THE STORY OF GRASSELLI

When our ancestors of a not too distant past needed physic or other medicines, they sought the "chemist's shop," a term still lingering vestigially in the language of Britain today. For the mysteries of the healing art and of alchemy were anciently allied. Throughout the Dark Ages, alchemy, standing to chemistry as does astrology to astronomy, was indeed a "black art", seeking the secrets of the "philosopher's stone", an "elixir of life", "potable gold", or the transmutation of metals and, when taught, included only as a minor subject of medical education. (Page 392, Science for the Citizen, Ref. No. 1, and Page 187, A Short History of Science, Ref. No. 2.)

The revival of learning, literature and the arts, flowering ultimately in Italy as the Renaissance, marked the beginning of the trend toward the systematic organization of man's knowledge about the physical universe. Albertus Magnus, Bernard of Treviso, Eck of Salzburg, and Basil Valentine with their work on the preparation of hydrochloric acid and the oxidation of mercury, heralded the dawn of chemistry as a science, the peer of medicine, mathematics, physics and engineering in education and industry (Page 187, Ref. 1).

The Grasselli Chemical Company, now the Grasselli Chemicals Department, unit of E.I. du Pont de Nemours and Company, is a name found in association with chemistry at this era of its beginnings as a science in 15th century Italy. The family of the founder of the American company which became the Grasselli Department of the DuPont Company traces its lineage back to the middle of the 15th century. Records in Milan, Italy, show that Grassellis at this early period were chemists.

Compounders of drugs, herbs, and perfumes, laboring in their primitive laboratories and offering their mysterious philters and medicinals in shops identified by weird monsters of nature such as star-fish and sea-horses, were these Grassellis of Lombardy of 1440, half-a-century before Columbus' time. The Sforzas, later in the century distinguished for their patronage of Leonardo da Vinci, then headed the powerful mercenary condoterri band in the service of the Visconti whom they succeeded as the dukes of Milan.

The University of Bologna was a flourishing center of learning of the time, with from 3000 to 5000 students in attendance from all over the civilized world. Its medical faculty had been instituted early in the 11th century and soon after it the philosophy faculty was established. Dante and Petrarch were students there in 1262 and Thomas Aquinas, author of several books of a chemical nature, chief among them being the "Most Secret Treasure of Alchemy", taught at Bologna during the 13th century.

All northern Italy came within the orbit of Bologna's influence which extended as far as Milan and nearby Lake Como, less than two hundred miles distant from the university, and even to Torno on the lake where the Grassellis became established. Caesar Augustin Grasselli, son of the founder of the American family and chemical company, on a visit to the ancient seat of his ancestors found the name engraved on brass plates identifying several shops at Torno as lately as 1898.

Giovanni Angelo Grasselli, father of the founder of the American family, with whom the history of the Grassellis as manufacturing chemists may fairly be said to begin, was born January 15, 1781, at Torno, in Lombardy, then within the realm of the Holy Roman Empire of Joseph II, who but recently had succeeded his mother, the Empress Maria Theresa, on her death, November 29, 1780, as King of Austria, Hungary and Bohemia.

At the time of Giovanni Angelo's birth, Napoleon, a lad of eleven, was attending the Brienne military school, in France, and in the same month, Necker's "balance sheet" exposed the bankruptcy to which the extravagance of Louis XVI's court had reduced that nation. Grasselli grew to young manhood in Italy and France during the European upheaval highlighted by the French Revolution.

He was fourteen when Napoleon wrested his native Lombardy from the toppling Holy Roman Empire of Francis II, setting up the Cisalpine Republic with Milan as its capital and placing all Italy except Venice and Naples under the control of France with the Peace of Campo Formio, in October, 1797. Meanwhile, the industrial revolution, already well under way in England, had made itself felt in Europe.

Carrying on the family tradition, Giovanni Angelo Grasselli became a chemist and for causes and at a date unrecorded in the annals of the family the Grassellis are found established at Strassburg, in French Alsatia. Here young Grasselli began the manufacture of sulfuric acid. He is said to have been one of the first manufacturing chemists in all Europe and has been acknowledged to be the first chemist to import into France brimstone from Sicily for the making of sulfuric acid.

Despite the troubled times, the Grasselli enterprise flourished. He developed wide markets and spread his merchandising efforts over a wide territory and even into Germany, across the Rhine from Strassburg. Tariff barriers erected by German states against French products, however, impaired Grasselli's competitive position in these growing markets and some time after the turn of the century he met this problem by extending his enterprise within the borders of Germany, establishing manufacturing operations at Wohlgelegen, in Mannheim, in the Grand Duchy of Baden. Here in 1898, while traveling in Germany an American grandson, C. A. Grasselli, was shown several massive three-story stone buildings which had been erected for the plant in 1805. At the time of the grandson's visit to Mannheim, these buildings were still in use by the Verein Chemische Fabrik, successors to his grandparent in the manufacture of chemicals at the site.

Giovanni Angelo Grasselli associated himself with a partner, Maggi, and the firm operated its plant, erected in the year of Austerlitz and Trafalgar in Wohlgelegen under the firm name of Maggi and Grasselli. The original Grasselli plant in Strassburg was continued and the affairs of the combined chemical interests prospered, extending into France, Italy and Switzerland, with several plants of large size. The Grassellis still continued for some years to reside in Strassburg, France.

