that project will stay alive." The application of that rule can also be seen in the dry copying process project, which was going on in Central Research at that time, and other successful projects at 3M during the last half-century.

Don LaZerte, who retired in 1987 as Technical Director of Industrial Chemical Products Division, was a newcomer in the meeting, having arrived only the month before.

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He remembered being excited about the "new horizon" offered by fluorochemical technology as well as being impressed by his new colleagues. "I had joined what looked like a remarkable team," LaZerte said.

It is interesting to note, Bryce added, that the "positive individuals that day became the bulwark of the Project, while those who were less enthusiastic or the two who voted against the Project left the company or went to other divisions."

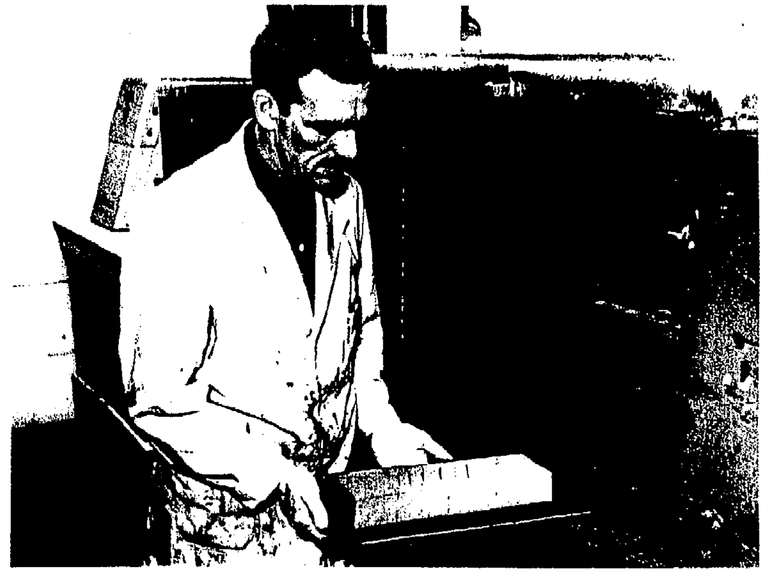
Robert I. Coulter, 3M patent attorney, attended the meeting and filed answers to Carlton's questions. In that response, he espoused releasing data and samples in order to stimulate outsiders to help define uses and markets. His wording implied that some insiders felt a need for secrecy.

"It seems to me," Coulter wrote, "that the job of developing the whole potential field of end compounds and their uses must inevitably require the labors of many persons outside the company. Many years will be required and so it seems to me that too much stress should not be placed upon the value of delaying the release of data and samples in an attempt to hog the field. I should think that during the next several years there might be quite a fair business in supplying research chemicals at a price that would return a profit on raw materials and labor, at least, and provide needed experience.

"I have no doubt that the fluorocarbon chemical field will have become quite important twenty years from now...Yet no one can safely assume that some major demand will not arise within the next couple of years, perhaps based on some use that no one has yet dreamed of. That is why I think it is so important that there be no undue delay in disseminating information and making samples available, not for just a few compounds but for as many as possible."

Coulter also noted that the importance of patent "coverage" on the extensions of the primary field "has been over-stressed by some." Profits are not made from patents, but are made "on the sale of products and the bigger the market the better." He said it was to 3M's "ultimate advantage to have many other persons working in the field and to be stimulated in part by the idea that they may get patents."

"An overly aggressive policy on filing patent applications may only serve to discourage others from doing work on use development...In the tape field it has not been company policy to attempt...to patent all tape uses, but rather to quickly disseminate all ideas on uses for tape and to encourage others to develop uses."



Lloyd Downs removes a eurethane foam sample from curing oven.

Joseph Selden's written comments are interesting. They show him as a fence-sitter, neither for nor against the Project. That from the man who was to be given credit for many fluorochemical marketing and sales achievements in the following decade. The Project was "a gamble" and "speculative," he wrote. "Since so much money and energy have already been expended, it would seem inadvisable to drop the fluorocarbon project abruptly...but expenditures...should not be prolonged unduly..."

"We were capable of producing refrigerant gases in salable quantities," Don Wardrop explained years later, "so we were confident we could manufacture fluorocarbons in reasonably large quantities, too."

(A list of Central Research Department employees concerned with the Fluorochemical Project and dated April 21, 1949, contained twenty-three names. They were: Harry Stephens, Director; James O. Hendricks and Nelson W. Taylor, Assistant Directors. Polymer Section: Frank A. Bovey, Leader; Joseph F. Abere. Catalytic

Section: W. H. (Bill) Pearlson, Leader; Hugh G. Bryce, Lyle J. Hals, Donald LaZerte, Lewis F. Beer. Analytical Section: Harold M. Scholberg, Leader; Edward A. Kauck, Assistant Leader; R. E. Drummond. Organic Section: Matthew W. Miller, Leader; Thomas S. Reid, D. R. Husted, J. L. Rendall. Pilot Plant Section: A. R. Diesslin, Leader; Donald J. Wardrop. Three engineers listed were Donald R. Guthrie, Division Engineer; R. R. McKenzie, AC&S Division Engineer; Erwin P. Brown, Engineering Division. New Products Division personnel were J. F. Dowdall, Laboratory Head; G. M. Ide, Clifford L. Jewett, James M. Rogers, Joseph W. Seldon, and William E. Sohl, Marketing.

The men at the meeting were Abere, Beer, Bovey, Brown, Bryce, Diesslin, Dowdall, Drummond, Guthrie, Hals, Hendricks, Husted, Ide, Jewett, Kauck, LaZerte, McKenzie, Miller, Pearlson, R. W. Perlich, Reid, Rogers, Scholberg, Sohl, Taylor, Walton, Wardrop and Weiblen. Cyril P. Pesek, Vice-President of Engineering & Properties, also attended.

All of them, with the exceptions of Pesek and Perlich, filed answers to the questions. Selden and Rendall as well as Coulter also submitted statements. (See Appendix I.)

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In the early 1940s, 3M's ability to attract top flight researchers was limited because the company did not have a carrot, an exciting new technology, to dangle before job-seekers. That changed in 1945, with the beginning of fluorochemical research.

Financing a scientific payroll, also a problem, changed in 1949 with the government research contract. The Air Force wanted an oil-resistant synthetic elastomer (rubber) that would be stable at high temperatures and flexible at low ones.* The dollars received from that contract, which lasted into the early 1950s, has been forgotten, but one 3M executive estimated it might have been a quarter of a million dollars a year based on his recollection that it supported fifteen to thirty people, a twenty percent expansion of the Central Research work force.

3M's dependence on that contract is illustrated by the hiring of

* M. W. Kellogg's chemical division, which was purchased by 3M in 1957, obtained a similar contract from the Air Force as an add-on to a contract it had obtained earlier from the Quartermaster Corps.

LaZerte. He interviewed with 3M in 1948 while attending Northwestern University graduate school, Evanston, Illinois. A fellow student suggested that LaZerte investigate Minnesota Mining and Manufacturing Company as a possible employer, but he dismissed the suggestion. He was not interested in working for a mining company, but when a 3M recruiter arrived on campus, LaZerte stopped by 3M's table out of curiosity. He was inclined toward silicone research, until he was told about 3M's fluorochemical project. And, he learned that 3M despite its apparently descriptive name, was not a mining company after all.

An interview was arranged in St. Paul where Nelson Taylor told LaZerte before he left to catch his train back to Chicago that 3M wanted to hire him. He would be contacted, Taylor added, but after the days turned to weeks and then months, LaZerte wrote to Taylor in the fall of 1948. In his return message, Taylor said there was no money available, but if LaZerte would be patient the situation might change.

LaZerte had to finish his graduate work, so he was content to wait. Finally, in March 1949, after 3M obtained the Air Force contract, Taylor made an offer and LaZerte moved to St. Paul. LaZerte remembers Taylor as a man who did not fit the common image of a scientist.

"Nelson Taylor was not a calm, deliberate manager," LaZerte recalled, "and was definitely a non-conformist. On hot days—the Benz building was not air-conditioned—Nelson occasionally worked without shirt or tie. On rare occasions he would gargle liquid air, a very dangerous practice. Despite those idiosyncrasies, he led us through some trying times and deserves much credit for our initial successes."

LaZerte is a quiet, soft-spoken man who sometimes still pronounces words with the accent of Western Canada, his native country.

"During my hiring interview, Nelson said things I realized later were designed to get me angry. Soon I found myself arguing with him, wondering all along what effect it would have on my possible future with 3M. At the end of my interview, he told me he liked people who had some fire inside and said he would hire me."

LaZerte's first trip to 3M for that interview was an adventure itself.

"I rode the train to St. Paul—the method of travel in 1948—and when I stood outside the Union depot I saw, as I recall, that I was in the two hundred block of East Fourth Street. I knew that 3M's address was in the nine hundred block of East Seventh Street, so I picked up my suitcase and started to walk there." More than an hour later, he arrived at Seventh and Arcade on St. Paul's East Side where he got his first look at the company where he was to live out his career.

He recalled Dr. Stephens as a "quiet, modest man," who after talking with the newcomer at some length directed him to the streetcar and to the Benz building west of Payne Avenue north of Seventh Street.

Another memory was that Harold Scholberg, a future colleague, invited LaZerte home for dinner that evening, which touched the young visitor.

Others hired in 1949, most likely because of the Air Force contract, included Dr. Robert M. Adams, Hugh Bryce, Davis (Dave) Shryer and William Petersen. Adams retired in 1985 as 3M's Vice-President of Research and Development. Bryce retired in 1982 as Staff Vice-President for Central Research. Shryer, with a bachelor's degree in chemical engineering, was hired into the New Products Division and retired from ICPD marketing in October 1989. Petersen was Marketing Director of Commercial Chemicals when he retired in the mid-1980s.

Three others hired by Central Research in 1949 were Clifford Japs, Harvey Anderson and Alfred Smith. Japs and Smith had graduated from the UofM with engineering degrees that June. Japs stayed with Central Research for eighteen years and retired in the mid-1980s as Manufacturing Director of CCD. Smith retired about that same time as Technical Director of Industrial Specialties Division.

Hirings into the early 1950s also depended to some extent on the Air Force contract. A chemist hired part-time in 1952, Patsy Sherman, discovered the polymer that became the first Scotchgard protector, the brightest star in 3M's specialty chemical products galaxy.

Others, like Bill Lundquist (1942) arrived earlier. Lundquist stayed on to become Technical Director of Central Manufacturing Division and later the Chemical Division. Charles Bentz began at 3M in 1943 and retired forty-seven years later from the Specialty Chemicals Division. Don Wardrop, a career man with 3M who was closely associated with chemical pilot plants, also arrived in 1943. Taylor, as noted earlier, joined 3M in 1944, Pearlson in 1947 and Brice in 1950.

Clifford W. Hanson, a chemical engineer, graduated from Iowa State University and joined 3M in 1948. He retired in the mid-1980s as Vice-President of SCD. Jack Sargent joined in 1950. Sam Smith came in 1951. Les Krogh began working fulltime in 1952 after several stints as a summer employee.

CHAPTER 6

Help Wanted, Found

The 1950s were development years.

The first industrial product sales were made.

Scotchgard rain and stain repeller was developed.

Other products for industry and government—some still being sold today—were formulated and transferred to the marketplace.

And, in the final year of the decade, the Project turned a profit for the first time.

The groundwork for those achievements was laid in 1949 when 3M decided to go public with its technology. For three years, 3M scientists had been coming up with one inert compound after another. Patent applications had been sent to Washington. But, that was about all. The problem was that while 3M had a wonderful new technology, no one concerned knew where to apply it. The need was for application information. To get it, 3M would have to involve scientists in other companies. They would have to be told about 3M's technology to stimulate them to begin thinking about ways to incorporate fluorochemicals into new and existing products or manufacturing operations in their companies.

As it turned out, going public proved to be a great idea, but the proposal was not supported unanimously at 3M. The pro-publicity faction believed that outsiders would create products and markets. Opponents feared those other companies would obtain samples, develop applications and patent them, stealing what rightfully belonged to 3M. Those negative thinkers had not accepted Robert Coulter's advice to management following the April 1949 meeting. Patent attorney Coulter had written that, "Patents do not of themselves bring in profits that 3M is interested in. Profits are made on sales of products and the bigger the market the better."

Fortunately, the activists won the debate. And, the resulting publicity generated sales.

The first public announcement, however, was made not by 3M, but by Penn State. In 1949, while 3M was debating going public, Simons—over 3M's objections—sent graduate student Tom Brice to present six papers at an American Chemical Society (ACS) meeting in Portland, Oregon. In the audience was 3M's Bill Sohl, by that time out of Central Research and in the New Products Department with responsibility for finding applications for fluorochemicals. When Brice finished, half the audience surrounded Sohl, eager to learn more about 3M's capabilities. Their interest was so emphatic that on the following morning, NPD General Manager Walton took over personal control of marketing fluorochemicals. Sohl was reassigned to marketing vapor coating products.

The next year, the Project joined the paper trail with Pearlson as one of the presenters. "We gave seminars at any company that would give us time," he said. "We accepted invitations for ACS tours. Every chance we got we presented our stable materials—showing their unique low temperature fluidity, their low surface tension, their stability to oxidation or reduction. I'd end my presentation something like this: 'Now, you know something about these unusual compounds—all the possibilities they offer for solving problems that have been intractable up to now. So, do you have any problems?"

DuPont did. In 1950, the Delaware giant approached 3M with an emulsifier for a polymerization its laboratory team had developed, but was unable to compound. Having heard about 3M carboxylic acids, DuPont wondered if 3M could produce a compound based on DuPont's formula. After study, the Project team decided it could not, but suggested that DuPont try an alternative carboxylic acid with fluorine (instead of the hydrogen DuPont wanted) on the end. DuPont's scientists were reluctant. They were certain that only their formula could meet their needs, but because their compound could not be made economically, they gave 3M's a try. They liked the results and still were buying the compound forty years later.

The effect on 3M when DuPont accepted its product was understandable elation. "For the first time we had a customer out there who was going to buy the materials today, and next week, and optimistically, next year. We were in business!" Pearlson exclaimed in a speech years afterward.

The yield on that product was about fifteen percent. The rest was inert fluids for which there was no known use. Those by-products were stored in the yard at Chemolite. Three or four years later an application was found and the by-products became profitable mainly because all the costs had been written off against the original production. That was a bonanza!

There were some notable failures along the way, too. "Many hundreds of trials resulted in no success (in some quests)," Les Krogh once said. One example, in 1950, involved a team which while working on surfactants developed a mixture that seemed to have commercial possibilities.

"Wouldn't it be nice," one researcher said, referring to the breakthrough, "if we could treat a paint can and it would drain clean?" They made that wish come true by coating the interior of a clean can, pouring paint into it, then pouring it out again. The can drained clean without a trace of residue.

After Mr. McKnight was told about the "breakthrough" he challenged the team to prove the result. Another can was coated and filled with paint to prepare a demonstration for 3M's chairman. They assembled in his office the next morning and performed their demonstration on his desk. However, when the paint was poured from the treated can, instead of coming out clean, paint residue stuck to the sides and bottom as it always does. "Mr. McKnight was not impressed," Pearlson said needlessly. Additional studies proved that the chemical liner had dissolved into the paint overnight, dissipating its effectiveness.

The sale to DuPont, however, must have cheered Mr. McKnight because his belief in fluorochemical technology had never wavered even in the darkest periods. Rogers recounted a story from a presentation to 3M's Executive Committee in late 1949 or early 1950 on a request for a special appropriation of one hundred thousand dollars for the Project. Mr. McKnight, Bush, Carlton and other committee members met with Taylor, Pearlson and several others in the second floor conference room in headquarters (Building 21) on Fauquier Avenue.

"The meeting lasted all afternoon," Rogers remembered years afterward. "There were a lot of questions and the answers didn't seem to satisfy the committee members. I thought the Project was

dead." One stumbling block was the number of research people in the Project: ninety-nine.

Through the long discussion, Mr. McKnight sat in silence until the hands of the wall clock reached four forty-five. Then he took charge, beginning with a compliment for his committee.

"You've all asked very good questions," he said and paused. "Obviously," he continued, "these people"—Taylor and the rest—"don't have any promising commercial outlets at the moment, but I'd like to say that the one hundred thousand dollars we're being asked to appropriate might amount to one hundred million dollars in the seventeenth year of the patent*. I believe we ought to grant the request." His motion carried and the meeting was adjourned.

Rogers, like LaZerte, recalled that Nelson Taylor was a major force in preserving the Project when questions were raised concerning its value or its future. "His dogged determination to make it a success always was apparent at the semi-annual review meetings," Rogers said.

Hugh Bryce recalled an important meeting held in 1951. One morning Taylor told Bryce that management wanted to review accomplishments and hear a report on future prospects. Bryce was to present that information to Lloyd Hatch and Walton.

Hugh Bryce

"I didn't know what to do," Bryce said. "I didn't have enough ideas to take to a meeting. I turned to Bill Pearlson, who suggested I solicit ideas from everyone in the lab. I ended up with more than two hundred ideas which I wrote down on three-by-five-inch index cards." The ideas fell into five broad areas: unique non-flammable liquids, supersurfactants, surface repellents and elastomers for "virtually everything under the sun."

Bryce's presentation may have resulted in the following paragraph in 3M's 1951 annual report: "This (chemical) group continues to make major basic contributions of entirely new unrelated products, such as Fluorochemicals. These versatile new carbon compounds each containing a high percentage of fluorine, serve as chemical intermediates

*Mr. McKnight was overly optimistic in that instance.

for use in the manufacture of other products giving greater weather resistance, greater heat and chemical stability, unusual optical properties, greater surface activity, increased fire resistance and greater fungus resistance. Among products that may eventually be affected are resins and coatings, pharmaceuticals, dyes, polymers, solvents, refrigerants, fire-extinguishing compounds, surface-treating agents, dielectrics, hydraulic fluids, coolants and lubricants. Fluorochemicals give the company its first basic position within the chemical industry and should permit greater diversification of the company's product line."

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Carlton, stricken by a terminal illness, resigned as President in May 1953. The gloom in the Project not only was caused by the scientists' feelings for Carlton, but by concern over who might replace him. Could a new man possess the same fervor for research, the same belief in the Project? Eventually, after a period during which Mr. McKnight assumed the job temporarily, Herbert P. Buetow became 3M's sixth president.

That worried the laboratory. Buetow was not a scientist. Nor was he an engineer. He had a financial background, had served as 3M's Controller (1935), Treasurer (1939) and Executive Vice-President in Charge of Finance (since 1949). Would the Project survive without a research champion as President? The fears proved unfounded, however, and the Project continued.

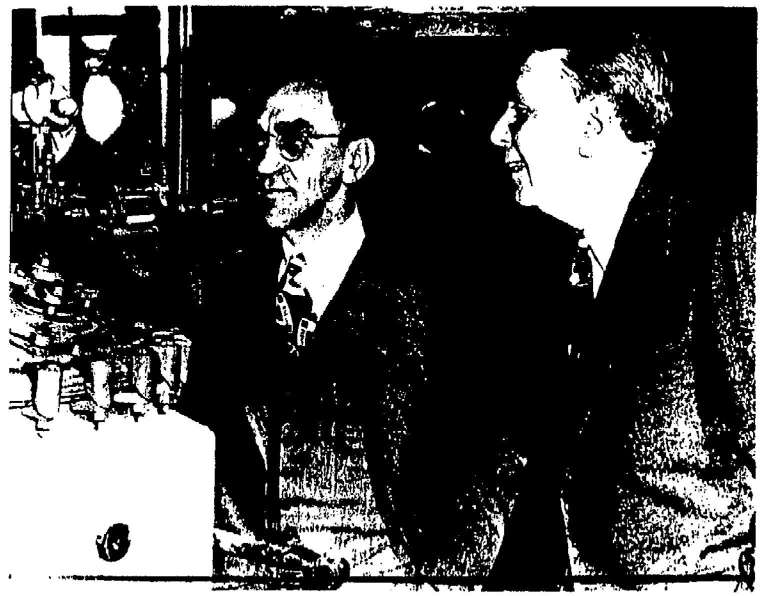
Complaints by other 3M people outside the Project persisted over the money spent on fluorochemical research. "That's not to say that we didn't get cooperation from other divisions and groups," Rogers said. An example was when Charles Murphy, Marketing Manager of the abrasives division, lined up a series of calls for Rogers and Maynard·Olson, who wanted to discuss protective chemicals with people in the leather industry. "We got in to see everyone we wanted and we were well received," Rogers said, "because of the abrasive division's reputation."

An interesting sidelight to events in the late 1940s and early 1950s was employee reaction to the annual appearance in the Benz building of Professor Joseph Simons. His yearly visits to St. Paul were specified in his contract to allow him to audit the program and collect his royalties. He was promised office space in the Benz building

during his stay which caused a problem because there were no empty offices. Each year someone had to vacate his office for a few days, removing his files, folders, photos, wall decorations, nameplate and so on. On the morning of Simons' arrival, a nameplate prepared for him was on the wall outside the empty room.

The professor routinely drove up in a hired limousine which had whisked him from the Ambassador hotel near Summit Avenue. Both limo and lodgings irked the Benz building occupants because they knew who was picking up the tab.

Simons did, however, provide a bit of comedy by appearing in his high crowned hat and elevator shoes. The 3Mers also got perverse gratification from knowing that Simons earned little or no royalties for many years.



Joe Simons (left) with Richard P. Carlton and a Simons cell at Chemolite, 1951.

In 1951 Tom Reid developed a chromium complex of carboxylic acid that caused fabrics to shed oil as well as water. It was an exciting development. At last, 3M had a stain-resisting product that worked as the researchers had predicted it would. And, it was inexpensive compared with carboxylic acid. But, like so many new developments, there was a glaring shortcoming. The chrome complex was green, a color that readily transferred when the chrome complex was applied to fabrics.

Green-dyed paper looked better than green-dyed fabric, so paper samples were used when the chrome complex was demonstrated to Walton. As the meeting proceeded in the Benz building conference room, the technicians struggled to retain their enthusiasm after they saw that Walton was not impressed. When he finally spoke, he said to Stephens: "Everything is green." He said it like green was a dirty word.

"I don't know, Chuck, the green on the brown paper doesn't look too bad," Stephens countered. He said that a man he knew at Marathon Paper Company might be interested in using the product to seal paper packaging materials against grease and similar substances. Then Walton came up with a contact at Dan River Mills. Someone carted a quantity of chrome complex to Marathon and someone made a pilgrimage to Dan River. The latter's representatives were taken by the demonstrated effectiveness of the product—until they learned its price. Two dollars a pound! That was too much to pay for treating paper!

LaZerte applied chrome complex to the summer slipcovers of a chair and sofa in his living room. The fabric accepted the spray-on liquid readily and dried acceptably. It seemed to work well until the covers were removed that fall, but the following spring when Barbara LaZerte removed them from winter storage, she saw that they were spotted with ugly brown splotches. Quickly, she telephoned her husband.

LaZerte took his wife's complaint in stride. In fact, he irritated her by seeming to change the subject. Was the sun shining in Highland Park, the St. Paul area where the LaZertes lived? he asked. Mrs. LaZerte began to protest her husband's apparent non sequitur question, but he convinced her to hang the slipcovers on the clothesline in the sunlight. In a few hours the spots were gone.

"We had recognized that feature as a problem," LaZerte said, "That's why I knew what to do. Oxidation had caused the spots, which the sun bleached out in one afternoon."

The green color was a more vexing problem.

"Our marketing man used to come around every Monday morning to say on bended knee, 'Please, can't you give us a white chrome complex?'" Pearlson claimed years later.

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In 1953, a second successful 3M fluorochemical product was produced. Although the product being sold to DuPont was the Project's first success, this new product created more of an impact at 3M. DuPont had never made its application public, so it couldn't be sold to any other customer. The new product opened up the first market for a 3M specialty chemical product.

The new product also began with publicity plus the initiative of a technical man employed by the Udylite Corportion, Detroit, Michigan. With 3M's help, Udylite developed the product application, which it patented under the name Zero Mist.™ The product itself was patented by 3M.

A foam blanket stablized by 3M's surfactant suppressed acid mist and spray that in the past had escaped from chromic acid tanks during metal plating. Udylite supplied chemicals to the plating industry and added Zero Mist to its product line.

The lead that resulted in that product was generated by a presentation Pearlson made in Detroit. Afterwards, the usual ring of listeners stayed to ask questions. One man, who loitered after the others left, approached Pearlson almost furtively. "I don't want my competitors to know what I'm talking about, but you've got what I've been looking for for ten years," he said. He introduced himself as Henry Brown, Udylite's Research Director, and requested a test sample.

"How large a sample do you want?" Pearlson asked. Fluorochemicals were expensive; 3M did not want to hand out samples by the pound, the quantity that everyone seemed to expect, Pearlson said.

"If I had a couple of grams," Dr. Brown replied, "I think I could show whether or not it would work. If I had ten grams, I could run a program."

Because of Brown's secrecy, Pearlson did not know exactly which sample to send to Detroit. All Brown had told him was that the product had to be soluble and stable in chromic acid. Pearlson discussed that with Jim Rogers, who like Pearlson knew that Miller, Reid and Ahlbrecht "had a lot of things in bottles" in their laboratory.

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"In that assortment were things that would be stable in chromic acid," Rogers said years afterward. "I said to Bill, 'Let's send him something, anything, and let him evaluate it.'"

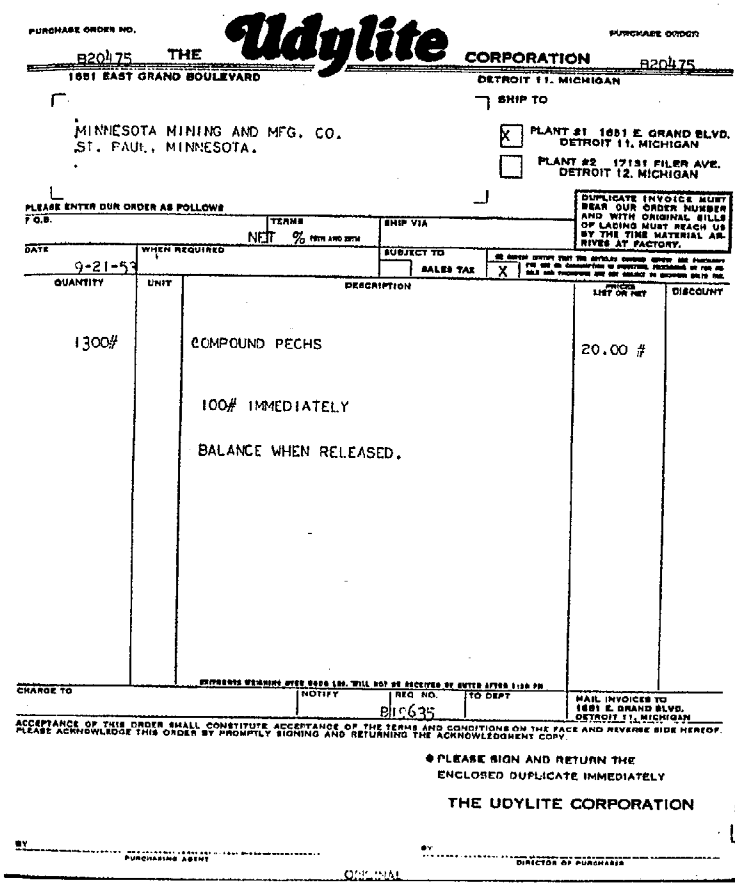
Within two weeks, 3M received a five-page handwritten letter praising the acid as the most remarkable product since sliced bread. Udylite, Brown wrote, would pay almost any price for production quantities of the product. He also confided in 3M, explaining that he had added 3M's acid to a plating bath of hot, concentrated sulfuric and chromic acid. In untreated baths, he added, gas bubbles rose to the surface, burst and created a vicious mist that wafted everywhere. In some plating shops the mist even meandered through open windows and chewed lacquer from parked cars. Some plants spent more money buying and maintaining ventilation equipment required to make the plant livable than was spent on the power used for plating.

Brown said his experiments had led him to believe that 3M's fluorochemical acid could withstand the acids in the tank. His supposition was correct. In fact, a fluorochemical was Brown's only chance for success because they were the only known organic compounds not affected by the oxidizing conditions of plating tanks.

As usual, it was too early to toss hats in the air. Success never was instantaneous. Rogers made a-once-month sales calls on Udylite for a year-and-a-half during which time a dozen tests of various 3M products were conducted.

One problem was that while the acid worked well, it evaporated rapidly. Udylite, despite Brown's assertion about paying any amount of money for the product, could not afford to keep replacing it. 3M researchers had to develop something less volatile to prevent it from dissipating. Several compounds were tried without success. At a dead end, the 3M researchers reviewed what they had already tried. Sulfonic acids are essentially non-volatile, but 3M had not made them. Why not try the impossible again? The result: perfluorosulfonic acid.

"It was beautiful," Pearlson remembered. "It went in the bath and stayed there. They had their foam blanket, but they still had to use too much of it to make it practical. We set out to sulfonate ethylbenzene, but couldn't wait for the necessary equipment to be installed, so in winter in Minnesota we did our sulfonating in a fifty-gallon drum in a tent at Chemolite. We had some really earnest process engineers who really worked hard. And, we were successful and had a customer who wanted our product."



PURCHASE ORDER NO. B20475 THE Udylite CORPORATION PURCHASE ORDER B20475
1651 EAST GRAND BOULEVARD DETROIT 11, MICHIGAN

MINNESOTA MINING AND MFG. CO.
ST. PAUL, MINNESOTA.

SHIP TO
X PLANT #1 1651 E. GRAND BLVD. DETROIT 11, MICHIGAN
PLANT #2 17151 FILER AVE. DETROIT 12, MICHIGAN

DUPLICATE INVOICE MUST BEAR OUR ORDER NUMBER AND WITH ORIGINAL BILLS OF LADING MUST REACH US BY THE TIME MATERIAL ARRIVES AT FACTORY.

PLEASE ENTER OUR ORDER AS FOLLOWS

F.O.B. | TERMS NET % | SHIP VIA
DATE 9-21-53 | WHEN REQUIRED | SUBJECT TO SALES TAX X

QUANTITY	UNIT	DESCRIPTION	PRICES LIST OR NET	DISCOUNT
1300#		COMPOUND PECHS	20.00 #	
		100# IMMEDIATELY		
		BALANCE WHEN RELEASED.		

CHARGE TO | NOTIFY | REQ NO. B19635 | TO DEPT | MAIL INVOICES TO 1651 E. GRAND BLVD. DETROIT 11, MICHIGAN

ACCEPTANCE OF THIS ORDER SHALL CONSTITUTE ACCEPTANCE OF THE TERMS AND CONDITIONS ON THE FACE AND REVERSE SIDE HEREOF. PLEASE ACKNOWLEDGE THIS ORDER BY PROMPTLY SIGNING AND RETURNING THE ACKNOWLEDGMENT COPY.

● PLEASE SIGN AND RETURN THE ENCLOSED DUPLICATE IMMEDIATELY

THE UDYLITE CORPORATION

BY PURCHASING AGENT BY DIRECTOR OF PURCHASES

ORIGINAL

Purchase order dated 9-21-53 records the Project's first sale of a product with a known application.

In use, 3M's fluorochemical formed a yellow foam blanket which prevented most of the mist and spray from escaping from the tanks. The blanket provided up to a seventy percent reduction in chemical waste, which improved working conditions and eliminated the need to wash exhaust fans and plating equipment so often.

The first production order was obtained on September 21, 1953, by a task force of 3Mers who flew to Detroit in the company's Lodestar airplane. The group consisted of President Buetow, Vice-President of Sales Lou Weyand, Oakes, Taylor and Rogers. They obtained an order for thirteen hundred pounds at twenty dollars a pound for a bottom line of twenty six thousand dollars. Udylite requested that one hundred pounds be delivered immediately with the rest delivered in one hundred-pound quantities on request. "That was a good thing," Rogers said, "because it took us a long time to make that material."

When Buetow and the others returned from Detroit they told the Laboratory staff that the price they had sold the product to Udylite was one-third less than the minimum price needed to make a profit. That revelation did not faze the laboratory crew; while the travelers were in Detroit, the laboratory workers had found a way to double the yield of the sulfonic acid from the cell. While the sales team was cutting the price one third, the laboratory had reduced manufacturing costs fifty percent.

Taylor told a 1956 sales meeting that it cost 3M more than two hundred thousand dollars to develop that product for Udylite. How much of that was fact and how much was sales meeting hyperbole is impossible to assess a third of a century later.

In the early 1950s, another fluorochemical was placed on the market with some success. Trifluoroacetic acid, the first of a group to be produced, was an intermediate used principally as a solvent in the preparation of dyes, pharmaceuticals, resins and plastics.

Those early products were produced in the semi-works plant which had been discussed at the 1949 meeting and which was built and placed in operation in 1951. The cell was capable of producing fluorochemicals in ton lots and larger, which allowed 3M to supply prospects with quantities of compounds they could test in their own pilot plant or semi-works facility.

In 1954, 3M's semi-works plant began producing another product that served an unspectacular, but important (and unfortunately low volume) industrial need. FC-101 was a fluid for sight glasses on force-feed lubricators. A sight glass is a transparent gauge built into a machine such as an air compressor so operators can check the quantity of oil being fed to an inaccesible moving part or bearing. When the glass is filled with FC-101, drops of the lubricant move upward along a wire in the center of the glass because oil is lighter than the

fluorocarbon and cannot mix with it, either.

Traditionally, sight glasses contained a glycerine-water mixture, but oils containing detergent additives broke down the resistance of the mixture, causing the glass to cloud up. FC-101, a typical inert fluorochemical, also has found wide application in industrial gauges that use detergent oil and for shipboard devices.

In 1955, 3M's scientists and manufacturing personnel also came up with a fluorochemical rubber compound that was to position the company in industrial markets to stay. 3M brand fluoro-rubber 1F4 could withstand temperatures above 350° F for more than five hundred hours without losing its dimensional stability. It could withstand deteriorative agents such as synthetic lubricants and hydraulic fluids which disintegrate or swell other synthetic and natural rubbers. It had unusual resistance to most solvents and was easy to work with. 1F4 could also be processed on standard rubber machinery, molded, extruded, vulcanized and strengthened by the addition of carbon black and curing agents in the same manner as natural rubber.

Its properties made 1F4 good for making seals, hoses, tubes and gaskets for the automotive and aircraft industries. It could also be used for protective coatings and as a substitute for metal type in printing operations.

The hope that fluorochemical rubber could be used as a raw material for automobile and truck tires didn't prove out because its ability to withstand severe temperatures and deteriorative situations was not needed for tires. Besides, the price was considerably higher than the price of natural rubber.

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In the 1950s, a fluorochemical order department was set up at Chemolite under the supervision of Stanley Karwoski, who had been in quality control in the Benz building. Lawrence Wagner who began as an Order Clerk in the department in 1957, was promoted to Supervisor and replaced Karwoski in 1958 after the latter joined the sales force. During that same year, the department moved to St. Paul where it was located on the fourth floor of Building 42.

Also in 1958, Steve Gorman came to St. Paul from Jersey City Chemical Division to become the Chemical Division's first Office Manager. Wagner, who replaced Gorman, has held the position of Office Manager for the Chemicals, Film and Allied Products Group for many years.

Not long ago, Wagner found in the file an order dated January 4, 1956, from California Research Corporation, Richmond, California, requesting three pounds of FC-26 at fifty dollars a pound. Later that month, Shell Oil Company in Emeryville, California, bought a half pound of FC-26 for twenty five dollars. There were twenty two other fluorochemical sales that year. The largest order was twenty pounds of FC-26 for twelve hundred dollars (the price had been raised ten dollars a pound in April.) The product is still being sold by ICPD.

In September 1957, Richard Raths started as a mail room clerk in the new Central Research Laboratory building on the present-day campus. At the time only the laboratory (Building 201) and one division laboratory (Building 207) were on the site. In 1990, Raths was the head of the Order Department in Building 223 that handles all 3M specialty chemical sales.

CHAPTER 7

A Group Is Formed

A Chemical Products Group was formed April 1, 1955, with Barney J. Oakes, General Manager of Hastings Chemical Division, as Group Vice-President.

It encompassed four divisions—Hastings and Color & Acid, both formed in 1948, Irvington, acquired in 1953, and a new Fluorochemical Division.

Hastings Chemical Division, originally Central Manufacturing Division, produced materials for other 3M divisions to use in manufacturing and also sought outside customers*. Joe Kugler replaced Oakes as Hastings' General Manager.

Color & Acid Division was an acid plant in Copley, Ohio, built in 1942. It produced oxides as color pigments for the Roofing Granules and the Adhesives and Coatings Divisions as well as sulfuric acid and pigments sold outside. Originally it was the Color and Chemical Division and as recently as 1953 the Color and Sulfuric Acid Division. In 1952, the Division's first General Manager, R. F. Sheahan, had been replaced by Arthur K. Telfer. Telfer, who would head the Chemical Division in 1960, had been hired from DuPont Graselli in 1939 when 3M set up its first color project.

Irvington Chemical Division, a part of the Irvington Varnish & Insulator Company in Irvington, New Jersey, was composed of two sections, Electrical Products and Chemical Products. The chemical section polymerized liquid obtained from cashew nut shells as a raw material for brake linings. Robert Jones, whose father had sold Irvington to 3M, was the Division's General Manager.

The fourth business unit, the Fluorochemical Division, was formed

*Jim Rogers said permission had to be sought from Hastings' internal customers before the Division was allowed to sell outside the company.

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with the Group on April 1 with Nelson Taylor, head of the Fluorochemical Project, appointed General Manager. The Division consolidated all research, production, marketing and sales of 3M fluorochemical products formerly in the New Products Department.

After 27 years with 3M, Oakes, 62, was nearing retirement so the vice-presidency was an honor more than an assignment. Management of the Group was handled by Joe Selden, who was given the odd title (for 3M) of Assistant General Manager. Selden, who was General Manager of the New Products Department, took the Group job with the understanding that he would replace Oakes when the veteran retired.

Selden was no newcomer to 3M or the company's specialty chemical business. He arrived in 1946 with eight years of business experience including production, sales and marketing. By 1953, he was Manager of the Thermofax™ copying products project and helped launch it in the New Products Department.


Joe Selden

He was described by a former co-worker as "a young bright and entrepreneurial guy" in his mid-thirties in 1953. Another said, "Joe Selden was one of the most astute men in the organization for seeing business opportunities. He really pushed us into the marketplace."

Decades later, when told those remarks, Selden smiled and said, "Maybe it was because I was the only guy in the program who had any marketing experience at all."

A native of New Jersey, but reared in Michigan, Selden earned an industrial engineering degree from Penn State in 1938. He was a trainee at a Goodyear Tire and Rubber Company plant in Jackson, Michigan, and later was transferred to the engineering department in Akron, Ohio. In 1940, he joined sales and marketing, but when the U.S. entered World War II, Goodyear got into war production so Selden became Assistant Production Superintendent in a Goodyear aircraft plant in Phoenix, Arizona. Later he worked at a similar factory in Ohio, where planning and scheduling were a part of his job.

In peacetime 1945 he was assigned to Goodyear's new Chemical Division, which marketed various rubber chemicals to the rubber, plastics and paper industries. By 1946, he was District Sales Manager in Chicago. Among his customers were Hugh Tierney, Richard Drew and others at 3M in St. Paul. Soon, 3M offered Selden a job. After eight years with Goodyear, he had itchy feet. He accepted.

Upon his arrival in St. Paul, he discovered fly specks on his career plan. To his surprise, his boss was Dr. Charles Walton, Manager of the New Products Department, who had preceded Selden to 3M only by a matter of months. The two men had known each other at Goodyear, where their relationship was less then cordial.

The New Products Department had been established in 1940. Joseph Duke, Sales Manager in the Philadelphia district, was placed in charge, but when a Sales Manager was needed for the abrasive business, Duke transferred to that job. Bert Cross, who had joined 3M in the late 1920s, replaced Duke in NPD. Then the Department died after Cross took its most promising product, reflective sheeting, and left to begin his move toward becoming General Manager of a new Reflective Products Division in 1948. NPD was resurrected in 1946 by Mr. McKnight, who hired Walton as its manager after setting up safeguards to prevent the Department from foundering again because of the success of a single product.

