Charles F. Wallace and Martin F. Tiernan. These are hardly household names and certainly not recognizable to many when thinking about the great U.S. inventors of the early twentieth century. And yet the accomplishments of these two individuals rival those of Edison, Westinghouse, and Ford, except that instead of introducing new products to make life easier, Wallace & Tiernan focused on products to provide one of man’s most basic needs: safe drinking water.

At the beginning of the twentieth century, the benefits of safe drinking water were beginning to become well known, but unfortunately, were not often attainable. Epidemics of dysentery, cholera, typhoid fever, and other water-borne diseases were common, even in the most modern, wealthy cities. They killed thousands of people and were a constant threat to strike at any time or place. Typhoid fever alone killed over 20,000 people every year at the turn of the century. For those Americans alive in the year 1900, the chances of dying from typhoid alone were one in 400. Today, according to the U. S. Public Health Service, those odds have shrunk to an incredible one in ten million.

This dramatic reduction stems in great part from the chlorination of drinking-water supplies. Chlorination’s importance is best shown by the following quote from a prominent American medical journal:

> Chlorination of water supplies is probably the most important contribution made by this country to the art of water purification. In fact, this process stands out as the most useful procedure yet devised for insuring the safety of a municipal supply.

As further testament to the effect of chlorine disinfection of drinking water on mankind, LIFE magazine’s millennium review of great events hails this as a top achievement:

> Along with the discovery of gravity, the Guttenberg Bible, and landing on the moon, the use of chlorine-disinfected water was named one of the millennium’s greatest historical events by LIFE magazine.

LIFE cited the filtration of drinking water and the use of chlorine disinfection as probably the most significant public health advance in the millennium, forty-sixth among the top 100 achievements of the past 1,000 years. The use of chlorine for the disinfection of drinking water ranked ahead of other significant discoveries that have been beneficial to human health - including DNA, the X-ray, anesthetics, and food storage.

In a 1992 survey, 92 percent of US public health officials agreed that chlorine is crucial to eliminating waterborne diseases, and 87 percent cited chlorine as the safest way to ensure quality drinking water.

Back in the early 1900s, engineers discovered that chlorine bleach added to the drinking water supply was effective in eliminating the micro-organisms that caused the waterborne disease outbreaks. The disinfecting power of chlorine was starting to be understood, although a skeptical public was slow to accept this new technology. Afterall, chlorine bleach is poisonous, so why would you add it to drinking water? It is the low level application in parts per million that allows chlorine to do its job without harm to humans.

Unfortunately, chlorine bleach is not an easy chemical to handle and application at low feed rates is difficult and often unreliable. This is a problem that persists even today. What was needed was a reliable way to feed pure chlorine gas. Luckily, for the world in general and for us in particular today, there were two young, unemployed engineers wandering around in 1911, who decided to pool their savings (approximately $1800) and venture into the water treatment equipment market.

What follows is the story of the beginnings of the Wallace & Tiernan Company as told by Martin Tiernan in a 1948 paper presented at the annual American Water Works Association Conference in Atlantic City, NJ. Tiernan named this paper “Controlling the Green Goddess”, in deference to the amazing properties of a simple chemical known as chlorine. Tiernan wrote:

> Well may chlorine be called the Green Goddess, because of the important place she occupies in the chemical field, and the tremendous scope of her influence and power; her ability to do good or evil for mankind and the ever increasing realm of her activity. Corrosive to practically all things, she is safe and docile when properly handled but can at times be most vexatious and dangerous to those who would woo her without an understanding and appreciation of her nature.
The association between C. F. Wallace and myself began in New York about the middle of 1909. Wallace, an electrical engineer with practical experience - which started with digging post holes for telephone lines - got a job with the Gerard Ozone Process Co., a manufacturer of machinery for producing ozone. I came to New York about two weeks before Wallace's arrival, from Pittsburgh, where I did laboratory work for the Pittsburgh Typhoid Fever Commission. The Gerard Co. hired me as a chemist. I had graduated from the University of Rochester in 1906 and my first job was at the Rochester Water Works on a reservoir job. Wallace and I lived together in New York and this was the beginning of an association which is now of nearly 40 years duration.