There Eugene Ramiro Grasselli, founder of the American firm and family, was born, January 31, 1810. Napoleon's power was then at its zenith and the youth grew to maturity during the troubled years of Europe's struggle for liberty, first from the domination of Bonaparte and then from the repressions by which Metternich and the Congress of Vienna attempted to stay the rising tide of republicanism throughout Europe.

Eugene Ramiro Grasselli was educated in Strassburg and also attended the University of Heidelberg, preparing for a career in chemistry. From his father he received invaluable training in industry. By the time the son had completed his university education, the family had become established in Wohlgelegen and on the occasion of the visit of Eugene's son C. A. Grasselli to Mannheim, he was shown stuffed sea monsters, trade insignia of the chemist's shop of those days, which had marked the family establis ment in Wohlgelegen.

Expanding opportunities in free America beckoned the youth of Europe with particular force during the early decades of the 19th century and a rising tide of emigration from Germany was the result of repressive measures aimed in 1815 and 1830 by Metternich and despotic rulers against the growth of agitation for democracy among university students and the press. Though the revolution of 1830 which unseated the Bourbon, Charles X, and placed the Orleanist, Louis Philippe, on the throne in France, spread to the rest of Europe it was unsuccessful elsewhere and the thirty years after 1815 was a season of gradual reaction against the tide launched by the French revolution.

Eugene Ramiro Grasselli, the American founder, in 1836 decided to abandon his native land to seek his fortune in America, a momentous decision since the family already was well established in the business for which he was destined and his future at home held high promise of sure success, and the journey to far-off America was not the tourist jaunt it is today.

On October 19, 1836, Eugene Ramiro Grasselli, sailed aboard the ship "Le Sully," arriving at New York, January 3, 1837. It was five months before his family received word of his safe arrival. From New York the young chemist made his way to Philadelphia, reaching that beehive of industry, he later recalled, with only two cents in his pockets.

A wealth of opportunity, however, offered immediate employment for his specialized training. Philadelphia was already established as a center of chemical manufacture in the third decade of the 19th century. There young Grasselli discovered John Harrison, "chymist" according to the city directories of that day and founder of an enterprise now still represented in the chemical industry by an important plant of DuPont's Grasselli Department, had been making sulfuric acid and other raw materials of the industry since 1793.

Harrison has been called the first commercial manufacturer of sulfuric acid in the United States and the first to replace the old-fashioned lead-lined stills for concentrating the acid with platinum stills. Dr. Eric Bollman successfully developed and constructed the first such still used by Harrison, a device with a capacity of 25 gallons in which he utilized 700 ounces of platinum, then plentiful and cheap in America. Grasselli, himself, was later to be the first to introduce such a still west of the Alleghenies.

But young Grasselli accepted an opportunity offered by one of Harrison's competitors, the firm of Farr and Kunzi, established in Philadelphia in 1818, and today also represented in the operating units of a great company, the pharmaceutical firm of Merck and Company.

Founded by Abraham Kunzi and John Farr, a young Englishman who had served his apprenticeship in chemistry in one of the foremost London pharmacies of his day, this firm had its plant at 185 Coates Street, now Fairmount Avenue. They made sulfuric acid, morphia, ether, refined camphor and a variety of acids.

Grasselli was hired at a wage of one dollar a day. His opportunity to demonstrate the value to his employers of his specialized knowledge was not long in coming. The sulfuric acid capacity of the plant was about 16 small demijohns a day, when Grasselli went to work. The firm needed all this production and about four additional demijohns daily for the manufacture of its varied line of chemicals. To supply the additional daily requirement, Farr and Kunzi had to buy sulfuric acid from others. The firm still used the conventional lead chambers for the making of the acid, concentrating it in glass vessels.

Grasselli with his experience was able to improve their processes by simple changes at little cost so that soon the company had not only sufficient acid for its own needs but was producing a surplus which found a ready market. His employers were appreciative but the enterprise of the young chemist urged him toward prospects for greater independence in a business of his own.

Kunzi retired in 1838, and Farr associated with himself, under the name of John Farr and Company, Thomas P. Powers, serving an apprenticeship with the firm, and William Weightman, Farr's own nephew, a native of Waltham, England, and at the time of Grasselli's connection with the company a student of the University of Freiburg.

Foreseeing Powers and Weightman would ultimately succeed to ownership, and with ambition newly spurred toward the more promising future of a business of his own by his marriage June 17, 1837, with Miss Friedericke Eisenbarth, of Philadelphia, Grasselli quit Farr in early 1839. In the spring of that year he set out with his bride, who had been born in 1820 in Stuttgart, Wurtemburg, Germany, in search of new fields, ripe for industrial pioneering.

Expanding frontiers had added 11 new states and three territories to the thirteen states, and the new nation spanned half the continent from the Gulf to Canada in the year when the Grassellis broke up their Philadelphia home and started their journey westward.