Another surprise for Selden was that while 3M provided him with regular paychecks there was no specific job for him at 3M. For six months, he moseyed around the company looking for a niche to fill. Carl Miller's dry copier project in NPD looked most inviting. Selden joined it and tried to drum up customers for 3M's new copying machine, which could copy typed or handwritten sheets of paper by burning words into a flimsy, heat-sensitive brown paper developed by 3M. It was unique because competitive copiers used wet technologies requiring liquid chemicals, but, despite that apparent advantage, customers didn't leap on the 3M bandwagon.

Selden said many years afterwards that the copier project would have been sold with relief to the highest bidder, but there were no bidders. In fact, he said, the Thermofax copying products program was nearly dead on the day two representatives of the Central Intelligence Agency (CIA) appeared in St. Paul. Prove the machine's capability, they challenged, and the CIA would purchase fifty of them. Fifty machines! There was not one on hand. There was no paper, either. The visitors were not advised of those problems, but were stalled long enough for the project team to get busy again. In a matter of months both shortages were rectified.

On a Labor Day weekend, Miller and Selden boarded a train to Washington with a copying machine and enough paper to allow two presentations to be made to the agency. Selden's account of what happened is not unique in the annals of 3M projects.

The huge presentation room was filling rapidly and hardly any of the several hundred chairs were vacant when Miller whispered that the Thermofax copier would not operate. "Keep talking," he told Selden when the meeting began. Selden talked in detail about the wonderful technology that soon would be demonstrated. Then, after Miller signaled that the copier was working, additional patter was needed to fill the time required for the machine to produce each copy. Despite the problems, the presentation was a success. So was the afternoon session. Not long afterward, the CIA ordered fifty machines and the program was saved.

That experience might have helped Selden solidify his belief that his future was not copying machines, although removing himself from the program proved difficult. President Buetow told Cross to take the revived copying project into his division. Cross agreed, but insisted that Selden be part of the deal. Selden solved that by grooming Ray Herzog, who became Selden's replacement before the move was made*.

That left Selden free to accept the top job in NPD because Walton had left to be General Manager of Adhesives, Coatings and Sealers Division. At that time, 1953, Lloyd Hatch, Vice-President of the General Staff, had, among other things, the responsibility for Central Research Laboratory and New Product Development. After Walton left NPD, Hatch assumed personal control of fluorochemical research, which had gained Department status in 1951.

That situation prevailed when Selden joined NPD. To his sorrow, Selden soon learned that it was not a pleasant workplace. Hatch had little faith in the future of fluorochemicals so was at odds with Nelson Taylor, Manager of the Fluorochemical Department. The two bickered about business almost every day, Selden said.

Hatch's negative attitude also caused problems for Stephens, Director of Central Research, and Selden, General Manager of NPD,

*Herzog was an apt pupil. He succeeded Cross as Vice-President after the Duplicating Products Division was formed. Later he was a Group Vice-President, 3M President and Chairman and Chief Executive Officer.

because both men reported to him. Soon after Selden's arrival Hatch told Stephens that he would recommend that fluorochemical research be abandoned. Stephens, who had been close to Mr. McKnight for more than fifteen years, not only blocked Hatch's recommendation, but got himself promoted to Vice-President of Research which got him out from under Hatch's jurisdiction. The promotion announcement, written by Mr. McKnight, said that Stephens would report to President Carlton.

Lloyd Hatch

Stephens also asked Mr. McKnight to remove Selden from Hatch's supervision, which was done, although the change was not announced. The two actions effectively distanced Hatch from fluorochemicals.

Selden's contacts with fluorochemicals began in his first years at 3M when he made several business trips with Bill Pearlson to discuss fluorochemicals with refrigeration equipment manufacturers. Selden and Pearlson also visited the UofM in 1947 and 1948 in attempts to interest university researchers to study fluorochemicals.

Selden did not attend the historic April 21, 1949, meeting—he was away on 3M business—but he filed a report to answer Carlton's questions. His written remarks indicated that he rode the fence on the future of fluorochemicals. Forty years later, Selden explained that he did not at that time know enough about the Project to take a stand.

Men associated with fluorochemical marketing and the laboratory in Selden's era said he must be given much of the credit for the early successes of 3M's specialty chemical development. Men close to him praised Selden not only for his marketing ability, but for his knack for placing people in the right jobs. He also fostered teamwork between laboratory, sales and marketing—not always an easy task—which contributed to the success of his organization.

Jim Rogers recalled that during the Scotchgard rain and stain repeller development period, Selden suggested that a yard of treated fabric be professionally dry cleaned. That, he said, would help to determine the 3M product's effectiveness when combined with dry cleaning chemicals.

When the cloth was returned from the cleaners and tested a few days later, the fabric's repellency had disappeared. In time, research proved that the fluorochemical had not washed out. Nor had it been altered by dry cleaning. Instead, a detergent used in the cleaning process to remove water-soluble spots had deposited a film coating on the 3M chemical. While it appeared that the fabric was being stained or spotted in dry cleaning tests, those stains and spots actually were on the detergent residue. Until that discovery was made, however, fluorochemical research was directed away from clothing that required dry cleaning and was concentrated on providing grease resistance to paper products.

Bob Adams

"Selden helped that program in the long run by that first dry cleaning test," Rogers said, "but at the moment he made the laboratory mad as hornets. In the few days required to have that material dry cleaned, he set the program back two years."

There also were many things done outside the Laboratory. One was the formation of a Group sales organization composed of seven salesmen from three divisions. Four were from Irvington, two from fluorochemical sales and one from Hastings Chemical Division. The new organization sold all products made by the Group.

Lyle Hals

Bob Adams and Lyle Hals came from fluorochemicals. Since 1954, the previous year, when he was named Eastern Region Sales Representative, Fluorochemical Products, Adams had been based at the 3M branch office in Ridgefield, New Jersey. Hals had been transferred to the Cleveland, Ohio, branch earlier in 1955 from his New Products sales position in St. Paul, where he had worked for Rogers even before Adams came on board.

All the Group salesmen had technical degrees. Adams had a doctorate in chemical engineering. Hals had a master's in chemistry. Of the four from Irvington, Anthony P. Genovese and Ray E. Brown

had bachelor degrees in chemistry and E. V. Tyne and R. V. Curtis were chemical engineers. The seventh man, J. M. Thompson, was a chemical engineer who had been in Hastings' Special Products Laboratory.

The Group kept Adams in Ridgefield and Hals in Cleveland while the others were assigned to Cincinnati, New York, Philadelphia, Detroit and Los Angeles.

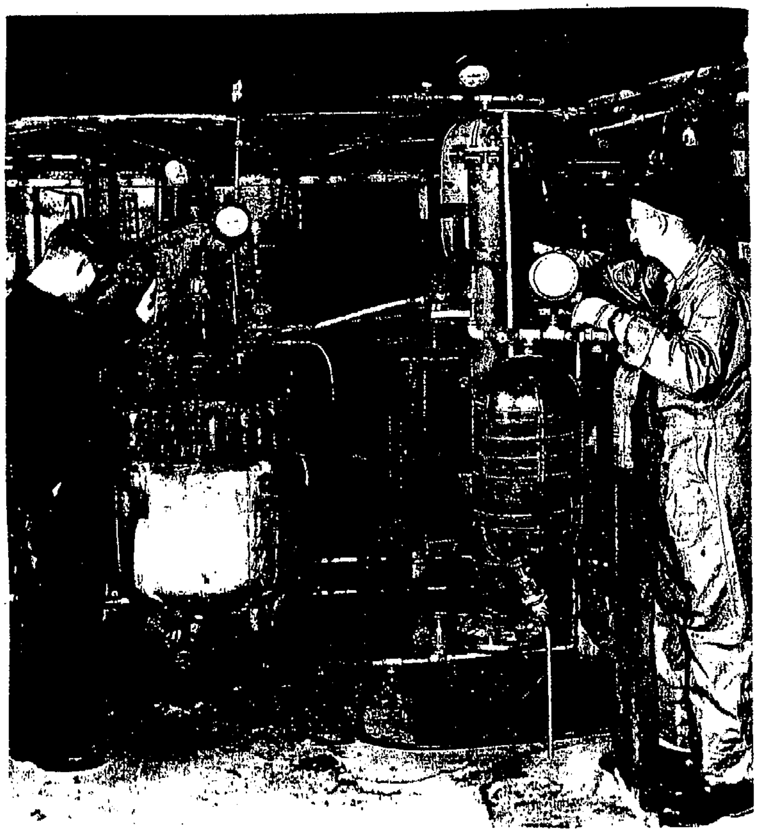
Adams, when he joined 3M in 1949, started as a chemist in Central Research's Polymer Section. He got into marketing for two reasons. First, New Products Department management believed that men with technical backgrounds were needed if meaningful dialogues (and subsequent sales) were to develop during calls on the scientific community. Second, Adams believed from observation that sales experience was a requisite for advancement at 3M.

Adams was offered the sales position in 1953 as a result of a presentation at a technical demonstration for 3M management. Mr. McKnight, with newly-elected President Buetow, Vice-President Bert Cross and others attended. So did Rogers and Hals, the two-man New Products chemical sales-marketing team. Years later, Adams recalled that day. His assignment was a polymer with a low refractive index he had prepared for Reflective Products Division. That program never reached fruition, but Adams' presentation impressed his listeners, especially Cross, by then Vice-President of the Graphic Products Group. "At least," Adams recalled with a smile, "he remembered my name."

Rogers, too, was impressed by Adams' "style and lightness." Not long afterward when Rogers was authorized to add a man, he approached Adams. By accepting the job, Adams became 3M's first field Sales Representative for chemical products.

Sales Manager Rogers chose a roundabout route to 3M, where he stayed until he retired in the late 1970s. A graduate of the University of Illinois in 1940 with a bachelor's degree in chemistry, he joined American Cyanamid, where he stayed nine years. His first post was in new products development in Stamford, Connecticut. Later he was with the firm's Industrial Chemicals Division in New York City.

He met Chuck Walton after he joined the Commercial Chemical Development Association, which was set up to help member companies get started marketing new products. Walton, an officer of the association, sensed that Rogers was not interested in a scientific



Technicians Ed Glaze (left) and Jack Hanson in the CRL tent pilot plant at Chemolite, circa 1950.

career and eventually offered him a marketing job in St. Paul.

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It must have been difficult for Adams to fight discouragement after he and his family were settled in the East. Not only was he isolated from 3M headquarters, but he had nothing to sell and did not know who to sell it to. The division's one best-selling product, the mist suppressing foam used by chrome platers, was being sold exclusively by Udylite Corporation. And, the account was serviced by Hals

from St. Paul (and later Cleveland.) The emulsifier produced for DuPont was bought through its plant in Parkersburg, West Virginia, which also was Hals' account. That product could not be sold elsewhere because 3M did not know how it was being used. (Long afterward, 3M learned that it was used in making Teflon products.)

Adams called on DuPont in Wilmington, Delaware, and firms like Union Carbide, Celanese, Shell Oil and International Paper headquartered in New York City. He recited his fluorochemical technology story over and over again, trying to find people who might have an idea or two for using an inert liquid, a surfactant, a polymer (rubber) or paper sizing in some manufacturing process.

"Our biggest problem was that we couldn't accommodate them at our price," Adams said, concealing a hard fact with pleasant words. 3M's products were too expensive for most companies to even consider testing. Adams was offering a fluorinated rubber at many dollars a pound to companies that were buying natural rubber for forty-five cents. Other products in Adams' sample case were priced as much as twelve hundred dollars a pound.

"The people we sold products to—or to whom we tried to sell them—were always after us to lower our prices. And, to produce products for specific applications," Adams said.

Hals mentioned another problem. He had to make calls on every company he drove past because it was impossible to qualify a prospect without going in and asking questions.

"I'd find someone willing to talk to me," Hals said. "Then I'd reach into my bag and pull out something." It might be a wetting agent. Or, an acid, Scotchgard repeller, a paint additive from Kellogg, a protective coating, a cashew resin. "Anything to get started with the hope of getting the prospect to imagine a possible application."

3M's annual report for 1955 included a brief report that the Fluorochemical Division "is now marketing these unique chemicals in the chrome plating industry" and that it had "developed new applications for treating paper and textiles and is test marketing a new fluorinated synthetic rubber."

Hals, a native of Rush City, Minnesota, earned a chemistry degree from Macalester College in St. Paul. With a recommendation from a chemistry professor, he obtained a job with the Manhattan Project at Columbia University in New York City. He worked two years in the fluorocarbon laboratory researching direct fluorination of hydrocarbon oils and lubricants for use with uranium hexafluoride.

Between 1947 and 1949, while attending Penn State on a scholarship, Hals worked with Joe Simons. He earned a master's degree in organic chemistry before Nelson Taylor hired him for 3M's Fluorochemical Project.

Hals left the laboratory in 1950 to pursue market development under Jim Rogers and stayed five years before he was transferred to Cleveland, Ohio, as a Sales Representative in 1955. He became Area Sales Manager for the Chemical Division in 1961 and was transferred to New York in 1966. In 1984, he was made Sales and Marketing Manager, Contract Manufacturing, for the Chemicals, Film and Allied Products Group.

He retired to Ramsey, New Jersey, in 1985 where he organized Biomedical Models Company, which imports anatomical models for sale to medical and chiropractic schools and others.

In another progression, Doug Hall, who had a background in textile finishes, was hired in 1956 as the Group's first Merchandising Manager. Hall, a native New Yorker, had worked in the textile industry eleven years.

His contact with 3M began in 1953 when Hugh Bryce called on Pacific Mills in New York City to demonstrate 3M's protective treatment for textiles. Hall, who was the Supervisor of Pacific Mills Textile Finishes Department, set up a mill trial in Lawrence, Massachusetts, and later in Brookneal, Virginia. The development period continued into 1956 at which point Pacific Mills became a customer. During those three years, Hall became acquainted with Adams, Selden and Bill Petersen, who worked for Bryce in NPD's laboratory. After Burlington Industries bought Pacific Mills in 1955, Hall became ripe for recruiting. In 1956 he accepted an offer and in August moved to St. Paul where he shared Rogers' office on the first floor of Building 21 on Fauquier Avenue for a few months.

Late in that same year, Adams was transferred back to headquarters to become Sales Manager for the Fluorochemical Division. And, although there were only a few Group salesmen spotted around the United States, another layer of sales management was established. Frank Woznak, who had been with Irvington, was given a new job as Eastern Region Sales Manager and Rogers became Sales Manager for the Western Region. The result was not atypical in the Group—there were too many managers and not enough sales dollars. The

Color and Acid and Irvington Divisions were profitable. And, Hastings Chemical would have been profitable except for bookkeeping adjustments. But, the unprofitable Fluorochemical Division absorbed most of the profits of the other divisions.

On May 1, 1957, Dr. John W. Copenhaver joined 3M as Associate Director of Central Research Department. Copenhaver, Associate Director of Research at Kellogg since 1949, was placed in charge of the Fluorochemical Section, Polymer Section and Organic Preparations Group in Central Research. He had earned his Ph.D. at the University of Illinois in 1934 and worked for Socony-Vacuum Oil Company, Rohm & Haas Company and General Aniline & Film Corporation before joining Kellogg.

In the early 1960s Copenhaver replaced Dr. Carl E. Barnes as Director of Central Research after the latter resigned from 3M. Barnes came to 3M in the 1950s and replaced Stephens after he retired.

Bill Pearlson presents shower gifts to Dorothy Everett circa 1950. Front row, from left: Joe Keating, Julie Crudo, (?), four women from steno pool; second row, (?), Don LaZerte, Bob Olson, Anna Mae Mirschel, Pete DeTomaso; third row, Bill Kirchner, Tom Brice, Jack Sargent, Winter Ensign, Ralph Coon, Wayne Severson, Duane Morin, Chuck Taylor; back, Bob Fletcher (glasses) and Dick Guenthner.

CHAPTER 8

Two Remarkable Achievements

"One of the truths of science is that most big discoveries are not designed. They are accidental. If discoveries could be made by predictions, 3M and everyone else could hire a few computer operators and fire the rest of us." Patsy Sherman said that years ago in an interview then laughed to temper her remark.

Invention or discovery is a process of trial and error. Some researchers say luck or serendipity play roles. The work also requires the ability to glean successful segments from a series of experimental failures. The promising segments are saved, the rest discarded. Knowledge and experience also must be applied if a researcher is to steer a successful course. Events that led to the development of Scotchgard rain and stain repeller were no exceptions.

Take, for example, that spring day in 1953, when a chemist in the Polymer Section of Central Research, preparing to run a test on a viscosity sample, spilled some of the liquid. Her frown turned to chagrin, then anger when she noticed that a few drops had splashed onto her new tennis shoes. Joan Mullin was even more distressed when the dried fluorochemical elastomer resisted efforts to remove it with soap and water, alcohol or other solvents.

A year later, the remaining elastomer that had not been spilled began to point the way to success in the search for a stain and water repeller. It also prepared a place in the Minnesota Inventors Hall of Fame and carved a niche in 3M history for a twenty-three-year-old chemist named Patsy Sherman. Sherman had prepared the sample that splashed onto the shoe, an incident which has been popularized as the point of discovery of Scotchgard repeller. Sherman's work in the development of Scotchgard repeller went much deeper than that happy accident, but it was true that by 1954 that particular sample directed 3M researchers away from trying to eradicate the green from the chrome complex and pointed them toward polymers. That change in direction led the scientists quite rapidly to a fluorochemical latex liquid which became the base for the repeller in 1956.

Patsy Sherman

Sherman, who was reared in Minneapolis, earned bachelor degrees in chemistry and mathematics in 1952 at Gustavus Adolphus College in St. Peter, Minnesota. Jobs were scarce, so when 3M offered her a temporary position she accepted and was assigned to a research project funded by the Air Force, an extension of the original 1949 contract. The understanding was that when the contract was terminated, Sherman's employment would end, too. At that time the Air Force was still seeking a synthetic rubber that could stand up to jet fuel and temperature extremes. Sherman's work on that latex product, identified as poly FBA, was 3M's first venture into what eventually developed into Fluorel™ fluoroelastomers.

Dr. George Rathmann was an interested observer as Mullin failed to remove the polymer. He dipped several cotton swatches into the remaining polymer sample, tucked the swatches in an envelope and took it to Hugh Bryce, head of the New Products Laboratory. The tenacious material, Rathmann told Bryce, might have value if a test could be devised to measure it. Bryce agreed as he dropped the envelope in his desk drawer.

The swatches in the envelope lay untouched until Bill Petersen returned from military service. Petersen, a chemical engineer and a graduate of the University of Wisconsin, joined 3M and Central Research in 1949. Two years later the Air Force recalled him for duty in Korea. He returned in 1953 to join Bryce's Product Development Department, which Petersen described as "a handful of guys each working on a different product development project." His colleagues were Maynard Olson, John Ernlund (later replaced by Jack Hessburg), George Blake, Murray Olyphant, Jr., and Vern Welschinger.

Petersen's assignment was surfactants, the type later sold to Udylite Corporation. In 1954 he was reassigned to research into treatments for textiles because Ernlund, who was researching chromium complex treatments, had dropped textiles to concentrate on paper. (Later, paper and paperboard research was pursued by Hessburg and Gayle Rengel which led to Scotchban™ protector products which still are being sold to the paper industry today.)

When Petersen turned to textiles, Bryce handed him the envelope containing Rathmann's swatches with the suggestion that Petersen develop a method to evaluate them. Petersen did so and after running tests on the latex-treated samples, told Bryce that the polymer showed promise as a durable oil and water repellent treatment for cotton fabrics. With that, the arrow pointing to success was ready for the bow. Feathers, shaft, head, varnish and decorations included Sherman's formulation, the spilled sample, Rathmann's swatches, Bryce's retention of them and Petersen's test development and evaluation.

Petersen's test data was passed to Central Research with a request for additional fluorochemical polymers to evaluate. In response, researchers in the Organic Section began producing monomers—the raw materials for polymers—and the Polymer Section began producing polymers. Those were sent to the NPD Laboratory for testing.

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For years 3M scientists had known that hidden somewhere was a key to unlock the commercial potential of fluorochemicals. And, they suspected an effective oil and water repeller for fabrics might lie behind that locked door. Their suspicion was based partly on research into how liquids wet solid surfaces begun in 1948 by Dr. William Zisman at the United States Naval Research Laboratory. 3M's samples among all those tested by Zisman imparted the greatest resistance to the spread of normal liquids.

3M research was directed by five objectives which had been identified by a product development team. Those objectives were to develop a coating that (1) would impart functional oil and water repellency to fabrics, (2) would be effective at low concentrations to keep costs in line, (3) would be durable—able to withstand wear, washing or dry cleaning, (4) could be applied in water, which was the common vehicle in both textile and paper industries, and (5) would not im-

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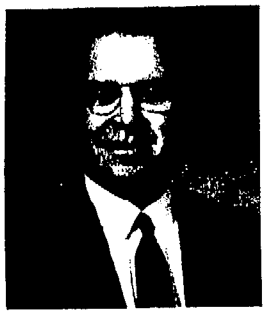
part an undesirable feel or look to fabrics.

Poly FBA applied to fabrics showed promising oil repellency, but its water repellency was marginal at best. Clearly, 3M needed a new fluorochemical, most likely a polymer, which would meet most if not all five criteria. With poly FBA as a starting point, Sherman and Samuel Smith, Sherman's supervisor, began making other polymers for evaluation on fabrics. To do that, they needed new monomers.

The Organic Section in CRL where the monomers and polymers were prepared was headed by Dr. Matthew W. Miller*. Four men provided the fluorochemical chemistry: Dr. Thomas S. Reid, discoverer of the chrome complex, Dr. Donald Husted, and their assistants, George Smith and Arthur Ahlbrecht. Miller, Reid, Smith and Ahlbrecht were destined to become members of the Carlton Society**.

One of the most prolific chemists was Ahlbrecht. In 1989, he related how the tempo of the research accelerated in 1955 and 1956 as the Laboratory workers created countless new monomers which were converted to polymers by Sherman and Smith. In NPD's Laboratory, Petersen, Chauncey Martin, Mel Vietor and Tom Berger were busy developing and refining test methods and evaluation procedures to screen the ever-increasing numbers of new samples. In one exciting month in 1955, Ahlbrecht prepared more than a dozen different acrylates.



Matt Miller

To keep pace, the analytical section provided overnight feedback which normally required a week. Ahlbrecht dealt with tiny amounts—ten grams was a typical monomer batch—which were delivered overnight to Sherman and Smith for polymerization. By the next morning, they were being evaluated in Petersen's area. When the results were announced, the group would make adjustments based on them and prepare another batch of samples.

"Within twenty four hours of making a monomer, we would know how good it was," Ahlbrecht said, "in terms of oil or water repellency

*Between 1954 and 1962, Miller was Technical Director of what is today the Industrial Abrasives Division. Then he returned to CRL as Associate Director where he stayed until he retired.

**3M founded the Carlton Society in 1964 to recognize outstanding contributions to the company's scientific and technical progress. More than 150 men and women have been honored.

and durability." Prior to that time, the cycle required two work weeks, but the excitement generated by the continuing progress caused everyone in both laboratories to work harder and faster than ever before.

Hundreds of samples were evaluated. Some were too sticky. Others dried to a powder that flaked easily. Some had excellent oil repellency, but little or no effectiveness against water. With other samples, the reverse was true. Still others affected the softness of fabrics. And, many would have been prohibitively expensive. It was not easy to find a balance between properties and economy.

Art Ahlbrecht

"It was a frustrating period," Sherman said years afterward. "Sometimes it seemed we were never going to be successful. Never going to be able to combine the desired properties in a product that could be priced at what people could afford."

Those projected high production costs were a difficult barrier. To leap it, Sherman and Smith had to invent a new emulsion polymerization process, a major breakthrough. In that emulsion, water—because it would not blend with the chemical—was mixed with a small quantity of an inert water-soluble organic solvent in which the fluorochemical monomer was somewhat soluble. With that, water became a carrier, but still fifty or more monomers went through the cycle before Sherman and Smith were able to settle on one. Smith, a polymer chemist, was the visionary. Sherman proved Smith's ideas while contributing ideas of her own.

The first Scotchgard rain and stain repeller was announced in September 1956, but the first totally effective product was not developed until 1960, which was after Smith and Sherman had transferred to the Chemical Division Laboratory. By that time, hundreds of experimental products had been made. "We got lucky," Sam Smith said. "The number of combinations you can put together is infinite."

The laboratory designation for that successful 1960 product was FC-208, which was a segmented copolymer with a non-fluorinated monomer. At last, 3M had a product which imparted both good oil

Patsy Sherman, inventor of Scotchgard rain and stain repeller, with Sam Smith in 1972. Smith, Sherman's supervisor, worked with her to improve rain and stain repeller in the 1950s.

and water repellency to all fabrics. It was durable when washed or dry cleaned and contained only half the expensive fluorine required in previous formulations. The latter bottleneck was broken by the fact that FC-208 was a copolymer with an inexpensive, commercially available monomer.

Today's Scotchgard protector is not just one product, but a family of products tailored for specific application. The realization that one product would not serve every need was learned through experience. In 1956, for example, the first commercial stain-resistant product worked well on wool fabrics, but was ineffective on cottons. Another fact learned through experience was that the repellers had to work in harmony with a variety of finishing agents manufacturers used to impart softness or body to their fabrics. Unless 3M's products were compatible, they would fall out of dispersion and be rendered

ineffective. It also was learned that formulations that changed the feel of a fabric were unacceptable to fabric manufacturers.

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In 1966-67, Sherman and Smith collaborated again to develop a product technology that was even more demanding and more astounding than the development of the rain and stain repeller. Bill Petersen called it "The most brilliant piece of chemistry that came out of the Scotchgard repeller program." Brilliant indeed! It created a revolution in the textile industry.

The new development came about because permanent press fabrics, which are highly finished blends of cotton and polyester fibers, were discovered and popularized in the 1960s. The fabrics were and still are easy to care for so they gained immediate consumer acceptance for shirts, blouses, pants and other apparel. Quite different from other fabrics, permanent press materials require more synthetic fibers and larger quantities of resins and finishing chemicals. That created problems. Permanent press materials tended to attract oil-borne stains and would not release them during laundering. At first that appeared to be an excellent opportunity for 3M, but to their dismay, the Chemical Division researchers could not find a fluorochemical finish that would solve the problem.

They also learned that the challenge was daunting, if not impossible. A successful product would have to ward off oily stains, but when and if stains occurred, the product would have to allow them to be washed out during laundering. Repelling oily substances was no problem; 3M products had been doing that for years. That, however, worked against Scotchgard repeller during laundering; fluorochemicals simply could not go against their nature. They could not release stains into water. It was an axiom which could not be changed.

Harris Laboratory in Washington supported the conventional wisdom. Its scientists had proved in a series of tests between 1962 and 1965 that an oil-stained garment which had been treated with a fluorochemical finish could not be washed clean. Smith and Sherman disagreed with Harris. They even pointed to a possible way to solve the stain release problem in a report to management in 1965. That report also signaled an end to the two scientists' repeller collaboration, but as it turned out the parting was only temporary.

In the report, Smith theorized that a possible path to success might be the design of a "flip-flop" or dual action polymer that would be hydrophobic and oleophobic in air and hydrophilic in water. Fluorochemicals are by nature hydrophobic and oleophobic; they will not mix with water or oil. Cotton is hydrophilic; it soaks up water like a sponge and readily releases oil stains in a detergent solution.

Scientific discussions between the two researchers were terminated in 1966 when Sherman went on maternity leave. During her absence, Smith turned to a new venture, that of creating polymers as raw materials for structural adhesives. That new research appeared to have severed the partnership permanently.

When Sherman returned to work, she resumed research on fluorochemical formulations. And, in her free time, she thought about possible solutions to the stain release challenge. Eventually she reached a dead end. The problem she wrestled with can be explained non-scientifically by using a greasy frying pan as an example. When the pan is dipped in water, the grease, which is lighter than water, should float to the surface. Instead it stays put because the grease has a lower surface energy than water.

A way had to be found to put a hydrophobic (water-hating) polymer together with a hydrophilic (water-loving) polymer. It was not possible to simply mix them. Neither would stand for that. Sherman had to find a way to put them together in one super molecule, to find a hydrophilic substrate that could be married to bread-and-butter fluorine chemistry. To accomplish that, she would have to develop an entirely new class of fluorochemicals. Even testing the concept would require a significant departure from existing technology.

Try as she might, Patsy Sherman could not solve the enigma. We remember that the apple fell on Isaac Newton's head. And, Carl Miller was reputed to have developed 3M dry copying technology because he saw a solar-heated leaf in the snow. Sherman's inspiration was far less memorable. It arrived quite prosaically one afternoon while she was reading in the Benz building library. In an article on an unrelated subject, Sherman spotted what she thought might be the other half of the molecule that could be chemically adapted to provide her novel composition. Luck or serendipity led Sherman to that article. And, Dame Fortune continued to beam on her. She learned that the author of the article, which had been written eight years earlier, still was at 3M as a polymer researcher in CRL. And, to

extend Sherman's lucky streak, John Erickson told her that he still had several ounces of his solid material.

Sherman used it to run an experiment that proved her theory.

A research team, headed by Smith, was organized to develop her product and lay the groundwork for a patent application. In 1967, the team effort led to the commercialization of Scotchgard dual action Stain Release™ treatment for fabrics. It was an instant success in the marketplace*.

Sherman developed sixteen patents over thirty years. Smith developed thirty-one based on polymers and novel methods of synthesizing polymers. Together, Sherman and Smith share thirteen patents on fluorochemical polymers or polymerization processes. Sherman holds three other patents filed between the late 1950s and the late 1970s. Smith holds three other fluorochemical patents, one shared with William Schultz, a chemist, and two with Arthur Ahlbrecht**.

Smith was inducted into the Carlton Society in 1969. In May 1974 Sherman became the first and (through 1990) only woman member of that organization.

A native of the Bronx, New York, Smith earned a bachelors degree in chemistry from City College in New York in 1948 and a masters degree in organic chemistry from the University of Michigan in 1949. His first job was with the Institute of Paper Chemistry, Appleton, Wisconsin, where his boss, Dr. Al Borders, left in 1950 to join 3M. Smith followed a year later and was assigned to the Polymer Section headed by Frank Bovey. He worked with Patsy Sherman and Joe Abere. Abere left soon afterward and Smith replaced him as Sherman's supervisor. In 1967, Smith was designated as a Research Associate (now called Corporate Scientist), which is the highest scientific position at 3M, equal to Technical Director. He has been with 3M's Film Technology Center since 1982.

In 1988, Smith earned the American Chemical Society Creative Invention award for his contributions to the Scotchgard protector program and for two other areas of technology. He is the only 3M

*Earlier in the 1960s, Deering-Milliken developed a stain release product, Visa™, but kept it a proprietary secret for use on its own products.

**Between 1948 and 1956, Ahlbrecht co-authored a dozen patents with Dr. Donald Husted and a dozen more with others in CRL. In 1956, he joined the abrasives laboratory and was the division's Technical Director from 1964 to 1982. He retired in 1988 as Quality Director of the Industrial Abrasives Division.

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scientist ever to win that honor.

Sherman became a Senior Research Specialist, 3M's second highest technical rank, in 1967 while in the Chemical Division Laboratory, where she worked from 1957 until 1973. She was Commercial Products Development Manager in Chemical Resources Division until 1982, when she assumed her present administrative position as Manager of Technical Development for the corporation.

Sam Smith

Dr. Thomas J. Brice and Paul Trott shared the important discovery that showed by changing the class of feed materials in the Simons cell a new class of fluorochemicals could be produced. Those fluorocarbon sulfonic acids became the essential building blocks for the development of Scotchgard protector products. In 1969, Brice was inducted into the Carlton Society for his joint invention of fluorocarbon sulfonic acids and for training and guiding young chemists in research. A native of Cedar Rapids, Iowa, Brice graduated summa cum laude from Coe College before earning his doctorate from Penn State. He retired in 1985 as a Corporate Scientist in the Life Sciences Sector after thirty five years with 3M.

CHAPTER 9

Faith, Hope and Dissolution

On September 22, 1955, only a few months after the Chemical Products Group came into existence, General Manager Oakes had an opportunity to talk about his Group to 3M's Technical Forum.

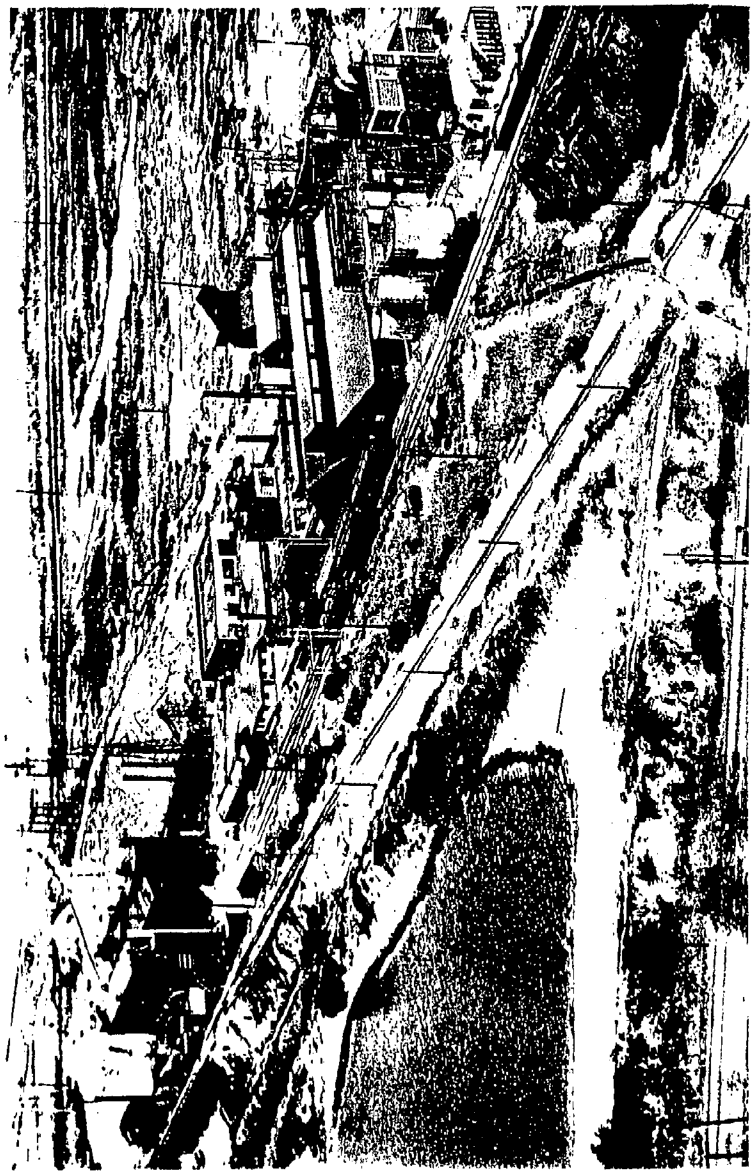
A written record of that meeting, dated six weeks later on November 7 and signed only with the initials "de," indirectly quoted Oakes. The information below was taken from that report.

The four divisions were interested predominantly in chemical products as opposed to fabricated products, Oakes said. They were formed into a Group to facilitate 3M's growth into the chemical field with the Divisions the home for 3M chemical products. Emphasis would be on growth and profits and continued service to other divisions, he said.

The Color and Acid Division at Copley, Ohio, suffered from the problems of any isolated operation. It was difficult to coordinate the Division's work with that of the other Divisions, particularly to obtain the benefits from association with people engaged in fundamental research and new product work. No change from the basic pattern was being considered, Oakes said, but some re-evaluation of products might be needed to improve the growth of the Division.

The Irvington Chemical Division, concerned with products derived from cashew nut shell liquid, had developed a wide variety of new products with potential applications in new fields. It all began in the mid-1930s after a research chemist, Dr. Mortimer Harvey, who worked for National Biscuit Company, began investigating various nuts as sources of proteins and oils. Harvey was intrigued by cashew nuts and made a thorough study of them.

Next page: 3M's Copley, Ohio, plant in 1950.



Cashew nuts were, Oakes said, native to Brazil and Mozambique, although they occurred elsewhere in limited quantities. The trees grow wild in jungles, stand fifty feet tall and have umbrella-shaped leaves. The seed pod on each tree is shaped somewhat like a lima bean and is suspended from the fruit which is similar to a persimmon. When ripe, the fruit and seed pod fall to the ground, where they are harvested. The fruit, crushed and fermented, becomes a base for an alcoholic beverage. The seed pod containing the cashew nut is a spongy, porous shell with liquid comprising a third of its weight. At that time, the pods were boiled in a kettle over an open fire to release the liquid, which let the pods float to the surface so they could be removed and dried. Then, the brittle pods were cracked to harvest the nuts.

The liquid remaining in the pot—the cashew nut shell liquid or CNSL—drew Harvey's attention. It must be handled carefully; in contact with skin it reacts much worse than poison ivy. Harvey's interest may have been aroused by the fact that while it was a waste material with no known use it was highly reactive.

His experiments showed that CNSL had properties similar to phenolic resins, which at the time were popular raw materials for making Bakelite™ and other thermo-setting plastics. What made CNSL plastics different was that when they were subjected to high temperatures they became soft and sticky instead of hard and brittle.

Harvey tested his find against known uses for phenolic materials, but struck out every time. Paint made with CNSL could cause "poison ivy" on contact. Molded articles gave people who handled them a poison ivy reaction, too. Somehow Harvey found a practical application—brake linings for automobiles. He learned that CNSL mixed with asbestos fibers and other ingredients could be molded into an effective brake lining. Heat applied over time is a foe of brake linings. CNSL helped linings stay soft and sticky instead of becoming hard and brittle. CNSL also made brakes operate without squeaking or chattering, which really interested automobile manufacturers.

Harvey had left National Biscuit Company and was self-employed when he made contact with Irvington Varnish and Insulator Company, which took him and CNSL under its wing. He was provided with a laboratory and several technicians to work on applications for the electrical industry. The manufacture of resins for the brake lining industry was begun and within a few years fifteen percent of every brake lining made in the United States was Harvey's material. 3M acquired CNSL and Harvey with Irvington.

Unfortunately, other uses were never found for CNSL, nor was it possible, because of their nature to grow the trees in plantations. But, in 1955, there still was hope for new products and Oakes told his audience that the Division's growth would be helped by the construction of a pilot plant and laboratory in Irvington, New Jersey.

At Irvington as at Copley there were difficulties caused by the Division's isolation from St. Paul. Oakes wanted to maintain Irvington as its own unit, but to integrate it into 3M's technical groups to allow Irvington to benefit from those contacts. To do that, an Irvington representative was invited to the Technical Forum monthly meetings and during that visit to confer with technical people in St. Paul.

The Fluorochemical Division, Oakes said, had several products in regular production, two surfactants, in particular. One was a mist suppressant used in chrome plating (Udylite), the other an emulsifier in a specific polymerization (DuPont). Products for the paper field and the textile field had not reached commercial status, but were approaching it, he said.

He also noted that confusion had risen over the use of the term "pilot plant." The Hastings Division operation at Chemolite was not a production unit, but to call it a pilot plant put it in a category that had so many definitions that it confused top management. Oakes said he preferred the term "semi-works plant."

Hastings Chemical Division, he said, served a well-established function of supplying chemicals to other operating divisions for their end products. In addition, it was preparing several products for sale outside the company.

In the Group, Oakes said the integrity of each division would be maintained and each would be responsible for its own growth and development. As the divisions grew, he said there was the possibility of salesmen handling primarily the products of just one division, but that luxury did not seem feasible at the time. Selden, who spoke later, said the Group sales force plan, the status quo, was set for five years.

The Group, Oakes said, might grow by purchasing other chemical companies.

In the question period, Oakes said the ratio of internal to external sales was about fifty percent in each category. There was, he said, no question that external sales would increase rapidly, but added

that the Hastings Division had to maintain its responsibility to provide products for internal use, which was important in the successful growth of 3M products.

Earlier in 1955, at a sales meeting held after first quarter results were in, Oakes told sales representatives and others in the Group that manufacturing standards must be raised because "you can cash in on that" with customers. He stressed the value of quality control and said that while two divisions had had quality control for a long time, the other two were just getting started. He did not name those divisions.