The ozone business folded up and Wallace and I joined the Moore Filter Co., an outfit making vacuum filters used in mining processes. I was sent to Mexico to install some special equipment in a mine. I was paid $5.00 a day and expenses and had managed to save up $1,000 when I returned about nine months later.

About the middle of 1911 I was let out of the Moore Co. and very shortly afterward Wallace followed. This probably was the most fortunate thing that could have happened to us. With my $1,000 and $800 that Wallace had saved, we decided to go into business for ourselves. We hired a small room in a loft building in downtown New York, spent three or four hundred dollars for second-hand tools and started in business. (It should be noted that 60 years later, this site would become part of the World Trade Center complex). I had been doing work for the firm of Charles E. North and E. B. Phelps, consulting sanitarians, in New York, and any odd dollars that I picked up here and there I turned in to our partnership.

In September 1911 a severe epidemic of typhoid fever broke out in Torrington, Conn. Phelps was called in on the job and sent for me to install an emergency hypochlorite or bleach plant. Using barrels and odds and ends, I put it in operation. Later on we (Wallace & Tiernan) made special calibrated orifices, float boxes, and the like for this plant and sold odd ones in other places.

At Torrington, I made the acquaintance of James A. Newlands, State Sanitary Engineer. The Torrington Water Co. kept me on until April 1912, when I returned to New York and picked up other free-lance jobs when I wasn't working with Wallace in our shop. At that time we had one employee. We developed various gadgets for handling hypochlorite solutions, and such items as orifices which might be used in experimental work. In the early fall of 1912 I spent about six weeks operating the hypochlorite plant for the Jersey City Water Dept. at Boonton, NJ, the chemist having gone on vacation. This background gave me pretty good experience in the hypochlorite picture.

I had previously learned that Carl Darnall, an officer in the U.S. Army Medical Corps, was working on the idea of using dry chlorine gas for water sterilization. Intrigued, I visited Darnall in Washington, where he told me of his work and gave me a copy of a paper he had published a year or so before. He had a small apparatus in the corner of his office, substantially the same as described in his article.

**Dover Hypochlorite Plant**

That fall William Griffin, the superintendent of the Jersey City Water Dept., was considering the installation of a hypochlorite plant at Dover, NJ, to treat a Rockaway River tributary which fed the Boonton reservoir. I suggested the use of chlorine gas to Griffin and he asked me to look into the matter. Griffin and I visited the office of the Electro Bleaching Gas Co. to see if chlorine was available, and I went to Niagara Falls to interview George Ornstein, a German scientist experimenting with chlorine gas disinfection. He took me over to the plant of the Niagara Falls Water Co., where Harry Huy was superintendent and where a method of making chlorine solution from chlorine gas was employed. The solution was made up in a tank from which it was fed by an orifice. The bacteriological results of Darnall and the Niagara Falls Plant compared very favorably with those obtained from hypochlorite.

I reported to Griffin that I thought a chlorine gas plant was the thing to install at Dover. As there was no water under pressure, a direct-feed apparatus had to be used. Wallace and I made a proposal to Jersey City to install such a plant, with guarantees as to operation, for the sum of $150. At that time we hadn’t even designed the apparatus.
We secured a cylinder of chlorine from the Pennsylvania Salt Co. (In a strange twist of fate, this was the same Pennsylvania Salt Co. that would merge with Wallace & Tiernan in 1969 to form the PennWalt Corp.) and started on the apparatus. We entered into the program full of enthusiasm but ignorant of the properties of compressed chlorine gas. Had we suspected the difficulties before us we probably never would have attempted this activity.