Pittsburgh, their destination, was no overnight Pullman hop in 1839. By horse and locomotive-drawn railroad cars and canal boat the Ohio River city was a three and a half day journey from Philadelphia over the main line of the state-built "internal improvements" transport system. Competing stage-coach, railroad and canal transportation companies operated their own conveyances for freight and passengers over the line, paying the Commonwealth toll.

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One company advertised a schedule of rates as $10 for a through trip accomplished in four days and $7 for a slower journey that took seven days to travel the same line. Another company advertised a three end one-half day schedule while the Peoples Line, a stage-coach operator, boasted its vehicles would make the trip in 56 hours.

The Grassellis left Philadelphia on the first leg of their journey from the shanty depot of the "Philadelphia and Columbia Rail-way" at Broad and Vine Streets. The time table advertised two trains daily. The "through" train, and "express", left "each morning at exactly six o'clock" making its first stop at "Brookville", now Radnor, where a "tarry" of 30 minutes was scheduled for breakfast at a hotel built by an enterprising host for the accommodation of the passengers.

The express arrived at Columbia, on the Susquehanna River, at 1:30 P.M. in time "to dine on board the boats", according to the advertised timetable which discounted stage-coach

competitors in a note to passengers saying those leaving "Philadelphia for Pittsburgh will arrive at the latter place as soon by keeping the railroad to Columbia as by any other route in consequence of the fact that all who leave Philadelphia in the morning, no matter what intermediate route they may take, must pass the Portage Rail Road together" and "only one transhipment of baggage will be necessary between Philadelphia and the portage and dinner will be ready at the usual hour aboard the boats without causing any delay."

The boats mentioned were those of the Eastern Division Canal by which the travelers of 1839 continued to Hollidaysburg, Pennsylvania, on the second leg of their journey by the 171 miles of waterway which followed the valleys of the Susquehanna and Juniata Rivers to the foot of the Allegheny Mountains. There another laborious transfer of baggage took place to the cars of the Portage Railroad which consisted of ten inclined planes, five on each side of the mountain, each operated by a steam engine at its top and each plane joined to the next by nearly or quite level portions of the road.

On this part of their journey the Grassellis could observe what were regarded as two of the modern engineering triumphs of that early day. These were the famous "Conemaugh Viaduct," a semi-circular stone arch which carried the canal across the Little Conemaugh River, and the Staple Bend Tunnel, called the first tunnel built in America by W. Bender Wilson in his book describing the Portage Railroad. The tunnel was 900 feet long and cut through a spur of the hills to avoid a long detour around the mountain. The Portage trip was only 37 miles long and ended at Johnstown, Pennsylvania. There began the final 104 miles of the route to Pittsburgh which followed the Western Division Canal along the Conemaugh, Kiskiminetas and Allegheny Rivers to Allegheny City where a branch canal connected with the Ohio River at Pittsburgh.

As they journeyed westward, Grasselli was appraising possible locations for the site of his operations. Arrived at Pittsburgh, he determined to push on and the couple embarked with their goods on one of the river steamboats of the packet line which since 1794 had been plying the Ohio River between Pittsburgh and Cincinnati. Schedules of the period show that the down trip took 60 hours while the return against the current required five days. The difference was reflected in the fare, costing $12 down and $15 up.

They traveled in leisurely fashion and took about three weeks to reach Cincinnati. The advantages of the Queen City set in the midst of a growing industrial area impressed Grasselli as the most promising for his purposes of any of the places he had considered. There he determined to found his chemical enterprise.

Cincinnati, with a population in 1839 of about 40,000, was an important market center for the area west of the Alleghenies Its commerce on the Ohio and Mississippi Rivers reached from

Pittsburgh to New Orleans. Heavy industry had been established there as early as 1817 with the opening of a "manufactory" of steam and fire engines, mill machinery brass and copper castings. Most of the engines produced went into Ohio and Mississippi steamboats, eight of which were built on the western rivers that year.

On his arrival Grasselli found the city a thriving industrial center. Iron foundries, engine works, tanneries, furniture factories, breweries, paper mills, textile industries, brickyards and a chemical laboratory were among the varied business activities he found in full swing. But more important, Cincinnati was the receiving point for livestock from a wide area. It was the slaughtering center of the day and its by-products provided the raw materials for another most important industry of Cincinnati, the making of soaps and candles. This industry was a large user of sulfuric acid and other chemicals, offering a promising market for the products Grasselli proposed to manufacture.

With Cincinnati determined upon as his seat of operations, there remained to be selected a site for his plant. Guided by his engineering knowledge, Grasselli chose a location where the natural slope of the land would provide the advantages of gravity flow for the processing of his chemicals.

He picked a site on Front Street, well back from the Ohio River and in the outskirts of the city of 1839, and built his plant on a hillside extending to Martin and Third Streets. With his own hands, Grasselli helped to construct his first building, aided by the experience he had gained under his father.

Offices of the new firm were on Front Street. The packing house and shipping yard adjoined the offices immediately to the west. To the rear, extending to Third Street, he built his plant. To the east of the offices on Front Street, an ample three-story brick house which was to be the home of the family for many years was erected. All the buildings were of the sturdiest construction in every detail.