There were, he said, sixty-five people in the four division laboratories.

Selden said the Group's ten salesmen were expected to sell two million eight hundred thousand dollars worth of products in 1956 and twenty-five million by 1960. The Group lagged five point two percent below forecast for the first quarter, Selden added.

He also discussed sales costs and what salesmen were expected to spend and earn in their territories. An average call, based on a Group survey, he said, cost the Group four dollars and seventy cents at a sales rate of six dollars an hour. Each man was expected to average seven hundred and fifty dollars in sales for each call, "a pretty good average," Selden said.

The survey also indicated that forty-seven percent of the sales calls were for fluorochemical products which produced twenty-eight percent of the sales dollars. Irvington Chemical Division products were presented on thirty-eight percent of the calls which resulted in seventy-one percent of the sales. Hastings products got exposure on twelve percent of the calls, but generated only one percent of the sales. When products of more than one division were presented in a call, that call was credited to all divisions concerned. Copley products were not sold by that sales force.

At that sales meeting, Nelson Taylor said that the Fluorochemical Division's goal was "uninhibited research for uninhibited markets," but did not explain his remark. He also said, "We probably spent two hundred thousand dollars to find the right product for Udylite application" adding that it was "a very nice business." Besides, he said, that product led to perfluorosulfonic acid, which was "important for much of our future development."

Good profits, he said, were generated by the sales to DuPont as well as Udylite. He predicted one million dollars in sales for fluorochemical products that year.

Bob Jones, General Manager of Irvington, talked about cashew nut shell liquid research. The liquid's heat stability led Irvington from paint manufacturing into the brake lining business, with the first patent obtained in 1956. "We are permanently entrenched" in the brake lining business, Jones said, calling it "our first honest-to-goodness product." He also pointed out that Irvington Division bought fifty percent of the world supply of cashew nut shell liquid every year. He said space was "tight" at Irvington and that the plant was understaffed.

Sam Baumann who spoke for Copley said it was one of fifteen sulfuric plants in Ohio. There also were fifteen in Georgia and fifteen in Illinois. Copley's production was sold within a one-hundred-mile radius of the plant, typical of the industry. The acid sold for a penny a pound and generated a twenty percent profit.

The Division was the world's largest producer of synthetic chromium oxides and it also produced synthetic iron oxides. The former were used as a pigment for 3M roofing granules and for paint and concrete. The latter were a pigment in manufacturing floor tiles.

Manager Al Deisslin (right) holds the interest of visitors to the Chemolite pilot plant. They are (front row, from left) Joe Simons, Richard Carlton, Archibald Bush, William L. McKnight and Harry Stephens and (back row, from left) Nelson Taylor and Charles Walton.

Baumann said millions of pounds of iron oxides in twelve different shades were produced in the first quarter. And, if required, Copley could manufacture millions of tons of chromium oxide in a year.

A spokesman for Division Engineering told the meeting that the staff of eight engineers assigned to the Group would be increased to ten by June 1 in order to handle close to two million dollars worth of project authorizations, including a new polymer building at Hastings, a warehouse at Copley and "fluorochemical expansion."

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On the very day that Oakes retired in 1959, the Group was disbanded and its Divisions were compressed into one business organization, a new Chemical Division. That drastic action was recommended by Selden, who was to have succeeded Oakes as Group Vice-President, but instead became General Manager of the Chemical Division. (He was made Vice-President a year later.)

Decades later Selden discussed his action. The earnings of the Group did not warrant "five of everything"—five general managers, five technical directors and so on. (The fifth division was the chemical operation of M. W. Kellogg Company which had been added to the Group in 1957.) It was a case of consolidate now or have it forced on me later on," Selden said.

The Group's financial problem, Selden asserted, was misleading because of 3M's accounting system. While it appeared that only the Color and Acid Division and the Irvington Chemical Division were making money, Selden said that Hastings, accounting reports to the contrary, was profitable, too. Only the Fluorochemical Division had not yet turned a profit at that time.

The system that altered Hastings' picture was that while 3M divisions were to buy Hastings' chemical production at free market prices, that was not done. Instead, Selden said, the accounting department, "was able to decide at the end of each year how much profit, if any, Hastings was to make."

His recollection was that Group sales were between thirty-five and fifty million dollars a year, "certainly less than one hundred million dollars."

When the ax fell, five general managers, five technical directors and five sales managers lost their jobs. The general managers were Nelson Taylor, then in his sixties, who reluctantly accepted 3M's retirement offer and moved to Mexico; Bob Jones of the Irvington Division; Telfer of Color & Acid; Kugler of Hastings and Louis Rubin of the Jersey City Chemical Division (Kellogg). Jones took his demotion in stride, but his father who had sold Irvington to 3M and was a major 3M stockholder, raised Cain, Selden said. Arthur

Jones's complaints had no effect on 3M management, however, and Selden's decision was allowed to stand.

That draconian solution to the Group problem resulted in a need to staff a new division. General Manager Selden appointed Bob Adams as Technical Director, Commercial Chemicals, the position Adams had filled since 1958 for the Fluorochemical Division. Bill Lundquist was appointed Technical Director, Internal Chemicals. Commercial chemicals included all products sold outside 3M. Internal chemicals covered products formerly handled by Hastings Chemical Division.

Other appointments were:

Dr. Hugh Bryce to Development Manager, Fluorochemicals. He had been in charge of the Product Development and Applications Laboratory of the Fluorochemicals Division.

Dr. Frank Honn, formerly of Kellogg, became Development Manager, Kel-F™ brand products. He had been Technical Director of the Jersey City Chemical Division since 1957.

Dr. Al Reynolds became Development Manager for resin products. He had been Sales Manager of the Hastings Chemical Division, which he joined in 1955. His new responsibility was for commercial resin products including 3M, Cardolite™, Furatone™ and Cardosol™ products.

Dr. W. H. (Bill) Pearlson was made Supervisor, Fluorination Research and Development, responsible for fluorination processes. Pearlson, at one time a Section Leader in Central Research, most recently had been Supervisor, Process Development Laboratory, Fluorochemicals Division.

Dr. Don LaZerte became Supervisor, Fluorochemicals Process Development Section, responsible for commercial products. Since joining 3M in 1949, LaZerte had been in the Catalytic Section, Central Research, and later in the Process Development Section, Fluorochemicals Department, NPD. In 1954, he became Group Supervisor, Process Department Section, headed by Pearlson.

D. A. Stivers was made Supervisor, Rubber Compounding and Services Laboratory. Stivers had joined 3M in 1956 after several years as a compounder in the rubber industry.

E. J. Grajec became Supervisor, Textile Products Development, responsible for application development and technical service. He had joined 3M in 1958 as a Technical Service Representative for fluorochemical textile products in the East. Before that he was Assistant Director of Research and Development for Collins and Aikman and had worked three years as a chemist with Geigy Chemical Company.

A Central Research announcement said that Clifford C. Japs had been promoted to Supervisor in the Process Section responsible for preparing pilot plant quantities of polymers and scaling up polymers produced in his section. The announcement was by Al Frye, Section leader.

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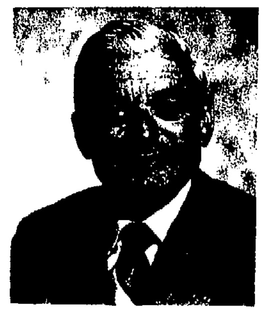
Selden left the Chemical Division in 1960 and returned to the New Products Division. He was replaced by Art Telfer, former Plant Manager at Copley and later Group Production Manager. Selden, as Vice-President and General Manager of NPD, replaced John Pearson, who transferred to another division.



Erwin Brown

Selden resigned from 3M in 1968 to become President of the Industrial and Marine Divisions (13 companies) of North American Rockwell in Pittsburgh. Three years later he was President and Chairman of Crane Carrier, Tulsa, Oklahoma, builder of large trucks, including ready-mix vehicles and mobile crane carriers. After three years at Crane Carrier, Selden went to Sands Measurement, a Dallas, Texas, maker of electronic scales, some capable of weighing moving railroad cars. From 1976 until he retired, Selden was self-employed as a new product consultant in Tucson, Arizona.

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In the early Fifties, Kugler, General Manufacturing Manager of the Central Manufacturing Division, (which became Hastings Chemical Division in 1955), got 3M started in the polyester film business. A film project authorized in February 1954 in the Internal Chemicals section of the Chemical Division became a Film Department in 1961. Erwin W. Brown, former Manager of Electrical Products in the Irvington Division, was Project Manager reporting to

Kugler. In 1962, the Film Department was separated from Internal Chemicals and Brown began reporting to Telfer. The final step in that evolution was the creation of the Film & Allied Products Division on May 31, 1963. Today it is the Specialty Film Division of the Chemicals, Film & Allied Products Group.

Kugler, who began at 3M in 1927, retired in 1965. He died in 1976 at the age of 73.

CHAPTER 10

The Turning Point

At a sales meeting in 1966, Bill Petersen* talked about the marketing challenges of the 1950s to an audience which included young men and women newcomers to the stain repeller program.

"There were no tests by which to evaluate our products," Petersen said. "There were no yardsticks of performance or economics. And, there were no guidelines as to what fabrics they should—or shouldn't—go on.

"The first sales calls were made in 1954. Imagine the reaction to our introductory offer—fifty dollars a pound! Fortunately, a few brave souls in the industry were intrigued by what they saw and agreed to work with us, so by February 1955 we were ready for our first mill trial."

That began in late 1954 when Selden met in New York with marketing people representing Deering-Milliken Company. They expressed interest in seeing what 3M's experimental textile protector product could do on their new fifty-five percent wool-forty-five percent Dacron™ blend fabric. To run a test, they would need twenty gallons of FX-401 and need it quickly; the fabric was ready for production and that schedule could not be changed.

Twenty gallons was a monstrous quantity. Selden estimated it would require six weeks or more to produce it, but he kept that information to himself. He said he had to consult his boss before making a decision.

There are managers who believe that given an incentive their employees can do anything. Oakes also was desperate to get the rain and stain repeller show on the road. After talking with Selden, he

*Petersen left the laboratory in 1968 to become General Sales and Marketing Manager after Telfer became the Chemical Division General Manager.

telephoned Deering-Milliken, then called Selden back into his office.

"I agreed to their February (1955) deadline," Oakes said. Delivery was to be at a mill in Pendleton, South Carolina.

Selden relayed that information to his team. The problem of covering the thirteen hundred miles between St. Paul and Pendleton ran a distant second to the challenge of producing twenty gallons of FX-401. Until that moment, 3M had made only one-liter-size batches in the laboratory. Production planning began at once in December 1954. Production would start in January to be completed in late February. The margin for error was thin as tinfoil, but the schedule was based on the best estimates of laboratory and pilot plant.

The lesser consideration was allowing time for Petersen and Bryce, who were assigned to the mill trial, to cart the product to South Carolina in a station wagon.

Only a few people talked about the possible weather in February in the Upper Midwest. That was an intangible, but it was likely to be harsh. Ice-slicked or snow-drifted roads would be a major obstacle to two men rushing to meet a mill trial deadline.

Bob Burford

But, first things first. Bob Burford's responsibility was pilot plant production. An experienced operator, he had been with 3M since 1947. Married and the father of two, Burford was, at that time, attending the UofM. In need of money, he went job-hunting and 3M hired him. Every day from midnight to 8 a.m. he and another man operated the electrochemical cell for the Project. Later he was on the four to midnight shift. In June 1949 he graduated with a degree in chemistry.

Burford's crew worked day and night to fill four five-gallon glass carboys. The last one was topped by nightfall on a Friday, three days before the Monday deadline in South Carolina. At last, Petersen and Bryce were ready to set out on their expedition. The two men recounted the story years later.

"Faced with a typical, almost impossible marketing deadline, Hugh Bryce and I loaded the world's only supply of FX-401 in a rented station wagon and headed south. We didn't dare stop until we were

out of the freezing zone for fear of ruining the product," Petersen said. "We would have flown, but the FX-401 could have frozen in the cargo hold. If it froze, it would coagulate and be useless."

Leaving Chemolite at 5 a.m. on a Saturday, they headed toward Iowa on a two-lane blacktop in that era before freeways laced our countryside. "The first one hundred and fifty miles were on ice-covered highways," Bryce recalled. By Saturday night, after driving through Cairo, Illinois, they were in western Kentucky, where they parked the wagon in a service station with a heated bay. Then they rented a room and grabbed a few hours sleep before continuing their odyssey early Sunday morning.

"Selden had warned us not to go over the Appalachians. He was afraid we'd get caught in a mountain snowstorm and go into a ditch," Bryce said. "But, Bill and I knew we didn't have time to go far enough south to go around them, so we risked the mountains south of Knoxville." The mountain trip went without a hitch. The tired pair and their precious cargo reached Pendleton about ten o'clock—bedtime—Sunday night.

"We didn't get to sleep. Instead, we spent the rest of the night getting set to run our mill trial. Those trials went extremely well especially toward the end of the week," Bryce said.

Although the mill trial was successful, Deering-Milliken decided against using 3M's product. The trial had its merit, however, because it demonstrated the feasibility of applying fluorochemicals using the padding method* and 3M gained experience in scaling up a mill run.

During that same period of the 1950s, 3M also conducted mill trials at Pacific Mills plants in Lawrence, Massachusetts, and Danville, Virginia. In the course of those trials, 3M developed Scotchgard repeller finishes for both worsted and woolens applied by exhaustion in a dye beck. That contact resulted in Doug Hall leaving Pacific Mills to become 3M's first Merchandising Manager for Scotchgard repeller.

The turning point came in 1955, Petersen said. That year marked the commercialization of the first oil and water repellent finish the world had ever seen.

"From that point on, it was no longer strictly a technical problem.

*In padding, a fabric is passed through a tank of (in this case) fluorochemical, then through squeeze rolls to remove the excess. In another method known as exhaustion, fabric is circulated in a tank called a dye beck until all the fluorochemical is absorbed into the fabric.

Unsophisticated early day publicity phot features Bill Petersen and fabric. Cutline says "Oil and grease stains on permanent press trousers now can be released after normal home laundry." Petersen was Textile Products Manager in the Chemical Division Laboratory at the time.

In fact, figuring out ways to sell these products (which were never cheap) was about as tough a job as making them," Petersen said.

The first treated fabrics were worsteds and woolens, but by 1956, an improved version of 3M's product was being applied on worsteds

and polyester-worsted blends. 3M also had developed a product for treating upholstery fabrics.

In 1959, 3M took aim at the wash-and-wear cotton market and introduced "the radically new concept of commercially applying fluorochemicals from solvents," Petersen said. That led to a whole new family of solvent-based Scotchgard repellers.

A few years earlier, in the mid-1950s, a new application was found for the chrome complex. It enabled the manufacturer of Hush Puppies™ leisure shoes to overcome a major marketing problem. The story has been told from two viewpoints. The sales version featured James McFadden, the 3M Sales Representative in Detroit, who was described as very industrious and very curious.

It began with Jim Rogers, the Sales Manager, and a colleague driving sixty miles down the Mississippi River from St. Paul to Red Wing to call on S. D. Foote Company, a shoe manufacturer. When McFadden found out about that, he headed for Wolverine, a shoe manufacturer in Rockford, Michigan.

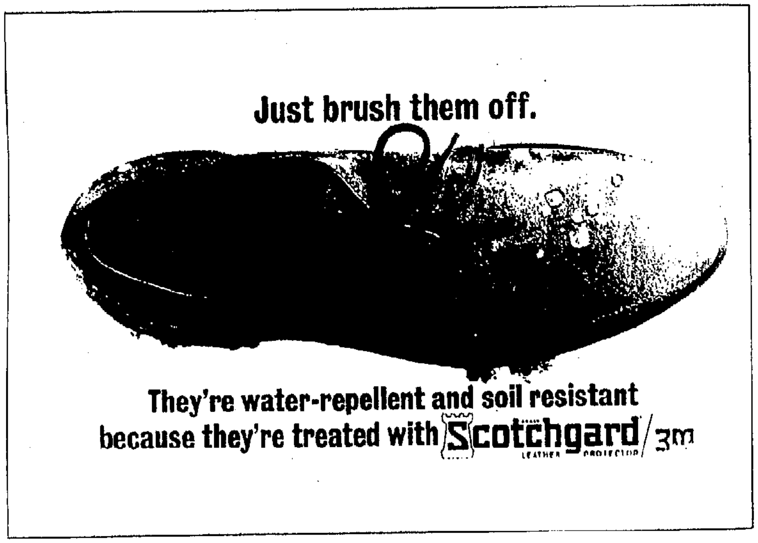
Wolverine evolved from a tannery founded in the late 19th Century by a German immigrant whose talent was tanning cordovan leather (horsehide) for work shoes and gloves. At its peak, the tannery employed two hundred people, but the firm fell on evil days after the evolution of trucks and tractors depleted its raw material.

In the late 1950s, Adolph Kraus, a grandson of the founder, set out to revitalize the company, which could tan cowhide, sheepskin and other hides, but could not compete with the giants in the industry. As luck would have it, one day an inventor walked in with a machine he said would replace hand skinning of pigs.

Skinning was an art. One slip and the knife would pierce the fragile skin and it was impossible to skin the hams at all. A skinner was fortunate to wind up with three or four square feet of pigskin. The inventor proved that his machine could skin a pig, hams and all in half the time it took a skinner. The machine also produced skins from six to ten feet square, well above the hand-skinning average.

Adolph obtained an exclusive license to build and sell the machines, but he and his customers soon realized that while they could machine-skin pigs faster and easier than ever before, the skins were no better than then machineless competitor's. And, there still was only one basic use—dress gloves—because untreated pigskin stretches and is ruined by exposure to water. Adolph hired a chemist to solve that problem, but a variety of waterproofing products he tested were unacceptable because they made the pigskins stiff as boards.

While the quest for an acceptable treatment continued, the tannery acquired a German process and began manufacturing pigskin leisure shoes. The shoes were inexpensive and because the leather was sueded to mask the blemishes, attractive. At first sales boomed, but then complaints began piling up. Purchasers learned to their regret that once exposed to rain or snow their shoes were ruined. Into that crisis stepped Jim McFadden with his story about a 3M wonder product. It protected leather against the elements and did not make it board-like in the process. His story was documented by testing, and after Adolph bought 3M's product his pigskin shoes were rescued and were still being sold in 1991.



An early 3M advertisement for Scotchgard leather protector and Hush Puppies pigskin shoes. 3M's product saved Hush Puppies from disaster by protecting them from terminal damage from rain, snow and mud.

The other version of the same story is entirely different. Which is correct or where the versions might blend is lost in the mist of

3M specialty chemical history. In any event, the laboratory version has Maynard Olson of the Fluorochemical Division Laboratory and Hugh Bryce making contact with Foote, the Red Wing shoe manufacturer, in 1955 or 1956. Trials proved that the 3M treatment would make leather repel both water and oil, but still Foote was not convinced, so no sales resulted. With that knowledge, however, Olson and others involved knew that they could help Wolverine after contact was made. First trials proved that the chrome complex would repel water when applied to pigskin, but the sticker was that Wolverine would have to change its manufacturing processes in order to use 3M's product. Furthermore, the tiny holes left in the skin when the hair was removed were not sealed, so moisture could penetrate the leather. Buffing to produce the suede also tore skin fibers, which caused the chrome complex to lose oil repellency. Some shoe colors were affected more adversely than others, too. Olson and Chemist John Lamb of Wolverine worked together for three or four years before they solved the problems. The solution was a two-part treatment designated as FC-233, which was a liquid in part A and a powder in part B.

During the development years, 3M was in competition with Pennwalt Corporation, which had a product similar to the chrome complex and was trying to sell it to Wolverine.

Refined versions of FC-233 are still used on Hush Puppies shoes today.

(Adolph produced the name Hush Puppies from deep fried cornmeal dough balls which cowboys squatting around their campfires supposedly tossed to their dogs to keep them from howling. He also coined the slogan "To quiet your barking dogs" and soon Wolverine, another Adolph appellation, was producing ten thousand dozens of pairs of shoes per week.)

Maynard Olson spent thirty-one years at 3M, all in specialty chemicals, after he was hired by chance in 1951. Olson was raised in West Salem, Wisconsin, and obtained a chemistry degree from the state university. His first job offer came from Linde Air Products in Buffalo, New York. While considering that offer, a friend invited Olson to ride with him to St. Paul where the friend had an interview with Minnesota Mining and Manufacturing Company.

In the 3M employment office on the first floor of Building 42, Olson's chum suggested that Olson might as well fill out an employment application, too. He did and soon was interviewed by Hugh Bryce, who made Olson a job offer a few days later.

"They were really eager to hire chemists," Olson said years later, "because of the rapid expansion of the fluorochemical areas." He accepted the offer and was still in the CCD Laboratory when he retired in 1982. Olson's friend, Robert Bowman, was also hired. He had a long career at 3M, beginning in CRL and ending with retirement.

After FC-233 had proved itself, Olson visited tanneries all over the United States trying to find another customer, but ran into constant problems. The product's best feature was its dry-cleanability besides its repellency. Its shortcoming was its high price.

In the 1970s, Olson helped develop FC-100, an additive for tanks in the electrowinning process used to obtain copper from copper ore. FC-100 was the copper industry version of FC-95, the Udylite product, and in fact was developed after it was learned that FC-95 did not work with copper. The benefits of the copper electrowinning process compared with smelting were more efficiency and less pollution.

CHAPTER 11

Selling Hangtags

The history of Scotchgard protector also was being written in the field by men like Bob Peiffer, James McAndrew and Joseph Tischio in the New York sales office.

McAndrew had been selling for Goodyear for eight years and living in St. Paul when he became enamored of 3M and Scotchgard repeller in 1959. He applied for a job and Sales Manager Doug Hall hired him in January 1960. He was sent to New York where the Scotchgard repeller sales team and 3M's Hartford City Paper Company operations were tenants of 3M's International Division in its office at 99 Park Avenue.

Peiffer was the field Sales Supervisor in Manhattan. With him were Sales Representatives Richard Engebretsen and Tischio, who was Sales Correspondent. Tischio joined the team the same week McAndrew arrived in the city.

"We were amateurs in the textile business," McAndrew recalled, "which was good because we didn't know what we couldn't do." He and other salesmen even sold hangtags, those merchandizing tags that are attached to treated furniture in showrooms around the world. Hangtags are produced by the millions and have been give-away items for more than a quarter of a century, but in the early 1960s the New York neophytes considered hangtags salable merchandise.

During one memorable afternoon, McAndrew spent hours tryng to convince Lou Ganze of Rain or Shine, a manufacturer of women's rainwear, to buy fifty dollars worth of hangtags. At the day's end, Ganz took McAndrew to dinner at the expensive Four Seasons restaurant, then told McAndrew to be back in the Rain and Shine office early the following morning. "We picked up where we'd left off the previous day," McAndrew said. "Ganz didn't want to pay fifty dollars for our tags, although he must have paid two hundred dollars for our dinner the night before. Anyway, I finally convinced him and he bought the tags."

Another recollection of the naivete of the sales organization concerned attempts to sell Scotchgard repeller in spray cans with a minimum order of eighty cases.

There were better days, too. Ingenuity is one facet of smart selling. McAndrew followed that rule after Jerome Kandell of Kandell Fabrics, a slip cover manufacturer, refused to buy Scotchgard repeller because he was certain in his own mind that his biggest customer, Macy's, would not want to pay for it. So, McAndrew made a sales call on Macy's.

"Do you know," he told Macy's buyer, "that Kandell refuses to give you a fantastic product?" McAndrew demonstrated his product and convinced the buyer. Macy's buyer called Kandell and said that from that point on Macy's slipcovers must be treated with 3M's repeller.

Cracking J. C. Penney was much more difficult. A typical sales call on Penney buyers, even with an appointment, inevitably resulted in long waits. "When I'd inquire after waiting perhaps an hour-and-a-half, the secretary might tell me the buyer had left for the day," McAndrew said. Frustrated, he finally made an appointment to meet with Penney's president in his office on Thirty-Fourth Street.

"What do my buyers think of it?" the president asked after the salesman had demonstrated Scotchgard protector's effectiveness. McAndrew told him he had no idea because he could not get in to see one of them. "I can't buy anything," the president explained. "That must be done through them." He dictated a memo to his buyers requesting them to provide him with information on Scotchgard repeller.

"After that," McAndrew said, smiling, "Penney's buyers began telephoning me."

Joe Tischo is an anachronism—a professional salesman and a 3Mer for more than thirty-five years in an era when many sales people view selling as a stepping-stone job. Although he is only fifty-nine years old, Tischio is the last old-time Scotchgard rain and stain repeller salesman still in harness. With his long service, Tischio could retire tomorrow, but has no intention of doing so.

There are some things that bother him. In recent years, for instance, he has been working with Sales Managers who are quite different from the men Tischio knew three decades ago. Despite that irritant, his enthusiasm and interest in customers and in representing his product are still strong. So, he plans, to keep on working, at least for the time being.

Some people mentioned in this book were hired by chance, but Tischio really joined 3M by mistake in 1955. Almost from birth, he was destined for the grocery business. Ten members of his family, including his father and his uncle Joe, were or had been A&P grocery store managers when Joe graduated from high school in 1949. Automatically, Tischio joined the family trade and by 1955, back from service in Korea, was making one hundred thirty-seven dollars a week as a store manager in Newark, New Jersey. ("I had been trained by my uncle Joe and my store ran like a clock.")

The ambitious employee wanted to attend night school college under the GI Bill, but A&P refused his request to be transferred to a day job in A&P's home office. Tischios are store managers, he was told. A&P management simply could not imagine him in an office job. So, Tischio looked elsewhere for a compatible job. College aptitude tests indicated he was suited for accounting or sales. He left A&P and became an Accounts Payable Clerk for Irvington Varnish and Insulator Company in Newark. Irvington had four divisions—electrical, plastics, cashew nut shell oils and chemicals. Tischio was assigned to chemicals.

He was quite surprised when he got his first paycheck which indicated he was working for a division of Minnesota Mining and Manufacturing Company. "Who's that?" he asked a co-worker.

"None of my friends would believe I was working for a large corporation. I wasn't the corporate type," Tischio recalled not long ago. "I wouldn't have taken the job had I known. I always considered myself an entrepreneur." But, he stuck with the job because by then he had enrolled in night school at Seton Hall University in South Orange. He earned a business degree there in 1962.

On the job at Irvington in 1959 while in Production Planning, Tischio attracted the attention of Supervisor Bob Peiffer in the New York sales office. Peiffer, taken by Tischio's outgoing personality, offered him a job as Sales Correspondent, the training desk for salesmen. At that time, the New York office consisted of Peiffer (later field Sales Manager) and Sales Representatives Richard Engebretsen and McAndrew, who had been there only a few days when Tischio arrived. Engebretsen was also new, a replacement for Robert Small, who had lost his sight as a result of a skiing accident.

Aside from part-time help from an industrial chemicals salesman in Chicago, Ed Rasmussen, the New York staff was the national sales organization for Scotchgard repeller in 1960. Sales effort was concentrated in the apparel industry with its billions of yards of fabric, but Tischio's training consisted of making calls in the home furnishing industry where the output was measured "only" in millions of yards.

The focus began to change in 1961 when Tischio sold more product to curtain and drapery makers than the other members of the New York team sold to the apparel field. And, the following year, Tischio became a fulltime salesman.

McAndrew was made New York Sales Manager in 1963 after Peiffer, by then Regional Sales Manager, returned to St. Paul to be Commercial Sales Manager for Scotchgard protector. Peiffer replaced Doug Hall, who had gone to another 3M division. In 1965, Tischio was advanced to Supervisor in New York.

Major changes took place in 1968. The Chemical Division reorganized with sales managers assigned to industries instead of being responsible for all markets. McAndrew became Sales Manager, Carpets. Tischio was made Sales Manager, Home Furnishings. Joe Diehl became Sales Manager, Apparel.

McAndrew was also responsible for sales to the carpet industry out of the High Point, North Carolina, branch. He finally transferred there in 1972 to be closer to that market. (His predecessors in High Point were Ed Gill and Paul Duquesne.) After spending six years in High Point, McAndrew moved his base to the new Sales and Technical Service office in Chattanooga, Tennessee. The establishment of the office in Chattanooga was vital to the success of 3M's carpet stain repeller business because the carpet industry was, and still is concentrated just across the state line around Dalton, Georgia.

McAndrew retired in 1988.

In 1964, Frank Wozniak, Sales Manager for Irvington Varnish, became General Sales Manager of the Chemical Division. In a reorganization of 1968, he was transferred to New York to be National Accounts Supervisor, where he became mentor and friend of Joe Tischio. "Frank didn't know much about the product, but he

Chauncey Martin conducts a demonstration in the Scotchgard repeller laboratory in 1957 for (from left) Sales Representatives Dave Towler, Fred Troester, Fran Ruggles and Cliff Travis.

was a great salesman," Tischio said. "There was something magical about him when he was with a customer. Even today, customers still ask about him." And, one Wozniak axiom Tischio will never forget is, "The customer is always right."

The work Tischio did for 3M during his long career was not just training for some other job at 3M. "The way I look at it, 3M is the horse and I'm the jockey," he said. "3M has the power, but I've got the feel of the marketplace in my hands. One is no good without the other. My job is not a function, like washing my hands or eating dinner. I don't leave the office at the end of the day and forget about it. Sales are an integral part of my life."

In 1990, there were one sales manager and five sales representatives in the New York sales office. Three representatives work for John Stanaway, Sales Manager, Apparel. The other two report to John Riley, Sales Manager, Home Furnishings, in High Point. Charles Hill in Chattanooga is Sales Manager, Carpet. Together with Ron Kiel, National Sales Manager, who is in St. Paul, Stanaway, Riley and Hill supervise Scotchgard protector sales for the entire country. Since 1987, Tischio has had the title of Merchandising Sales Manager in New York.

Apparently every man or woman who has ever sold Scotchgard protector had made at least one major miscue while demonstrating the product. Tischio and McAndrew made a sales call in the 1960s at a department store in Boston. During the discussion, Tischio reached over the buyer's desk and sprayed Scotchgard protector on the man's necktie. After the tie was dry, Tischio tipped a drop of salad oil from a demonstration bottle onto the fabric. As advertised, the oil beaded up nicely on the treated surface, then it rolled down the length of the tie and plopped onto the buyer's trousers.

"Dammit!" the man exclaimed. "You've saved a two dollar necktie and ruined my sixty dollar slacks!" Tischio paid for the dry cleaning.

Golf supplemented salesmanship in at least one instance. McAndrew had a problem obtaining an order from a division vice-president at Spring Mills, a major producer of fabrics. After McAndrew learned that the man had attended Seton Hall with Joe Tischio, he enlisted his colleague in the campaign.

"Joe," McAndrew said, "I call and call on that guy and can't get him to sign. You knew him when you were students at Seton Hall. How about getting together with him someday to see if you can soften him up?"

"I knew Nick Milos in school and still know him today," Tishio said. "I played golf with him and we got all of his business, Scotchgard stain and release treatment applied to Spring Mills sheets."

Unfortunately, repeated washings caused the 3M treatment to lose its effectiveness and eventually Spring Mills stopped buying from 3M. "But, you know something," Tischio said, "Nick is now president of the Bed, Bath and Linen Association and runs a consulting business, Milos Marketing. He still talks about finding a permanent stain release product for sheets."

Bill Sohl explains the operation of a Simons cell for newspaper reporters at an open house in the 1940s.

A favorite Tischio story concerns Vice-President Cecil March, who at the time was in charge of the Group. It seems that March won a door prize, a golf putter, at a sales meeting in St. Paul.

"We weren't suppose to leave the hotel where we were meeting—to keep us out of trouble—but, another salesman and I sneaked out near the end of the evening program and went looking for a dance floor," Tischio said. He is an excellent dancer and once helped support his family by teaching dancing in an extension class for Newark Public Schools.

"Just before we left the meeting, Cec March won the door prize.

At the end of the meeting, he insisted that the putter be raffled off again. Unfortunately for me, my ticket was chosen. I was gone, of course, and Wozniak found out where I'd been. If he hadn't been such a good friend..."

3M set up a unique licensing system for mills to regulate the application and quality of finishes of materials using its products. Performance standards, tests and test procedures, a performance monitoring system and an identification program were to become patterns for competitors to follow later on.

CHAPTER 12

Whips, Whistles and Balloons

By the 1950s, 3M had developed a large central Advertising (and publicity) Department on the top floor of Building 42. The department, directed by Charles Moosbrugger and his assistant, Roger How, included more than seventy men and women—division contact men, creative people, copy writers, artists, division publicists and clerical workers.

Ross Garrett and Stan Prater of Moosbrugger's Staff Advertising organization worked with the chemical Group. So did Russ Roth, a division publicist, and artist Frank Kuettel, assisted by Frank Thornburg, who was in charge of the Art Department in Staff Advertising. With their help, the Group tackled the job of naming its products, which at that time carried only laboratory identification numbers. One of the first trade names and the castle symbol identified with it was born in 1955.

Frank Kuettel

A series of names were considered and discarded before Scotchguard was settle on. Then the "u" was dropped to spell it Scotchgard. The castle developed with it symbolized the strength of the product. At first, a knight in armor was suggested, but Kuettel and Thornburg protested. The figure would be cumbersome and use too much space in future advertisements. Knights also had become tedious through overuse by other companies.

Kuettel drew hundreds of sketches before the symbol was accepted.

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Originally it had a plaid crosshatch interior, but that was discarded. The final red and black castle symbol charmed trade magazine editors, who reproduced it in their publications from publicity photos mailed by Roth. That particular "free" publicity caused a great stir in the Division, which did not have much money for advertising. Publicity had to be relied upon to carry most of the promotion load.

The Scotchgard name was a "grabber" because it linked 3M's honored Scotch trade name with the repeller's protective feature. However, it generated a blast from Jack Borden, the Tape Division's General Manager. His division had marketed Scotch brand tapes for so many years that they believed they owned the name. He did not use that argument, however, but hid his proprietary feelings behind an expressed fear that if Scotchgard repeller failed as a product it would reflect unfavorably on his entire Scotch brand line. That appeal did not carry with management and the protective product donned the name which was destined to become respected and widely known, one of the leaders in 3M's long line of respected brand names.

The development of the demonstration bottle began with Doug Hall. One day the Merchandising Manager walked into the office he shared with Jim Rogers. He was carrying a glass laboratory tube eighteen inches long and an inch-and-one-half in diameter sealed with a glass stopper. Inside were three layers of liquids, red, green and colorless. Hall shook the bottle. The liquids swirled together in a multi-colored mixture. He set the glass on Rogers' desk, and in a few moments the mixture settled into three distinct layers again. The colorless liquid at the bottom, Hall explained, was Scotchgard repeller. The green in the middle was colored water. The red on top was tinted salad oil.

"Isn't that terrific?" he said. Rogers did not share Hall's enthusiasm, even after Hall explained his "sure-fire" demonstration idea. It was, he said, a quick, easy, economical way to show how Scotchgard repeller rejects both oil and water. It made the invisible action of the product visible to everyone.

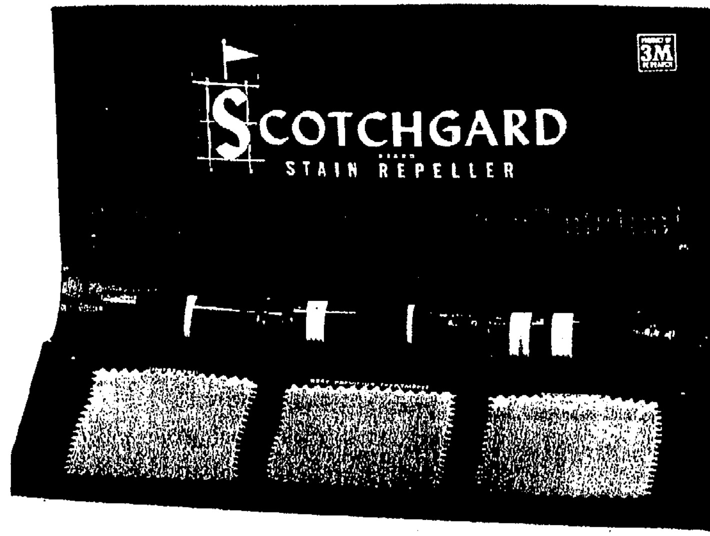
Two weeks later, Lou Weyand, Executive Vice-President of the Tape Group, borrowed Hall's oversized bottle and took it to New York for a meeting with security analysts. When he returned, Weyand was very complimentary to Hall.

"When I shook that bottle," Weyand said, "after explaining its contents, then let it settle again, everyone in that room knew immediately how Scotchgard repeller performs." It was a great merchandising idea, he told Hall. Rogers, at his desk, nodded in agreement, then presented Hall with a sheepish grin after Weyand left.

Hall's merchandising tool has been replicated thousands of times in the last fifty years. It still is a quick, easy and economical way to demonstrate Scotchgard protector. The credit for its creation goes to Bob Adams and Tom Brice, who filled that first cylinder Hall noticed during a visit to the laboratory.

Hall's first question was, "Can the liquids be colored to make their separation more apparent?" The scientists tinted the water and oil. That essentially is the way Scotchgard protector demonstration bottles are made today.

In 1956, Ross Garrett of Staff Advertising presented the first advertising program at a Group meeting and mentioned that Stan Prater had been assigned to the account, too. In his presentation, Garrett



Early Scotchgard protector demonstration kit containing three vials and three swatches. Sophisticated versions still are in use as a quick, easy way to prove the product's effectiveness.

referred to the staff copy writers as "producers," a public relations kind of appellation no doubt designed to add a touch of class to the operation when making first contacts with a new 3M business unit.

Ted Lucas joined 3M and staff advertising in 1956 to write advertising copy and produce advertising and merchandising materials for several divisions. He arranged for printing brochures and merchandising pieces as well as preparing advertisements for coated abrasives, pressure-sensitive tapes, chemicals and other products. One vivid memory tidbit retained by Lucas was that Scotchgard stain release originally carried the unwieldy name Scotchgard dual-action fabric protector.

At a sales meeting at Wonewok* in 1956, Garrett presented the Group advertising program. Scotchgard paper size treatment was to be introduced in a brief campaign in the *Paper Trade Journal* and *Industrial Packaging*. The former was read by manufacturers and converters, the latter by consumers of heavy duty packaging products. Direct mail advertising using advertising reprints and a reply card as self-mailers would support the three-month media campaign, Garrett said. Later, he continued, "when we get the green light" the advertising department would run one advertisement in *Rubber Age* to introduce Fluorel elastomers.

Ted Lucas

In the 1950s, the staff advertising organization began to disintegrate as groups chose to operate their own advertising departments. For example, Bert Cross' Graphic Products Group Advertising Department headed by George Sandell was thriving in 1954.

The Chemical Division Advertising Department was organized in 1960. As work demands grew, Manager Prater hired Ted Lucas, Matt Howard and Fred Detloff from Staff Advertising. After some time, Detloff moved to another division's advertising department and Howard left the company, but Lucas stayed in chemicals until he retired. Paul Novotny, who replaced Howard in 1962, was ICPD advertising Marketing Communications Manager in 1991.

*A 3M meeting center for customers and 3M groups near Park Rapids, Minnesota.

In 1960, 3M's artists continued as a staff group with Kuettel assigned to the Chemical Division. Roth was assimilated into a new Department of Communications (later 3M's Public Relations Department.)

Carlene Holt, who joined 3M in 1956, was Prater's secretary in staff advertising and followed him into the Chemical Division. In 1991, she was PCPD's Senior Marketing Communications Coordinator.

On her first day in the Chemical Division, secretaries in the Sales and Marketing Departments stacked scores of sales leads on Holt's desk. Each inquiry not only required assessment (and culling if warranted), but the prospect's information had to be typed on a multipage form. That seemed formidable to secretaries not trained in advertising processes, so the task had been set aside awaiting the advent of someone like Holt. She tackled the stack as her first assignment and after a long drought more than one hundred lead cards were mailed to salesmen in the field. In the beginning, advertising and sales promotion budgets were thin. A shoe manufacturer in Milwaukee requested a supply of labels to apply to his shoe boxes. Prater refused the request because no money was available for that type of promotion.