The first apparatus used hard rubber parts, in contact with the chlorine, and ordinary solder for joints of metal tubing. When subjected to chlorine under pressure it literally blew up in our faces. After many tries, we produced a controlling mechanism which, under a short test in our shop, seemed to be all right, and we arranged to install it at Dover. The apparatus was put on the wall in the pattern shop of the McKernan Drill Works, which happened to be located on the edge of the Rockaway River tributary, and had a lot of nice bright, shiny tools. To effect the solution of the gas in the stream, we put an inverted trough across the stream bottom, weighing it down with stones, and introduced the gas at one end of the trough. In as much as this water was a tributary to a drinking water supply, it was necessary to get the approval of the New Jersey State Board of Health. Fitz Randolph, the director, was present to inspect the installation when the gas was turned on. A considerable portion of the gas came to the surface of the water, but a good strong breeze diluted it so that Randolph got just a very slight odor. He said, “That smells okay and the installation seems to be in order.”

We left the apparatus turned on and returned to New York. The next morning when we entered our shop the phone was ringing. The McKernan Drill people wanted to know what we were trying to do up there. The apparatus had sprung a leak during the night, all the tools in the shop were coated with rust, and they had promptly thrown the device out the window.

We redesigned the apparatus and made diffusors out of small Aludum grinding wheels, cemented into the saucer of a flowerpot. We had a small house built on the bank of the stream, made the installation and anchored the diffusors to the bottom of the stream, where the gas was led, first through hard rubber tubing and later through silver tubing. We completed the installation on February 22, 1913. The meter was a volumetric inverted syphon type, which we are still using. The apparatus gave satisfactory service for a good many years.

[Martin Tiernan’s story continues with other early installations that put the fledgling company on its feet.]

A second installation of this kind was made at Fords Pond, on another stream at Dover. This time we raised our price to $200. Fortunately for our finances, payment on the two installations was received fairly promptly.

James A. Newlands, whose name I mentioned above, was acting as consultant for the Stamford Water Works, which was considering a hypochlorite plant. Newlands wanted an automatic device to feed a sterilizing agent in proportion to the flow of water, which fluctuated widely and rapidly. Wallace and I discussed the matter and offered to install a Venturi-operated automatic chlorinator for $500 before we had even made the design. We guaranteed that the apparatus would operate satisfactorily for two years and would proportion the chlorine properly. We even went so far as to absolve the Water Company from any loss in case of patent infringement. Mind you, all for the sum of $500! This surely was a mark of our confidence and ignorance.

It was only a matter of a few days until Wallace had figured out a way of handling the problem. Three balanced diaphragms, functioning as two, were operated by the differential pressure across a Venturi throat in the water main, to maintain a drop in pressure across the gas control valve in proportion to the drop across the Venturi throat. This would give a proportional flow of chlorine to the water through a variable orifice (the control valve). A simple, low-voltage dc. toy motor, operated by six dry cells and costing some six or eight dollars, was cut in and out by contacts operated by connections to the diaphragms. This motor operated the control valve in the gas line until the drop in pressure across the valve was proportioned to that across the Venturi throat.

The installation was made at Stamford on September 3, 1913, and functioned perfectly from the very beginning. Chlorine was introduced into the intake well through a silver tube and a diffusor submerged to a depth of 25 ft. So sensitive and accurate was the automatic chlorinator that it would vary the flow of chlorine before the change in the flow of water was indicated by the Venturi meter.
Later that year we installed automatics at New Haven, Torrington and Hartford, Conn. The automatic feature of these three machines was modified to eliminate the electric motor.

In June 1913 Herman Rosentretter, of the Newark, NJ, Water Dept., hearing of our installations for Jersey City, gave us an order for a direct-feed manual-control machine for the entire Newark supply. The installation was made at the Macopin intake, using diffusors which fed into an open well.