Sulfuric acid was the first product of the new plant. But soon additional chemicals were being made. Alum, Le Blanc soda, salt cake, Glauber's salt, nitric acid, muriatic acid, and several pharmaceutical chemicals were added early to the firm's line. Allen and Company, an important wholesale drug house, provided the sales outlet for the company's products in those days.

Prospering from the start, the company at its outset embarked upon a course of continuing development which marked it as one of the most progressive in the chemical industry. A striking instance of progressiveness, highlighting also the extent to which the attitude of the founder contributed to the company's successful industrial philosophy, was the installation in the plant of the first platinum still ever set up west of the Alleghenies.

The still was imported from Paris, France, in 1845. Up to that time sulfuric acid had always been concentrated in glass vessels. Importation of the new equipment attracted widespread attention. It was an outstanding advance in the industry and its proper installation was a matter of prime importance to the plant. Grasselli with his own hands laid the bricks and conducted the precise operations for adjusting the still upon the cushion of loam which provided its foundation. For many years, the founder himself performed the labor of resetting the stills on their foundations every three or four months.

His son and successor as head of the firm, Caesar A. Grasselli, born November 7, 1850, and apprenticed at 15 to learn the chemical business in his father's firm, took over this important function and performed it for years until more important duties of a rising executive interfered.

The first invasion of Cincinnati by a competitor in the chemical field occurred during the same year in which the Grasselli installed their improved sulfuric acid process. David M. Marsh and Edward Harwood launched their chemical manufacturing project in 1845, attracted to Cincinnati by the same advantages which determined Grasselli's decision. These new rivals for markets opened up by advances in chemistry provided keen competition and Grasselli met it by constantly striving to improve the price and quality of his products.

By 1858, sulfuric ether and chloroform had been brought to the stage of commercial development. Grasselli devised a unique process of his own for making these chemicals and by the opening of the Civil War production at his plant reached a scale that enabled the firm to play an important part in supplying the needs of the Federal Army.

The development of processes for deriving kerosene for lighting from cannel coal interested Grasselli in the early 'Fifties. He built one of the first American plants for making kerosene at Newport, Kentucky, across the Ohio from his original plant, and operated the Newport Oil Company in connection with his other interests.

By 1859, petroleum began to bid against kerosene for acceptance in the lighting and fuel fields and Grasselli instituted research at his Newport plant to explore its possibilities. He actually began refining crude oil brought by barge to his plant on the Allegheny and Ohio Rivers but soon concluded that the long haul made competition with refineries then being built in the oil fields of Pennsylvania and at Cleveland, Ohio, unprofitable. He abandoned the project.

His original enterprise prospered, expanding to the point where by 1860 he had enlarged his plant by putting in a new system of production which raised his output of sulfuric acid and

other chemicals to a total of about 3000 tons per year. At this time the inevitability of war gave rise to fears which paralyzed all industry. For some months it appeared that all might be lost in the recession of markets, but soon the realization that industrial production was even more vital to national security in war had its effect.

In consequence Grasselli and his entire force were working both day and night to meet the demands of the national defense program. The crisis of war imposed its peculiar problems upon manufacturing. To finance the appalling costs of war the Government found it necessary to multiply its levies and instituted every conceivable type of internal tax. Income, receipt, check and finally import taxes were imposed.

Foresight in one instance averted what might have proved a serious blow to the Grasselli project. Observing the trend in Congress, the young industrialist seized an opportunity to provide himself with a shipload of brimstone, the sulfur so essential to the manufacture of his principal products just before Congress enacted a bill levying an import duty of $6 a ton on the material. As the effective date of the act approached he watched for the arrival of the cargo which he had bought while the vessel was at sea. The due date for the ship's arrival in port passed without news of the vessel and when it appeared the cargo might have been lost at sea, he bought still another incoming cargo. As it turned out both ships made port before the sulfur became subject to the tax. Soaring prices gave Grasselli a cost advantage from this transaction that made his venture most profitable.

There were also other wartime and post-war problems. The firm was forced to pay for raw meterials, such as sulfur, in gold. Gold was at a premium, the rate reaching 50 percent and even soaring at times to 75 percent. Production costs thus were forced to prohibitive high levels. Prices reflected the inflation but increased production costs prevented any large increase in rates of profit. Nitrate of soda, a raw material required in heavy volume by the industry, increased in price, too, adding a complicating factor.

Increased capacity at Grasselli's plant, regarded as a burdensome factor when first brought into production in 1860, soon marked him as an industrialist distinguished for uncommon foresight.

It was during the stress of war that the founder's son entered the family business. Born in Cincinnati, the youth attended the local elementary schools and St. Xavier's College until 1865 when his father, feeling the necessity of training a member of the family to succeed him, determined the next head of the firm should be his fifth child and second son, Caesar A. Grasselli.

"I cannot remember a time when I was not interested in chemistry or when I did not expect to follow my father in his business," Caesar Grasselli wrote toward the end of his long and

successful life. "Whenever possible, even as a very small boy, I visited the plant, and my father never made the mistake of considering my childish curiosity an annoyance. He explained to me all that could or could not be done and encouraged me to learn all I could about every operation."