Holt remembered that MacManus Johns & Adams (MJA) advertising agency used its employees as models in advertising illustrations to avoid paying talent fees. Most of the promotion money available was allocated to the furniture and carpet markets (where the industry still congregates each year.) The Division leased a permanent office-showroom in the Furniture Mart in Chicago for years before 3M's interest in carpet protection required a move to the Chicago Merchandise Mart.

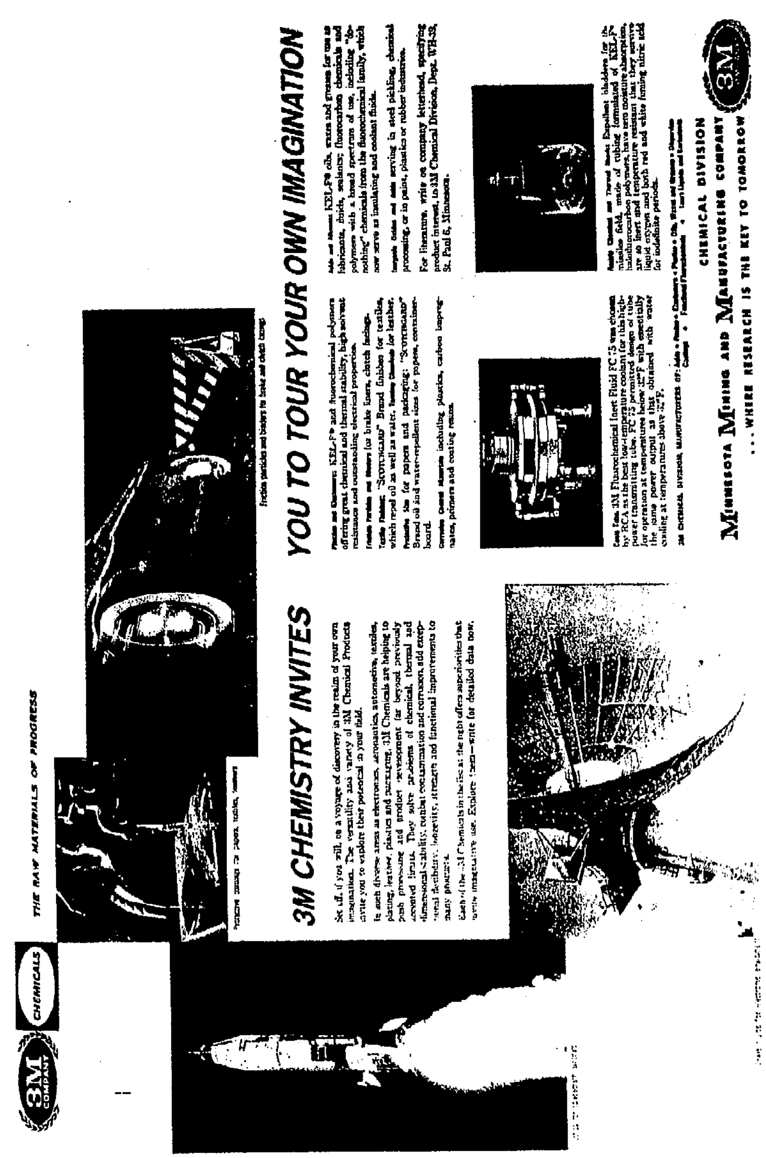
Models dressed as Scots in tartan kilts manned 3M's ten-foot booth at the Chicago Furniture Mart and later in Dallas, Atlanta and elsewhere after 3M expanded to those cities. Demonstrating Scotchgard repeller on treated and untreated fabrics and carpet samples was the best way to show its effectiveness. Prospects couldn't see it, feel it or smell it, so the term "Invisible Shield" was in vogue for a time. Another problem was that uses had to be shown on other firms' products—sofas, carpets and the like. Choosing one customer's brand over another still is a choice which must be dealt with in advertising 3M's product today.

New products, especially products introduced twenty-five and thirty years ago, thrive on outlandish promotions. The men who publicized Scotchgard repeller contributed some of their own. The "Spotless Look" featured a mechanical leopard displayed at trade shows for mill operators and retailers. Scotty girls wearing tartan outfits dumped dirt on carpet samples and vacuumed them up again to demonstrate how dirt could not harm protected carpets. In time, those treated areas on samples were formed in S-shapes (for Scotchgard repeller), castle-shapes or (for use by mills) in the form of a mill logo. And, when the models complained about the dirt and dust contaminating their clothing and their skin, the advertising geniuses came up with a portable booth on wheels. It was a box six feet high with a Plexiglass™ window. Opposite the transparent plastic were shoulder high holes with sleeves and gloves of a black protective material attached. A model would insert her hands through the holes and into the gloves to spread the dirt, then pickup a small vacuum cleaner inside the booth and use it to whisk the dirt away. The box was a bright idea, but it didn't last long because models had an aversion to working it.

In a more ambitious move to attract attention to Scotchgard repeller, Lucas hired the pipe band and Scottish dancers from Macalester College in St. Paul and flew them to Chicago. The thirty young men and women attracted a lot of attention in the hallways of the Furniture Mart, but their performances also generated enmity with exhibitors. They complained that they lost most of their audiences whenever the pipes began to skirl.

Mechanical leopards, demonstration boxes, Scottish pipers and dancers were followed by more eye-catching and ear-tingling events, not only in the Chemical Division but throughout 3M. Advertising-sales promotion personnel referred to them as "whips, whistles and balloons." That encompassing phrase has been adopted with admira-

Opposite page: "Set off, if you will, on a voyage of discovery in the realm of your own imagination. The versatility and variety of 3M Chemical Products invite you to explore their potential in your field," reads the not-too-well-written lead of this 1959 advertisement. At right is a list—plastics, elastomers, textile finishes, corrosion control materials, acids, alkalines and more. "Explore them—write for detailed data now" is the call to action for readers of *Scientific American* magazine.



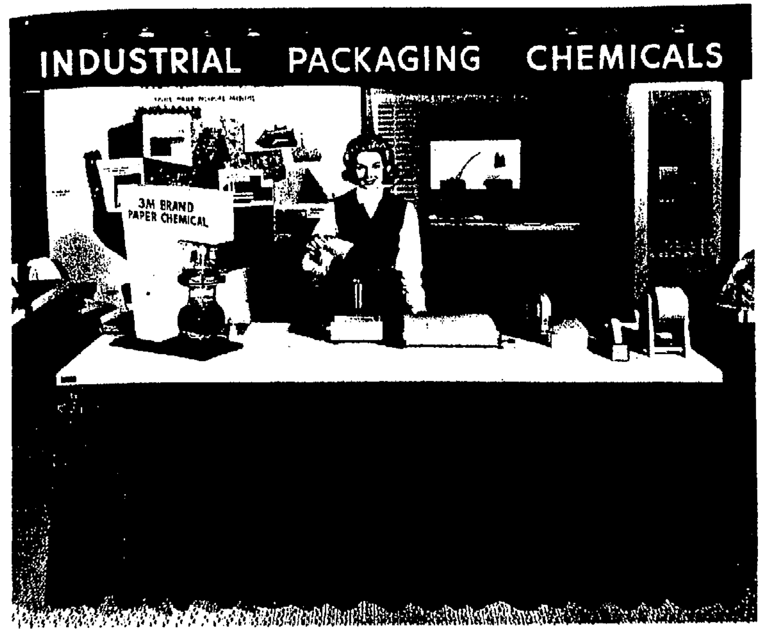
tion over the years by 3Mers in other functions who understand and believe in the efficacy of promotions. Detractors call promotions a waste of profits. They are in the minority, however, and whips, whistles and balloons are still fixtures at 3M and other companies today.

The development of stain release treatment and the spray can served as brand new merchandising springboards. One stain release demonstration kit consisted of a Tupperware™ cake pan with cover, a package of cold water laundry soap, a six-inch embroidery hoop, a vial of salad oil, an eye dropper, a face tissue and pieces of treated fabric. The fabric was stretched over the hoop and a few drops of oil applied. Then, hoop and fabric were submerged in the soapy water. Presto! The oil stain lifted and rose to the surface. Nearly five thousand kits were assembled and distributed in one two-year period, Lucas said. He laughed as he remembered that he had bought the Tupperware pans from a housewife-saleswoman in the 3M area. "She probably retired with the money she made," he added.

Embroidery hoops also were part of a spray can demonstration kit. Untreated fabric was stretched over the hoop, then half the fabric was treated from a can. After the repeller dried, drops of oil were applied to each surface. It beaded up on one and soaked into the other.

All merchandising ideas were not fruitful. One example was a hat promotion for the spray can in the 1960s. The Division bought thousands of shapeless felt hats which were offered to grocery stores as a self-liquidating item for spray can customers. The floppy wide brimmed hats, each with a sewn-on emblem of a National Football League team, were heralded as Fun Hats—one size fits all, shapes to the wearer's fancy, a three dollar value for one dollar and seventy five cents by mail with a proof of purchase. A promotion package sent to grocers was shaped like an over-sized football. "Take the ball and...RUN WITH IT!" exclaimed the headline. Inside the promotion folder, grocers were promised "PROFIT PUNCH in your laundry supplies section!" Other copy blocks carried additional messages including one that said that ten million football fans would see a full page Scotchgard repeller advertisement in *Life* magazine. Network and local TV and Arthur Godrey's CBS radio network show also carried 3M's advertising for the promotion period.

Many grocers did not nibble at the idea. And, the hats which carried a negative aura of hillbilly haberdashery, did not grab the



Industrial Chemicals trade show booth with Scotty girl at Chicago show in 1961. Sign at left rear reads: 3M Brand Paper Chemical FC-803 solves major packaging problems. Kel-F plastic film display is at right rear.

fancy of football fans or anyone else. The failed Flim Flam hats became humorous giveaway items at 3M parties and other internal events for years.

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Kugler, General Manager of Hastings Chemical Division from 1955-57 and then General Manufacturing Manager, Internal Chemicals, was in 1962 appointed General Manufacturing Manager of the Chemical Division.

Also in 1962, Adams became the Division's Technical Director. Bryce was Adams' assistant for commercial chemicals and Lundquist for internal chemicals. Clifford W. Hanson was Division Production Manager. Charlie Bentz was appointed Manager, Process

Engineering and Production Planning for the Division and Al Diesslin Plant Manager at Chemolite.

When the Chemical Division was split in 1973, Les Krogh was appointed General Manager of the new Commercial Chemicals Division (CCD), a non-manufacturing sales oriented business unit. Hanson was appointed General Manager of the new Chemical Resources Division (CRD), which assumed the role Hastings Chemical Division had held fourteen years earlier. CRD manufactured chemicals in its four plants for internal sales to other 3M divisions and manufactured fluorochemical products for CCD.

In 1973, CCD also began operating its own laboratory under its new Technical Director Don LaZerte, who had been Manager, Fluorochemicals Research and Development for the Chemical Division.

Appointed Technical Director of CRD was Dr. Thomas J. Savereide, who had been Technical Manager, Internal Chemicals in the Chemical Division laboratory.

Other changes announced simultaneously were those of Robert L. Ahlness to Manufacturing Manager for CRD from Technical Manager, Internal Chemicals in the Chemical Division, and Hugh Bryce to Executive Director, Central Research Laboratory. Bryce had been Technical Director of the Chemical Division and was Chairman of the 3M Technical Council.

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The 1960s ushered in what Petersen called the Age of Finishes. Until then, 3M had done little or no promotion, used product identification infrequently and had no quality control function. In the decade of the 1960s, 3M set out to change all that, undertaking the Herculean task of educating mill operators, finishers, cutters, retailers and consumers to their need not only for stain repellency, but specifically for Scotchgard repellers.

"Talk about pioneering," Bill Petersen said. "We were walking trails no one had ever walked before. There were no oil repellent finishes on the market and hence no references to them in anyone's literature. We were writing the book." Programs conceived and executed in those early years were copied by competitors years later. One promotion tool—the three-phase demonstration bottle—still is being utilized effectively today.

CHAPTER 13

A Big Score

A very expensive (but self-liquidating) marketing program of the early 1960s was a bold venture that moved huge quantities of Scotchgard repeller into the market chain.

It was wrapped in a media campaign that featured the nation's top mills and their key customers in expensive magazine advertisements prepared and paid for by 3M. It cost the Division one and one-half million dollars, which it borrowed from the corporation, but repeller sales made up that cost and much, much more. By the end of the second year, Selden said, "We had repaid all of the costs of the fluorochemical program and costs of the Project back to 1945."

It was among the all-time marketing coups ever conceived and executed at 3M because it got Scotchgard repeller into major mills, the headwaters of the stream flowing to the marketplace. At the same time, the advertisements publicized Scotchgard repeller and its benefits to readers of consumer magazines. That made it appear that 3M's advertising was aimed at homemakers, to convince them to ask for Scotchgard repeller when they bought clothes for their families. That was a residual benefit, but the actual goal was to get the nation's biggest textile mills to buy and apply 3M's product to millions of yards of cloth in production. Selling large quantities of Scotchgard repeller to the top mills was the necessary first step of several required to get consumers to buy treated fabrics.

It would have done little good to stimulate shoppers to request 3M's product when they were buying shirts, blouses, trousers and dresses unless treated clothing was available in retail stores at that time. To accomplish that, mills had to be supplying treated cloth to clothing manufacturers who in turn were supplying retail outlets, all in advance of demand. Shoppers' requests for treated articles would, of course, eventually persuade retailers to sell treated articles of clothing. But, if the secondary goal of the program was achieved, 3M's media advertisements would stimulate retailers to have in stock merchandise that had been treated with Scotchgard repeller simultaneously with consumer demand.

And, mills, clothing manufacturers and retailers had to be convinced in advance that consumers wanted treated clothing.

The program was conceived by Roy Mordaunt, a Division Controller turned marketing man, with the help of Prater and the Division's advertising agency, MacManus John and Adams (MJA). As planned and executed, key prospects such as Burlington Mills were promised exposure in 3M's Scotchgard repeller advertising at no cost if the mills would buy and apply 3M's product. Despite the sizable commitment required by each mill, 3M's free advertising proposal attracted them. An additional hook was an offer to identify the mill's key customers—White Stag, for example— in the advertisements as well.

Selden was taken with Mordaunt when the latter was the Division's Comptroller because of "his unusual perception for getting the job done." So, Selden offered Mordaunt a job that quickly progressed into his becoming Manager of the Division's Commercial Development (marketing) Department.

Mordaunt's plan required figuring how much Scotchgard repeller had to be sold to make the proposed two million dollars (the original proposed spending level) advertising campaign profitable. Then, he prorated that amount against the names of the industry's seven top mills and set out to sell the program.

In a New York hotel suite he held separate meetings with the president and merchandising manager of each mill. In one week he obtained total commitments from every one of them. At those meetings, MJA presented what was an eye-popping program for the era. It included visuals of advertisements slated for publication in *Life* and other consumer magazines, plus projections that millions of housewives would read the advertisements and so on.

MJA had a vital interest in making the program a success. The advertising agency had invested its time and money in the creative materials, which the Division promised to pay for **after** obtaining its money from the 3M Management Committee. Borrowing the

Radio show personality Arthur Godfrey, hired to promote Scotchgard spray cans poses in the late 1960s with Roy Mordaunt (left), the Chemical Division's Commercial Development (Marketing) Manager, and Charles Willey, Advertising Manager.

money was the next step in the program.

Selden and Mordaunt found out that selling 3M management was more difficult than selling Burlington, J. P. Stevens and the other mills. Two days of discussion elapsed before the Committee approved the Division's request and only after cutting it to one and one-half million dollars. Furthermore, approval was delayed until Joe Duke, Lou Weyand and several others on the Committee had telephoned the board chairman of several mills to verify their support of their presidents' actions. That despite the fact that Mordaunt had showed letters from the president and merchandising manager of each mill spelling out their commitment to buy a specified quantity of Scotchgard repeller over two years.

To call the result a success would be an understatement. "We sold tons and tons of our product," Selden said.

So as not to risk going to the well too often, after that major score the Division settled back into more conservative advertising programs.

Telfer made some significant changes in the 1960s, starting in 1962. Bob Adams became Technical Director. Hugh Bryce was made

Assistant Technical Director, Commercial Chemicals, and Bill Lundquist became Assistant Technical Director, Internal Chemicals.

Art Telfer

Joe Kugler, General Manufacturing Manager, Internal Chemicals, was advanced to General Manufacturing Manager.

Charlie Bentz was appointed Manager, Process Engineering and Production Planning, and Al Diesslin became Plant Manager at Chemolite.

In 1964, Frank Wozniak, former Sales Manager for Irvington Varnish and Insulator Company, by then in field sales management for 3M, was appointed General Sales Manager. Mordaunt, whose title had been General Planning Manager, became Commercial Development Department Manager.

Four years later, in 1968, Telfer made an appointment that restructured the Division.

In September, Bill Petersen, Technical Manager of the protective chemical laboratory, was appointed to the previously unfilled position of General Sales and Marketing Manager. Petersen had been running the program from the laboratory, but the promotion made him the number two man in the Division. It leap-frogged him over Wozniak and Mordaunt, the men responsible for selling and marketing the Division's products. General Sales Manager Wozniak soon transferred to New York to take over a new position of National Accounts Manager. Mordaunt, manager of marketing functions, left 3M in 1971.

Bill Petersen

In October, Petersen made changes. Robert Peiffer and Jim Rogers were given new titles. Peiffer, Commercial Sales Manager, became National Sales Manager, Textiles and Leather Trades for protective chemicals. Rogers, Industrial Sales Manager, became National Sales Manager, Industrial Trades.

Petersen also enlarged the marketing department. Lou Cove and

Gayle Rengel were brought from the Laboratory to become Product Supervisors. Cove and Rengel, plus James Noel, who joined the department later on, still were handling marketing functions in the Industrial Chemical Products Division in 1990. Noel, who joined 3M in 1961, switched from Laboratory to marketing in 1974. Others who joined the Commercial Development Department in the 1960s were Don Norton, Dave Shryer, Ray Brown and Jack Sargent.

Bill Skown

In 1971, William Scown, West Coast Area Sales Manager in Los Angeles, returned to St. Paul to become Marketing Manager. Two years later, the Commercial Chemical Products Division was formed and Scown was made National Sales Manager for Industrial Chemical Products. He replaced Rogers, who had become Manager of a new project involving Light Water AFFF.

Skown held that job until 1981, when he was reassigned to a new position, Business Development Manager. He retired in 1985.

In that same period, James Johnson was assigned to the laboratory in High Point, North Carolina. He reported to Joseph Spearman, Supervisor of the new Quality Control laboratory.

When Petersen left the Scotchgard protector laboratory in 1968, he was replaced as Technical Manager by Chauncey Martin, who joined 3M in 1954 and had been the laboratory Supervisor since 1963. A native of Sargeant, Minnesota, Martin held a chemical engineering degree from Michigan Technological University in Houghton. He worked for Petersen from 1954 until 1959, then he transferred to High Point as Supervisor of the Technical Service laboratory until he returned to St. Paul in 1963.

Martin joined marketing in 1973 as Manager, Textile and Leather (Commercial) Markets, and once again reported to Petersen. Martin's sole employee was Donald Velky,* but Richard Galash, John Miller and Charles Armfield joined the department later on. Lou Cove was Martin's counterpart as Manager, Industrial Markets. Cove,

* A Sales Representative, Textile and Leather Trades, in Los Angeles, Velky transferred to St. Paul in March, 1969, to be a Product Coordinator. He was made Sales Manager of Scotchban protector products in 1983 and Business Manager in 1986.

Galash and Armfield still were in the chemical business in Protective Chemical Products Division in 1990.

Between 1979 and 1982, Martin was CCD's Product Manager in Antwerp, Belgium. When he returned to St. Paul he joined the Industrial Electronic Sector Laboratory as Marketing Manager, New Products Department.

Telfer's era lasted until he retired in 1973, the year the Division was split into the Commercial Chemicals Division and the Chemical Resources Division.

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Les Krogh, General Manager of CCD, was a Nebraskan who had earned a bachelor's degree in chemical engineering in 1945 and a master's degree in organic chemistry in 1948 from the University of Nebraska then transferred to the UofM to earn his Ph.D in organic chemistry. During that period, he worked summers at 3M until he was hired as a Senior Chemist in Central Research in 1952. In 1954, he switched to the abrasives laboratory, where he became Manager of Research and Development. In 1964 he returned to CRL as Director of the Chemical Research laboratory and later became Director, Corporate Technical Planning and Coordination. In 1969-70, he was General Manager, New Business Ventures Division (the renamed New Products Division), then returned to CRL as Executive Director.

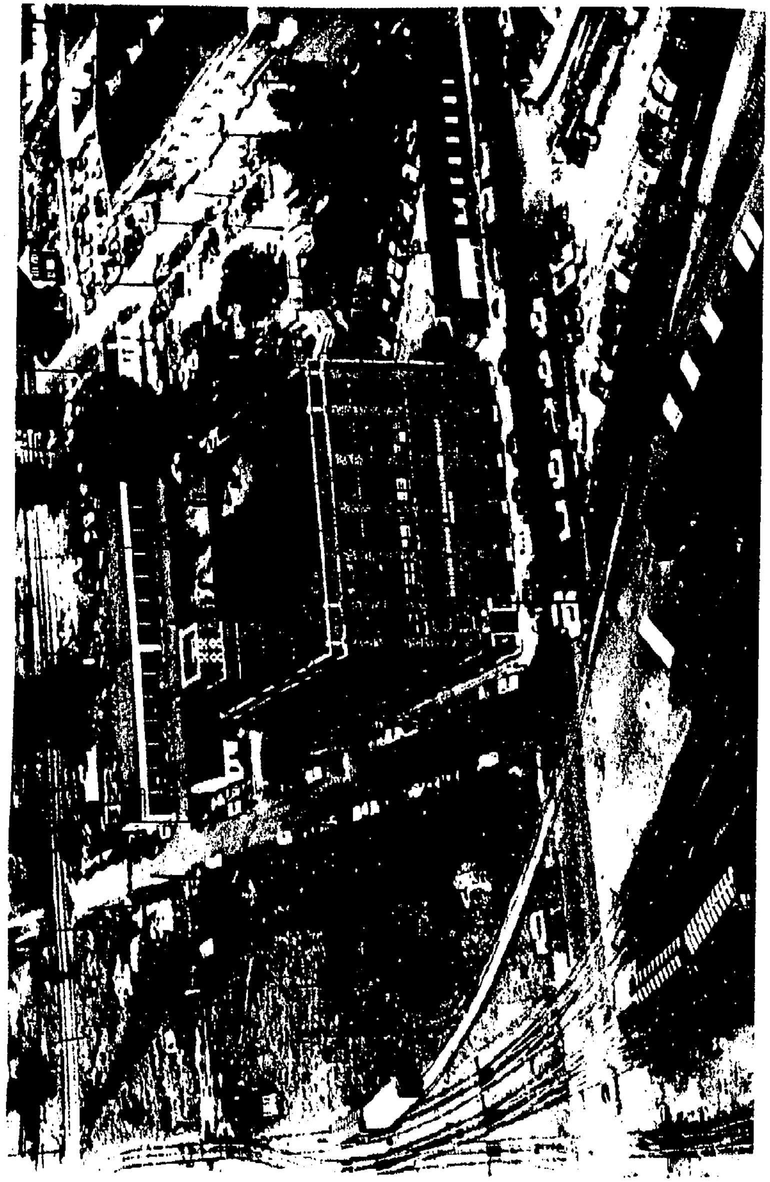
Soon after his appointment as General Manager of CCD, Krogh was made a Vice-President. He left CCD in March 1981 to become Vice-President, Research and Development, Industrial and Consumer Sector. In October 1982 he was appointed Vice-President, Research and Development, for the corporation. He retired in 1990 as Senior Vice-President, R&D.

Cliff Hanson

Adams left the Chemical Division in 1966 to be Technical Director of 3M's International Division. In 1968 he was appointed General Manager, New Business Ventures Division. Between 1969 and 1981, Adams was 3M's Vice-President of R&D. From June 1981 until his retirement in 1985, he

was Senior Vice-President, Technology Services, for the corporation. In 1983, he became the first honorary member of the Carlton Society and also served on 3M's Board of Directors from 1970 until 1986. He died in December 1988.

Bryce, after serving as the Chemical Division's Technical Director from 1966, returned to CRL in 1973 as Executive Director. He stayed there as Vice-President and Staff Vice-President until he retired in 1982.



CHAPTER 14

Pilot Plants

Products evolve. They may start with a concept that is researched and developed in a laboratory, but laboratory success alone does not assure that a product can be manufactured successfully. That should be proved before factory expenses are incurred.

To obtain that necessary manufacturing data at reasonable cost, companies conduct small production runs in mini-factories called pilot plants. There, production capabilities can be proved using small quantities of materials, which saves time and money compared with trial runs in manufacturing plants. There is a safety factor, too. Experienced engineers and technicians recognize risks and modify processes if required so factory scale-ups can be made safely later on. In the final analysis, faster, less expensive runs in pilot plants can assure success for full-scale production. Fluorochemical product manufacturing followed that track beginning in the 1940s.

In May 1946, the year after Simons' patents were acquired, Project Engineer Roy McKenzie designed and Chemical Engineer Don Wardrop drafted specifications for a two-thousand-ampere cell. That cell, a giant compared with the cells in the Laboratory, would be housed in the Benz building garage, the first fluorochemical pilot plant.

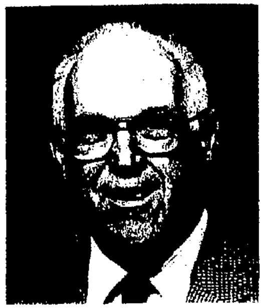
Cell construction contracts were signed that fall. Remodeling the garage was begun, which included removing the overhead doors no

Opposite: Looking north toward the Benz building in 1954. Pilot plant is behind it and white shed at right was Duplicating Products Division pilot plant (Building 44). Employees' cars flank the 3M buildings on two streets.

longer required for trucks, walling in an HF room with concrete and partitioning office space.

Al Diesslin, recently returned from training at Penn State, was appointed Pilot Plant Manager. Ed Kauck became Assistant Manager. Wardrop and Bob Anderson were shift bosses. Others assigned to the plant included Lorne McCluskey, Jim Smith, Ted Haas, Ralph Swonger, Don Snyder, Carl Klaus and Glenn Church. The latter, hired as a seventeen year old trainee, retired more than forty years later as a Production Planner in the Specialty Chemicals Division.

The new cell, at the time, of course, the largest Simons cell in the world, began operating in the converted garage in 1947. "In two years we expanded the range of products we could and did produce," Wardrop said years later. "The pilot plant was usually busy and sometimes it was frantic" as the shift crews worked to produce sample quantities for internal use. Later, samples also were made for outside companies on request. "That was slow going. Sometimes it took a year for a company's researchers to evaluate our products," Wardrop said.



Don Wardop

Pilot plant usage was so great that after only two years, a movement was begun to replace it with a semi-works plant on the 3M property near Hastings. Whether to build the expensive new plant was one of the topics at the April 19, 1949, meeting.

The semi-works plant—a bridge between a pilot plant and a manufacturing facility—was necessary if the Project were to grow, although at that point not a single fluorochemical product had been sold. 3M property near Hastings was the logical plant site because East Side residents had complained about discharges of solvents into the air from the main plant complex on East Seventh Street. Relocating the pilot plant would eliminate any possible future complaints from other businesses near the Benz building.

Construction of the semi-works plant was begun in 1950 and completed in September 1951. Simultaneous with the construction, a new cell and other equipment were fabricated. When completed, the one-story brick building designated as Building 15 enclosed six thousand

square feet and including equipment cost 3M half-a-million dollars.

Expertise gained from four years of operating the Benz building plant helped get the semi-works plant producing quickly. In operation, the new facility was light years removed from the old plant. Its ten-thousand-ampere electrolytic cell made it possible to produce fluorochemicals in commercial quantities of one ton and larger. Prospective customers could be supplied compounds in large enough quantities to allow evaluations in their own pilot plants or semi-works operations. The large capacity also allowed immediate production to begin when the first order was received from DuPont in 1952.

The list of products produced and subsequent sales continued to expand each year. By 1959, 3M's fluorochemical business was profitable for the first time in its fourteen-year history.

Besides the changes inside the semi-works plant, there were two major ones made outside, too. One answered the question of how to handle anhydrous hydrofluoric acid (HF), the raw material of 3M fluorochemicals. At the Benz building, HF was delivered by truck in two hundred pound steel cylinders. That was changed at Chemolite to purchases of HF in one ton cylinders that resembled horizontal propane tanks seen on farms and in small towns today. Each HF delivery was a filled tank and the truck that made that delivery hauled away the empty tank.

The other change was to alter the way in which direct current was supplied to the cell. The motor generator at the Benz plant was too small to power the ten-thousand-ampere cell, so a rectifier was installed to change alternating current to direct current.

The Benz building plant continued to operate, but in March 1953 the plant's two-thousand-ampere cell was removed and installed in the semi-works plant. With that, the pilot plant workers moved to Chemolite, where Diesslin had been semi-works Plant Manager since 1951. Kauck, who had replaced Diesslin as Manager at the Benz pilot plant, became Production Supervisor and Wardrop was made Engineering Supervisor.

The semi-works plant originally was identified as the Central Research Department, Hasting Fluorochemical Pilot Plant. In 1953, it was transferred to NPD and renamed the New Products Division, Hastings Fluorochemical Pilot Plant. Not long after that, it changed hands again. A report in March 1955 identified the semi-works plant as the Fluorochemical Experimental Production Department. Less than a year later, in May 1956, it was the Fluorochemical Production and Pilot Plant Department, then in January 1957, it was the Fluorochemical Division Fluorochemical Production Department.

Those name changes reflect the evolution of the semi-works plant from an oversized pilot plant into a full-scale manufacturing plant between 1952 and 1957.

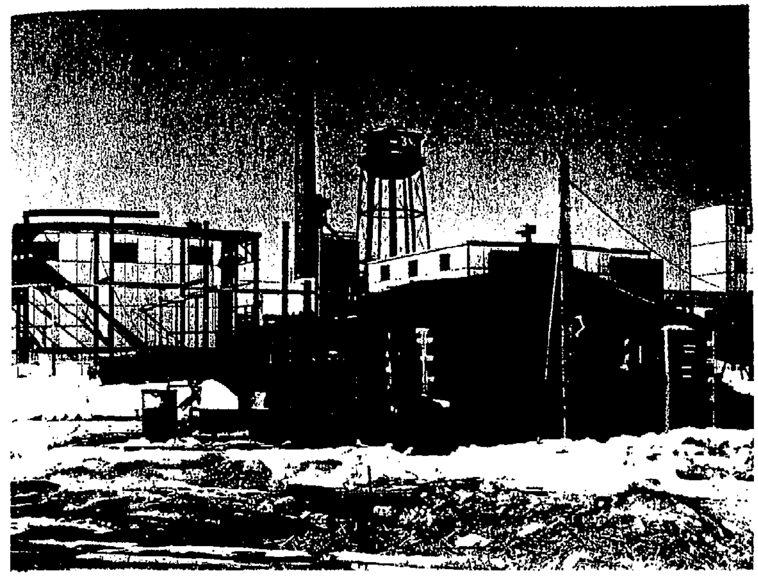
Wardrop, a native of Pennsylvania and a Chemical Engineer who came to 3M in January 1943, after graduating at the top of his class at Penn State, was recruited by Dr. Stephens, who offered Wardrop less money than he could have gotten elsewhere. He took the 3M job because of the "novelty of being away from home" and the attractiveness of the state of Minnesota. His first assignment was the acrylic acid project on the top floor of Building 2, where he also designed laboratory equipment. His 3M career was interrupted by Army service from February 1944 until May 1946 when he returned to become involved with McKenzie in planning the first pilot plant.

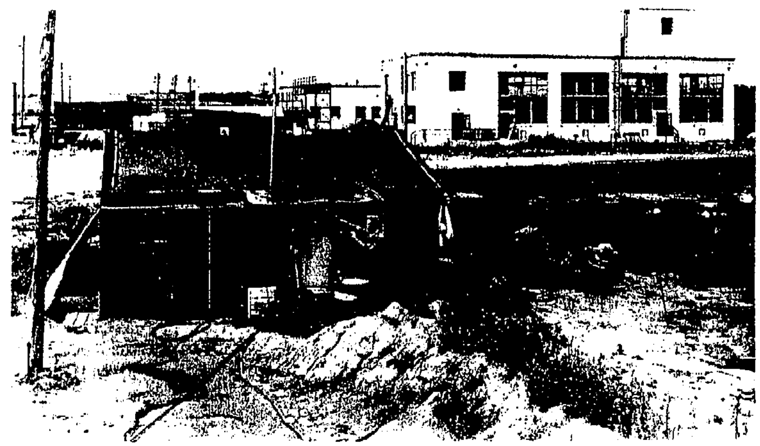
"Upon my return after an absence of two years, I was struck by the general air of optimism about the company," Wardrop said. "I was certain that 3M was going to do great things in the future." One change was more people in the laboratory than in 1944. And, most important, Simons' technology had been obtained during his absence.

Things moved swiftly after the semi-works plant was placed in operation. Less than two years later, work was begun on a second ten-thousand-ampere cell, which was in production by March 1954. That additional capacity, Wardrop said, changed Building 15 from a large pilot plant to the world's largest Simons' process chemical plant, although it was very small compared with production facilities today. The new cell and those that followed were needed mainly to keep up with growth of Scotchgard repeller sales.

By September 1954, construction was under way on two more ten-thousand-ampere cells. And, a twenty-thousand-gallon storage tank was installed to allow ordering HF in railroad cars. In December

Opposite: (Top) Winter view of tent, snow-free because of heat loss from inside operations. Hay-filled trench (foreground) may have held heating pipes. (Bottom) Clifford Japs at the low temperature cooling system outside CRL's tent pilot plant. Tent was used for nearly two years until Building 16 (background) was ready for occupancy.





1954, the first tank car was delivered and by the following February the two new cells were in operation.

Growth continued. By August 1957, five new ten-thousand-ampere cells were operating in a large addition constructed on the north side of Building 15. That meant that nine large cells were in place, more than double the capacity of two years before.

A month later, a ten-thousand-ampere cell of a different configuration was installed in an experiment that didn't pan out. Simons cells were (and are today) upright cylinders four to five feet high. The experimental cell was square, an effort to learn whether cell construction costs could be reduced by adopting a shape that was easier to build.

Additional manpower was needed not only because of the increasing number of cells, but because the process required attention around the clock every day seven days a week.

In the early 1950s, CRL's research facilities consisted of space on the sixth floor of the Benz building and a small room on the fourth floor of Building 7, a Hastings Division facility at Chemolite. At that time, a tent was set up as a safety measure east of Building 7. There CRL employees made polymers from vinyl chloride and butadiene, both volatile chemicals, for the Tape Division. The tent had fiberboard sides, a canvas roof and concrete floor. Inside, stood a twenty-gallon kettle salvaged from the Benz building pilot plant, a small office space and a distilling area. Because the chemicals had to be isolated from possible sparks, the office telephone was housed in a box on a pole fifty feet away. Steam for heat was piped from Building 7.

The tent facility was operated around the clock five days a week for more than a year. Cliff Japs and Al Smith, who worked there, said that the emulsifier sold to DuPont to make Teflon products was developed in the tent. (Even in the middle 1950s, some compounds were mixed outside using fifty-gallon drums and canoe paddles to avoid concentrations of dangerous fumes.)

CRL's new pilot plant designated as Building 16 was started in 1951 and placed in operation a year later. The building which was shared with Hastings Chemical Division, contained a small office, a small laboratory and a maintenance area, plus two bays. Bay one was occupied by CRL, bay two by Hastings.

During its first ten years, Building 16 was primarily a scale-up

for internal chemicals. It also was involved with the processing steps required to finish the production of Scotchgard repeller after it was processed in a Simons cell in the semi-works plant. In 1962, a two-thousand-ampere cell was built and installed in Building 16. At that point the plant was capable of working on innovative processing techniques for protective chemicals.

Cliff Japs

Japs and Smith had graduated as engineers from the UofM in 1949. Japs stayed with CRL eighteen years and retired in the late 1980s as Manufacturing Director of Commercial Chemicals Division. Smith retired in the 1980s as Technical Director of Industrial Specialties Division. Some others hired by CRL at Chemolite during that period were Jack Hanson, Erwin Korn and Willis Olson.

Eventually, after a new Central Research Laboratory was built on 3M's Maplewood campus in 1953-55, Stephens built a new pilot plant there, too. Japs was Pilot Plant Manager and reported to Al Frye, an Associate Director of CRL. That pilot plant, enlarged over the years to include another division's pilot plant, was still being operated in 1991.

Dr. Wilfried Hirsch arrived at Chemolite in October 1957 to be a Process Engineer with John Thorpe and Robert J. Olsen. In 1990, both Hirsch and Olsen were in the SA&CD laboratory. When Hirsch arrived, Bob Libey was Pilot Plant Manager, reporting to Bill Lundquist, Technical Director of internal chemicals. Building 16 had been enlarged to three bays by that time. Later, the fourth and fifth bays were added to the east end and an office wing built to the north and west. That construction also more than doubled the original size of the plant laboratory.

Informality was the word at the pilot plant, Wil Hirsch recalled. "Someone would phone from St. Paul to ask if we could help them. We'd say, 'Sure, come on down.' When they arrived we'd take a few notes and often as not the visiting customer would stick around to help do the job."

The world has changed since those informal days. To work with the Process Development Center in 1991 required completing two order forms, having a product code number on the order and establishing an SA&CD laboratory contract. Before a pilot plant run can be made, a Product Information Sheet (PIS) must be filled out. A detailed chemical description of the product is required. The requester also is given a pilot plant Visitor's Package which explains policies.

The use of some chemicals in synthesizing new products also is restricted or banned by 3M and by law. Benzene and phosgene are two. Other chemicals require workplace monitoring. And, still others that are suspected to be damaging to humans must be approved (or disapproved) by 3M's Industrial Hygiene Department.

Another major change from thirty years ago is that chemicals (hazardous or non-harzardous) cannot be transported in personal vehicles. Samples, like drums, must be properly packaged, labeled and shipped through the warehouse by approved carrier.

And, that's just a quick look at some of the changes over the years.

In 1960, Libey was transferred to Decatur to be Production Superintendent of the Chemical Division's manufacturing plant. Later he became the first Plant Manager at Cordova. After that, Libey was Plant Manager of 3M's Antwerp plant. Now retired, he lives near Cordova, Illinois.

After Libey left Chemolite, he was replaced as manager by Robert Ahlness, a Project Engineer who had been hired in 1955 and assigned to the chemical Group. A native of Minneapolis, he earned a chemical engineering degree from the UofM in 1950, then spent five years as a Process Engineer with Phillips Chemical Company and served in the Navy before joining 3M.

Ahlness was in charge of the pilot plant from 1960 to 1966 when he was made Engineering Manager for the Chemical Division. He held that job until 1973, when he was appointed Manufacturing Manager for the new Chemical Resources Division. (3M's Manufacturing Manager title was changed to Manufacturing Director in 1974.)

In 1986, Ahlness became Director of Manufacturing Technology for the Division (by then called Specialty Chemicals Division) and retired in April 1990. He operates a consulting firm in Mendota Heights, Minnesota.

Ahlness's credits at 3M include designing the first cell that was installed in Building 16 in 1962 and the first multi-cell system installed in the semi-works plant. He also helped design the Decatur plant, introduced computerized drafting to the Engineering Department and was in charge of Chemical Division Engineering during the design and construction of the plants at Cordova and Antwerp.

Because Ahlness was finishing up other activities, he could not replace Libey for several months, so for that period the pilot plant was without a manager. Technician Supervisor Nick Moes was the number two man, but there was very little to do, Hirsch said. "Everyone knew his jobs," he said. "And, when we got in a bind, we called Bill Lundquist."