In July 1913 we installed a direct-feed machine at the pumping station of the Bernardsville, NJ, Water Co. The apparatus fed directly into the in-take line of a pump. I remember quite clearly going by train to Bernardsville, carrying the machine under my arm, then taking a bus to the south, down toward the pumping station, and walking at least two miles with the machine on my shoulder. Wallace and I spent the July 4 holiday cutting a tap into the suction line in the engine room. It was a pretty hot job. We hung the apparatus high up on the wall, above the hydraulic gradient, figuring that the water would not get back into the machine. Of course, as soon as the apparatus was turned off, when the pump was shut down, the chlorine in the line from the apparatus was quickly absorbed by the water, and before morning the machine was flooded. After the development of a satisfactory check valve, the installation was completed.

In October 1913 the city of Philadelphia called for bids on chlorine apparatus for five filter plants. We offered direct-feed machines, and the Electro Bleaching Gas Co. solution-feed machines. Although we were the lower bidders, the contract was awarded to Electro Bleaching Gas. This was our first experience in which the low bidder did not get the job. Naturally we were very much disappointed, but we accepted the situation, feeling that the city had a right to purchase whatever equipment it thought best for its needs.

The Boys’ Club at Waterbury, Conn., wanted a machine to sterilize its swimming pool. After a direct-feed apparatus proved unsuccessful, we developed a solution-feed machine using an enclosed glass jar in which a volumetric meter was submerged and into which an impinging jet of water was introduced to effect the solution of the gas. The scheme worked out very well and we made quite a number of installations of that type. The maximum capacity was about 10 lb. of chlorine per day.

Trenton, NJ, was in the market for a solution-feed machine of a much greater capacity than ours, and we developed an enclosed glass-jar arrangement with an impinging jet which, for its size, had a very large dissolving capacity. Being a closed system, the danger of gas escaping was eliminated. This type was also very successful in operation.

My files show that in September 1914 we had 23 installations in eighteen different cities.

In July and August 1914 New York City ran comparative tests on the equipment of the manufacturers of chlorine apparatus, then three in number. We installed a direct-feed manual control, and the results of this test were very satisfactory to us.

On April 4, 1916, we installed nine of our direct-feed units to treat the water of the new and the old Croton, NY, aqueducts, with a capacity of 340 mgd. This installation functioned very well until the water became cold, when chlorine hydrate forming in the diffusors caused difficulty. Later on, this installation was changed to a solution-feed type.

By this time we were pretty thoroughly established in the chlorination field. In solving practical problems, we had found it necessary to make a great number of ingenious devices to meet special operating conditions. For the glass solution tower we had substituted the injector, to dissolve the chlorine. We had developed special valves for various purposes; cements; lubricating materials for valve packing; rubber tubing and hard rubber of formulas best suited to withstand corrosion; and machines of ever increasing capacity and constantly improved design. We had developed the vacuum type of apparatus for manual, semi-automatic and automatic control. The time and cost of all these things was simply tremendous, and only a genius like C. F. Wallace could have accomplished such results. As a matter of fact, after a nationwide poll on the occasion of the 150th anniversary of the founding of the U.S. Patent Office, Wallace was named as one of the nineteen great inventors in the United States and was given a suitable memento.
THE COMPANY’S FOUNDERS

Charles Frederick Wallace was born July 1, 1885, to Charles Stewart and Nellie (Gatehouse) Wallace. Since his father was a colonel in the U.S. Army, he spent his boyhood and adolescent years on or near the army posts where his father was stationed. Although highly intelligent, he never earned a college degree. Wallace did, however, develop an early fascination with gadgets, especially those powered by electricity. He would then study scientific books while tinkering with various instruments and devices.

In a similar manner to which computers have been applied to our lives today, so it was with electricity during this era. People were discovering thousands of ways in which electricity could be used to improve the quality of their lives. So Wallace became the inventive genius of the company with his own army of engineers and scientists to assist him along the way. Before his death in 1964, Wallace held more than 80 patents making scientific contributions to the fields of science and health.