Recalling an incident on one of his visits to the plant in 1858 after the elder Grasselli had designed his first apparatus for making chloroform, the son wrote:

"In those days chloroform was made in a leaden vessel, about six feet in diameter. The bottom was convex and the top concave. The pot was heated by direct fire, a very dangerous procedure.

"Sulfuric acid was first introduced into the vessel and after being heated to the proper temperature, alcohol was introduced. Somehow, in this first operation of the device, the detail of stirring the acid was forgotten and when the alcohol was put into the over-heated contents, there occurred a violent explosion.

"The force of the blast bulged the top and bottom of the vessel, forming it into a perfect sphere. Luckily there was no fire to cause more serious damage and the incident passed into the realm of the amusing, but the occurrence illustrates how I came naturally to understand and accept the risks of the routine of the business."

The apprenticeship laid out for young Grasselli was no easy one. He donned overalls and pitched in at the bottom of the ladder. His first job was the heavy task of firing the steam boilers of the power house, and here he worked side by side with grown men, returning home in the evening after long hours, grimy and weary.

He soon determined that his progress would be slow without some systematic training in addition to the practical experience he was gaining, so on his own initiative he enlisted the aid of one of the chemists in his father's pharmaceutical laboratory, a former professor in Karlsruhe University, who became his special tutor. For two years, the chemist came to the Grasselli home in the evenings and supervised the young man's studies, recommending textbooks and correcting his paper work.

It was during the son's early connection with the business that the use of sulfuric acid for petroleum refining was developing into an industrial process promising vast importance. Other possibilities, including the use of sulfuric acid for the cleansing of steel, wire and nails, and for fixing ammonia in wash water from gas works into sulfate of ammonia, an important fertilizer, began to loom as important outlets for Grasselli products.

By the end of the War between the States, production had reached the rate of 10,000,000 pounds of 66°Be. sulfuric acid at the Cincinnati plant. Soap and candle manufacturers continued as important consumers of Grasselli products but since 1860 a new use for sulfuric acid was claiming an ever increasing share of the company's output.

John D. Rockefeller had saved $700 from the profits of his produce commission business in Cleveland, Ohio, and had invested in his first oil well. By 1866 Cleveland had 50 petroleum refineries and the price of 66° sulfuric acid, an essential chemical in refining processes, had risen to six cents a pound.

Acid plants began to spring into existence there to take care of the mounting volume of business. A group of refiners associated with a banker in starting a plant to make sulfuric acid in 1866, and at Cincinnati, Marsh & Harwood, competitors of Grasselli, decided to double plant capacity. Eugene Grasselli, with keener insight, determined that Cleveland offered advantages as a location for future expansion of his business.

Brimstone used in acid making came from Sicily and reached Cincinnati by way of Cleveland. Acid three times the volume of the brimstone then had to be shipped from Cincinnati to refiners in Cleveland. Grasselli saw a handsome profit in freight savings alone was to be gained by building a plant in Cleveland, while a location in the center of the oil industry where Rockefeller's and other refineries were small but promising customers meant a further advantage.

He bought a tract of land at Independence Road and East 26th Street, near Broadway, just outside the corporate limits of the city, from Alphonso Holly in the summer of 1866. As in Cincinnati, a hillside on the tract provided the altitude for a gravity flow system for the plant.

Eugene Grasselli himself designed a chamber system, a concentrating house with two platinum stills and two sets of pans, a boiler house, a packing house, and an office building, all of brick construction. The proprietor, himself, completed the engineering details and drew all the plans for the new plant, including a unique flue installation for the boiler house which extended up the hill to the level of Broadway where it connected with a stack, providing the equivalent of a single stack 200 feet high.

Eugene Grasselli, accompanied by his assistants, Daniel Bailey and R. H. Andrews, went to Cleveland in the autumn of 1866 to start construction of the new plant. Bailey took charge of construction, while Mr. Grasselli directed the installation of the lead work in the chambers, the boilers and the setting up of machinery in the buildings. The proprietor returned to Cincinnati, remaining there until spring when he went back to Cleveland, taking with him his son, Caesar A. Grasselli, destined to succeed the founder as head of the company.

With construction in full swing, father and son, together with their staff, undertook the work of personal direction of the project under a schedule which the son often recalled brought them to the plant at 7:00 A.M. and kept them busy until 7:00 P.M. daily.

Factory construction in those days, the son recalled, was carried on without the services of a contractor or even an engineer. The head of the firm bought the machinery and equipment, hired all his own employees, directed their work and served at once as architect, superintendent, foreman and gang boss. The son labored as a bricklayer, plumber, stone mason, machinist and boiler tender. All structures were finally completed in September, 1867.

The first chamber system was housed in a building thirty feet square, and the still or concentrating house was a building fifty feet by fifty feet and contained the first installation of platinum stills and lead pans. This equipment represented an investment of $50,000. The still had a capacity of 20,000 pounds of sulfuric acid a day.

Installation of the lead in the chambers was accomplished by a method that represented an innovation in that day. Within these chambers huge curtains of lead reached from floor to ceilings. The curtains were fabricated from separate sheets of lead and the practice had been to join these by burning the seams as the sheets lay flat and then raise them into position.