In 1966, Hirsch replaced Ahlness. As Pilot Plant Manager, Hirsch had a small office, but no secretary. When he or anyone needed a letter or memorandum typed, they walked across the street to the Factory Administration office to "wheedle" help. "There were no sidewalks and no grass, just loose sand everywhere at Chemolite," Hirsch recalled. "Every time I walked back from the factory office, I had sand burs sticking to my socks." It was so hot in the summer in the pilot plant office, Hirsch recalled, that he and the Process Engineer who shared space often worked shirtless in the afternoons. "Every once in a while someone would sound an alert. A secretary was walking over from Factory Administration to deliver some typed material. We all put our shirts back on so we'd be presentable when she came into the office."

It was during Hirsch's tenure that the final two bays were added to Building 16. The fifth bay was built larger than the others because Hirsch recommended and Charlie Bentz in Factory Administration agreed to extend the last bay to the railroad tracks. The tracks blocked further expansion and set the stage for the construction of Building 70 in the late 1980s.

Building 16 did not work exclusively with fluorochemicals. In fact, the new plant was doing more non-fluorochemical than fluorochemical work. By the mid-1960s, work on copying paper chemistry for Thermofax copiers, acrylate polymers and monomers for adhesives, polyester films for the Film Project and similar projects accounted for two-thirds of the business of the pilot plant.

In 1976, Hirsch left Chemolite to go into the laboratory in St. Paul and Duane Sanderson replaced him as pilot plant manager.

In St. Paul, Hirsch was assigned to making existing factory processes more compact so they would work faster, which increased production without additional equipment. Soon, however, he switched to producing Chemical Safety Information Sheets (CSIS), forerunners to the Material Safety Data Sheets (MSDA) required by the federal government.

Sanderson managed the pilot plant until 1984 when he was replaced by Glenn Damerell. By 1990, Damerell not only was in charge of Building 16, but also supervised a new Process Development Center, Building 70.

The Center was conceived in the 1980s after it became clear that Building 16 was becoming a product development plant and that changes were required to regain the Division's responsibility for process development. The Process Development Center, housed in a state-of-the-art facility, began operating in 1989.

The Simons cell in the Process Development Center looks very much like cells did years ago, but it is only a distant cousin to earlier cells. A retired Division employee referring to that cell said, "We put things on it we never had done before."

Despite the attention given Building 70 these days, Building 16 still is bustling. In 1990, it handled more (but different) projects than Building 70.

Building 15 at Chemolite—the original semi-works plant of 1952—is now a fluorochemical production building. There are five other chemical production buildings at Chemolite (Buildings 4, 5, 6, 7 and 25.) Building 17, which began as Chemolite's warehouse, now is a film manufacturing plant.

Building 41, built in the early 1970s, is SA&CD's Chemolite office building. It is joined to the Process Development Center and shares the Center's front lobby.

CHAPTER 15

A Bittersweet Acquisition

A jarring note sounded in 1957 when the Group purchased a division of M. W. Kellogg Company; the discord reverberated for years. Two retired 3Mers who were involved with the Jersey City Chemical Division—3M's name for its new business—still exhibited rancor more than thirty years later.

By January 1950 major fluorinated elastomer research was being pursued only by three companies—3M, DuPont and M. W. Kellogg. The latter, a New York engineering firm, operated a chemical division in a cluster of buildings in Jersey City, New Jersey. It produced Kel-F™ thermoplastics using a fluorochemical technology Kellogg had purchased from the federal government. Some fluorochemical research also was being pursued by Pennsylvania Salt Manufacturing Company, Linde, General Chemical, Firestone, Sprague Electric, Westinghouse and General Electric in the United States. Imperial Chemical Industries and several other firms were doing the same overseas. None was a major player in the game.

DuPont was first into the market in 1943 with a thermoplastic resin sold under the Teflon trade name. The product gained rapid recognition and popularity with homemakers who could fry meat without adding oil or fat to a frying pan factory-coated with Teflon. Industrial applications included gaskets, diaphragms, seals, anti-friction bearings, armored hoses, high temperature electrical tapes and wire insulation as well as anti-sticking coatings.

Kellogg's product had been developed at Oak Ridge, Tennessee, where Kellogg designed and built a gigantic diffusion plant for the Atomic Energy Commission (AEC) during the war. Kellogg's management was impressed with the plastic pipes, valves, storage

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tanks and other components made with the product which were used to handle and store corrosive chemicals in the AEC's gaseous diffusion process. They could see a future for it in the postwar plastics industry because of the product's exceptional chemical inertness and thermal stability.

At the war's end, Kellogg obtained the rights to the fluorocarbon resin and began to develop applications. In 1947, four years after the appearance of Teflon resin, Kellogg introduced Kel-F thermoplastic resin. Kel-F plastics and elastomers found customers in the chemical, electrical and electronic industries and in medicine and surgery. It was used as wire insulation and where mechanical strength, toughness, form stability, clarity and resistance to liquid oxygen and water vapor were required. (An identical product to the first Kel-F plastic was made and marketed by Union Carbide & Carbon's Bakelite Division in 1947 under the Fluorothene™ brand name.)

Kellogg's chemical division produced a number of products under the Kel-F brand including plastic resins, dispersions, polymer oils, waxes, greases and printing inks. It also manufactured acids sold as raw materials for other products.

At first, the viscosity of Kel-F elastomers was so high that they were almost impossible to process, but years later after compounding modifications, they became more suitable for handling. Some uses were for O-rings, electrical connectors, tubing and hoses, especially those requiring resistance to liquid oxygen. Kel-F plastics found application in nose cones of thermal-seeking rockets and as components for proximity fuses in artillery shells, but that business declined with the end of the Korean War. For a time in the mid-1950s 3M was, indirectly, Kellogg's largest customer because Kel-F thermoplastic resin was used by a firm in Chicago to make wide belt paper transports for Thermofax copying machines.

In that era, 3M also entered the specialty elastomer market with 1F4 (or Poly FBA) rubber. Its primary use was for aircraft O-rings, but it was also turned into printing press rollers and fuel line hoses. A poor balance of acid, steam and heat resistance prevented 1F4 from

Opposite: The M. W. Kellogg Company's complex in the late 1950s consisted of five buildings housing the firm's chemical operations, plus others occupied by segments of the engineering division. The large buildings housed the bulk polmerization operations.

achieving broad acceptance, but at least it was a beginning.

In the early 1950s, Dr. George Crawford, then a Kellogg chemist (who retired from 3M in the late 1980s) was part of a task force working to invent a solvent-resistant elastomer with a low glass transition temperature (the temperature at which it would become brittle.) The work, funded by the Army Quartermaster Corps, was known at Kellogg as the Arctic Rubber contract. By 1954, four Kel-F products were being produced, some the result of the Arctic Rubber research. In 1955, Wright-Patterson Air Force Base became a co-sponsor with the QM Corps and a new requirement—high temperature serviceability—was added.

A similar contract funded by the Air Force at Wright-Patterson field was held by 3M between 1949 and 1955. That resulted in poly FBA and by coincidence helped in the development of Scotchgard rain and stain repeller.

In 1983, writing about that era, Crawford said that Kellogg's research team tested 3M's FBA (fluorobutyl acrylate rubber), but discarded it "since it wasn't really a fluorocarbon polymer, but rather a conventional acrylic with fluorocarbon tails." He added: "I can recall that we regarded the 3M work with some contempt."

Then, a woman member of the Kellogg project used that acid to make a persulfate recipe, ran an experiment and came up with a water-white liquid. There was disappointment, Crawford said, because the expected milky latex was not there.

"Fortunately," Crawford wrote, "we didn't throw it out, but hit it with a salt-acid coagulant and down came this big chunk of rubber—the first Fluorel fluoroelastomer. Because of its composition, it was referred to as 2/14, which became 2140 later on."

O-rings and seals made with Kellogg's synthetic rubber were highly resistant to heat, gasoline, oil and other enemies that quickly destroy natural rubber. That, and similar products were revolutionary in terms of the chemical and thermal resistance properties for materials with elastomeric properties.

About that same time, DuPont introduced Viton™ elastomer which was similar to Kellogg's. An ensuing patent squabble ended when the Patent Office declared interference between the two companies. A cross-licensing agreement made DuPont the patent holder, but granted Kellogg a license.

Soon after that Kellogg put its chemical division up for sale and

3M bought it. Selden, who was Assistant Manager of the Chemical Group at the time, said he was unaware of the negotiations until after the contract was signed. 3M was represented by Carl Barnes, Director of Central Research, and Irwin Hansen, 3M's Vice-President of Finance, Selden said. Dr. Barnes had been Director of Central Research Laboratory since 1954 when Vice-President Harry Stephens, who was ill, retired.

Kellogg was represented in the negotiations by Butch Hanford*, whom Selden described as a close friend of Barnes, a friendship dating from their employment at DuPont. Barnes was convinced that Kellogg's process was practical and he wanted 3M to acquire Kellogg's patents, more than one hundred twenty five of them. Pearlson, who studied the patents later on, said they were of little value. It was, he said, as if they had been deliberately "fudged" to make them more attractive.

In March 1957, Kellogg's chemical division, with its products, patents and manufacturing facilities in Jersey City, was transferrd to 3M. Selden went to Jersey City to try, he said, to create "order out of chaos." Kellogg, he said, was manufacturing Kel-F plastic in "hundreds and hundreds of pipes made of ordinary high pressure steel. They would place monomers in the pipes, seal them and let them work for as long as two weeks, using kerosene and dry ice to keep the pipes cool." Pearlson's recollection was of a big sheet-iron structure where "hundreds" of individual tubes were being used to polymerize monomers and catalysts. The same process, he said, could have been done in a drum with a capacity of one thousand gallons or more.

Bill Leder, a chemical engineer, began his career as a parttime employee of Kellogg's chemical division in 1954, transferred to 3M in 1957 and retired from SCD early in 1990. (SCD was renamed Specialty Adhesives & Chemicals Division in March 1990.) Kellogg's complex, Leder said, consisted of five buildings, plus several others occupied by segments of Kellogg's engineering division. Two buildings housed so-called bulk polymerization operations—the "bomb" pressure cylinders. Another was the monomer manufacturing facility, the fourth a finishing and extruding plant and the of-

*Dr. William E. (Butch) Hanford, Vice-President of Research and Chemical Manufacturing at Kellogg, wrote a brief account of the development of Kel-F thermoplatic resin in 1954. Some of that information has been used in this chapter.

fice. The fifth structure was the laboratory, a two-story building shared with M. W. Kellogg engineering's chemical research facility.

Leder said the two polymer manufacturing buildings were about three hundred feet long and two hundred feet wide. Each contained three or four huge tanks each seventy feet long and four feet deep. In operation, each tank held one hundred or more steel cylinders each three feet long and six to twelve inches in diameter.

Leder said Kellogg designed and built a large plant for bulk polymerization of Kel-F in the early 1950s to replace the steel "bombs." However, that plant, which included monomer manufacturing, distillation and purification, produced unsatisfactory products. After experiencing poor results with the bulk plant, Kellogg began developing emulsion polymers from Kel-F monomers and co-monomers.

Leder earned his bachelor's degree in chemical engineering from Columbia University in 1950. He worked on silicone products process development at General Electric's plant in Waterford, New York, for four years before going to work part-time at Kellogg as a Process Engineer for Kel-F plastics. During that period, he obtained a master's degree in applied mathematics from Rutgers.

In 1957, he became a Process Engineer at 3M's Irvington plant in Newark, where he worked ten years. Then, at Chemolite he was a Production Planning Supervisor until 1974 before he became Global Planning Manager, Fluorochemicals, for Chemical Resources Division in St. Paul. Since then, he served three years as Technical Manager of 3M's Antwerp plant, four years as Process Engineering Manager at the Chemolite chemical plant and in various other chemical production jobs in St. Paul. For the six years before he retired, Leder was International Manufacturing Manager for SCD and later Business Development Manager for the Chemicals, Film and Allied Products Group.

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During his first visit to Jersey City, Selden had a run-in with Hanford over the fact that no laboratory or laboratory equipment were listed on the inventory of buildings and materials. "You didn't buy that," Hanford said. He added that 3M would have to pay three hundred and fifty thousand dollars more for that facility and its equipment. Selden gulped. The laboratory and equipment were not mentioned in the contract.

Fortunately for Selden, he was dealt new cards in the game. 3M's inspection team learned that two boilers in one of the 3M buildings were supplying heat to the Kellogg engineering buildings next door. Hanford was "surprised and asked if 3M would sell back the boilers," Selden said.

"I told him yes, for three hundred fifty thousand dollars." Hanford, red-faced, agreed to a trade. 3M got the laboratory and equipment, Kellogg got the boilers.

Wrangling typified the relationship between 3M and Kellogg over the next several years. Kellogg's version is in Crawford's history and a report written in 1960 by Billy Landrum, who had been the leader of Kellogg's Arctic Rubber Project. Landrum's report was written while he was employed in Central Research Laboratory.

According to Landrum, Kellogg's management recommended the development of an emulsion polymerization process as absolutely essential to the success of Kel-F products. But, he added, "3M made only abortive attempts to attract the engineers and chemists who were already working on that development." According to Crawford, 3M lost the potential market for Kel-F 2140 by neglecting its development. That delay allowed DuPont time to gain control of almost all of the fluoroelastomer market by the time 3M got into it in February 1959. Pearlson countered that 3M did not have the raw materials needed to produce Fluorel 2140 in 1957 and, furthermore, had better products to pursue.

There also were differences concerning Kellogg personnel who had been retained by 3M. Major mistakes, according to Landrum, included inept appointments to management positions in Jersey City, a lack of communications from St. Paul and allowing Kellogg's sales force to deteriorate. Pearlson thought L. C. Rubin, 3M's General Manager in Jersey City, was a good manager. However, Pearlson admitted, 3M's choice for Technical Director, Dr. Francis J. Honn, who had been Section Leader for Applications in the Organic Chemistry Laboratory, was a "plodder." Landrum disliked everyone except Hanford, Pearlson added. Landrum, Joe Selden said, "Contributed nothing except constant bitching."

By 1960 many former Kellogg employees had left 3M. That was caused, in part, Pearlson said, by the fact that the best Kellogg employees never moved to St. Paul, but chose to seek jobs in the

East. Leder's view was that "Kellogg's good men weren't sure that 3M was interested in pursuing fluoropolymers." Of sixty-four Kellogg people skilled in fluoropolymers less than half expressed interest in 3M.

A major irritation to 3M personnel was that Kellogg personnel who came to St. Paul retained the salaries they had been earning in New Jersey. In many cases, those salaries were higher than those being paid in St. Paul.

Jim Rogers told an anecdote that pointed up a major difference between Kellogg and 3M. Kellogg was known for its liberal expense account policy. So, when Carmen Gianotta, former Manager of Kellogg's Customer Service Laboratory, made a West Coast trip for 3M, he flew from Jersey City to Los Angeles, drove a rented car to Las Vegas and on to San Francisco. In two weeks, he visited a half-a-dozen accounts.

Not long afterward, Barney Oakes met Rogers in the hallway and beckoned the Sales Manager into his office in Building 21. He showed Rogers the less-than-modest expense report filed by Gianotta. What should be done about it, Oakes asked, apparently having forgotten that Gianotta was not Rogers' employee. "Well," Rogers replied, "if he worked for me, I'd fire him." The Customer Service Laboratory for which Gianotta worked, was headed by Joe Kugler. Whether Oakes pursued the matter, Rogers never learned.

In a summary to his report in 1960, Landrum wrote that "I do not think that aside from the decisions reached during the first days of the acquisition of the Kel-F business by 3M there have been decisions which in themselves were catastrophic. There has been, rather, a continuing series of mistakes resulting largely from lack of understanding of the problems attendant in this type of business. The Kel-F business will never grow without intelligent leadership on the part of Management. This leadership cannot be supplied without understanding the products."

A list that appears to have been attached to a memo on another subject written by Selden, by then Chemical Division Manager, to Cecil March, Group Vice-President, provided employee counts different from Landrum's. Selden indicated that of twenty-five men employed by 3M in the Jersey City laboratory, sixteen had resigned by September 1960. Among those who stayed were C. Kronche in St. Paul; Stan Zaluda, who went to the chemical plant in Decatur, Alabama, and Dennis Deehan, who entered military service and then returned to 3M. Deehan was still with the company in field sales in 1990 and Zaluda also was with Industrial Chemical Products Division in St. Paul.

Of the Kellogg sales force, Selden wrote, eight men had resigned, leaving only Francis M. Ruggles, who stayed with 3M until he retired. A list of engineers showed three active: R. F. Schaaf (who left in 1960). R. A. Sundback and William B. Leder. (Sundback of the Decatur plant as well as Leder retired early in 1990.)

Those lists showed that twenty-seven of forty employees assigned to Jersey City left 3M within three years.

Jim Rogers recounted an early incident involving a Kel-F elastomer customer. Tennessee Eastman, Kingsport, Tennessee, called Rogers to say that Tennessee Eastman was having a "major problem" with 3M's product, which was used as a binder for detonators produced for atomic bombs. A pickup truck transporting the detonators had blown up. Investigation revealed tiny shards of glass in the elastomer binder.

Rogers got firsthand information at Kingsport, then flew to Jersey City where the elastomer was manufactured.

"A plant manager and I talked with every employee in the plant," Rogers said. "We finally talked to the man who solved the problem. He had set a Coca Cola bottle on the edge of the vat and it accidentally fell in.

"I was awfully happy that man was honest with us."

Rogers returned to Kingsport and reported his findings. 3M had, he told the company, culled the suspect lot. "I walked out," Rogers said, "with a very large order."

In 1990 Les Krogh said that "With the acquisition of the Kel-F and Fluorel product lines, we gained expertise with high-performance polymers." Without Kellogg, Bill Leder added, 3M would not be in the fluoroelastomer business today.

Kel-F plastics and Fluorel fluoroelastomers were two of the product lines acquired from Kellogg. Others were oils, waxes, greases and printing inks, which 3M sold for a time, then dropped due to poor sales. Kel-F thermoplastic polymers and copolymers still are marketed by 3M.

Today, Kellogg is a large engineering company which designs and builds chemical plants. It is headquartered in Houston, Texas.

CHAPTER 16

A Remarkable Turn Around

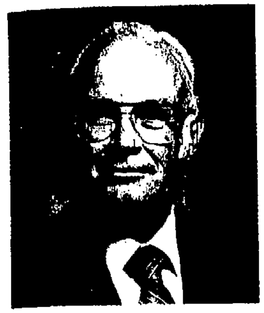
One day in 1973, Krogh, Vice-President of the new Commercial Chemical Division, checked over the sales figures for Fluorel elastomers. They were not very good, not for a product that had been in 3M's sales book for years. That rankled Krogh. It also rankled him that DuPont dominated the fluoroelastomer seals and O-ring market with a share of more than ninety-five percent. And, 3M did not even have most of the remaining five.

Krogh was the first manager of CCD, the selling arm of the former Chemical Division. Since assuming that position, he had reviewed the history of Fluorel elastomers. 3M made its new product introduction in 1959, but DuPont was in the market first with its Viton™ fluoroelastomer. 3M followed with a series of improved Kel-F elastomers, but the line limped through the 1960s. DuPont also improved its products and retained its stranglehold on the market.

3M's stagnation continued into the 1970s despite the introduction in 1968 of FC-2160, the first truly low compression set fluoroelastomer ever made. Another 3M elastomer, FC-2170, introduced in 1971, was the first ever to incorporate a cure system. Despite those advantages, neither created much of a stir with processors and molders.

Enough was enough, Krogh thought. 3M fluoroelastomers must be made profitable or they would disappear. Furthermore, a comment by Jack Whitcomb, Group Vice-President, continued to circulate in Krogh's mind. 3M had just resolved a patent dispute with DuPont over fluoroelastomers in which DuPont had agreed to pay 3M a royalty. "If DuPont was willing to do that, we must have a product that's as good as their's," Whitcomb had said. (In 1973, because a large number of patents were filed by both 3M and DuPont, a mutual cross-licensing agreement was signed to allow each company to continue manufacturing its own products.)

Krogh discussed the problem and his intentions with Marketing Director Bill Petersen and Technical Director Don LaZerte. "We should get into this market or quit it altogether," Krogh told them.


Les Krogh

Petersen and LaZerte wanted to stay in contention. To do the job, all three agreed, a fluoroelastomer laboratory would have to be established. Dr. William Isaacson, a chemical engineer, was brought in from the Central Research Process Technology Plant (pilot plant) to manage the laboratory. Isaacson hired a research team, men like Dr. Arthur West and Dr. Allan Worm, who began developing new and improved products one after another.

Krogh also strengthened Process Development and Technical Services by adding manpower. He authorized hiring five new sales people, stipulating that they be rubber chemists, and approved a hefty increase in the budget for fluoroelastomer advertising. Sales offices were set up in Boston, Cincinnati, Chicago, Dallas and Los Angeles in 1974. Technical Service laboratories were established in Japan and Belgium to serve 3M customers overseas. Four new Fluorel fluoroelastomers were introduced.

DuPont fought back. Each time 3M made an improvement in FC-2174, 3M's O-ring grade elastomer, DuPont improved its product. 3M responded with improvements of its own. DuPont did the same. Back and forth the battle raged in the laboratories, factories and sales territories. Then the war ended quickly. In late 1974, DuPont gave up; it couldn't leapfrog anymore. 3M's fluoroelastomer sales curve continued climbing.

Customers benefited greatly because FC-2174 was light years ahead of O-ring grade elastomers produced by anyone anywhere five years before. The development of FC-2172, 73, 75, 78 and 79 presented an opportunity for 3M to clearly establish a fluorochemical leadership role.

An inspired marketing action program tipped the balance in 3M's favor. The idea came from Paul Novotny of Advertising and was developed by him and Dennis Deehan of Marketing in the fall of 1975.

They began by making a list of names of molding companies 3M wanted as customers. In the program, called "We're Blowing Our Own Horn," a series of mail advertising messages were sent to the targeted firms. In them, 3M offered to give each company enough Fluorel elastomer for a trial if they would conduct the trial on their production line. The only other requirement was that 3M must have technical representatives at the trial to assure a successful evaluation. The mailings included the advantages and benefits of using 3M's elastomer as well as explaining the offer. Apothecary jars filled with candy were sent with the first mailing. The jars were identified with the Fluorel elastomer logo as was each piece of candy. Additional candy as refills for the jars was included with subsequent mailings. The theme was based on the practice of American frontiersmen who sounded hunting horns to alert others in their party when they discovered something new. "You'll Blow the Horn for FLUOREL" and "You've been hunting for the finest fluoroelastomer" and similar slogans were in each mailing. Molders who accepted 3M's challenge were given four pewter hunting horn mugs and enough of 3M's twenty-dollar-a-pound product to conduct their own trial runs.

The promotion was a resounding success as ninety-five percent of the targeted processors and molders asked to be introduced to Fluorel fluoroelastomers. But, as often is the case, orders did not pour in overnight. The story of how one major O-ring manufacturer went from buyng nearly all of its raw material from DuPont to buying almost exclusively from 3M is one of the major success stories of the campaign.

Mike Harnetty was Regional Sales Manager for Chemical Division industrial chemical products and Vince Lopez was a new Sales Representative when the opportunity arose in the Cincinnati 3M Sales Center. It was set up by the "We're Blowing Our Own Horn" offer that was received by the firm located in Kentucky. Despite an interest in Fluorel elastomer expressed to 3M's Sales Representative, the firm did not accept the offer.

Then, the day before Christmas 1974 during business hours Harnetty's phone rang in the Cincinnati office. The company's purchasing agent said his company would place a major order for Fluorel elastomer if 3M could deliver before the end of the year. Harnetty said 3M could and called in Lopez. In the next seven days, the Sales

Representative located and collected enough boxes of FC-2174 to fill the order by borrowing from other 3M Sales Centers and cleaning out the factory inventory at Decatur, Alabama.

On the day before the new year would dawn, Lopez and Harnetty were ready to deliver. They loaded dozens of boxes of their product into a rented moving van and set off on the seventy-mile trip to northeastern Kentucky. By day's end the load was in the customer's receiving department and the two jubilant 3Mers were headed home to celebrate New Year's Eve.

Mike Harnetty

"That swung the balance," Harnetty said, "with the help of something DuPont must have done. Maybe, they missed a delivery. I think we also amazed the account by doing what they asked us to do. Whatever the reason, we got all of their business after that."

Mike Harnetty became General Manager of ICPD when it was established in 1986 and has been Division Vice-President since 1987. He attended Ohio State University, intent upon becoming a veterinarian and graduated in 1967 with a bachelor's degree in agricultural chemistry. He sold agricultural chemicals for Monsanto Chemical Company for two years, then joined 3M in 1969 as a Sales Representative for Light Water™ AFFF and Fluorinert™ fluids in Chicago.

By 1971 he was selling Scotchban size in seventeen states. Two years later, Bill Skown, National Sales Manager for industrial chemicals, reassigned Harnetty to Los Angeles as CCD's West Coast Sales Manager and the following year to Cincinnati. In 1977 Harnetty was transferred to St. Paul to be CCD's International Marketing Manager. Skown took a new job with the Division in 1980 and Harnetty replaced him as National Sales Manager for industrial chemical products. From 1983 until he returned to St. Paul to take charge of his new Division in 1986, Harnetty was Managing Director of 3M's subsidiary in Venezuela.

Skown was another chemical old timer. He started in 1947 as a Junior Chemist in the Special Products Division and retired thirty-eight years later in 1985. He was reared in Lead, South Dakota, and in 1947

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obtained a bachelor of science degree in chemical engineering from the South Dakota School of Mines in Rapid City. He had enrolled there in 1941, but left to go into the Navy in 1943 and did not return until 1946.

In 1951 he became a Process Engineer at Chemolite and between 1953-56 was in the Polymer Development Laboratory. Skown turned to marketing in the Irvington Chemical Division in 1956. Reorganization in 1959 found him in sales in Chicago and his first exposure to fluorochemicals. After seven years as West Coast Sales Manager in Los Angeles, he was transferred to St. Paul in 1971 as a Market Manager under Marketing Director Bill Petersen. Eight years as National Sales Manager for industrial chemicals covered the years from 1973 until 1981 when he returned to marketing. In 1982, he became Business Development Manager before ending his career in that job in June 1985.

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As part of the Fluorel elastomers product line rejuvenation, the Technical Service department had been turned into a marketing tool. One requirement was that Technical Service personnel visit all major customers quarterly to discuss customer requirements, needs, applications, processes and so on in addition to handling regular problem-solving calls. That not only made Technical Service people visible, but allowed the development of technical relationships with molders. Furthermore, it gave 3M's technicians the opportunity to learn how 3M products and compounds were performing in production.

More elastomer products were introduced in 1976 and 1977. In 1978 3M won approval of Fluorel elastomers for use in manufacturing high output flares for the Navy and Air Force. 3M also introduced a product to the pyrotechnics industry, a fluoroelastomer in strip form that facilitated the preparation of solvent solutions.

More products were introduced in the 1979-82 years. In 1980 the Fluorel fluoroelastomer teams from CCD and CRD were awarded 3M's Quality Award for outstanding program achievement with the product line. Fluorel elastomer 2182 won an IR 100 Award from *Industrial Research and Development* magazine as one of the one hundred unique products developed in the United States in 1981.

A modern major application for Kel-F plastic is to make moldings and gaskets for solid propellant rockets, an application developed by Aerojet General. Kel-F plastics also were used to produce "windows" for the noses of Sidewinder missiles. The windows allow the missiles to read infrared rays emitted by enemy aircraft engines.

The bottom line of all that happened since Krogh made his decision is that 3M has controlled a major share of the fluoroelastomer market for many years. That situation is a far cry from the dismal picture he got from reading those sales figures in 1973.

Specialty chemical markets are relatively small. The fluoroelastomer market, for example, comprises only about one-half of one percent of the total elastomer market. However, that tiny percentage grew at a rate of ten to fifteen percent a year through the late 1970s into the early 1980s, so new companies became interested and entered the business fray. Those firms have become fierce competitors and DuPont still is strong with its Viton product. In the late 1970s, Italian and Japanese companies entered the overseas market, so global competition has been active for more than a decade.

A passing note: fluoroelastomers are strategic materials, so exports to some countries are prohibited by the federal government.

CHAPTER 17

The Long Wait

Today's super-computers run faster and are more compact than computers built in the mid-1980s. And, you can bet that even today's wonders will be obsoleted by faster, smaller versions before the dawn of the Twenty-First Century.

The quest for speed is understandable; the faster the computer, the more work it can produce. Compactness is a factor because reducing circuit lengths reduces signal travel time and speeds up the computer. Consequently, each of the thousands of wires in a CRAY-2 computer, for example, has been cut to a precise length and circuits are packed close together. Compact configurations create problems, however, because they result in enormous heat buildups. Compact computers also have obsoleted standard cooling systems—plates cooled with refrigeration lines—because they simply take up too much space.

Cray's solution to that problem was a sealed cabinet with all components immersed in 3M Fluorinert™ electronic liquid. Fluorinert liquid not only is an excellent coolant, but because it is inert it cannot react with—harm or be harmed by—other materials. It will not conduct electricity, can be cooled (or boiled) and has low surface tension. It flows readily through every tiny space, cooling every circuit module and logic device, every wire and contact. It is easy to handle; it can be pumped under low pressure into the housing of the computer directly from a heat exchanger. It is, in short, a solution to a major problem.

No one was dreaming about cooling computers in 3M's Fluorochemical Division thirty years ago. Researchers and marketing men responsible for inert liquids were busy trying to find prospects

for inerts. And, equally important, find someone willing to pay the high price 3M had to ask for them.

Inert perfluorocarbon compounds as 3M products date from the late 1940s. They were among the first 3M fluorocarbons produced in the Fluorochemical Project laboratory and pilot plant, but the initial enthusiasm for them evaporated after it was learned that they were too expensive to be sold as coolants for refrigeration units. After that, the Project concentrated on pursuing the technology of reactive fluorochemical acids. When that goal was reached in the early 1950s, inert liquids were all but forgotten. Inerts, incidentally, is a 3M word coined in the 1940s to describe perfluorinated liquids that do not react with other substances or materials.

Because fluorochemical fluids cannot harm anything and will not conduct electricity, they can be used for immersion testing. And, because they can be heated and vaporized, inerts are extremely useful for heat transfers such as in reflow soldering, a technique used in manufacturing electronic assemblies.

But, in the 1940s, inerts were a product before their time. Until Sputnik flew overhead in 1957, until the United States space exploration program, and until the military electronics market began to develop in the 1960s, inerts did not have a need to fill. After space requirements forced designers and engineers to miniaturize vehicles, componets and their cooling systems, inerts stepped out of the wings and into the limelight.

The biggest obstacle to converting from a fan to an inert as a coolant in an electronic device, for example, was the fact that the device had to be redesigned for use with fluids. That made selling inerts a long process. The benefit that salesmen could point out was that the new device could be made smaller than its predecessor. Mechanical cooling devices like fans, cold plates and refrigeration units still compete with inerts, but not in space applications.

One of the first uses—if not the first—was a RADAR transformer designed and built by Raytheon.

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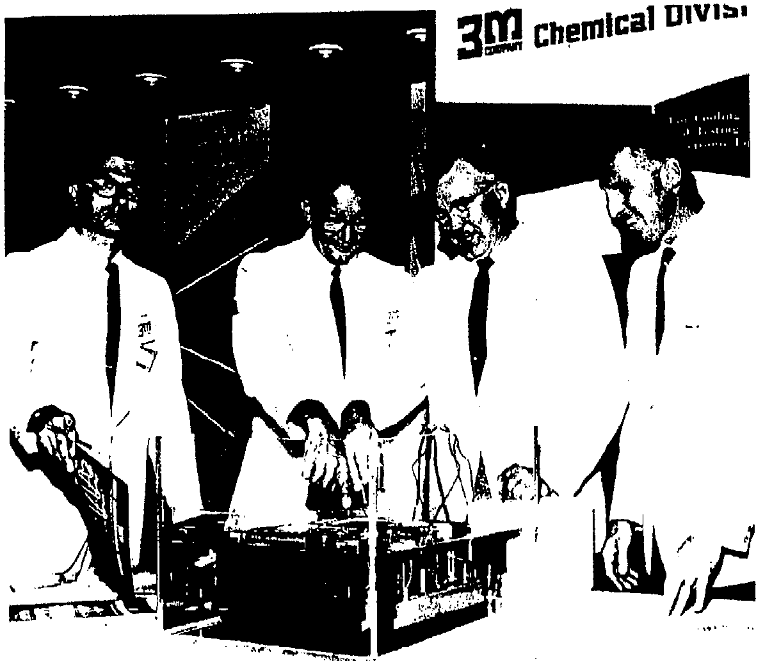
Price as usual was a major mountain to climb. In the late 1950s, Jack Sargent, a Chemical Engineer in technical service, and Sales Representative Lyle Hals conducted a seminar on inerts at Westinghouse. Interest in the 3M product presentation was peaking when someone interrupted to ask the price. Hals recited the figure and the room erupted with hysterical laughter punctuated by remarks like "You guys got to be crazy!" and "You must be kidding!" Hals wasn't surprised. In the five years he had been selling 3M specialty chemical products he had generated similar reactions almost every time he quoted a price.



Operating a tape recorder while it was submerged in a tank of 3M inert liquid was a feature at trade shows in the early 1960s. 3Mers (left to right) are Lou Cove, Technical Service; Bill Skown, Los Angeles Area Manager; Jim Rogers, National Sales Manager, and Edward T. White, Los Angeles Sales Representative. Cove and White were still with the Industrial Chemical Products Division in 1990.

The Sargent-Hals presentation must have had a positive effect, however. Several years later Westinghouse built two prototype one-

hundred-thousand-kilowatt transformers each cooled with about one hundred gallons of inert liquid. Decades later, in the late 1980s, two Japanese firms built giant electrical transformers that used 3M inerts instead of oil as the coolant. In that application, inert liquids made it possible to install the generators on roofs of buildings without the risk of fire. Hundreds of gallons of inert fluids filled the cavities in the monster pieces of equipment.

Sargent was a chemical engineer from the University of Illinois, who joined the Fluorochemical Project in 1950. Five years later he was in the Fluorochemical Division, first as Supervisor of the Electrochemical Fluorination laboratory, later in Technical Service.

Jack Sargent

In 1962 he was assigned to market inert liquids, Kel-F polymers and some other products in the Chemical Division. Manager Roy Mordaunt was developing a marketing staff in his Commercial Development Department and Sargent was the third to join the ranks. The first, Ray Brown, who handled Scotchgard repeller, was a chemist who had been a Sales Representative for 3M in Ohio. The second was Dave Shryer, a chemical engineer who also had a 3M sales background. A year or two afterward Don Norton came into the Marketing Department. Shryer was responsible for Kel-F and Fluorel fluoroelastomers, Norton for urethane and several other products.

Marketing was a blanket covering everything necessary to find customers, get a product sold and keep end-users happy. Besides market planning and development, Sargent and the others handled market research, merchandising and provided technical service when necessary. "We also gave technical seminars to customers, trade associations and technical societies," Sargent recalled.

The space age directed 3M away from large power equipment as the marketing staff learned that fluids could be important in high reliability aerospace and military electronic equipment. 3M's liquid enabled airborne radar transmitters and other airborne equipment to be made smaller and lighter in weight. Inerts also extended the period of use of equipment and improved performance by lowering operating temperatures. A long list of electronic countermeasure and radar systems in our U.S. Government arsenal still depend on Fluorinert liquids for cooling. Even today they are specified by name in several military standards because no other products can fill the bill.

Another application for inert fluids is in electronic test baths where the fluid is in direct contact with sensitive materials. 3M fluids also are used to test thermal shock, hermetic seals, burn-ins, electrical performance and other tests for reliability of electronic components. Even in non-sensitive testing, inerts save money by saving time because they leave no residue to be cleaned up.

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As was the case with other 3M products, when inerts were new in industry, some customers did not understand them. In the 1960s, a customer in Milwaukee telephoned St. Paul. Someone had to be in the firm's office the next day to discuss the failure of a guidance system the firm had built for a Titan II missile. The guidance system, cooled with an inert liquid, had malfunctioned in flight and the missile had to be destroyed. The company engineers were certain that 3M's product was the culprit.

Because Fran Ruggles, the Sales Representative, was not available, Sargent found himself facing forty concerned people in a conference room. He deflected criticism as best he could until the meeting was adjourned, then in a private meeting reminded 3M's engineering contact in the firm about a serious discussion they had had months before. It was not FC-75, Sargent reminded him, but an air bubble in the fluid that was at fault. The bubble had deflected the laser beam designed to shine through the fluid.

"Fran and I had stressed that many times when we were making the sale," Sargent said. "All bubbles had to be purged from the fluid in the system. The engineer didn't take that seriously until the guidance system failed."

Sometime during the early days of Scotchgard repeller, Selden recalled, yields of that product from the cells amounted to only about fifteen percent. The remaining eighty-five percent were inerts for which there was hardly any market. Rather than throw them away, they were sealed in fifty-five gallon drums and stored outdoors at Chemolite. Eventually, the stockpile totaled one hundred eight drums containing nearly six thousand gallons. Year after year went by before

inerts found their market niche. When that point was reached, the Division sold its stockpile at a handsome profit.

By the time 1970 rolled around, Lockheed, LTV and other big defense contractors in the military electronics business were 3M customers. As the market expanded, Sargent asked for help. Lou Cove, a chemical engineer who was a Process Development Supervisor in the Laboratory, was provided on an as-needed basis, but Sargent kept insisting he needed Cove fulltime. As for Cove, he learned that he liked marketing and was agreeable to Sargent's suggestion, but Bob Burford, Cove's manager, balked at a transfer.

Then, in 1964, Sargent got a break. Or, to be concise, he broke an ankle while traveling on business to Newark, New Jersey. After a week in a Newark hospital and a day in Miller hospital in St. Paul, Sargent recuperated at home while Cove filled in for him at 3M. One day he received a telephone call. "Okay Sargent," Burford's voice came over the line, "you've made your point. You can have Cove fulltime." Cove sometimes refers to the time Sargent broke his ankle as "the turning point in my career."

The third major use for inert fluids after cooling and testing was developed in the mid-1970s with the help of Western Electric. That firm was experiencing problems assembling back panels for large electrical equipment which required soldering. Hand soldering was not cost effective, so bits of solder were laid on each connection point and the panels were inserted into "ovens" where hot air made the solder flow. Then at room temperature the solder hardened and sealed the circuit.

Hot air is difficult to control and often the device got so hot it warped and became useless. Western Electric gave DuPont a crack at solving the problem, but DuPont's fluid was not quite inert. And, it was expensive. Then 3M was given a chance. 3M's solution was to vaporize a Fluorinert fluid and immerse the panel in the heated vapor which melted the solder. Exposing the device to air, cooled and hardened the solder again.

Western Electric was charmed. So charmed, it began publicizing its system, which, of course, helped 3M. An engineer in Massachusetts got excited about building equipment and became the driving force behind developing a market for vapor phase soldering. Today, Cove says, vapor phase soldering equipment, much of it made by the HTC company in Massachusetts, can be found in shops all over the world. The simple device uses a conveyor to transport the circuit board or any object to be soldered into a chamber where the fluid is vaporized by electric heaters. The circuit board is conveyed through the chamber and when it exits the soldering is finished.

Vapor phase soldering is used by manufacturers of electronic assemblies for coffee makers, microwave ovens, automobile instruments, communications equipment and thousands of other products of industry.

Lou Cove

When Cove joined the marketing department, he proved to have staying power. He stuck with the Division through its various name changes and splits and in the late 1980s was named Business Manager for Fluorinert Liquids (which was changed to Engineering Fluids and Systems in 1989.)

Cove's career began with a chemical engineering degree from Illinois Institute of Technology in 1959 and a master's degree in chemistry from the UofM. In 1961 he began at 3M as a Process Development Engineer in the Chemical Division Laboratory, where he stayed until he transferred to marketing in 1969. In 1980 he accepted a position as Sales and Marketing Manager for the Agriculture Products Project, but since 1983 has been associated with engineering fluids and systems.

A low spot remembered from the 1960s was an assignment to present a seminar at Goddard Space Flight Center in Maryland. When he arrived, he was overwhelmed by the size and facilities of the meeting room. "There were hundreds and hundreds of seats in that auditorium," he recalled, "each row elevated above the one in front of it to provide a clear view of the huge stage. The acoustics were superb. So were the projector screens."