A most reserved individual, Wallace rarely spoke at board meetings or public functions, depending instead upon Tiernan as the salesman and spokesman. Wallace was most at home in his office-laboratory, surrounded by shelves piled high with his inventions, and his ancient rolltop desk full of tubing, valves, fittings, and other metallic remnants of many years.

Martin F. Tiernan, on the other hand, tended to the company’s business interests. Born in Charlotte, NY, a suburb of Rochester, the seventh of an Irish immigrant farmer’s family of nine, he had worked his way through the University of Rochester and then studied sanitation at the Massachusetts Institute of Technology. Although he was highly qualified as a chemical engineer, and in fact worked together with Wallace early in the company’s development, the company’s growth found him doing what he did best in his managerial ability.

An article in Nation's Business in 1951 notes: “It is difficult to imagine partners with more opposite talents and tasks. Wallace doesn’t like to travel. Tiernan loves it. Wallace neither smokes nor drinks. Tiernan does both. Wallace seeks no amusement outside his work except a movie on Tuesday and Thursday nights. Tiernan hunts, shoots and plays golf.”

Nonetheless, the two men had complete faith and confidence in each other, and respectively each gave the other independence in his own sphere. Out of this mutual trust they developed a corporate partnership which seemingly knew no bounds.
WALLACE & TIERNAN – THE GROWING YEARS

The success of the original installations and Tiernan’s aggressive salesmanship soon generated many chlorinator orders. On November 13, 1913, Wallace & Tiernan was officially incorporated and the company was on its way to success. By 1916, 300 W&T Chlorinators had been installed and the company had outgrown its original home, the $20-per-month loft on Liberty St. The shop and office were relocated to larger quarters at 137 Centre St. in Manhattan.

At the onset of World War I, Wallace & Tiernan sold a large number of installations for use overseas by the British Army. Many of these were installed on special trucks equipped with pumps and filters and proved a great advance over the old chloride of lime disinfection process. When the United States entered the war, there was a great demand by the army for much of this equipment for camps and cantonments (temporary troops quarters).

When World War I ended in 1918, the number had grown to 600 installations and the company had made a significant contribution to the war effort: W&T supplied over 4,000 portable chlorination units to the American and allied armies in the field and to the American Red Cross.

By the end of 1918, the company’s offices had moved to 349 Broadway, leaving the factory to occupy two floors on Centre Street. More important, 1918 marked the first use of W&T Chlorinators in an industrial application: the Berkshire Paper Company’s mill at Adams, MA.

By 1920, W&T had completed over 2,000 successful chlorinator installations and, for the first time, used chlorine for other than water or waste treatment.
WORLD WAR I ERA PHOTOS

The 500th Chlorinator and a portion of the organization in 1917.

Production Department presses to meet ever-increasing insatiable demands of the sales manager – 1919.

The growing young concern exhibits its wares in the public mart – Cincinnati, 1915.

A W&T Sterilab Truck in operation.

W&T Sterilab Truck - A complete water purification plant and laboratory on wheels.

Five of a fleet of 14 W&T trucks delivered December 29, 1917.
THE MOVE TO BELLEVILLE

By 1921, the company outgrew the rented space in New York and decided to look for another location where they had the opportunity to expand, should the need arise. This would prove to be a wise decision.

They purchased property and a factory building at 11 Mill Street in Belleville, NJ. The three-story brick building had previously been a manufacturing site for piano rolls. As the business grew, so did the need for more space. Additional property was acquired and a succession of new buildings was built starting in 1927. This would not stop until 1968, when the last plant expansion increased the size of the plant complex to an astounding 400,000 sq. ft.

Architectural plans called for the construction of tennis courts on the roof of one building and an outdoor, canopied rooftop dining area adjacent to the fifth floor cafeteria. Unfortunately, neither of these plans was fulfilled.

During the excavation of the pit for the foundation of one of the two passenger elevators, skeletal remains were found, causing quite a bit of excitement. It turned out that the remains were of horses that had died and were buried out behind the barn of the old Belleville Hotel.