After operation for a period of years these seams provided trouble spots for the attacks of corrosion that required frequent and continual patching. Grasselli brought to Cleveland a Frenchman named Valiant who had become expert in the burning of seams in upright sheets of lead. His system was adopted and a source of trouble was successfully eliminated. Grasselli's initiative in obtaining a source of fresh, cold water for his plant was equally enterprising. Despite the opinion of neighboring industrialists that he was wasting his time, Grasselli decided to dig a well. No water had ever been obtained that way in the vicinity. At thirty feet he struck a four inch head, flowing at from 55° to 65° F. the year round, astounding the doubters. A storage system on the hill fed water under gravity to all points where it was needed in the works. Subsequently the Rockefeller, Andrews and Flagler refinery on the other side of Broadway from the Grasselli plant assured by the advice of Grasselli that they too could find water for their needs on their own property, drove a well and obtained adequate supplies as Grasselli had predicted.

With access to the nearby Cuyahoga canal, the firm depended upon water transport and horses to haul acid from the plant to the local Cleveland market and to railroad stations, and it was 1884 before the Grasselli plant had access to a railroad by a siding. The road from Cleveland to Canton, Ohio, was completed in 1880 and four years later the company was permitted to fill in the canal and used the portion passing the plant for its right of way.

The coming of the railroad brought great changes in the method of handling materials at the plant. No longer was it necessary to pile up huge stocks of coal and materials in the fall for using during the winter when the freezing of the canal closed it to traffic. Chemicals could then be brought to and shipped from the plant by switching to and from any of the railroads running into Cleveland and the foresight of the designer in laying out the plant made it possible to completely track the company's yard without removing or altering a single building.

The change to rail introduced the use of tank cars for the first time. The earliest tank cars were made of iron and had capacities of about 27,000 pounds. Development of this method of transporting chemicals advanced to the point where the company pioneered construction of cars with capacities of 140,000 pounds. Earlier shipments had been made in glass carboys, 60 carboys to the carload for a weight of about 9000 pounds of acid.

Though the post-war economic slump caused a recession in other industries, the petroleum business flourished, taking all the sulfuric acid that existing facilities could supply. While Grasselli was building in Cleveland, Marsh and Harwood were doubling the capacity of their plant in Cincinnati, one refiner was setting up a restoring works in Cleveland and another group of refiners there was operating its own acid plant, the Cleveland Chemical Works. The demand continued through 1867.

Then the production from four new plants flooded the market, and prices fell ruinously. Though 1868 opened with a revival of business in general, Grasselli that year noted a drop in sales to a total of 68 cents and receipts to the sum of 75 cents during the worst week of the slump.

The Cleveland Chemical Works located on Independence Road across from Grasselli was operated for the refiners interested in it by an organization headed by Dan P. Eells, president of the Commercial Bank, and included the brothers Charles and Lewis Bratenahl, Joseph G. Hussey, and William D. McBride, partners in a copper business, W. C. Schofield, with I. H. Mansfield, later a prominent figure in the chemical field. These men were unfamiliar with the chemical industry and had as their technicians a Mr. Leidenfrosch and Julius Daub, the latter a graduate of a German university who had gained wide practical experience in the chemical firm of Hasenclever, at Stolberg, near Aachen, Germany. The acid works a restoring plant for the recovery of sulfuric acid from refinery wastes, occupied the former site of the Hussey and McBride copper plant, also on Independence Road.

By the fall of 1868, Marsh and Harwood decided it was hopeless to attempt to retain their Cleveland markets in the face of the overexpanded production facilities in a glutted market. In conferences between Grasselli and Marsh, it was decided the solution lay in combining some of the plants. Marsh, aided financially by Grasselli, purchased the Cleveland Chemical Works, and it became the Cleveland plant of Marsh and Harwood.

There remained the restoring works. Here iron kettles were being used for concentrating sulfuric acid. These in addition to giving off an odor highly objectionable to residents of the now thickly built neighborhood often exploded, frequently causing loss of life and property damage. Troubles piled up and when the company failed, Marsh and Grasselli, joining with equal interests, purchased the plant, naming it the Union Acid Works. The new partnership relocated the plant on the Ohio Canal, near Willow, and installed new glass stills, replacing the iron pots. The new unit proved profitable for many years, until Standard Oil began restoring its own acid, when the plant was abandoned and the property eventually sold.

The partners then were supplying acid to Standard Oil in Cleveland and also to refiners in Pennsylvania fields. In 1870, they expanded their operations, acquiring an acid plant that had been established at Titusville, Pennsylvania. Soon after, another joint project was launched with the construction of a restoring plant at Boughton, Pennsylvania, near Titusville. These two projects proved profitable, but when flush production in Pennsylvania's western oil fields dropped off, the plants were dismantled.