One man showed up for the seminar.

"He sat way in the back. I could barely see him." Cove encouraged the man, who introduced himself as a development engineer, to come down front where Cove made his presentation while seated on the edge of the stage, legs dangling.

Cove predicted that cooling applications will expand into the largest business area for inerts before the year 2000. Heat removal requirements are growing, he said, not only in the computer industry—including PCs—but for many other sensitive communications devices still using fans or refrigeration.

CHAPTER 18

A Decade of Churning

The 1960s have been described as the Chemical Division's decade of churning by a retired 3Mer who was in charge of CCD in the Seventies.

When the decade dawned, one of the division's most successful and most profitable products was a surfactant sold as a leveling agent for self-polishing floor polishes. That application would be diminished by the development of no-wax floor tiles and linoleum, but the surfactant survived. Another surfactant (still holding its own in the 1990s) was being sold to Udylite as a mist and vapor suppressant in chrome plating operations.

When permanent press fell from its pinnacle after a brief heyday, it took stain release with it. And, the only leather industry customer buying Scotchgard repeller was Wolverine Shoe Company. Furthermore, Scotchban size was still blocked from entering its most promising market, food packaging, pending approval from the Food and Drug Administration.

So, while the Division was in the black, there was not one item in the Division's product line capable of brightening the eye and quickening the step of General Manager (soon to be Vice-President) Joe Selden.

The Division Laboratory and Commercial Development Department were frustrated by their inability to ferret out more applications for surfactants. They decided to gain exposure by resuscitating a successful technique from 1950. That tactic was to tell the world about fluorochemical surfactants and see who might jump up and say, "I've got an application." Instead of presenting papers at meetings, however, which was the technique used during the previous

decade, the Division advertised in trade magazines circulated to the chemical industry. Each advertisement invited readers to request information or samples. When replies were received Marketing mailed back a questionnaire which asked the inquirer to define his application idea.

Application information received was evaluated by the Laboratory and the Commercial Development Department. Then, if a sample had been requested, one was sent without identifying its chemical structure. With that, the Division obtained application ideas without divulging proprietary information, and interesting leads could be followed up by telephone or direct contact.

Whenever a sample cast upon the commercial waters resulted in an order, Mordaunt's department knew the intended use for the surfactant and could determine whether to pursue the application with similar prospects. By early 1962 several hundred sample requests had been filled and a number of small accounts covering a variety of applications developed. Unfortunately, none looked capable of producing worthwhile profits.

Then, on March 2, a questionnaire was returned from the Naval Research Laboratory (NRL) near Washington, D.C. Dr. Richard L. Tuve requested a sample of a surfactant that could improve resistance to breakdown of aqueous foams caused by silicones. A sample was sent and two months later Maynard Olson followed with a visit. At NRL he learned that the Navy researchers were trying to develop a fire-fighting foam that would be stable in the presence of silicone-treated potassium bicarbonate, a dry chemical used to extinguish petroleum fires.

Dick Guenthner

More samples were sent and ideas and information exchanged. Eventually, Tuve and an employe, Henry Peterson, met with 3M's scientists in the third floor conference room of the Benz building. Maynard Olson, Bob Burford and Dick Guenthner represented 3M. (Later, Guenthner began working with surfactants and continued that endeavor for the rest of his thirty-eight-year career. A native of Bridgewater, South Dakota, with a bachelor's degree in chemistry from the state's university, Guenthner arrived at 3M in 1947 after spending three years with Eastman Kodak Company in Rochester, New York.)

When the visitors entered the Benz building, Henry Peterson was carrying a small can containing gasoline, several sealed test tubes, a metal tray and an ultraviolet light. Navy scientists, Dick Tuve explained, had mixed a solution of 3M surfactant and water with interesting results which he wanted to show to 3M. Peterson poured gasoline into the tray and added the solution from a test tube. The solution had been treated to make it visible under UV light. Peterson turned on the light and the 3Mers saw the fluorochemical mixture spreading across the surface of the gasoline.

"I don't need to tell you how flammable gasoline vapors are," Tuve said. "Now, watch this." Peterson lighted a match and held it near the surface. Nothing happened. There was no flareup. "There's the basis for a new product," Tuve continued. "If it can be combined with a foam, it could be effective in stopping jet fuel fires. That's what the Navy wants and needs. We know that in many airplane crashes the pilot isn't killed by the impact, but burns to death in the wreckage." Lives could be saved if fires could be quelled and victims pulled from the wreckage within three minutes, Tuve said.

The accepted fire fighting product of the day was protein foam, but that product could not seal the surface of a petroleum fire. When breaks occurred in the foam, the gasoline vapor could re-ignite.

The Navy had tested hundreds of products, but not one was effective. Foam was a necessary ingredient of any successful product, he went on, because it provided depth for the blanket and carried the fire fighting product across the surface to replenish the supply when and where it was needed.

3M's scientists went to work and by the summer of 1962 the Navy researchers tested a formulation based on 3M's L-1083 product on a fire. The test site was the Ansul Chemical Company in Marinette, Wisconsin, because Ansul was the chief supplier of dry chemical systems to the Navy.

On August 8, Rogers and Frank Warner of 3M's Government Service Department in Washington visited the Navy laboratory in Maryland to obtain more information about the Navy's requirements. A lot of development work remained to be done, Tuve said, before 3M's surfactant would be acceptable.

3M, Ansul and the Navy working together continued to develop a system for dispensing what was referred to in reports and correspondence as "light water." (Navy researchers had begun to use that term after they learned that their mixture of surfactant and water formed a thin layer on the surface of gasoline. Soon 3M and others began using the appellation, too.) Ansul also used 3M samples to conduct tests involving hydrocarbon vapor suppression and the treatment of dry chemicals. Other companies in the foam business became interested and began working with the Navy and later 3M under the assumption that companies in the foam business would manufacture the fluorocarbon foam when it was perfected.

In the spring of 1963 Navy researchers tested a formulation they believed might be what they were seeking. After they requested more and larger quantities of the surfactant, 3M decided to get into the formulating business. The product the Navy seemed to like was FX-1831 which consisted of one part concentrate and three parts fresh water. It was stored in pressurized vessels and was expelled by nitrogen and refrigerant gas. The system was effective, but was economically limited to small semi-portable systems. Eventually fire trucks carried 3M's product and water in separate tanks, the system still used today.

Ansul Chemical also built fire-fighting units that used dry chemicals with a premixed solution of FX-1831 and proved that system's effectiveness in November 1963 in a test for the Air Force. 3M's foam without the dry chemical also was tested against protein foam at that time and its superiority was obvious to bystanders, including Mordaunt and Burford, the latter 3M's laboratory contact with the Navy. That test proved conclusively that "light water" did not need dry chemicals to be effective because it was superior to protein foam all by itself.

Bolstered by that finding, Mordaunt surveyed the market and learned that FX-1831 could not compete against the six percent protein foam concentrate. 3M's product not only was priced too high, but it could not be used with existing equipment, so 3M turned its efforts toward producing a competitive product. By August 1965—nine months after the successful test at Ansul—a satisfactory six percent light water concentrate designated FC-1941 was developed. About that time 3M registered Light Water™ aqueous film forming foam (shortened to AFFF) as its trade name, which was approved in 1966.

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Reformulation work and Navy testing continued into 1967. That spring the Navy in a monitored experiment supplied five major naval air stations with FC-1941. 3M continued its own testing and pursued the Navy's request to improve FC-1941's compatibility with salt water; Tuve's group had learned that the product's effectiveness was reduced greatly when it was mixed with sea water. Most of 3M's efforts, however, were aimed at improving production capabilities and evaluating FC-1941's performance with fresh water.

Time dragged on and it seemed that the Navy would never be satisfied, would never start ordering Light Water AFFF in profitable quantities. Unfortunately, the balance was tipped by a shipboard tragedy. On July 29, 1967 the aircraft carrier USS Forrestal was ravaged by a flight deck fire in the South China sea. The blaze was contained, then flashed up again and again. It spread to armed jet aircraft and the resulting explosions and fires killed one hundred and thirty four sailors and airmen. The disaster also caused more than one hundred million dollars worth of damage to the carrier, which limped back to the States for repairs and was out of service for nearly a year.

The tragedy had been magnified by the failure of protein foam and dry chemical agents to prevent reflashing of aviation gasoline.

The day after the fire Navy brass in Washington were given Light Water AFFF demonstrations. Immediately, twelve systems were ordered flown to the Philippines and placed in service on other carriers. The Navy also urgently requested 3M to develop a formulation that would be compatible with sea water. That urgency was relayed to 3M's researchers and the result was offered to the Navy for testing that year.

It had taken five years to convert the Navy from a prospect to 3M's first Light Water AFFF customer. The next priority prospect was the Air Force.

Mike Harnetty* now Vice-President of ICPD, was in the vanguard of that sales expedition. He vividly remembers sales calls made at an air base near Kansas City where Fire Chief Darryl Saul was a difficult nut to crack. Harnetty made countless calls trying to convert the hostile chief into a friendly customer. The major problem was that Saul, like every Air Force fireman, knew that the Navy had helped to develop Light Water AFFF. Inter-service rivalries are

*Harnetty's starting salary in 1969 exceeded his sales quota for that year.

strong; what one service develops is likely to be eschewed by others. It was extremely difficult to overcome that prejudice and on each call, Harnetty, despite his size, absorbed nasty remarks and comments from the fire chief.

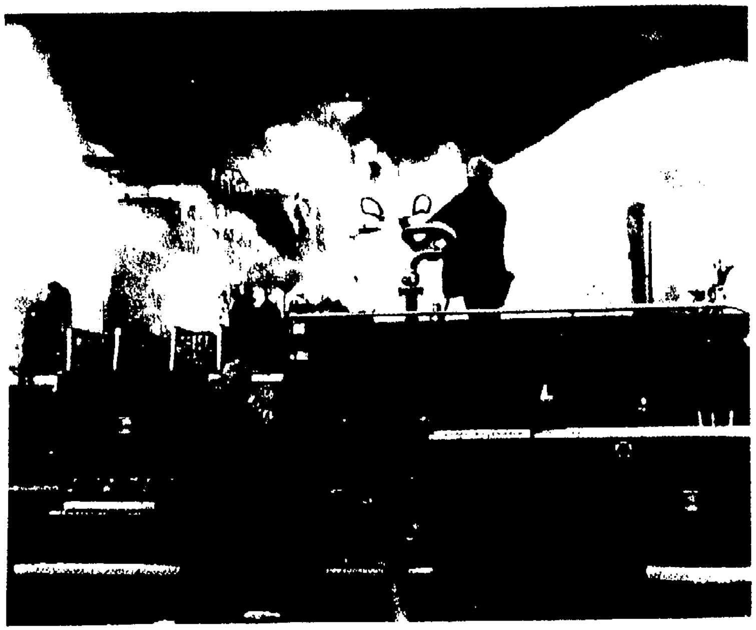
(Rude behavior is encountered by every salesman. "You just have to ignore it and keep coming back," Jim Rogers said. "You must remember that you're not trying to make yourself look good. You're trying to sell products.")

Saul's hostility was especially galling to Harnetty because the Air Force had been using ineffective fire-fighting foams on petroleum fires for years. Airmen's lives and the well-being of the men who fought aircraft fires depended on their equipment. Firemen bet their lives on those products, so Harnetty and the Division were convinced that the Air Force could not afford to hold out forever.

Oddly enough, Light Water AFFF lacked credibility with some prospects. Skeptics simply could not believe that fires requiring five to ten minutes or more to quell with protein foam could be doused in one to two minutes with 3M's new chemical. Articles published in trade magazines citing the effectiveness of Light Water AFFF in fighting shipboard and naval base fires were not believed, either. Unless doubters would agree to a demonstration, those beliefs could not be changed.

Five years after the Navy began ordering Light Water AFFF, 3M still had not overcome the Air Force's resistance. Then 3M luck took charge. In the early 1970s, an Air Force jet crashed and burst into flame at an air base in England. By coincidence, a group of military officers and a gaggle of news media representatives were assembled at the base waiting to see a Light Water AFFF demonstration. The scenario called for two fire trucks to speed into videocamera range where firemen would smother a test blaze. Still-picture cameramen and reporters were also poised to record that event.

Moments before the test blaze was to be ignited, the jet crashed just off a runway a few hundred yards away. The trucks equipped for the test sped to the burning plane and quickly doused the flames. Two airmen, frightened and injured, but alive, were dragged from the blackened wreckage as cameras whirred, shutters clicked and writers scribbed notes. That publicity was fantastic. How many times does a company get its product right down front in a major news story? But, as effective as it was, it took an officer to finally convince the Air Force. Colonel Jack Salmon, a part of the Air Force officialdom in the nation's capital, was a convert from the fire in England. "I'm going to get your product specified no matter what opposition I run into," he told Jim Rogers. And, he did. Salmon also predicted that 3M sales of its product to the Air Force would triple the business 3M was doing with the Navy. He was right about that, too.



Fighting a fire in petroleum storage tanks with Light Water AFFF.

But, despite Salmon's accomplishment, Harnetty's job at Kansas City was not made easier. It still required nearly two years to get that first order from Fire Chief Saul, but then to Harnetty's pleasant surprise, he not only had a customer, but a spokesman for 3M's product. On order of the chief, demonstrations and seminars were set up for firemen on all three shifts at the base. Harnetty made the presentations, showed 3M films and distributed written materials. Then, Saul set up another presentation to a visiting general which was of great benefit to Harnetty and 3M. Saul was limited to spending ten

thousand dollars on any project, but no such restraints applied to the general. Soon every fire truck on the base was converted to carry 3M's product.

Saul was not the first Air Force fire chief to buy into the program. Harnetty made the first Light Water AFFF sale to the Air Force in November 1970 at Ellsworth Air Force base, a Strategic Air Command facility, near Rapid City, South Dakota. Again, tragedy was the catalyst as a B52 bomber crashed and burned. The base supply of protein foam was exhausted before the blaze was extinguished, so a test quantity of Light Water AFFF that happened to be on hand was used. It doused the flames quickly and almost as quickly resulted in a twenty five thousand dollar order for Harnetty.

Since those early pioneering days with Light Water AFFF, 3M's product has been used to extinguish large and small petrochemical fires in the United States and other parts of the world.

In the late 1970s a new formulation was designed to fight alcohol fires. The change was necessary because alcohol, which has an affinity for water, extracts water from Light Water AFFF concentrate. The new formulation not only solved that problem, but often is used in smaller concentrations compared with Light Water AFFF to fight petroleum fires. It is considered the premier product in 3M's Light Water AFFF product line.

Years ago, oil-rich Iran was 3M's biggest overseas customer, partly because it had one of the world's largest air bases and partly because Iran feared its neighbors. Later, Saudi Arabia reigned as 3M's largest foreign customer, because of its air force needs and its large petrochemical industry.

In 1991, as it has for many years, Light Water AFFF is stored and used on every Navy, Air Force and Army base having a flammable liquid fire potential everywhere in the world.

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By the time Les Krogh became General Manager of CCD in 1973, Light Water AFFF had won acceptance by the military, but had not penetrated very far into civilian markets except for aircraft rescue uses. The one exception was California, where fire fighting uses of 3M's product totaled nearly one hundred percent through diligent sales efforts. The major obstacle to expanding civilian sales were the companies that manufacture trucks, fire-fighting tanks and extinguishing materials. Those firms controlled distribution of products to that market then as they do today.

To concentrate on that market worldwide, Krogh established a Fire Protection Systems Project (later Department) with Jim Rogers as Manager. Dave Shryer, who had been marketing Light Water AFFF since 1965, joined the project. Bob Burford became Laboratory Manager. Jim Salter, Area Sales Manager on the West Coast, came in as Sales Manager.

Dave Shryer

Shryer had a successful sales career before turning to marketing. In 1960 he became the first 3M Sales Representative to sell a million dollars worth of chemical products in one year. With a chemical engineering degree earned in 1947 at Purdue University, he began in chemical processing and manufacturing areas with Procter & Gamble in Cincinnati. But, by September 1949, Shryer was employed at 3M operating a vacuum metalizing pilot plant for the New Products Department in the Benz building. He was still with NPD in 1955 when the Chemical Group was formed and two years later he was the Chemical Division Sales Representative in Dayton, Ohio, assigned to the Cincinnati branch.

The Fire Protection Systems Department was taken back into the Division in 1978. It was strong in sales to the government, but had made little penetration into the commercial markets. Eventually, however, the objective of a broad-based commercial business was achieved.

Rogers retired on March 1, 1979, and lives in North Carolina. Shryer retired in 1989 and stayed in the Twin Cities.

An Agriculture Project established in 1973 did not fare any better. Dr. Jack R. Sjolander transferred from Director of Corporate Technical Planning and Coordination to become Project Manager. Sjolander had earned his degree at the UofM before starting with 3M in NPD in 1952.

In the early 1960s Central Research made an extensive effort to learn whether properties of fluorocarbon derivatives were biologically useful. 3M scientists proved that certain compounds were capable of potent and unique activity on germinating seeds and growing plants.

Speculation was that the compounds functioned as strong nitrogen acids to impart the properties required for plant penetration and activity.

Tom Reid, who discovered the chrome complex back in the 1950s, worked in the United States Department of Agriculture before coming to 3M and talked about his ideas regarding fluorochemical herbicides as early as 1949. Thousands of compounds were synthesized and evaluated as herbicides and plant growth regulators over the years. The most promising were subjected to exhaustive environmental and toxicology studies to assure that new products could be developed safely. And, to satisfy requirements of government agencies, including the Environmental Protection Agency (EPA). By 1968 CRL developed a grass growth regulator. Later the Laboratory developed a herbicide to control a variety of weed species including nutsedge, which can damage cotton, tobacco and rice fields, plus a chemical to control nematodes.

The Project achieved several near misses, but never made a real hit. One product, Embark™ plant growth regulator ("The best anyone's made so far," Krogh said) was unreliable. It slowed the growth of grass and suppressed seed head formation, but could not prevent tufts from springing up. And, because those tufts required mowing, they defeated the purpose which was to limit lawn care. Destun™ herbicide, an effective pre-emergence control for many weeds, leached out of the soil and could not be priced competitively. Vistar™ herbicide, an effective post-emergence weed treatment, was effective against johnson grass, but without a line of products to go with it, the product was useless to 3M. In 1981 the work was transferred to another 3M business function which later abandoned it.

One product sprang from an experiment to learn whether laboratory and marketing people working together could develop entirely new and unrelated products. Gayle Rengel from Marketing and Jack Deviny, Roger Alm and Ken Gilleo from the Laboratory developed a method of curing epoxy coatings with ultraviolet light instead of heat. They produced a resin curative that could be activated by exposing it to UV light for a split second. The system was more effective than oven-drying methods, but had no relationship to fluorochemicals. The development team was disbanded after a decision was made to work within established product groups.

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CHAPTER 19

The Paper Chase

Tom Reid's chrome complex was nearly obsoleted as a textile treatment by Scotchgard rain and stain repeller, but managed to attain limited success in upholstery and drapery applications where its color was not a drawback. It also found use as a leather treatment. More important, it led to a successful paper treatment product now called Scotchban™ paper protector.

In its evolution to a paper treatment, the carboxylic acid base of Reid's chrome complex (FC-804), was replaced by sulfonic acid, which made it less expensive and improved its stability in water. That product began as Scotchgard FC-805, but was renamed after the Division decided to reserve the Scotchgard name for its textile protector. A Scotchgard leather treatment (FC-149) was also renamed.

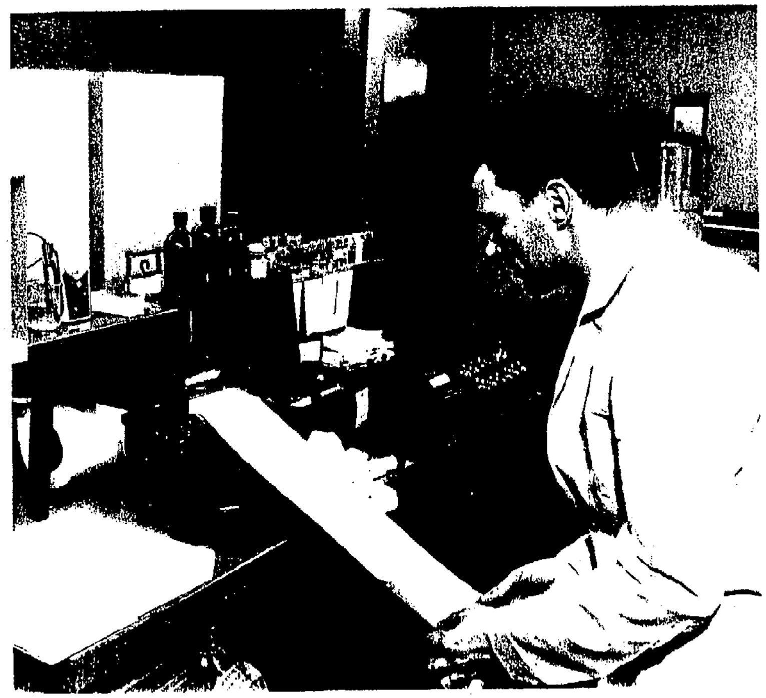
Before Scotchban treatment achieved regulated status from the Food and Drug Administration, it could only be used for non-food packaging. One early application prevented asphalt, which was incorporated into seed corn packaging, from bleeding through and defacing the bag label. And, Thilmany Pulp and Paper Company used 3M's product to prevent black wax coatings on carbon papers from migrating through pinholes to disfigure the other side. That application was developed in the late 1950s by Gayle Rengel, a laboratory technician who worked for Jack Hessburg. To carry out his research, Rengel had learned how to make paper so he could understand the requirements of various types of paper produced by the industry. To do that he acquired a paper beater, a freeness tester and a twelve-by-twelve-inch sheet mold for the Benz building fluorochemical laboratory. In time he became proficient in making a variety of papers.

Rengel discovered the carbon paper application accidentally while

running laboratory tests. The discovery came in the test in which Rengel made fifty sheets of carbon paper to which he applied Scotchban size formulation followed by a wax carbon coating. To his surprise his experiment worked well on one sheet, but failed on the other forty-nine. He investigated and learned that he had applied the wax carbon coating to the "wrong" side of one sheet of paper.

"I had been treating the ink side of the papers because we believed it was necessary to prevent the ink from getting into the paper. My mistake proved that applying the size to the opposite side was the effective method," Rengel said.

The move to obtain government regulation to allow Scotchban size to be used on food packages was begun by Marathon Paper Company. Marathon, which manufactured food packages, was looking for



Gayle Rengel makes clay coated paper in Scotchban size product laboratory in the Benz building in the late 1950s.

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a method of preventing oils in margarine and other foods from staining packages. When the Wisconsin company became aware of 3M's fluorochemical repellent Marathron and 3M began the long process of developing a size to meet food packaging standards. A federal government regulation is required when chemicals are used in food packages and to get that, extensive testing is required.

At least one humorous incident occurred along the way. Marathon, while extremely interested, could not use Scotchban size until the product regulation was written in Washington. The long delay irritated laboratory people in St. Paul who knew a small exposure to the product would not harm anyone. The grumbling included an oft-repeated observation that to absorb a lethal dose of those chemicals a victim would have to eat enough margarine to fill a railroad car plus all the wrappers and cartons in which the margarine was packaged.

Into that atmosphere Marathon sent researchers Ross Wilcox and Willard Stinger, who traveled to St. Paul to discuss the required approach to the FDA. Nelson Taylor, Hugh Bryce and Jim Rogers represented 3M at the meeting in Taylor's office in the Benz building. Before the meeting began Taylor dealt five paper plates out on his desk top. Then he took a jar containing chrome complex and sprinkled a small mound of the crystals onto each plate. He handed the plates around, gestured toward the crystals and told his audience to eat them. Despite reservations, Rogers ate his portion, considering it a job requirement, but as he munched he wondered why the Marathon people were doing the same without protesting. Bryce and Taylor ate theirs, too. "See," Taylor said, when all of them had swallowed, "those crystals aren't toxic. They can't hurt you."

That was his way of emphasizing his conviction that FDA involvement was unnecessary. Wilcox and Stinger, accustomed to working with the Government, felt otherwise, so the clearance process was begun. In the meantime Scotchban treatment was sold for non-food uses.

A food contact regulation was not achieved in that work with Marathon, but came later after the development of Scotchban size FC-807. A temporary solution during the interim was to insert a barrier sheet between the Scotchban size on the outer wrap and the contents. That system is still being used in some applications today.

Even after the FDA regulation for food uses was obtained, Scotchban paper size*—like many innovative products—was difficult to sell. The product was so different from competitive products (mainly glassine papers) that it was difficult to get prospects to grasp its utility and value. There was the matter of the high price of Scotchban size, too.

"We would compare one of their stained packages with one of our clean mockups," Rengel said, "but mill representatives had trouble understanding what we were showing them." There was nothing to see, nothing to touch, taste or smell, only the claims made for the product by the 3M representative. A technical man at KVP Sutherland Paper Company (later Brown Paper Company) in Kalamazoo, Michigan, was one skeptic who converted himself. In the beginning, he was convinced that 3M's treatment was nothing more than a coating containing titanium dioxide, a chemical used in clay coatings to resist staining, which maintains the coating's white appearance.

That was not true, Rengel insisted. The discussion was getting nowhere when the technician took Rengel's mockup and left the room. He must have run a test on the package, because when he returned he agreed that the material did not contain titanium dioxide.

"That led to a mill trial and KVP became one of our biggest customers. And, that man never seriously questioned any of our statements again," Rengel said.

Rengel, still at 3M in 1991, started there in April 1951. A native of Minneapolis, his first job out of high school in 1949 was in the chemistry laboratory stockroom at the UofM. A broken leg as the result of a motorcycle accident in 1950 cost him his job and, after a long hospital stay, he was job hunting again in 1951. Hired by 3M as a Laboratory Technician, he was assigned to shift work on electrofluorination cells in the Fluorochemical Project. Between 1953 and 1959 he worked in Hugh Bryce's Applications Section where he treated papers and textiles for John Ernlund and Bill Petersen. (Ernlund was working on paper treatments, Petersen on textiles. George Blake was studying surfactants and Murray Olyphant inert fluids.) Married and starting a family in 1954, Rengel enrolled at the UofM while working fulltime and graduated in 1959 with a bachelor's degree in chemistry.

*The first regulation covered uses for animal food packaging. DuPont actually was first on the market with a paper treatment for food products with its Zonyl RP™ product.

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As a chemist, Rengel was assigned to the Project's paper laboratory headed by Maynard Olson and later Bob Burford. At peak times the laboratory employed three or four men, including Dick Sward, who retired from the Quality Control laboratory, and Ed Perrault, who retired from Central Research Laboratory. Sometimes Rengel was all by himself. For ten years he ran tests and experiments while also handling technical service work. In many 3M divisions technical service has its own department, but in the chemical areas technical service was and is handled by Laboratory personnel. In the Scotchban size market, for example, salesmen and technicians worked together, frequently running paper mill tests day and night. Often odd hours were the rule because production could only be interrupted at a point when the plant was making a changeover from one grade to another.

Gayle Rengel

Rengel's technical service work took him into paper mills, often with Ray Brown of Marketing and Bill Skown and later Sam Bauman of Sales. He saw the inside of his first paper mill under trying circumstances. A mill trial run was scheduled in 1959 at Sorg Paper Company in Middletown, Ohio, where Rengel was to work under the tutelage of Lyle Hals of the Cleveland branch. Hals and Rengel prepared the test a day in advance, then when they were finished, Hals dropped a bomb. He had a conflict and could not stay for the test. Rengel would have to conduct it by himself. Concern bordering on fear caused him to lose sleep that night.

The next morning he tried to shake off his nervousness as the FC-805 trial got under way on Sorg's paper line. Middletown's city water supply was alkaline so he monitored the pH factor of the treating solution to keep abreast of any changes. 3M's product worked best at pH four, so when the pH factor began changing Rengel knew the point could be reached soon where the repellency of paper would be affected.

"I started to run upstairs to tell the foreman, who I'm sure would have stopped the test," Rengel said. "Then, I remembered one of the last things Lyle said to me before he left the day before."

"If things go wrong tomorrow," Hals had told him, "and you can't change them, don't panic. Just keep quiet and hope for the best." Rengel returned to the line and continued to test samples ripped from the web. To his surprise, the pH stabilized within acceptable range. He smiled as he realized how close he had been to having the test end with failure. "We ran ten tons of acceptable paper and turned Sorg into a customer," Rengel said.

Skown, when he was a Sales Representative out of Chicago, came up with the idea of treating nonwoven paper used to make surgical drapes which consist of thin nylon scrim sandwiched between thin layers of paper. A shortcoming was that body fluids could saturate and migrate through the porous material, which also was used to make surgical gowns for surgeons and nurses.

Another division of 3M made surgical drapes and gowns from film that solved the saturation and migration problem. But, because they were not porous, the gowns were uncomfortable under certain conditions while the paper/nylon drapes and gowns were not. Scotchban size made the paper/nylon drapes and gowns into more successful competitors to 3M's product. (Because of its diversity, 3M divisions often find themselves in internal competition. It is an accepted fact of business life in the corporation.)

Rengel was also responsible for devising test methods for Scotchban size. He developed tests for new formulations in the laboratory and also tests that could be used by customers and prospects to make quality control checks of their own treated products.

A simple test for use on surgical drape materials was developed with the help of Skown and a paper company. A twelve-inch ruler held on end was allowed to fall onto a treated sheet with a drop of fluid placed on the surface. If the impact did not force the fluid into the treated sheet, the test was considered a success.

In 1969 Chemical Division Marketing Director Bill Petersen invited Rengel to market Scotchban size, so he hung up his laboratory coat and joined Roy Mordaunt's Marketing Department. (Two years later, Mordaunt left 3M and was replaced by Skown, who was West Coast Area Sales Manager.) Rengel was appointed CCD Marketing Manager in charge of industrial products in 1983. When the Industrial Chemical Products Division was formed in 1985, the title of Business Manager was used, which Rengel assumed for Chemical Specialties and Fire Protection products. In 1988 he became Business Planning

Manager, which involved compiling the Division's global strategic plan and working on agreements, contracts and companywide business improvement programs.

Rogers once made a Scotchban size call with a brash young salesman, who, during his demonstration in the prospect's office, accidentally spilled cooking oil on the desk pad. As the oil spread into a pool and soaked into the pad, the salesman said, "If your desk pad had been treated with our product, Mr. Jones, it wouldn't have been ruined."

"I don't think we turned that one into a sale," Rogers said.

Another Scotchban size sales call in 1971 was at the Brown Paper Company in Kalamazoo. Brown was a 3M customer, but DuPont had set up local distribution and was using that to tempt Brown to switch its account. Area Sales Manager Fran Ruggles recommended stocking an inventory in the Chicago branch warehouse, but Sales Manager Rogers did not want to incur that additional expense.

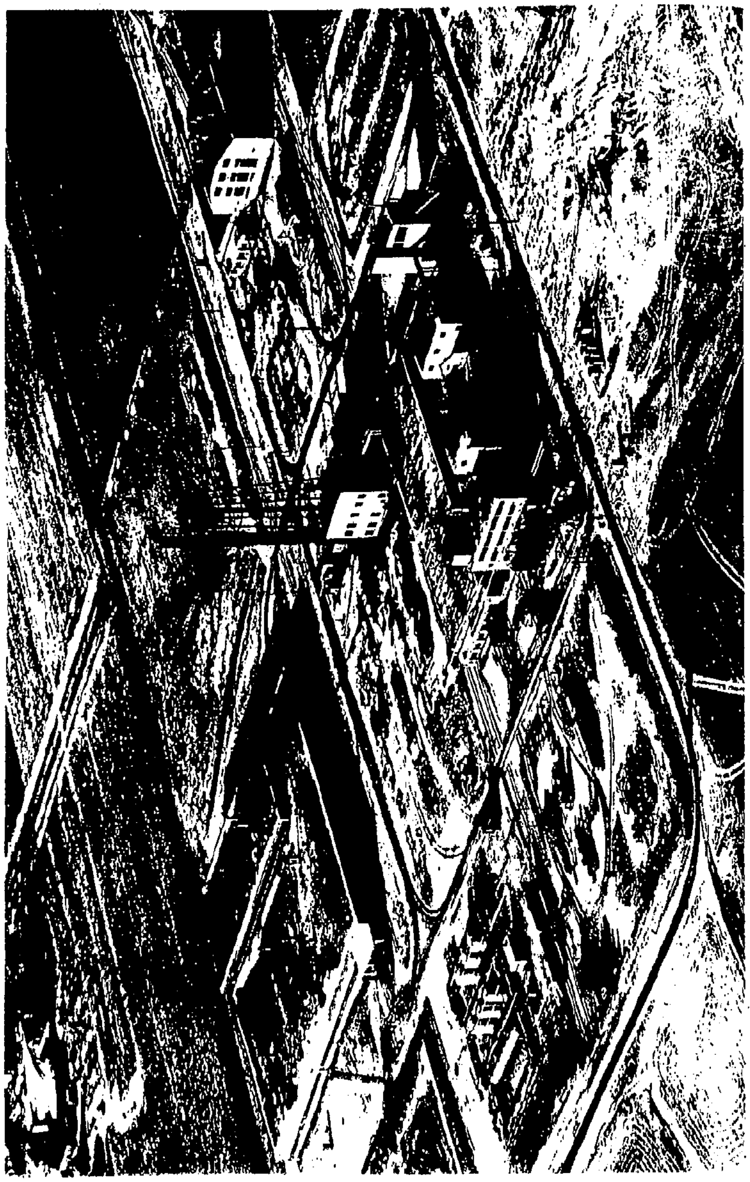
"I knew I could convince Brown that we could serve them just as well from our plant in Decatur (Alabama). Sales Representative Mike Harnetty, who had been with 3M a couple of years, and I went into Brown together."

Rogers, Harnetty and their contact talked business without getting to the main discussion. As the meeting seemed to be drawing to a close, Rogers got ready to broach the subject when the Brown representative said: "Mr. Rogers, I want to tell you before you leave that Mike has convinced us that 3M can assure good service without stocking your product in Chicago." From that moment Rogers was certain that Harnetty would have a successful career at 3M.

Paper mills produce oil- and grease-resistant paper by applying Scotchban size in solution as the paper is calendered or being passed through a size press. Because it can be applied on most lines with existing equipment, application costs are reduced. And, because the treatment does not affect the strength, porosity, flexibility, appearance or color of papers, it is ideal for many applications.

Scotchban protector was and still is used to make paper cups impervious to wax penetration and to prevent wax bleed-through in cartons used for food materials such as cake mixes. And, to prevent oil stains in bags and cartons of pet food. It is an effective oil barrier for corrugated cartons and a treatment for fiber drums and paperboard containers used for items like machinery parts, putty, caulking and sweeping compounds. End user benefits are lower costs compared with metal containers as well as reduced shipping costs. Another use is on paper drip cloths used to protect new cars and trucks in transit. Others are on outdoor paper tarpaulins and wrappers for reams of typing and copying papers.

Another major use was developed over the long period of time in the late 1960s and 1970s. Lyle Hals met employees of the Keyes Fibre Company at a convention in 1967. Keyes, Hals was told, needed something to protect its paper plates from becoming soggy or stained from food. The need was very important to Keyes because plates and trays molded from paper pulp were its only products. It took years of testing many different trial compounds—and an FDA regulation—but finally Keyes Fibre Company became a prize customer which bought 3M's product by the truckload, Hals said.



CHAPTER 20

Manufacturing Evolves

In March 1990 the Division that manufactures specialty chemicals for 3M was renamed for the sixth time in forty-two years. The change was necessary because Specialty Chemicals Division had been merged with the manufacturing segment of the Adhesives, Coatings and Sealers Division which was dissolved.

The new Specialty Adhesives and Chemicals Division (SA&CD) traces its lineage to the Central Manufacturing Division (CMD), which was started at Chemolite in 1948*, but its roots go deeper than that. Chemical manufacturing at 3M can be discerned in varnish-making at 3M nearly seventy years ago.

People who know 3M only as the multi-billion dollar company it is today must be reminded that forty five years ago the corporation was ever-so small. Worldwide sales were only about sixty-three million dollars, which was still a huge increase over the less than nine million dollars recorded in 1935, ten years earlier. In the mid-1940s, 3M divisions were the size of 3M departments today.

And, some factories were tiny, too. In 1944-46, for example, Charlie Bentz was the Resident Engineer at a 3M plant in Lemont, Illinois, which employed six production workers. The plant produced a waterproofing substance 3M applied to a granule surfacing material

Opposite: Seven buildings, including a large warehouse (left), a water tower and storage tanks (left) comprised Chemolite in the winter of 1949.

*In between were Hastings Chemical Division (1955), Chemical Division, Internal Chemicals (1959), Chemical Resources Division (1973), Specialty Chemicals and Film Division (1982), Specialty Chemicals Division (1986).

for tennis courts.

The first workforce at Chemolite in 1928 totaled twenty, including six or eight people in a quality control laboratory. That startup crew expanded rapidly, however, as half-a-dozen buildings were under way before the end of the first year.

Near the beginning of the 1950s Central Manufacturing operations at Chemolite included a high temperature reactor building, a storage building containing varnish tanks, a milling and mixing plant, a chemical and polymer building and a combination warehouse, office, laboratory and tank farm—Buildings 3, 4, 5, 6 and 7.

CMD produced a variety of 3M products besides chemicals: abrasives, film, alkalize, low adhesion backside adhesives, phenolics, Centerlight™ reflective paint, polishes and more.

Chemolite received its name in the early 1950s. Before that time, CMD's operation was called the Hastings plant, which caused confusion because of the site's proximity to the city of Hastings. Truckers making first deliveries invariably drove into the city of Hastings and had to be redirected back up Highway 61 to the 3M location. The name Chemolite was a composite of chemical and Scotchlite in honor of its first tenants.

CMD's specialty chemicals in 1948, the first year, had a sales value of about eight hundred thousand dollars. That figure climbed to a million dollars in 1950 and to a million dollars a month by 1960. Specialty chemical sales from the production at Chemolite, Decatur, Alabama, Cordova, Illinois, and Antwerp, Belgium, total hundreds of millions of dollars today.

More than production has increased. Since 1960 3M chemical plant productivity also has increased about five hundred percent. That huge increase included improved output from Simons cells and corresponding improvements in other product lines. SA&CD also has achieved eighty percent of its goal to computerize its manufacturing processes. The result is improvement in operating costs and product quality.

Like its ancestors, SA&CD is responsible for supplying most of the specialty semi-finished materials and finished products, including adhesives, used at 3M. Manufacturing plants operated by more than fifty divisions and departments are SA&CD customers. And, more than thirty divisions spend a million dollars each year buying specialty chemicals from SA&CD. In fact, if you exclude outside purchases of solvents, which are low cost commodity chemicals used in many

manufacturing processes, and the raw materials needed to produce specialty chemicals, SA&CD provides sixty to eighty percent of 3M's chemical needs.