What made all of this expansion and construction necessary was the prolific development of the chlorination process and the wide variety of equipment that evolved from that first chlorinator less than 10 years earlier in 1913. One of these products was the Chloro-Clock, a device that was developed for metering small amounts of chlorine solution in industrial and swimming pool applications. Wallace designed an extremely accurate clock-work mechanism as the control device for this equipment. In 1924, either Wallace or Tiernan saw an opportunity to evolve this mechanism into a new line of business: Clocks.
The Belleville plant in its heyday - the last plant expansion increased the size of the plant complex to an astounding 400,000 sq. ft.
SOME W&T PRODUCTS FROM THE 1920S

The W&T Chloro-boat was used for disinfecting large reservoirs or sterilizing large outdoor swimming areas.

The W&T Chloro-meter was controlled by a water meter and used for applying bleach and other chemical solutions to a water supply.

The W&T Chlorine Inhalator for the therapeutic use of chlorine in the treatment of respiratory infections.

Mr. Tiernan demonstrates the W&T Chlorine Inhalator for the NYC Dept. of Health.

The A-367 Volumetric Chlorinator was intended for low-accuracy applications.
Gen. Fries Finds Chlorine Effective Weapon In Man’s War Against Germs

By BRIG. GEN. AMOS A. FRIES
Chief, Chemical Warfare Service U. S. A.

ON Flanders Field in 1915 chlorine gas was used as a deadly war weapon to mow down men by the thousands. In twenty minutes a handful of men completely broke the Allied front, making a gap three miles wide. For a few hours there was nothing to prevent the German hordes marching to the English Channel.

Today, instead of human lungs being its target, chlorine gas is waging war on the germs responsible for so many of our ills. From killing to curing is the change that science has gradually brought about. Modern times furnish no such graphic example of beheading swords into plowshares as that contained in the discovery that chlorine gas, introduced by the Germans, as a powerful weapon of war, is now an effective treatment for colds, influenza, whooping cough and other troublesome and injurious diseases.

If the future vindicates the indications of the present, and we have no cause for doubt, it is believed that this chlorine gas will save in peace more lives each year than was destroyed in the entire World War. Thus does civilization progress.

Since January of last year when the Secretary of War demonstrated his faith in this new treatment by submitting to it, following which he declared himself much relieved, 2362 persons have been treated with chlorine gas in the Medical Division of my office in Washington. Two thousand, three hundred and sixty-two of these have been completed, 86.3 per cent reporting themselves cured or greatly benefited. Among them were members of the U. S. Senate, the House of Representatives, the Diplomatic Corps, many other government officials and prominent people from all parts of the United States who came to Washington solely for the purpose of trying the chlorine treatment.

Governing the prevalence of colds and bronchial troubles among members of the Senate and House, of course, we will want to know if such be possible, exactly what chlorine does to the human system and to the germ. In the meantime, I am vitally interested in whether or not it will aid in preventing respiratory diseases, or will cure them or will decrease their danger. Scientists or no scientists, doctors or otherwise I want to go on record, definitely, here and now, that chlorine helps prevent the development of certain respiratory diseases, decreases the danger and vigorous character of others, and cures still others. Whether it cures by killing all of the germs, a part of the germs, or none of the germs, I do not know and matters little.

Brig. Gen. Amos A. Fries

A room in the Capitol building was used as a gas chamber for treating members of Congress and other government officials. This room remained in use until the adjournment of Congress in June. During that period nearly 1,000 persons received the chlorine treatment.

About the middle of last March chlorine chambers were established in the offices of the Attending Surgeons of the Army and Navy, where nearly 5,000 persons have been treated. Among them was the President of the United States.