Expansion of Grasselli interests brought into the various plants a number of men who were later to play an important part in the company's development and operation. I. H. Mansfield, from Cleveland Chemical, went with Marsh and Harwood as head of sales and accounting. Julius Daub was operating superintendent of the Titusville works, remaining with Grasselli until 1901, when he died. Herman H. Gronemeyer, from Cleveland Chemical, was retained as superintendent when Union Acid Works succeeded to ownership. He later entered the Grasselli plant at Cleveland, became superintendent and was finally advanced to be a member of the Manufacturing Committee of the firm. Marsh and Harwood recruited a valuable member of its staff in John H. Metz, originally a plumber who had learned the acid business, and had built the Titusville plant. Later he joined the Grasselli organization.

During the decade of the '70's the chemical industry was threatened with an invasion of their field by the oil refiners. C. A. Grasselli, by this time active in leadership of his father's firm, recalled in his reminiscences of the company's affairs that sulfuric acid manufacturers were notified by the refiners that prices were too high.

Word that the refiners proposed to make their own acid reached the sulfuric acid manufacturers and after a number of conferences it was decided the chemical men should meet in New York while the oil men were holding their meetings there. The oil men assembled at the Metropolitan Hotel, he recalled, and the chemical men met at the St. Nicholas.

"Confronted with a rather well defined proposal on the part of the oil men that they would make their own acid," he wrote, "the chemical manufacturers on their part projected a

petroleum refining company which would locate its refineries at the plants of the members of the organization and would market its products in competition with those of the oil men.

"All those present were in accord with the suggestion and it was felt we would be placed in a position equally as strong as that of the oil industry. It was remarked that we had more capital represented in the St. Nicholas than the petroleum industry at the Metropolitan."

Charles Pratt, of New York, and William G. Warden, of Pittsburgh, were finally appointed members of a committee to consult with representatives of the chemical organization. Negotiations for a satisfactory settlement of the differences were under way when an important member of the chemical group suddenly began absenting himself from sessions of the organization. Grasselli prevailed upon him to attend one more meeting, but it was soon disclosed that he had yielded to the persuasion of some of his friends in the petroleum group and had won a contract for supplying acid for New York and Buffalo refineries.

He built a plant at Buffalo but upon the expiration of his contract with one refiner, lowered prices which they insisted upon as the condition for a renewal so exasperated him that he built a large oil refinery at Buffalo to enter into competition with his former customers.

Shortly after the New York negotiations, John D. Rockefeller visited the Grasselli firm in Cleveland and arrangements were completed by which the company continued to supply acid for the Rockefeller refineries for five years at prices entirely satisfactory to Grasselli, and Standard Oil continued to use Grasselli acid throughout the years. Recalling the association, Mr. C. A. Grasselli in 1928 wrote: — Diary July 7, 1928

"We supplied oil refineries from the time petroleum was discovered until today. In our early days in Cincinnati, the Cleveland firm of Rockefeller and Andrews, small as it was, was one of our very good customers. Since then our relations with the Standard Oil Company have always been happy. The tonnage increased year by year with the growth of their business and we still sell very large quantities of acid to Standard. We are in fact, the only firm now dealing with Standard companies who started doing business with Rockefeller and his associates in the 'Sixties."

He also relates how after he had succeeded to the presidency of Grasselli, then titled The Grasselli Chemical Works, upon the death of his father Eugene Ramiro Grasselli, in 1882, Mr. Rockefeller sent for him and explaining that the sulfuric acid business was so closely related to the oil industry asked him to join his interests with theirs, offering Grasselli Standard Oil stock for his company. Grasselli inquired what was to become of Mr. Marsh, and revealed that upon being told there was no place in the picture for the close associate of the elder Grasselli he "promptly advised them their proposition did not interest me."

Though sulfuric acid remained the major product of the Cleveland plant throughout the years immediately following its opening the company meantime continued to add to the line of chemicals manufactured there, planning to duplicate the varied line being produced at Cincinnati.

Items added to the Cleveland line included nitric and muriatic acids; sulfate of iron, or copperas; aqua ammonia; soda ash; sal soda; Glauber's salts; and sulfate of zinc. Virtually all the chemicals made in Cincinnati, except for some pharmaceutical products, were being turned out by the new plant.

By 1870, Grasselli and Marsh and Harwood, operators of Cleveland's two chemical plants, were producing yearly 70,000 carboys of sulfuric acid, by far the greater part coming from Grasselli. That year the entire state of Ohio boasted 18 drug and chemical plants whose combined annual twelve months' output was valued at $572,370. Two years later, annual output of the two Cleveland companies reached a total of 105,000 carboys of sulfuric acid.

C. A. Grasselli, himself, set up the apparatus for making muriatic and nitric acids at Cleveland. When that was completed he proceeded to install a boiler and lead and glass condensing units for making aqua ammonia, and finally erected machinery and equipment for processing sulfate of iron. The company next installed facilities for making soda ash by the Le Blanc process and crystal soda, designs for both being projected by the senior Grasselli.

A detailed description of the original method of making sulfuric acid is recorded by C. A. Grasselli in notes on the history of the company, compiled in 1928.* The process was still in use when he became active in the business. Brimstone was used, not pyrites, he recalled. * Died [illegible], 1927.