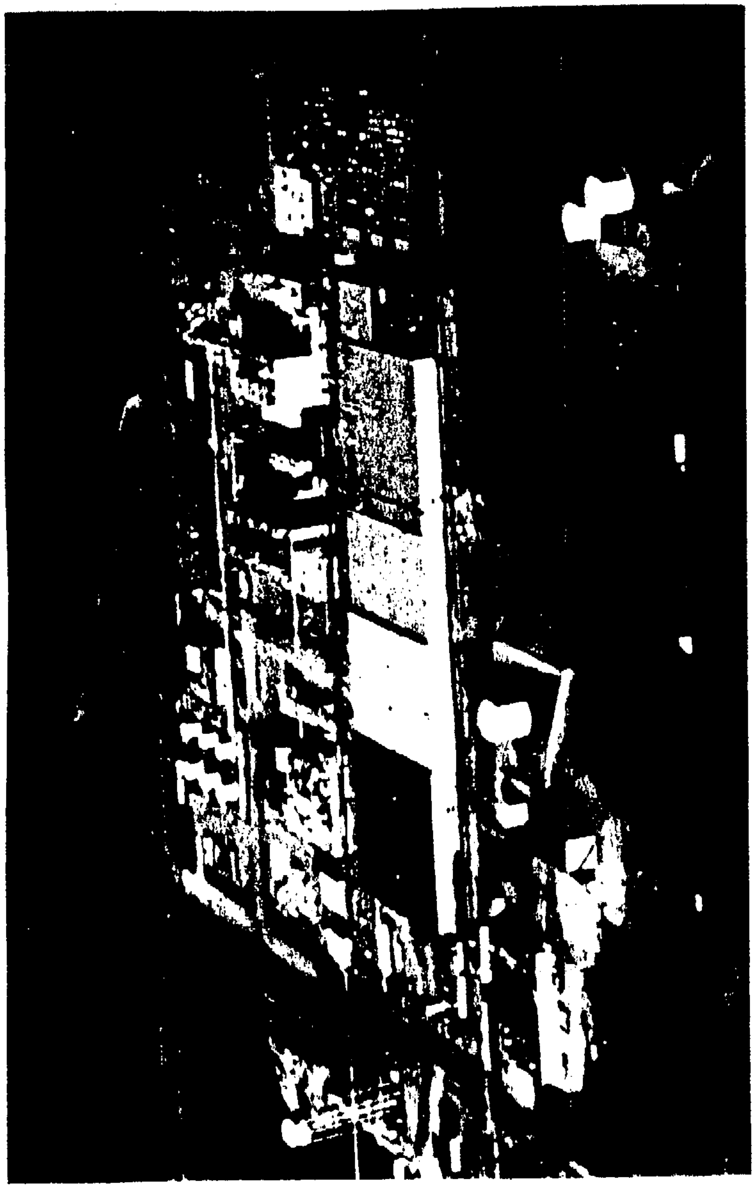
Those raw materials and intermediates supplied by SA&CD are vital in the production of an array of 3M products. SA&CD's adhesives are applied to hundreds of tapes—Magic, vinyl, masking, strapping, packaging, cloth, cellophane, damping, mounting, duct, electrical, filament, film, foam, so on. Adhesive for Post-It™ removable notes and the anti-static coating for surgical drapes, laminated absorbent material used in face masks, binding agents used in Scotchbrite™ pads and insulating resins for electrical products are SA&CD products. So are the imaging chemicals in 3M dry silver film and paper, photographic chemicals, binder resins in magnetic tapes and coated abrasives, and the resins that bind reflective glass beads to freeway signs. Raw materials include specialty chemicals used to produce high-strength bonding materials for the aerospace industry. And, that only scratches the surface.

SA&CD products and raw materials are transferred internally at cost, which is a marked financial advantage for its 3M customers. It is not, however, the only reason 3M divisions and departments find SA&CD's output attractive. Another is that by buying inside, divisions are assured that their technologies are safe from competitors' eyes and ears. An example is 3M's Post-It note technology, an adhesive that grips many surfaces, but releases easily. How that is made to work is a secret, but if the adhesive was produced outside, the process would have to be divulged, creating a risk of pirating. Keeping processing technologies inside provides another advantage, too. Many improvements made in 3M manufacturing processes are not patented because patents can be obtained and studied by anyone while proprietary information cannot.

There is no corporate rule that 3M divisions must buy specialty chemicals internally, but SA&CD's expertise, convenience, security and costs persuade divisions to buy inside.

Another advantage is flexibility. Because much of SA&CD's processing equipment is versatile, it can be used to manufacture product A today and be switched at little or no expense to make product B tomorrow. That flexibility allows customer divisions to defer

Next page: Decatur, Alabama, plant with Tennessee River visible in the background.



deliveries or increase orders on short notice, which might be impossible in dealings with outside chemical companies. Flexibility also means that SA&CD is able to sell its excess production capacity to outside chemical companies. And, sometimes SA&CD buys specialty chemicals from outside sources to meet sudden increased internal demands. That process of buying and selling seems to go on continually.

SA&CD's impact on the sales and profits of its customers by providing raw and semi-finished materials at attractive transfer costs sometimes is overlooked by those beneficiaries. 3M management, however, is very aware of the important role that SA&CD plays in the success of the company. And, some 3M divisions—chiefly ICPD and PCPD—could not obtain specialty chemical products or raw materials in the quantities they require from outside sources.

Despite its record of stellar performances SA&CD employees sometimes complain that their Division is not fully appreciated. There is a belief that line divisions which compete in global markets do not respect a division which does not. That is misplaced thinking, because SA&CD is organized and operates the way other 3M divisions do. It has a profit and loss statement on which its performance is based and it does not have a captive market. SA&CD customers are free to buy where they wish and occasionally ask 3M Purchasing to obtain price quotations on specialty chemicals from outside sources. More often than not, the quotations prove how well off they are having SA&CD as their primary supplier.

SA&CD began publicizing its value in 1989 by investing in a low-key publicity program directed not at the corporation, but at sixteen hundred SA&CD employees around the world. A series of posters were posted in plants and other installations each quarter to make employees aware of their contributions to the corporation. Each poster highlighted a 3M product that SA&CD helps produce—Scotch Magic mending tape, Scotchgard fabric protector, Scotch-Brite scrubbing sponges and Scotch videocassettes. A letter mailed to each employee's home told about the Division's role in 3M product quality. Employees also were invited to obtain a free sample of the product featured each quarter.

The father of specialty chemical manufacturing at 3M was Joseph Kugler, who first signed the payroll in 1927 and stayed in chemical production thirty-eight years. Kugler, a chemical engineer, was in graduate school at the UofM when Lloyd Hatch lured him from the campus. Kugler retired in 1965 and died in 1976 at the age of seventy three.

Another figure in 3M's rise to eminence in specialty chemical manufacturing was William McNamara, the first manager of the semi-works plant at Chemolite and a driving force in getting Chemolite established.

Charlie Bentz worked for McNamara, who was a chemical engineer from the UofM. He also was an agitator who knew how to get things done. One evening Bentz received a telephone call at home in the wake of a heated argument which had taken place in McNamara's office that afternoon. The flare-up had culminated in Bentz stalking out, as angry as a hazed bulldog. McNamara's opening words on the phone sounded solicitous. "Bentz, are you still mad?" he said after hearing Bentz's hello. "Yah damn right!" Bentz said.

"Okay, forget that," said McNamara, unfazed, "here's an idea I want to talk about..." and continued on talking business. Bentz smiled broadly at the recollection forty years later.

Men who managed the internal chemical laboratory in the 1950s and 1960s also made notable contributions to specialty chemical manufacturing. George Harrison and Les Axdahl were monomer experts. Erwin Ulrich and Frank Brown made strides in acrylate adhesive polymer technology. Howard Brinker and Harvey Anderson were experts of their day on phenolics and varnishes. Cliff Hanson, Bill Lundquist and Bentz, who have been featured earlier in this book, are the three other internal chemical veterans whose employment dates from the 1940s.

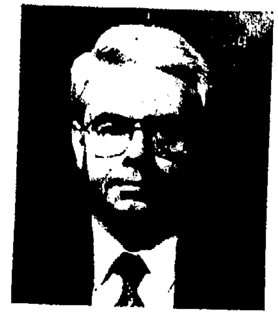
In 1953, after McNamara transferred to another division, Bentz was Manager of the Chemolite plant. Hanson, who had been Manager of the Chemolite Pilot Plant and Supervisor in the Fluorochemical laboratory, replaced Bentz as Plant Superintendent.

At that time, Bentz and Hanson recalled, the plant employed one shift that produced two thousand gallons of chemicals a day. Five years later, three shifts worked around the clock and produced fifteen thousand gallons a day.

In 1945 Bill Lundquist left Central Research to become Director of Research and Development in the tape laboratory. He returned to the chemical business in 1953 as Kugler's Technical Director for internal chemicals. At the time Hastings Chemical Laboratory was

in Building 2 on St. Paul's East Side.

SA&CD is directed by General Manager Frank T. Vikingstad, who joined the Division on July 1, 1989. He had been with 3M nearly twenty-seven years, but until 1989 had no experience in 3M's chemical business.



Frank Vikingstad

Vikingstad, a St. Paul native, did his undergraduate studies and obtained a master's degree in chemical engineering from the UofM in 1964. During his first twenty-five years at 3M he handled a variety of engineering jobs, starting in the Adhesives, Coatings and Sealers Division pilot plant. From 1983 to 1987 he was Director of Engineering and Staff Manufacturing at 3M's subsidiary in Japan. In 1988 he left Information and Imaging Technologies Sector where he was Director of Engineering to become Manufacturing Director of Consumer Video and Audio Products Division. Eleven months later he was made General Manager of SCD.

CHAPTER 21

Engineering's Role

Planning, building, equipping and remodeling factories is part of SA&CD's history that included a resource called the 3M Division Engineering Department. Division Engineering, established sixty two years ago, had been in existence twenty years by the time the semi-works plant was built at Chemolite.

The 3M concept of having employees design and supervise the construction of 3M plants was begun in 1929. The first department head, E. M. Johnson, was in charge for twenty years. After he retired in 1948, Johnson was replaced by Cyril Pesek, an architect who modernized the department 3M operates today.

Johnson was a forceful figure in the company, although his appearance was unprepossessing. He stood just five feet four inches tall and had a clubfoot that forced a pronounced limp. Some described him as a fiery engineering genius, although, according to his successor, "His was a machine design group more than anything else."

What is uncontested is that Johnson was an autocrat who kept strict control over 3M's capital expenditures. His shortcomings included an inability to delegate, handling one project at a time and a penchant for overbuilding equipment. An example of the latter is a rock crusher Johnson designed and built in the 1930s that was still being operated in the 1980s at the 3M plant in Wausau, Wisconsin. Oldtimers aver it was the finest crusher ever built; superior to those on the market today.

Former CEO Bert Cross sang Johnson's praises. "He didn't require books," Cross said, "Believe me, he knew everything and it was all in his head. He was also a mathematical genius. We lacked all sense of engineering until he came to work."

When Cross arrived at 3M in 1926, he was appalled at the state of engineering. During his first visit, he reported, "All I saw was an outfit that really lacked everything. They had a very crummy factory. I don't know why they let me go through the plant, but they did. There was a coating machine making sandpaper only by the grace of God and breaking down regularly."

While he was there, the winder needed some repair work, Cross said, "which I'm sure they did with haywire and a lot of beautifully selected cuss words." He recalled that the foreman became angry and threw a wrench at the machine. "That was our engineering department on the day I first saw it."

Before he was employed by 3M, Johnson worked for Herman Behr Company in New York, where he designed and built sandpaper machinery. Johnson left to join 3M after Manning Abrasives bought Behr and formed Behr-Manning Company.

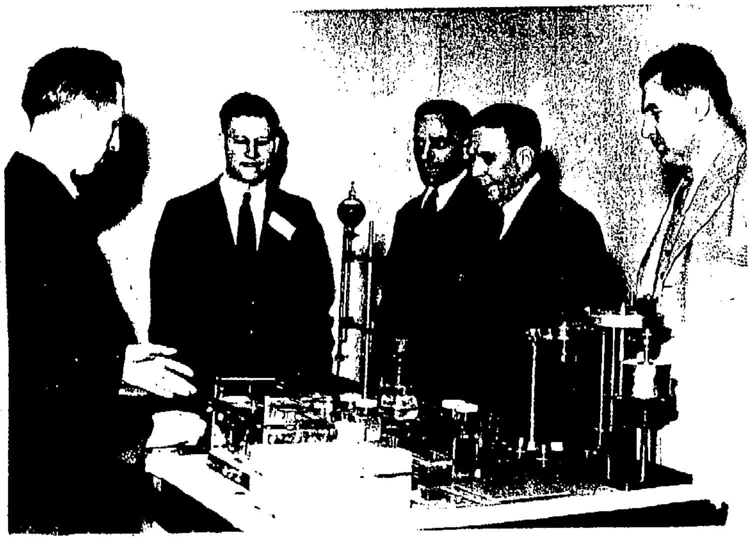
A few years after Johnson arrived 3M joined eight other abrasive companies to form the Durex Abrasives Corporation to manufacture and sell abrasives outside the United States. (Durex was dissolved in 1950.) Johnson and an old Behr colleague named Krupie were chosen as lead engineers to design and build a plant for Durex in Birmingham, England, in about 1930. That project yielded the first sandpaper maker that could coat both paper and fabric backings. Based on that design, 3M built a less complicated machine in St. Paul and was using it before the one in England was placed in operation.

Startup was difficult for the Durex factory in Birmingham. One problem caused two weeks of downtime including the final night when Cross and an engineer worked until dawn to get the maker running. That morning, the machine operated well until ten o'clock, then was shut down while the English operators took a break for tea. During the break, the glue solidified in the pots, mixing tanks and pipes and the mineral jammed the hoppers. The result was two more weeks of downtime.

"That's why I still hate tea and coffee breaks," Cross said years later.

In or about 1940, Johnson designed and built 3M's first electrostatic abrasive coater. It used an electric charge to make the sharp points of the minerial grit face up as the minerals were being glued to the backings, an innovation which greatly improved the effectiveness of 3M abrasives.

Johnson's right-hand man, W. A. Thomas, was in charge of approving—and disapproving—purchases by laboratory personnel and did his job with a vengenance. He was ruthless in preventing laboratory staffs from spending money—even their own money—for equipment. To enforce his edict, Thomas stalked the laboratories after hours and on Saturdays. When he spotted a piece of equipment or an add-on he had not authorized, he removed it on the spot and consigned it to the scrap heap.



Robert Bauer (left) explains a project to (from left) Bill Lundquist, C. B. Sampair, Richard Carlton and Cyril Pesek at CRL open house in 1945.

By 1940 the Division Engineering Department was housed in part of the basement of Building 21. Some men who worked there with Johnson and Thomas were Harvey Livermore, Jim Trask, Walt Vhorman, Al Horning, Jim Rogaslcski, Francis B. Richerson, Gurdon Jones and Bob Marchant. Ed Piret, a Chemical Engineer from the UofM, worked with Special Products, the forerunner of the Chemical Group. After Pesek arrived, Piret left to take charge of the UofM's Chemical Engineering Department.

Changing times forced 3M's management to begin thinking of re-

placing Johnson. In the early 1940s, management realized that 3M would not be able to operate the Engineering Department effectively during the expansions planned for after World War II with Johnson in charge. They needed someone who could delegate, who could oversee multiple projects, who could hire talented, experienced engineers and give them decision-making responsibilities.

Cyril Pesek was the man they found. An architect and one-time varsity basketball player at the UofM, Pesek was in charge of building plants for Northern Ordnance, a war contractor in Fridley, Minnesota. His final defense job was to supervise construction of a sulfuric acid plant in Rosemount, south of St. Paul. Then, as the war picture began to brighten, the government decided to sell that plant and assigned Pesek to assist potential buyers.

3M was interested, so nine executives including Carlton and Cross toured the facility. Pesek did not make a sale—the plant was too large for 3M's use—but in the process he sold himself. Soon afterward, Carlton made him a job offer, which Pesek did not accept immediately. He had planned to reopen his architectural office in Minneapolis at the end of the war, but after weighing that ambition against Carlton's offer, he joined 3M in 1943.

His assignment was to build a modern Engineering Department, a project that had to be delayed five years because management would not offend Johnson by replacing him. So Pesek did not get the job until after Johnson retired in 1948.

With that change, the engineering philosophy changed abruptly. Pesek told his engineers that while they must stand firm on project quality, they must remember that they were working **for** the divisions and not vice versa. Johnson's inclination to refuse requests was also changed.

Another major change coincided with 3M's restructuring into product divisions in 1948. Pesek sold his idea that one engineer should represent each division, including sitting on the division Management Committee, while remaining as a member of Pesek's department.

Pesek's role was that of an administrator who gave support to his engineers when they encountered problems or had conflicts with the divisions they served. He took personal responsibility for obtaining management approval for division requests for capital projects. He and the division engineer involved would meet with Carlton to get his aye or nay on a project request, but after Carlton's death Pesek presented those requests directly to the Board of Directors.

While he did not ignore the staff he inherited, Pesek brought in outside engineers who had worked with him during the war. He attracted skilled employees from other areas of 3M, too. As new divisions were formed, the Engineering Department hired men like John Pearson, Gerry Mueller, Erwin Brown, Bill Ludka, Hal Rehfeldt, Joe Ling and Clair Larson.

"(Pesek) was strictly an administrator and he let you do your job," Al Horning, who had "grown up" under Johnson's tutelage, said. "Maybe I like him especially because he let me do my job."

John Pearson, who was one of Pesek's successors, said there was—and probably still is—a conflict of philosophies between Engineering and the divisions.

"Divisions are often willing to trade equipment quality to save time and costs," Pearson said. "When they want something, they want it now and cheap. They don't realize that you pay for that equipment throughout its life with maintenance and problems. If you get something quick and cheap you'll be living with those costs for a long time. "Pesek recognized that there are trade-offs, but you shouldn't trade off too far either way. That's one of the roles filled by Division Engineering."

Don Guthrie, who succeeded Pesek in 1966, joined Division Engineering after Pesek came to 3M. Guthrie had been with the Acid and Color Division in Copley, Ohio, but joined Engineering from Central Research. Pesek and Guthrie were acquaintances because Pesek's office in the Benz building was close to Central Research.

Guthrie was Pesek's first chemical engineer and he brought needed skills to the organization. He also attracted other chemical engineers and started Engineering Research in 1952 which evolved into the 3M Engineering Systems and Technology organization of today. He left Engineering in the early 1960s to be Technical Director and then Vice-President of the Coated Abrasives and Related Products Division. He returned in 1966 to succeed Pesek, then in 1974 became Executive Vice-President of Engineering and Manufacturing. Two years later he left the Department and was succeeded by Gerry Mueller.

Pearson told a story that involved Guthrie, Bill McNamara and Barney Oakes. The latter, Pearson said, had a "habit of not running

his people as a team, but playing them one off another." Because of that, Guthrie and McNamara, Oakes' Manufacturing Director, had an understanding that when Oakes telephoned either of them, that man would call the other immediately before Oakes could contact him. "That way," Pearson said, "Guthrie and McNamara always had a united front (with Oakes)."

Division Engineer Frances Richerson was connected with 3M's specialty chemical operation for many years. As engineer for the Hastings Chemical Division in 1948, he was involved in the construction of the first building at Chemolite while serving on a team led by Guthrie. Other members were Bert Cahill and Bob Johnson with help from Roy McKenzie.

"The engineering team," Richerson said, "developed a reputation as 'doers.' Bert Cahill, for example, made all the process piping and equipment layout drawings from sketches and flow sheets prepared by Charlie Bentz (Process Engineer) and me. That working relationship between project and process engineering paved the way for later close working relationships between Engineering and Manufacturing."

In 1957, Richerson directed the staff that began the design of the Decatur chemical plant and then helped build it in 1960-61. In 1962 he moved to Decatur to take on a new 3M position of Plant Engineering Manager. In that job he directed two resident engineers, one of whom was assigned to the film plant, in matters concerning maintenance and construction. Richerson also was Project Manager for construction of the factory in Antwerp, Belgium, and was in Europe from 1969 until 1972. Upon his return to St. Paul he left chemicals to concentrate on environmental and energy construction projects for 3M.

A native of Bagby, Virginia, he earned a chemical engineering degree at Virginia Polytechnic Institute in 1938. He spent a year in a DuPont rayon-nylon manufacturing plant in Richmond, Virginia, before becoming a civilian employee of the United States Chemical Warfare Service at Pine Bluff Arsenal in Arkansas. He joined 3M in 1945 after an advertisment he placed in *Chemical Engineering* magazine caught the eye of someone at 3M. He became a Project Engineer and stayed with the Department until he retired in 1979.

In 1990, eleven years after leaving 3M, Richerson, by then seventy-three-years-old, was working as much as forty hours a week as as Vice-President, Engineering, for United Bio-Fuel, Richmond, Virginia. United Bio-Fuel Company manufactures products from solid waste.

While it is true that the semi-works plant evolved into a full-scale specialty chemical production facility, the first factory built as a chemical manufacturing plant was in Decatur, Alabama, in the early 1960s. Several years were invested looking for a plant site, purchasing property, designing the plant and so on before construction began. The four and one half million dollar factory was located on a five hundred acre tract—later expanded to one thousand acres to accommodate a film plant—on the Tennessee River in northern Alabama.

The factory's thirty-two employees produced and shipped its first specialty chemicals in May of 1961. (The nearby Specialty Film Division plant was announced in June 1961 and was in production by mid-1962. By 1990 the two plants employed more than three hundred fifty men and women.)

Enlargement of the production capacity was begun during the plant's first decade when Simons cells were added to expand fluorochemical production previously limited to Chemolite. By adding Kel-F thermoplastics production at Decatur in 1963 the old Kellogg factory in New Jersey became obsolete as far as 3M was concerned. That plant was sold back to Kellogg.

A third specialty chemical plant was built and began operating in August 1970 on the Mississippi River at Cordova, Illinois. Eighty employees opened the plant, which enclosed one hundred and fifty thousand square feet on a three hundred and seventy-five acre site. Its location placed it close to 3M plants in the Middle West and also to an ample water supply available from the river.

At the start Cordova produced chemicals for internal 3M use, but fluorochemical cells were added in 1975. And, in 1986, a multimillion dollar expansion was completed, including a three story process building containing fifteen thousand square feet. Since 1973 Cordova also has manufactured magnetic coatings for video and computer tapes. The plant now employs about three hundred and fifty people.

Rated by production capacity, the three domestic plants—Decatur, Cordova and Chemolite—are nearly the same size.

The first overseas plant was built in Antwerp, Belgium, in 1972. It began as an internal chemical plant to serve four factories operated by 3M Europe. A Simons cell was added in 1976 and a Product

Development Laboratory was opened in 1983. Fluorel fluoroelastomer manufacturing was added in 1986.

Antwerp, like the domestic specialty chemical plants, supplies customers worldwide, but Europe is the plant's biggest market. Besides placing 3M in that market, the Antwerp facility gave the company credibility in Europe. It also allowed 3M to offer employment on the Continent to chemists and engineers graduating from European universities. An added benefit is that Antwerp gives 3M an on-the-scene look at what is happening in the European specialty chemical community.

The specialty chemical plants in the United States and the multiple product plant in Antwerp—as well as all 3M plants around the world—are tributes to Division Engineering.

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In the 1980s 3M divested itself of the Copley, Ohio, plant which it had operated since World War II, and its Irvington operation, acquired in the 1950s.

By 1982 Copley had become unprofitable. Raw material costs were rising and increased competition for sulfuric acid business had depressed selling prices. SCD dismantled the facility and leased the building. Not long afterward the property was sold.

Newark, while profitable, did not meet the 3M standard of profitability, so the division was sold in December 1984. Dr. William G. Paterson, who was to handle the sale, thought it would be an easy task. Twenty-five companies from around the world expressed an interest, but in the end none made an offer. Irvington did not fit their business. Or, the price was too high. Or, financing was not available. Those were just some of the reasons. The result was that Paterson, Director, Business Development for the Chemicals, Film and Allied Products Group, was left without a single prospect.

The sale finally was made under favorable terms to Anthony M. Stonis, SCD's Plant Manager in Antwerp. Stonis left 3M to become President of the business, renamed the Cardolite Corporation after one of its product lines. He was still in charge in 1990.

It should be noted that Cardolite still manufactures products derived from cashew nut shell liquid.

CHAPTER 22

The Pendulum Swings

Scotchgard protector is a beauty, admired by consumers. Her name appears in articles and advertisements in slick magazines, on television, on hang tags attached to furniture, on carpets and wall treatment samples in showrooms in many parts of the world.

3M's industrial specialty chemicals are Plain Janes, the sister scarcely noticed by the retail public. That is because her advertising and publicity appear in trade magazines and in direct mail advertisements mailed to business offices, industrial plants, various departments of government and the military.

No customer quizzed in a retail store could be expected to identify Light Water AFFF or Kel-F elastomers or even to associate them with 3M. However, nine out of ten shoppers who were surveyed a few years ago recognized the Scotchgard protector name. That high level of recognition was achieved in part because Scotchgard protector advertising, merchandising pieces and sales presentations contain promises that the product fulfills. Another reason is that Scotchgard protector has been supported by advertising, merchandizing and publicity for more than twenty-five years.

It is fun to speculate on what the product might have been named (Fabricgard? Fabri-Gard? 3MGard?) had Jack Borden, Vice-President of the Tape Division, prevailed. Scotch* had been a trade name for the Tape Division's line of cellophane, masking and other tapes for many years before the Scotchgard brand name was devised. Borden believed his division owned the name, but 3M management thought otherwise.

Gil foster is Vice-President of the Protective Chemical Products Division, which markets Scotchgard protector products throughtout the world. Although he is a relative newcomer to fluorochemicals, Foster sometimes is called "Mr. Scotchgard" by people in his organization because of his contributions to the product's success in the last sixteen years.

Foster joined Commercial Chemicals Division in 1975 as National Sales Manager for Scotchgard protector after fifteen years with the company. A native of Croydon, Indiana, he earned a bachelor's degree in history and speech at Indiana State University in 1957. As a second lieutenant from the university's ROTC program, he enrolled in Air Force flight school and later was a special investigations agent for the Air Force in the Defense Department.

A civilian again in 1960, he joined 3M as a sales trainee in the Reflective Products Division. He spent four years as a sales representative in Detroit, then switched to Dynoc, a 3M subsidiary in Cleveland, Ohio, to sell decorative trim products to the automotive industry. In 1969 he became Midwest Region Sales Manager for Decorative Products Division (formerly Dynoc) in Detroit.

In 1957 Krogh was looking for someone to inject vitality into his Scotchgard protector program so he hired Foster as Sales Manager after Bob Peiffer transferred to another division. Foster stepped into a difficult job. His charge was to revamp the Scotchgard protector sales force into an effective organization and reverse the falling sales curve. Sales had plummeted fifty percent to less than ten million dollars in recent years and Scotchgard carpet protector, introduced three years before, had only two customers.

Gil Foster

Foster changed his sale forces from product specialists who traveled the country to full line sales people in territories. Some men and women were reassigned. Others were replaced. After a study of the business, Foster got Krogh's approval to concentrate the sales effort in the carpet market. The revitalized sales forced began to write new orders, the sales curve began to rise. By 1976 black ink had replaced the red.

*One account of how Scotch trade name came into being is that to cut costs in the 1920s, 3M applied adhesive only to the edges of its masking tape. A painter in an auto body repair shop, who experienced trouble with the tape because of 3M's stingy use of the adhesive, growled at a 3M salesman, "Why be so Scotch with the adhesive?"

That allowed money to be added to the promotion budget. In one super event, a nylon carpet was unrolled on the graveled surface of a future Los Angeles freeway and a truck dumped a load of dirt* on it. A bulldozer spread it around. A power roller packed it down. Finally, a crew shoveled and vacuumed away the dirt to reveal the treated surface, a huge Scotchgard protector logo, which was spotless. Untreated areas were a dirty mess. Overhead, a cameraman in a helicopter filmed footage for a one-minute TV commercial.

"It was," Foster attested, "impressive." It was also the "Dirtiest Commercial Ever Aired" according to an article in the Sales Digest published by 3M's Public Relations Department. Charles M. Kent, Jr., CCD's Advertising Manager, was quoted as saying that months earlier only eight mills were applying Scotchgard carpet protector to fifty-three carpet lines. As of June 1976, more than seventy mills were applying the 3M product to more than two hundred carpet lines.

One story that made the rounds centered on a prospective customer who had given 3M a cold shoulder following a carpet protector presentation. He saw the "dirtiest commercial" one night on TV and called the 3M Sales Representative the next day. "It's absolutely unbelievable! No product is that good!" he protested. Nevertheless, the commercial not only helped turn him into a customer, but also led him to become an enthusiastic supporter of 3M's product.

One success led to another, Foster said, with the "bandwagon effect" helping to bring about more and more improvements. Opening a laboratory and technical service center in Tennessee was another positive factor, he said. That facility was opened late in 1978 in Chattanooga although its territory was across the state line in Dalton, Georgia. Dalton, thirty-nine miles from Chattanooga, is the hub of our nation's carpet industry. Sixty-five to seventy percent of the carpeting produced in the United States comes from mills within sixty miles of Dalton.

"This facility is necessitated by increasing demand for Scotchgard brand protector products and 3M's commitment to provide technical services and assistance to customers," Vice-President Krogh said in 1978.

"Almost overnight we had a going concern in the center of the

*3M quality control includes the dirt used in tests and promotions. To assure consistency, it is still being produced on demand at Chemolite and sold to the Division.

carpet business," Foster said.

The building in Chattanooga formerly housed a 3M subsidiary, American Lava Corporation. It was large enough to contain a carpet protector sales office, too. In fact, the new building was three times the size of the previous laboratory-service space formerly used in the 3M High Point (North Carolina) Branch.

Personnel in Chattanooga included Sales Manager Jim McAndrew and four salesmen and Technical Service Manager Jim Johnson and fifteen technical service people. McAndrew had been Sales Manager for the furniture business in High Point and Johnson had been a technical serviceman there.

An aggressive marketing program in 1978 included a contest called "Aim for the Top." Teams consisting of Sales, Marketing and Laboratory personnel representing each industrial product market not only raised sales significantly, but also generated teamwork throughout the Division. Two teams increased their sales performances by more than twenty-five percent.

In January, 1979, a European Scotchgard carpet protector promotion was announced at the Frankfurt (Germany) International Trade Fair for Home Furnishings Textiles.

The snowballing carpet business rolled on into other sales areas of the Division. "Success in carpets grew more success in other businesses," Foster said. "We got consumers to understand what Scotchgard protector was on carpeting and that made it easier to make them aware of Scotchgard protector in textiles." Furthermore, enthusiasm in the Division sales department kept climbing, he said, as sales personnel "realized they were part of a real winner for the first time."

That success and enthusiasm included sales accomplishments for Scotchban treatment for paper, which was healthy enough in 1983 to warrant its own sales force and laboratory under Manager Donald Velky.

There were good and bad things in the early days of the Scotchgard protector program. False starts included an apparel program, chiefly girls' dresses, suit fabrics and rainwear. The attraction for 3M was the enormous size of the market. What was not considered was that girls' dresses and suit fabrics do not require stain resistance. Mothers wash dirty dresses. Men and women have their suits dry cleaned. As for rainwear, DuPont's Zepel protector and silicone products had swept that business. Another factor not discerned immediately was that clothing is not a big ticket item.

There were sales and successful uses, but nothing that was going to be a big producer. In 1966, 3M reported that besides upholstered furniture, people could buy treated yard goods, draperies, hunting and fishing gear, shoes, leather goods, auto interiors and convertible tops, upholstered lawn furniture, window shades, mattress ticking and, of course, jackets, slacks, coats and the like.

Basically, it was the upholstered furniture industry that kept hopes alive. That was the market 3M turned to after it became apparent that apparel was not going to be a big winner. In upholstered furniture there was a need for 3M's product.

All that trial and error took time. Scotchgard stain repeller was introduced in 1955 and perfected by 1960. Stain release followed in 1967, but carpet protector was not marketed until 1972, seventeen years after the advent of Scotchgard protector. In 1974 Krogh announced that thirty formulations of Scotchgard protector finishes were being sold worldwide. Carpet protector, the savior, did not turn a profit until 1976.

Penetration into the drapery or wall covering market came later. The home furnishing industry is Scotchgard protector's primary market today, with carpets the strongest sales area.

"We had to learn by experience that the benefits offered by Scotchgard protector were of real interest to people who buy furniture. When they buy a sofa, they want to do whatever is possible to keep it looking clean and new," Foster said.

"Later we learned that people who buy carpeting are also interested in protecting it from stains. And, we began to see a consumer interest in protecting draperies."

In the process 3M began to perceive the tie that binds upholstered furniture to carpeting to draperies. All are home furnishings. All are expensive items people will pay to protect. All suffer from cleaning—once cleaned they are not as good as they were.

Another product that made a contribution to 3M's success, Foster said, was Scotchgard protector in aerosol cans, introduced in 1963. "The aerosol can," Foster said, "was launched as an add-on to 3M's mill-application program. It surprised everyone by becoming a self-liquidating merchandising item. Consumers who bought spray cans tested Scotchgard themselves while checking to see whether they'd

3M President Bert Cross holds the Burlington Industries invoice dated 12-31-65 that raised the Chemical Division sales total to one million dollars. Standing (from left) are Frank Woznak, Sales Manager, Cecil March, Group Vice-President, and Arthur Telfer, Division Vice-President.

applied it correctly. Then, when the can was placed on a kitchen shelf it was a constant reminder of the product, the brand name and 3M."

For the first time a product that had been intangible in magazine advertisements, TV commercials or in-store promotions became apparent, real—a can, its spray, a wet surface that dried to invisibility on a chair or sofa. Scotchgard protector not only became visible, but the man or woman who purchased a can got involved in its use.

Since 1963, 3M has sold millions of cans, each a kind of test kit and mini-billboard that proclaims its brand name. It also has been noted that in the three countries where the Scotchgard protector brand name is most significant—the United States, Canada and Australia—spray cans are sold.

After Scotchgard protector in cans went on the market Roy Mordaunt's Marketing Department began receiving letters from users. "Probably no one told you this before, but your product is perfect for preventing underarm perspiration stains on dresses," one woman wrote. Another said that a girls' drum and bugle corps sprayed the feathers on their hats to keep them from wilting in rainy day parades. Other customers sprayed tennis balls to keep them clean and treated trout flies to keep them floating. One user sprayed her horse's mane and tail to keep him looking perky in case of rain at a horse show.

The account of how one and one half million dollars were spent on advertising to convince mills to buy and apply Scotchgard repeller (Chapter 13) was not the entire promotion story. Mills and manufacturers were reached through many personal contacts, too. 3M sales representatives made demonstrations which included present and future advertising and sales promotion plans. Prospects were also shown results of past promotions. Slowly, by dint of effort day after day, most mills and manufacturers were convinced 3M could and would turn retailers and consumers into believers.

Thousands of demonstrations have been made over the years and are still being made today. The technique is very effective.

"Once you've seen it, you never forget it," Foster said. "There's magic connected with spraying a prospect's necktie, spotting it with salad oil, then proving that it can be returned to his neck still good as new." For grander demonstrations the division's trade show booth incorporated a miniature waterfall tumbling down on treated fabric to show the product's ability to repel liquids.

Making Scotchgard protector a widely known product was achieved without spending vast sums of money on advertising and sales promotion after that first big splash in the early 1960s. In later years, barring one exception—the introduction of the aerosol can—3M has never financed a multi-million dollar consumer advertising program for Scotchgard protector in any year. However, the Division always has spent relatively large numbers of dollars to woo the trades. Budgets for advertising and merchandising and a much larger budget

for a manufacturers' support program have equaled more than twenty percent of product sales every year.

"We take pride," Foster explained, "in knowing that we spent our money—and still spend our money—where it does the most good. Our tagging program is one of the best ways we know for making one dollar do the work of many. We print Scotchgard protector tags and made them available to our customers, generally at no cost to them. We also participate in customers' tag programs, allowing them so much per thousand if they use our Scotchgard protector trade name properly on their tags."

No one in or outside of 3M could begin to total the number of tags—each carrying the Scotchgard protector name and message—that have been printed and distributed over the years. Certainly it amounts to tens of millions, each one a tiny advertisement reaching home furnishing purchasers in display rooms everywhere.

Sears, the nation's largest retailer, has been closely identified with Scotchgard protector for more than thirty years. In the mid-1950s Sears laboratory workers were involved in testing, developing specifications and in discussions of performance properties for 3M's product. The program for Sears to market clothing treated with Scotchgard rain and stain repeller was sealed at a meeting between Sears and 3M executives on December 24, 1956, making Sears the first retailer to offer stain protected clothing.

When Scotchgard stain release was introduced in 1967, Sears was instrumental in marketing and promoting the new product. In the early 1970s Sears worked closely with 3M to help set standards for the industry's first carpet protector announced in 1972. Sears was also in the forefront with Scotchgard stain release in the early 1980s with its McKids™ clothing line, one of the most successful children's labels ever devised by Sears. The giant retailer also worked closely with the release of carpet protector and more recently stain release for carpets.

In the early 1980s Sears came up with the idea that 3M should develop a Scotchgard protector for wood furniture. That product, introduced in 1985, was one of the Division's four major marketing announcements of the decade.

One of those came in 1983 when CCD began a program whereby Levitz Furniture Company sold and applied Scotchgard protector in spray booths built into its stores. The following year 3M's Gold Seal

Warranty Program allowed a purchaser of furniture treated with Scotchgard protector to buy a warranty that stated that if the treatment should ever fail, 3M would repair or replace the damaged furniture. (Levitz had been selling furniture that had been mill-treated with 3M's product since 1979.) And, in 1986, Scotchgard stain release for carpets was announced as the latest addition to the line.

Growth of Scotchgard protector sales has been remarkable since before the start of the last decade. In 1977 sales were seventy-five percent more than in 1976. By 1987 global sales were nearly five times greater than they were ten years earlier.

Bill Petersen, retired Marketing Director of the Commercial Chemical Division, has a favorite story involving a product demonstration in Chicago years ago. He was making a presentation at Marshall Fields department store where the merchandizing manager was a "difficult sell." Petersen treated an upholstered chair from a spray can, then sprayed a dresser to show that his product would not harm wood. He also sprayed half of a yard-square cloth handed to him by a Marshall Fields employee, who then left the room. When the man reappeared soon afterward he wore a broad smile. He had, he said, used the treated cloth as a dust rag with spectacular results. He held the cloth up for inspection by everybody in the room. Half the cloth was matted with clinging dust. The other half was spotless.

To this day, Petersen said he does not have the remotest idea which side had been treated and which had not. The moral, he added, is it's not what you see, but what you perceive.

In 1980 CCD commemorated the twenty fifth anniversary of the Chemical Products Group by listing thirteen charter members still with the Division. They were: Bill Petersen, Don LaZerte, Bill Pearlson, Lyle Hals, Dave Shryer, Dick Guenthner, Gayle Rengel, Maynard Olson, Joe Keating, Dick Danielson, Bill Skown and Stan Zaluda.

Twenty-six other charter members still were at 3M in other areas. They were: Hugh Bryce, Harry Paulus, Jack Sargent, Gordie Anderson, Ray Brown, Cliff Hanson, Duane Morin, Dick Heine, Dick Sward, Chauncey Martin, Flip Grasso, Les Axdahl, John Umber, Tom Billings, Frank Brown, John Hakanson, Mel Sater, Jack Hanson, George Harrison, George Rothweiler, Charlie Bentz, Wally Schmidt, Stan Karwoski, Ray Sundback, Chester Kabina and Jim Hinckley.

CHAPTER 23

"A Sense of Excitement"

Dr. Sidney M. Leahy, Vice-President of the Chemicals, Film and Allied Products Group, has been with 3M thirty-four years. Starting in 1956 in Central Research, he reached his present position through the Industrial Abrasives Division, Traffic Control Materials Division (TCMD), Sumitomo 3M Limited (a subsidiary in Japan), and Memory Technologies Group. He has been a Research Chemist, a Research Supervisor, Product Development Manager, Department Manager, Technical Director, Division Vice-President, Senior Managing Director and Group Vice-President. From 1979 until 1981 he was Senior Managing Director in Japan, then returned to be Vice-President of Memory Technologies Group before moving to his present assignment in 1983.

3M is organized into divisions, groups and sectors. Four sectors (until 1991) supervise twelve groups which oversee more than forty divisions, departments and other operating units. In 1990, the Chemicals, Film and Allied Products Group was in the Industrial and Electronic Sector headed by Vice-President Harry A. Hammerly. Leahy's Group includes the three chemical divisions, ICPD, PCPD and SA&CD, plus the Specialty Film Division and two departments.

Leahy had never worked with specialty chemicals when he took over the Group, which was not important. Group Vice-Presidents are not involved with the day-to-day operations. That is the responsibility of the Division Managers. Leahy is a businessman who brought to his job business acumen and decision-making ability learned during more than thirty years with the corporation.

He has a bachelor's degree in chemistry earned in 1952 from Reed College, Portland, Oregon, and a doctorate in chemistry earned in 1956 from the University of Washington in Seattle.

Leahy's distance from specialty chemicals during the formative decades (although at times he was a customer of SCD) provides him with an interesting perspective. In 1956, his first year at 3M, "there was a mystique, an aura, a sense of excitement that remained with the men and women from the Fluorochemical Project." Researchers outside the Project were not envious, but rather admired those pioneers, he said.