The brimstone was burned in a sheet iron box containing a double row of sheet iron drawers upon which the brimstone mixed with 10 percent of nitrate of soda was ignited. The mixture was fired in the morning and burning continued until late in the evening. The vaporous fumes from the burning boxes were conducted to an adjoining chamber, a lead-lined room, thirty feet in cube. The chamber filled gradually with the sulfur dioxide and nitric acid vapor. When puffs of the pungent yellow vapor were observed seeping from leaks in the leaden chamber, it was time to extinguish the flames in the burning box.

This was accomplished by cutting off the supply of air from the receptacles in which the burning took place. The room, of course, was filled with dense fumes from the combustion so that workmen could not enter it, Grasselli said. The operators were forced to stand at some distance from the air vents to the boxes. The vents were closed by mud balls hurled at the openings by the workmen. With skilled marksmanship, the operators finally checked the flames after a barrage of mud plastered the holes shut.

When combustion had ceased, jets of steam were introduced into the huge leaden chambers, and in the drizzle, sulfuric acid was precipitated to the floor of the room. This process continued all night and next morning an operator would climb to the top of the chamber to open a trap door through which remaining gases were allowed to escape. The process began again with burning of the mixture and the cycle continued. Five such chamber systems were installed in Cleveland between 1866 and 1884.

The younger Grasselli was sharing increasing responsibility in the direction of the firm and two years after he married Johanna Ireland, of Cincinnati, whom he had known from childhood, there appeared in Cleveland and Cincinnati newspapers the announcement that he had been taken into partnership with his father. The new style of the firm became Grasselli Chemical Works, E. Grasselli and Son, Manufacturing Chemists.

Then after about nine years of this association, the elder Grasselli died suddenly on January 31, 1882, and Caesar A. Grasselli assumed the entire direction of the business. Up to that time his activities had been devoted to the operation of the firm's various plants. Of this time he wrote:

"Without warning, I was forced to assume not only direction of operations in the plants, but also the many complications that arose in regard to the business problems of that time.

"Mastering the financial problems which confronted me and with which I was quite unfamiliar and yet which were so necessary in the operation of the family interests was so overwhelming at times that I felt almost as if I should be unable to cope with the many problems I faced.

"The new situations that arose can be regarded as succeeding phases of a busy life, and each held its own peculiar beauty. The period that was closing had brought all the magic spells of romance and youth. The period that was opening was to bring the fullness of achievement in business."

It was shortly after he became its head that C. A. Grasselli entered into important association with E. I. du Pont de Nemours and Company. Grasselli with Marsh and Harwood had been supplying mixed acids to manufacturers of nitroglycerine since 1866 and by 1882 among the most important customers in the new line were the California Powder Company and Lake Superior Powder Company.

General Henry du Pont, then head of the du Pont Company for many years resisted efforts of Lammot du Pont, his nephew, to enter the nitroglycerine field. But in 1876, du Pont acquired an interest in the California company and a few years later bought outright control, including the Hercules plant, at Cleveland, and reorganized it as the Hercules Powder Company. About the same time du Pont also acquired the Lake Superior Company, at Marquette, Michigan.

Meantime, Marsh and Harwood formed their own explosives subsidiary to make nitroglycerine, and though untrue, a report gained currency that Grasselli was interested in the venture also. J. H. Willard, one of the operators of the original California company, later associated with du Pont, and Lammot du Pont considered the Marsh and Harwood subsidiary a serious menace. It appeared the explosives manufacturers might provide their own source of acids.

"We were confronted with losses of acid business like those we had faced when oil refineries were thinking of making their own supplies," wrote Caesar Grasselli, "and our reply was the same as it had been to the oil companies, if our customers would go into our line we would go into theirs.

"Thereupon, Mr. Willard came privately to us and made a proposal which looked like an effort to divide the acid interests. He was willing to keep on buying all of the Hercules mixed acids requirements of us in view of the encroachment of Marsh and Harwood on the dynamite field.

"My position on this suggestion was something like that father had taken on a similar occasion with the petroleum people years before. I informed Mr. Willard that we would furnish half his acid provided he got the rest from Marsh and Harwood. Naturally this irritated him, but after I refused to deviate an invitation came to Mr. Marsh, Mr. Mansfield, of Marsh and Harwood, and me to attend a conference with Mr. Lammot du Pont and Mr. Willard. We discussed matters at the Continental Hotel in Philadelphia, Pennsylvania, for five weeks."

Several times negotiations reached an impasse and were on the point of being broken off, but finally a seven-year contract was concluded between the two chemical firms and du Pont by which all the acid required by the two plants would be supplied by the acid manufacturers, Grasselli continued to supply all the acid used at Hercules in Cleveland until the plant closed in 1897.

But the conferences in Philadelphia bore further fruit In the course of discussions, Mr. du Pont told of his need for sulfuric acid stronger than the 66° product then supplied and said samples of greater strength generally contained traces of the platinum from vessels in which the acid was made. Mr. Grasselli said he thought he could produce acid of at least 97 percent concentration and possibly near 98 percent, in carload lots.

"He did not doubt our ability to do just that but he bet me a box of cigars it couldn't be done," Grasselli has recorded, "and I took him up.

"We were using glass stills in concentrating sulfuric acid from the oil refinery acid wastes and were carrying the concentration to a point where the carbon in the acid was decomposed.