Sid Leahy

"Art Ahlbrecht (in the 1950s) was fond of reminding us of 'the way we did it in the Fluorochemical Project.' That included team play and thoroughness. And, Leahy said Bob Adams called the Project "a microcosm, a 3M model for how things should happen."

Leahy said a perception lingers to this day that chemical laboratory people think of themselves as an elitist group, as men and women who follow their own leads and are difficult to manage. They are considered "different" by scientists in other laboratories, who are themselves, of course, bonded by their own technologies.

Since 1980 turnover in the specialty chemical laboratories has been among the lowest in 3M. There are three reasons for that, Leahy believes. First, rapid growth in the 1980s allowed laboratory personnel to be well-supported and therefore contented. Second, specialty chemical laboratory people are different from other men and women in 3M laboratories from a standpoint of education and skills. Third, fluorochemical technology is not interchangeable with other 3M technologies.

A modern version of the Fluorochemical Project will never be seen, Leahy added. "Those people were entrepreneurs who lavished time and money on the development of fluorochemical products." But, times have changed, he points out. The corporation has grown too big for that to recur. Now, when a worthwhile program is conceived "we load up the front end with resources (manpower and equipment) and complete the job thoroughly and quickly."

Leahy cited an example from his experience as Vice-President of the Memory Technology Group in the late 1970s. Videotape cassettes were selling at retail for twenty-five dollars, far too much if 3M was

to develop a market for home recording and playback units. To lower that price 3M's manufacturing costs would have to be slashed and intensive cost reduction programs would have to involve every division employee from laboratory to factory.

The consumer videotape laboratory employed twenty people in 1980. Four years later employment was at four hundred and videocassette manufacturing costs had been reduced to one-seventh the original cost. "A variety of talent and enough talent was applied in all areas. Costs were reduced through sheer power," Leahy said. That talent was hired from other divisions. After the goal was reached some were invited to stay. The majority moved on to other 3M laboratories armed with another positive paragraph on their resumes. The task force approach was possible because 3M is in effect a huge talent pool of twelve thousand men and women who can be attracted into exciting programs when necessary. What a change from 1936 when Jim Hendricks became the second man with a doctorate in the company!

A different challenge confronted Leahy in the chemical group in 1983. Although new to the Group job he quickly discerned vestiges of the entrepreneurial spirit of the early days. The evidence was one hundred thirty-two active research projects in the CCD laboratory. Those that would be successful would contribute perhaps a million dollars each in annual sales, inconsequential amounts to a multi-billion dollar corporation.

Leahy's job was to convince his scientists to drop ninety percent of those projects, team their talents and concentrate on the ten percent that could promise major profits. It is not difficult to imagine the resistance to that suggestion. Whose project would be dropped? Whose would be saved? Who would lead the ten teams? Who would follow?

Expecting that reaction, Leahy employed a technique he had used before. Meeting and sleeping rooms were reserved in a center away from the campus. Twenty managers and key specialists were invited to a week-long meeting. An outside facilitator led the discussions, which kept comments to the point and away from personalities. Even then it was not pleasant, Leahy recalled, but the facilitator from a management consulting company was able to convince the group and get members to agree that changes had to be made.

Then the question was how could the laboratory make a more

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significant contribution? The new concept was accepted by some, but others continued to protest. Tradition was being meddled with. It would be impossible to make the proposed changes. Besides, there were not enough resources to carry out the work outlined by the facilitator. Leahy promised to obtain the resources—which meant he had to convince 3M management to allow him to spend some Group profits for several years in return for a promise of greater profits later on. With that agreement obtained, the laboratory staff was nearly doubled and sophisticated equipment purchased. The one hundred and thirty-two projects were reduced to key projects.

One of them was stain release, which was introduced in 1986. An add-on to Scotchgard carpet protector, stain release provides protection against difficult stains. The story of how the product was marketed in the face of strong competition from DuPont's Stain Master™ protector is nearly as interesting as the product is profitable. The original market for its new product, the Division believed, was luxury carpeting, which is about ten percent of the carpet market. That direction was being steered when DuPont entered the arena in 1987 with its product supported by a massive advertising and promotion campaign. In Leahy's words, "It created a buying frenzy in the market." The excitement of the two advertising campaigns—although 3M's was low key compared with DuPont's—created such consumer demand that carpeting in every price range was being treated with one or the other product and snapped up in showrooms across the country.

"DuPont's advertising increased the market so much," Leahy said, "that we also benefited. The demand for treated carpeting doubled, expanding the market five-fold." 3M's market share—which had been the lion's portion in 1986 with Scotchgard carpet protector—was reduced, but the increased business created by the greatly enlarged market made that an easy pill to swallow. "Besides," Leahy said, "the game isn't over. It's still under way." He seemed to be saying that 3M wanted its lion's share of the market back again.

Not everything produced by the laboratories turns into an immediate success story. An inexpensive polymer was developed, but no one could find a large market for it. "It took years," Leahy said, "for us to stumble onto an excellent use—stabilizing a foam for blocking odors and air pollution in waste disposal sites. So, patience is required when a development doesn't seem to match our early vision.

"Sometimes it has to wander around until it finally finds a friend."

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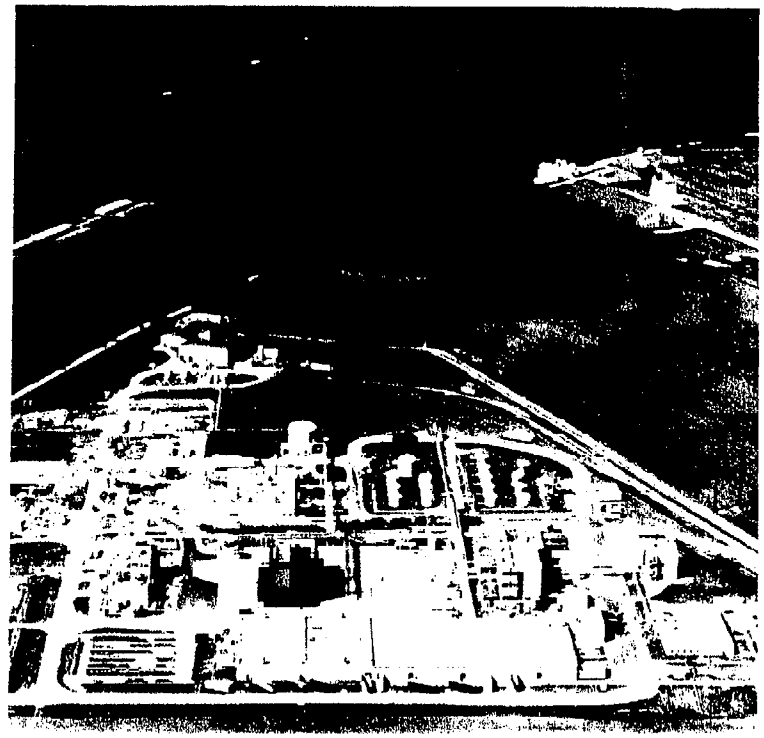
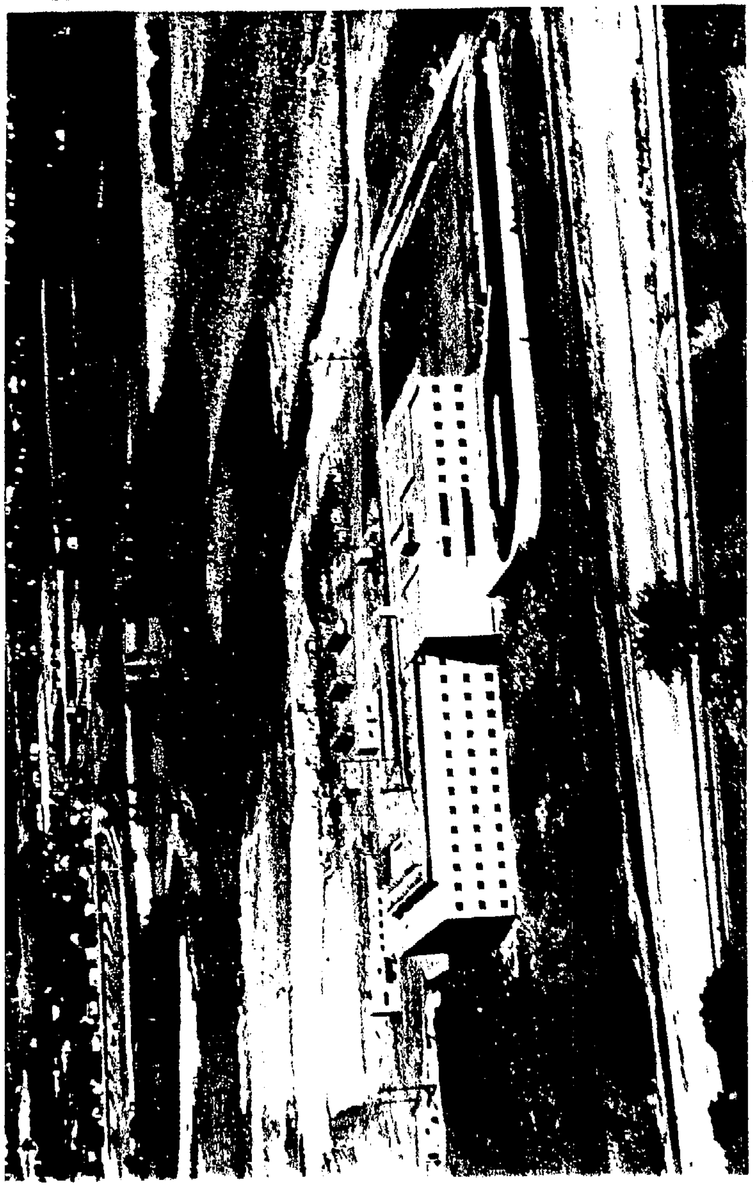
Since the end of the 1980s the word protector has been applied to all PCPD products: Scotchgard carpet protector, Scotchban paper protector, Scotchgard wood protector and so on.

"That's what we are and what we represent," Leahy said, "protection." The word is important to homemakers because the furniture and furnishings they buy are expensive, sometimes even once-in-a-lifetime purchases. For a small extra cost they get protection for a houseful of things that need protection. We've expanded to everything in the house—sofas and chairs, wall coverings, even wooden table tops—dining room tables, coffee tables, end tables—any surface."



Cordova, Illinois, plant on Mississippi river in 1971.



CHAPTER 24

Today and Tomorrow

In the 1980s, 3M established ten new laboratories called Technology Centers, each staffed with exceptional scientists who were directed to focus on a single technology.

The collective responsibility of those men and women is to assure the future of ten technologies that are of strategic importance to 3M. They must make certain that those technologies never become obsolete, that they remain state-of-the-art as long as they are vital to the corporation.

The first Technology Center was established in 1981 to protect the future of pressure-sensitive adhesive technology. The nine that followed are responsible for film, encapsulation, nonwoven materials, ceramics, weathering, electronic circuitry, hardgoods, software and fluorochemicals.

The Fluorochemical Technology Center was opened in September 1987 in Building 236, also the home of the ICPD and SA&CD Laboratories. (PCPD's Laboratory is in the Benz building.) The Fluorochemical Center employs twenty-five technical people and seven support employees who are seeking to find better ways to make carbon fluorine compounds. That effort produces more efficient manufacturing processes for fluorochemicals and new molecules with potential for developing unique products. The Fluorochemical Center staff includes scientists like George Moore, a 3M Corporate Scientist and one of our nation's foremost organo-fluorine chemists.

Opposite: Central Research Laboratory (Building 201) stands alone on the 3M Maplewood campus. Highway 12 (now Interstate 94) is in the foreground.

The Technology Center concept was developed in the 1970s because of a management concern that 3M research was becoming fragmented. The cause of that was growth. As 3M divisions used their technologies to develop new products, those products were spun off into new divisions which straightaway created their own research laboratories. Those laboratories pursued technologies which were the same or similar to their parent division.

Another concern was that long-range research sometimes was neglected. That came about because divisions, facing rising costs, did not have the resources to pursue programs that might not reach fruition for a decade or more.

Fluorochemical research, although not a prime example of fragmenting, is conducted by ICPD, PCPD and SA&CD in their separate laboratories and to a lesser degree in the Industrial and Electronic Sector Laboratory and by Corporate Research. ICPD and PCPD laboratories are concerned with product development and advances in technology that will develop into products in one to five years. The Sector frame is five to ten years in the future. And, Corporate Research is concerned with technological breakthroughs that can produce profitable products in ten years or more.

Technology Centers are hybrids, part Sector, part Corporate Research. A Center's scientific eyes look toward the latest scientific developments being reported worldwide as well as on 3M-developed opportunities for the technology in a time frame of three to ten years.

Vice-President Harnetty of ICPD said that the Fluorochemical Technology Center "is the single most critical component of our Division's global strategic plan for fluorochemicals. Without the Center we would not have the direction for technological development and expansion."

"We are currently tied to the Simons cell," Vice-President Foster of Protective Chemical Products Division said. "The Technology Center is working to improve the efficiency of that cell and to find compounds that can result in new products."

Foster's and Harnetty's divisions support the Fluorochemical Technology Center financially, although, by 3M rule the Center's achievements are available to all 3M laboratories. In turn, ICPD and PCPD have access to the accomplishments of the other 3M laboratories and Technology Centers.

The Fluorochemical Technology Center is directed by Dr. Thomas Savereide who reports to Group Vice-President Leahy. Savereide left the Industrial Abrasives laboratory in 1969 to become Chemical Division Laboratory Manager. In 1973, the year CRD was formed, he became its Technical Director. Later Savereide was with Sumitomo 3M and Corporate Research before taking his present assignment in 1987.

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Harnetty of ICPD remembers vividly how difficult it was to market fluorochemical products years ago. It was a case of Sales, Marketing and Laboratory needing to educate their prospects. When that job was completed, Sales Representatives had to justify 3M's higher prices. Only then were they able to get a prospect to sign an order.

"None of those users, with few exceptions," Harnetty said, "believed that he needed our products. Each was satisfied with what he had. We had to convince each one otherwise. In the process, we replaced products that were cheaper, but not as effective as ours."

For example, Light Water aqueous film forming foam replaced lower cost protein foam which had been used for years as an agent for smothering petroleum fires. Success did not come easily. Fire fighters found it difficult to believe that any new product could replace the one they had been working with for years. Even the United States Navy, which came up with the idea in the first place, was deterred by the cost of 3M's product and did not switch from protein foam until after a tragic shipboard fire. In civilian markets, the same problems had to be overcome. Public fire departments and private ones operated by refineries, petroleum storage facilities and industrial plants had to be convinced, too.

It is almost a contradiction of the above paragraphs to recall that in the beginning fluorochemical product applications were pointed out to 3M by would-be customers who needed to find a new product to satisfy their need. But that was the case, because, in the 1950s, 3M scientists had no idea that surfactants were needed in electroplating shops. Udylite Corporation helped out with that development. Navy scientists found out that a 3M product could be effective in fighting petroleum fires and helped to develop Light Water AFFF. The Air Force needed a super material to make hoses and gaskets for its planes so it got 3M involved in that research. Fluoroelastomers for manufacturing O-rings, hoses, gaskets and seals were the result.

3M specialty chemical products can be separated into five business areas:

• Fluoroelastomers are rubber-like polymers used in thousands of products. They can be made soft and pliant or tough and wear-resistant and are used to fabricate O-rings, seals, metal bonded composites, hoses and coatings. Their resistance to high temperatures and aggressive fluids makes them ideal for automotive, commercial and military aircraft and petroleum production uses. Other elastomers are flexible in low temperatures, which makes them ideal for other applications. The chief trade name is Fluorel fluoroelastomers, first developed in 1957.

• Engineering Fluids and Systems are surfactants used in heating or cooling applications. They dissipate heat in super-computers and other electronic equipment. They transfer heat efficiently in certain solder reflow operations and have become the industry standard for testing semiconductor devices. Trade names are Fluorinert liquids and Fluorinert liquid heat sink.

• Chemical intermediates are used to make other finished products, including Scotchgard protector. Surfactants are used in electroplating baths and to make shiny, easy to apply waxes and satin-smooth coatings. Fluorochemical acids and salts improve the action of a range of products from catalysts to battery electrolytes. Trade names are Fluorad intermediates and surfactants.

• Light Water AFFF and ATC agents are used to fight fires and suppress toxic and obnoxious vapors, odors and dust in landfills and hazardous waste sites.

• Scotchgard protectors resist soiling, staining and water-spotting especially in apparel and home furnishings. Even hard surfaces such as wallpaper and vinyl flooring are protected with fluorochemical products. The Scotchgard trade name is applied to carpet protector, fabric protector, leather protector, rain and stain repeller and stain release and wood protectors.

• Scotchban fluorochemicals are incorporated into paper, paperboard and nonwoven fabrics during the manufacturing process as barriers to oils, greases and watery liquids. That includes paper products used in fast food and convenience packaging, disposable medical garments, hospital linens, personal hygiene items and a range of other nonwoven materials used in industry. Trade names are Scotchban paper protector and Scotchban products for nonwovens.

It is also interesting to categorize fluorochemical technology by decades. The 1940s were the technology acquisition and start up years. The 1950s marked the development of the first products. The 1960s were marketing development years. The 1970s were boom years for space age fluids, rubber and Light Water AFFF products. The 1980s brought prosperity—and a more competitive environment.

Most 3M specialty chemicals—Fluorel elastomers are the exception—are manufactured with a process invented more than fifty years ago. 3M's original patents for the Simons cell expired a quarter of a century ago so 3M's fluorochemical technology and the Simons cell are available to all who wish to utilize them. Competitors stub their toes on the inefficiency of the Simons cell. The challenger who operates a cell learns that his output is more dross than gold. He produces a small quantity of usable product along with a large amount of waste materials. 3M, through trial, error and experience learned how to change intermediates and waste from cells into an array of products that are sold in half a dozen markets.

"We've found ways to make money out of scrap," Harnetty said with a grin.

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Complacency, while not banned, is never seen at 3M. If a competitor sets out to overtake 3M, he must start at breakneck speed, because the corporation will not slow down to wait for him.

"Forty-five percent of our Protective Chemical sales in 1989," Foster said, "came from products we didn't have five years before."

More new PCPD products appeared in 1990. Some were for the leather industry, including one that shows promise for leather processing. Another protects resilient flooring against staining and marring. It is possible that it could provide the same protection for exterior surfaces of buildings.

Product improvements are being made constantly. 3M plans to announce a new delivery system for Scotchgard protector foams which will be more efficient and more hygienic for mills. Scotchgard stain release, a two-part stain-soil-static system with Scotchgard carpet protector, is being improved. The product combats previously hard-to-fight stains caused by acid dyes such as those found in tropical fruit punch, grape soda and similar soft drinks.

So, the beat of the 1940s continues into the 1990s.

Jet airplanes, space travel, a moon landing, a host of business products such as electric typewriters, computers and facsimile machines, retail products such as PCs, VCRs, camcorders and microwave ovens have appeared since 1945. It would take a miracle to foresee what might be added to that list by the year 2035.

And, that includes the specialty chemical products 3M will add to its list in the next forty-five years.

But, as far as 3M specialty chemicals are concerned, why talk about the future? The future is now.

APPENDIX I

The men who attended the April 19, 1949, meeting were asked by President Carlton to provide written answers to three questions:

- Is the project commercially sound?
- What will be the determining factors of success or failure?
- How should 3M proceed to determine as rapidly as possible the likelihood of the fluorocarbon project becoming a financially successful proposition?

Replies from twenty-nine men were included in a written report. Twenty-six were from people on the list of attendees reported in the minutes. In addition, J. L. Rendall, Joseph Selden and Robert I. Coulter, whose names were not on that list, submitted answers to Carlton's questions.

Others listed as present at the meeting were the following management personnel: Cyril P. Pesek, Charles Walton and Nelson Taylor.

Walton added four points of elaboration "to forestall any misinterpretation of the conclusions" of the meeting under the heading Post-Meeting Elaboration on Conclusions. His one-page memorandum was attached to the meeting minutes. His points were:

1. Fluorocarbon materials released to date for customer evaluation have all been of the unreactive type. Such customer release has been restricted, and has not been general. While customer interest in such products has been genuine, it has not been of the type which would make 3M desire to build a production-size manufacturing unit.
2. In the very near future unreactive type fluorocarbon materials will be given general customer release.
3. No specific selling or advertising program has been initiated as yet in behalf of 3M fluorocarbons. With present limited pilot plant facilities, advertising can only be on a research sample basis.
4. Field contacts have indicated that most customer companies are primarily interested in "reactive" fluorocarbon materials, which they can use for chemical synthesis. Market evaluation of such reactive type fluorocarbons will have to wait for six to nine months, until present 3M research and patent work is concluded. While we believe that "customers hungry for such products will exist, we have no real proof other than preliminary interest."

Walton's evaluation was dated May 11, 1949, some three weeks after the meeting.

Here, in alphabetical order, are excerpts from the reports:

J. F. Abere, Polymer Section, Central Research Department: It is my opinion that fluorinated organic compounds and the products derived therefrom will form the basis of a business which will be very profitable to one or several companies.

Lewis F. Beer, Catalytic Section, Central Research Department: With regard to the question of whether the project is commercially sound, my answer is yes; however, this answer is being given with reservation. Its soundness also depends on how wise the management is in selling the products. I believe that, if the project is to be considered successful, the process must be improved, before large-scale expansion of the pilot plant is contemplated or before the building of a semi-works plant.

Frank A. Bovey, Polymer Section Leader, Central Research Department: It seems to me that the fluorocarbon project, so far as monomers and polymers are concerned, is undoubtedly sound commercially.

Erwin P. Brown, Engineering Division: I firmly believe that fluorocarbons are destined to play an important role in the industrial chemical field within the next few years...We are now in the process of enlarging and modernizing the small cell laboratory (to give research personnel) the tools necessary to rapidly evaluate the electrolytic process...(We) are now in the process of constructing new equipment for the present pilot plant.

Hugh G. Bryce, Catalytic Section, Central Research Department: It is my candid opinion that the Fluorocarbon Project is destined to become a financially successful undertaking for 3M. I am amazed at the work that has been accomplished to date and I have been tremendously stimulated by the optimism and enthusiasm of the personnel working on this Project.

Robert I. Coulter, Patent Attorney: I have no doubt that the fluorocarbon chemical field will have become quite important twenty years from now. The next five years in particular are in the realm of speculation apart from supplying research chemicals. Yet no one can safely assume that some major demand will not arise within the next couple of years, perhaps based on some use that no one has yet dreamed of. That is why I think it so important that there be no undue delay in disseminating information and making samples available, not just for a few compounds, but for as many as possible.

Patents do not of themselves bring in the profits that 3M is interested in. Profits are made on the sale of products and the bigger the market the better. It is to 3M's ultimate advantage to have many other persons working in the field and to be stimulated in part by the idea that they may get patents. (He referred to Quaker Oats Company, as the supplier of furfural—a colorless mobile liquid byproduct of oat hulls—benefiting from outsiders discovering the tonnage uses for it. The use of furfural in oil refining was developed and patented by an outsider and provided one of the first volume markets.)

I think some individuals have stressed too greatly the need for thoroughly exploring the chemistry of derivatives, and of derivatives of derivatives, and of uses, before releasing information and samples on what is available. A certain amount of such work is desirable, but it seems to me that the major effort should be on perfecting the electrochemical process and the processes for making the immediate derivatives of the cell products...

3M's basic position depends upon the electrochemical process and the cell products thereof, and those further products derived directly therefrom by other processes (such as the thermal processes that are being studied.) The control of the electrochemical process and its use in making compounds having direct use and for supplying raw materials for further processing (whether by 3M or its customers), gives to 3M an outstanding position in the fluorocarbon field. Because of this there is justification for gambling on the ultimate profit-making possibilities.

A. R. Diesslin, pilot plant Section Leader, Central Research Department: While the long-range outlook for the project is good, it is definitely speculative with no positive assurance of ultimate commercial success. As a research gamble, it is as good a one as can be found.

J. F. Dowdall, New Products Division Laboratory head: The 3M electrochemical process for the production of fluorocarbons is an extremely interesting and intriguing research project...To determine whether the fluorocarbon project will become financially successful requires that more detailed and exact information concerning yields and costs of fluorocarbons be obtained as soon as possible.

R. E. Drummond, Electrochemical Section, Central Research Department: I profoundly consider that we are in a position to immediately proceed with the design and erection of a semi-works plant consisting of two 10,000 ampere cells. Irreparable harm may be done if we are unable to supply fair quantities of our products to a potential customer for his pilot plant work in a relatively short time. A long wait...is as discouraging as any effect of price. During such a waiting period (the customer) may become deeply involved in some other program...

We all have the tendency to wait a little longer to see what improvements we can make on our process. This is natural since research personnel are inclined to be perfectionists. However, all industries are continuously improving themselves or are soon outmoded and out of business. It is preferable to be in a position of being forced to improve as we go rather than not get started.

D. R. Guthrie, Division Engineer: There seems to be widespread opinion in the technical staff that our process can produce products that no other known process can manufacture. This is certainly a plus for this project if we can continue to hold this edge. It will be very dangerous for us to become complacent and assume that we do have the only process, and that price will not be a major factor in the success of the project...

I think we should pick two or three reactive fluorocarbons and concentrate on them. We should pound away at every possibility of improving yield and lowering cost, develop our chemical technology and knowledge of behavior of the products, check process design ideas and gather complete engineering data for plant design, and get as many samples as possible in the hands of potential users. This project is so broad in scope that to attempt to cover the waterfront may break the bank before any deposits from profits are made...the capital investment for manufacturing facilities in the project will be so high that mistakes and errors in judgment will be very costly. I feel that this project is still in the research stage, and I do believe it is a good research project.

Lyle J. Hals, Catalytic Section, Central Research Department: From a chemist's point of view fluorocarbons are new and unique, therefore, an exciting field of chemical research. However, it is a difficult thing for a chemist to evaluate the economic soundness of his pet project. He is apt to be over optimistic in his estimates...I feel that with the research group we now have organized that after the next year or eighteen months, sufficient research and development knowledge will have been accumulated so that a intelligent evaluation of the technical potentialities of fluorocarbons can be made.

J. O. Hendricks, Assistant Director, Central Research Department: "The project looks so promising now that we should proceed with full steam ahead in our laboratory, pilot plant and market development areas. If we remain alert and aggressive combined with good judgment, success should be ours."

D. R. Husted, Organic Section, Central Research Department: I do not feel that possession of the Simons process for fluorocarbon production is a guarantee of success...Whether it will operate at a profit later, on a production scale, remains to be proven...We may find it economical to blanket the field with patents and operate on a larger scale by another process (other than the Simons process.)

I think the process is probably sound, but the results obtained are dependent on the soundness of the research, the breadth of patent protection and the cleverness of the engineer, and not on any magical formula based on a novel process, just because it is novel.

G. M. Ide, New Products Division: The main claim of the 3M-Simons electrochemical process is economy; it is said that fluorocarbon compounds can be made more cheaply by this process than by other methods. This claim has not been proved.

I believe that commitments of any kind should be avoided until the economy of the process has been proved. I would like to see no expansion of research, pilot plant, or market development until this most important task is done.

(Ide included eight pages of information on theoretical costs. Those costs were refuted by Nelson Taylor, Assistant Director of the Central Research Department. See APPENDIX II.)

C. L. Jewett, New Products Division: 1. The fluorocarbon program is an expensive gamble. 2. It is rumored that other substantial companies have studied the fluorocarbon field and the Simons process and have rejected both. (He mentioned American Cyanamid and Westinghouse.) 3. The Simons process so far has given very low and erratic yields in most cases. 4. For the lower molecular weight products and particularly those which also contain chlorine...other known processes are said to be more efficient... 5. Fluorocarbons are likely always to be expensive. 6. In general, the use of the fluorocarbons are not known. (He mentioned that DuPont had a long headstart in products of the "Teflon" type.) 7. The usual 3M yardsticks (existing equipment, sales outlets, 3M techniques or cheap raw materials) do not seem to have been applied to this program. 8. After one or two million dollars have been invested in research, it will be difficult to drop the project...There will be a strong temptation to continue or even accelerate the costs.

E. A. Kauck, Electrochemical Section, Assistant Leader, Central Research Department: 1. A large volume fluorocarbon business is likely, providing selling prices are reasonable. 2. The project is still a gamble but appears to be a good risk. 3. 3M should continue the project on a research scale.

J. D. LaZerte, Catalytic Section, Central Research Department: On a long term basis I am convinced the fluorocarbon project is a sound business venture. However, I am also convinced that it will be some years yet before fluorocarbons can stand on their own feet...The most rapid way to a financially sound project would be to continue the intensive research program and to expand the pilot plant to such a size that those compounds needed by ourselves and by serious potential customers can be made available.

R. R. McKenzie, Division Engineer, Adhesives and Coatings: Fluorocarbons, particularly the reactive variety, will undoubtedly have a major place in chemical industry (sic). Speaking generally, therefore, it is my opinion (a) fluorocarbon project is a commercially sound business venture. Whether it is sound for 3M depends on the business philosophy of 3M management... 3M must plan on spending considerably more time and money to achieve a firm position in the chemical field.

Matthew W. Miller, Organic Section Leader, Central Research Department: Qualified by two assumptions...I believe the Fluorocarbon Project and 3M's investment in it are sound.

Fluorocarbon chemicals and substances derived from them are a very recent development. As such, and when consideration is given their unique physical properties and stability, intense interest in them by chemists and research organizations is a foregone conclusion. Those few substances which have reached the position of industrial importance indicate that the development of many other commercially useful items will follow.

From the literature, patent abstracts, and 3M's market research, it is evident that many concerns are actively engaged in research on fluorocarbons. Others are now following these proceedings closely. Those interests point predominately toward a desire for fluorinated molecules containing reactive groups.

The electrochemical process for the production of fluorocarbons, on a research basis, has already demonstrated its versatility in that a variety of organic chemicals can be fluorinated using it. Many of them have been heretofore unattainable. Of particular interest is the discovery that chemicals containing a reactive group, such as the carboxyl group, can be fluorinated and this reactive center retained for subsequent chemical operations. The possibility of employing fluorocarbons as conventional chemicals and by known methods of synthesis cannot only be visualized but also is a reality.

...Limiting factors...are two in number: (1) The (Simons) process must be competitive economically; and (2) Complete patent protection on the process and the fluorocarbon chemicals themselves must be had.

The electrochemical process quite certainly will not revolutionize all fluorocarbon production. It, therefore, has to be competitve economically and be controllable in such a manner that, predominately, the desired product is produced. These questions can be answered only by continued intensive research on the cell reactions and conditions.

(Miller mentioned the value of patents and the "protection of past investments, should other processes prove more economical. Chemical compound patents are more important here than would be those on a process.")

How should 3M proceed to determine as rapidly as possible the likelihood of the fluorocarbon project becoming a financially successful proposition? The fluorocarbon project is somewhat foreign to 3M's normal business activities. As now seen, it puts 3M initially in the role of a chemical raw material supplier. It cannot be contemplated that every possible end use or product, or even a small percentage of them, can be investigated or exploited in a reasonable time. (He suggested that other companies and research organizations be supplied with fluorocarbons and technical information to allow them to conduct investigations and evaluations. Both reactive and non-reactive fluorocarbons "should be sampled quite freely.")

In the meantime 3M's efforts should be predominately on research activities concerning the process and its economics, as well as basic research on the chemistry of fluorocarbons themselves. The former...is necessary because of the competitive aspect...already apparent in this field...The latter is required to protect 3M's position firmly as a basic chemical producer and supplier.

W. H. Pearlson, Catalytic Section Leader, Central Reseach Department: Having been associated with this work since 1942, and actively engaged in research concerning it since 1944, I have had many occasions for comparing the process with competitive processes as well as with other lines of chemical research...I was convinced that the highest probability for future success would come from...the electrochemical production of fluorocarbons. Recent advances in our laboratories make this feeling even stronger at present.

...Even at present we are able to produce several types of compounds at a price which is moderate for specialty chemicals. Just as soon as an assured market appears, I believe we should take advantage of it by preparing for production within a year.

R. W. Perlich, Analytical Section Leader, Central Research Department: It is my opinion that the Fluorocarbon Project is a worthwhile business venture for the 3M Company.

...The field of fluorocarbon chemistry is a new one and the companies who do the pioneer work in the field will undoubtedly encounter many difficulties. However, since it is a new field, the profits to be derived are greater and the development can be carried on with less competition. The Simons process gives the 3M Company a good start on producing fluorocarbons commercially and I am definitely in favor of continuing the work of the project.

Thomas S. Reid, Organic Section, Central Research Department: If the price will be low enough to be competitive with existing materials, I think there is no question about the future success of the fluorinated materials. However, if the present indication of very high prices continues to hold true, these new products must do things which the cheaper materials will not do, in order to be successful.

J. L. Rendall, Central Research Department: The wide variety of new chemical compounds made possible by this process leads me to believe that certainly one or more of such products will find extensive use by industry and thus make the project "pay out."

J. M. Rogers, New Products Division: Recent months have brought forth a steady stream of publicity concerning fluorochemicals in both technical and popular publications. Popular scientific articles in appealing to the layman too often overemphasize the glamorous side of research and the fluorochemical publicity has been no exception to this rule. Some people have unfortunately been led to expect miracles from the 3M Simons process. Nevertheless, this publicity has served to whet the appetites of potential customers for fluorochemicals. We are constantly receiving inquiries from reputable companies who are asking for further information. These inquiries cover a wide range of interest in all types of fluorinated products and come from representatives of many varied industries. All of the unsolicited publicity and all of the varied types of inquiries which we have received are an excellent indication of both the interests and desires of those people and also the broad market potentials of our products. We have in the 3M Simons process the basis for an entirely new field of chemistry which has scarcely been tapped.

...From a marketing standpoint, more knowledge is necessary from the field concerning what products the customer is most interested in and what lower priced materials such as Freons for refrigeration and carbon tetrachloride, methyl bromide, CO_2, and chloro-bromo-methane for fire extinguishers. The current questions in these fields are whether the increased stability and non-toxic properties of fluorocarbons will warrant the difference in price.

(He mentioned that Celanese, Merck, GE's plastics division and the major rubber companies had been solicited for their interest in fluorochemicals. All indicated a desire for reactive fluorinated chemicals and little interest in inert compounds.) The proposed release of fluorinated acids should hasten the commercialization of fluorochemicals (which might find uses) as intermediates in the preparation of such end products as pharmaceuticals, dyes, resins, plastics, tanning agents and elastomers.

Harold M. Scholberg, Electrochemical Section Leader, Central Research Department: (The potential field of fluorocarbon chemistry) is enormous...Our present position is strong. We control the only one-step method known for the production of organic fluorine compounds. Among electrochemists whom I have met at national meetings, 3M is recognized as the leader in fluorine chemistry in this country ... The problem is to make a profit out of fluorocarbons. To do this we must get into production. If we get into production fast, we will make mistakes in technology. If we are too slow we will endanger the ready-made interest in the field and our research costs will become very large.

I am inclined to think that what should be done is expand the Fluorocarbon Pilot Plant to produce more sample material, intensify the fundamental work, and start preliminary plans and engineering design for buildings, cells, and auxiliary equipment, where feasible, for a large plant.

J. W. Selden, New Products Division: The fluorocarbon project as it stands today is still a gamble insofar as commercial success is concerned...the advantages of this (Simons) process over others have not been conclusively demonstrated.

No established market exists...The long period of market development for such new chemical products places further emphasis on the speculative nature of this project.

(Selden went on to note that, "This sort of program can snowball rapidly." He suggested concentrating on "one or two materials" with the "best chance of early success.")

Since so much money and energy have already been expended, it would seem inadvisable to drop the fluorocarbon project abruptly...but expenditures on such a project should not be prolonged unduly so that research funds are too narrowly concentrated on one development.

W. E. Sohl, New Products Division: (Fluorocarbons) are expensive and their introduction to serve useful needs is far more difficult (than other products) because they must have all of a lot of different and critical properties... Economically, the development of the (Simons) process appears to be in only the initial state. This is indicated most forcefully by the Ide report. [Note: it can be found in this appendix.] The yields are poor and much fragmentation to volatile fluorocarbons or tarring to useless residue occurs. All of these by-products require an expenditure of the initial starting material and hydrogen fluoride, both of which raise the cost of the desirable product. The waste of electricity overbalances the theoretical saving of power claimed for the process.

Donald J. Wardrop, (Process Engineer), Pilot Plant, Central Research Department: In my opinion the fluorocarbon project has a good chance of becoming a commercial success. I am convinced that fluorocarbon materials have properties sufficiently unique so that a number of them will find use in applications where they will be superior to other materials.

D. G. Weiblen, Analytical Section, Central Research Department: I believe that the fluorocarbon project has a very good chance of being commercially successful. The fact that "reactive fluorocarbons" can be obtained by our electrolytic process as well as inert materials is an important factor in hastening the day when commercial success will be attained.

APPENDIX II

Excerpts from:

THEORETICAL COSTS OF SOME FLUOROCHEMICAL COMPOUNDS

By Nelson W. Taylor

[The following was produced in reply to G. M. Ide's report which is excerpted in Appendix I.]

The Fluorocarbon Project has been under way in Central Research for nearly five years, although not very intensively until about three years ago. The New Products Division...has been charged with the responsibility of developing markets for fluorochemicals. It is natural and healthy that many differences of opinion arise from time to time between the respective groups. As a rule these differences are resolved or compromised by friendly discussion without any publicity...(but) since the Ide report is already in your hands, the only way open to present our views (is this report.)

[Taylor said he did not question the right of anyone in the company "to express his sincere and considered views" on the merits of the Project.] In this case, however, we believe that the average reader of the Ide contribution will get rather a serious misconception of the present status of the Project, due largely to the extreme over-simplification of the treatment of certain research data. So many modifying factors were ignored that we believe the conclusions to be completely invalid.

[Tayor began by examining Ide's claim against the economy of the Simons cell. Economy, Taylor wrote, is only one of the major claims; versatility is the other.]

Other known processes are capable of producing only a very limited number of compounds while the electrochemical process has yielded several new classes of compounds which have never been made before...Certainly in these cases our process is cheaper than any other, for there is no other.

[Taylor took issue with Ide's treatment of the economics of the process "which are based upon the yield of 'desired product.'" Ide also used the words "ultimate efficiencies," which Taylor would not accept.]

It seems curious that his calculations are based on the output of only two 10,000 ampere cells, which corresponds to a very small daily production of something between 100 and 500 pounds of an arbitrarily chosen material...costs and efficiencies based upon such a small pilot operation bear little relation to those ultimately to be found in a commercial plant.

[As for "desired product(s)" Taylor said that the criteria for desirability "are changing so rapidly from week to week that we have no stable definition" for it. Often, he said, the "by-product(s) of one day become the product(s) of the next.]

At this stage of the game it would seem to be quite meaningless to select arbitrarily one product from each operation as "desired" and throw the rest away. Next week we may find that we have thrown the baby out with the bath water.

Without going into further detail it might be said in general that the status of our fluorochemical known-how is changing so rapidly that calculations of costs can only be very tentative and exploratory. The assumptions which are chosen may be far more significant than the calculations themselves. With the aid of a sufficient assumption it would be easy to calculate how many angels could ride on the back of a unicorn, but no one would pay much attention to the results of the calculations.

In conclusion it should be said that although we cannot accept the pessimistic analysis of the Ide report and although we disagree with the assumptions on which the analysis rests, we are thoroughly in agreement on one point; this is, that there is still much to be learned as to the technology of the electrochemical process. Improvement as to control and the end product has been an important concern to Central Research for the past two or more years. Unfortunately, technical problems such as the invention of reliable methods of chemical analysis have been difficult, experimental facilities have been limited and progress has been far from satisfactory. A great deal of effort has also, of necessity, been directed to purely exploratory work with the object of building up a patent structure on new fluorochemicals. Thanks to the funds provided for the purpose we are now nearing completion of facilities which will permit both intensive and extensive work on process development. We are looking forward to rapid progress in the future.

[It was signed by Taylor, Assistant Director, Central Research Department, and dated June 8, 1949.]