I am not primarily interested as to whether chlorine kills a part of the germs or all of the germs or none of the germs. Eventually, of course, we will want to know if such be possible, exactly what chlorine does to the human system and to the germ. In the meantime, I am vitally interested in whether or not it will aid in preventing respiratory diseases, or will cure them or will decrease their danger. Scientists or no scientists, doctors or otherwise I want to go on record, definitely, here and now, that chlorine helps prevent the development of certain respiratory diseases, decreases the danger and vigorous character of others, and cures still others. Whether it cures by killing all of the germs, a part of the germs, or none of the germs, I do not know and matters little.
THE WALLACE ELECTRIC CLOCK

After three years of research and development, a battery-powered, electric clock was perfected. In keeping with the company’s proud reputation for quality and precision, 30 models were placed under laboratory test and observation and subjected to every conceivable breakdown test. They were operated at high speed to give them the equivalent of 50 years of actual wear. Only when all of these tests had been successfully met, was the clock entered into production. Two thousand clocks were manufactured and sold into a limited test area. Public response was enthusiastic. The clocks were marketed in jewelry stores where they were also praised for their quality. Unfortunately, one year following the introduction of the clock, the stock market crashed in October 1929. With a virtual monopoly on the chlorination business, W&T itself would hold up quite well. The clock business, however, with many competitors and the availability of inexpensive synchronous motor clocks, did not survive. In 1931, the Wallace Electric Clock was removed from sale.

THE W&T FLASHER MECHANISM

Ironically, a more successful venture grew out of the clock business with the advent of aids-to-navigation. These were marine beacons, range lights, lamp changers, foghorns, sun switches, buoys, and flasher mechanisms. This business got its start when a senior member of the U.S. Lighthouse Service (known today as the U.S. Coast Guard) was strolling around the W&T exhibit at a tradeshow in 1928, the year the clock was formally introduced. He suggested to the W&T salesman present that it might be possible to adapt the clock mechanism to flash aids-to-navigation lights in a precise and reliable manner. The salesman advised Mr. Wallace of this suggestion and within months, Wallace developed a prototype battery-operated flasher.

This would replace the common gas-burning marine beacons in use in those days with an electric lamp. Unfortunately, lamp technology at that time was able to produce lamps with only a limited operating life. This was a large obstacle to the use of electric lights for critical navigation applications. To solve this problem, Wallace developed and patented an automatic lampchanger in 1928. This consisted of a rotating drum holding a Model T headlight lamp at the focal point of an optic. When the operating lamp failed, a new lamp automatically rotated into the operating position. The U.S. Lighthouse service quickly embraced this lampchanger technology and rapidly converted the largest aids-to-navigation system in the world to electricity. Various models were made to hold from two to seventeen lamps. Today, you can see an example of one of these marine light lampchangers on display at the Ben Franklin Institute of Technology in Philadelphia.
THE "OTHER" CHEMICAL FEED PRODUCTS

In the early 1920s, W&T moved into the manufacture and sale of feeders for dry, free-flowing chemicals simply because the water and wastewater industries needed them. It was logical to develop better feeders to apply the lime, soda ash, etc., that they used. A little brother to the chlorinator, the hypochlorinator, was born in the mid-'30s to meet a related need. For small water supplies and swimming pools, economy dictated the use of liquid hypochlorite rather than chlorine gas. Thus W&T started making a variety of small diaphragm metering pumps. Eventually, larger, heavy-duty plunger metering pumps were designed and produced to address a wide variety of industrial applications. Many of the products that we manufacture and sell today evolved from these early designs.

PRECISION PRESSURE INSTRUMENTS

The design and manufacture of precision pressure instrumentation may seem unrelated to the chlorination business, but, like the aids-to-navigation products, the origin of these products can be traced to chlorine. It seems that in the mid 1930s, Mr. Wallace was doing some development work on chlorinators and needed a pressure measuring device. Commercially available gauges could not give him the accuracy and sensitivity he had to have. So, he designed and built one that would do the job! Wallace reasoned that other industries needed similar qualities in instruments. Therefore, the first instrument was quickly introduced for sale.

What followed was a wide variety of meteorological and pressure-sensitive instruments of high precision and superior accuracy. These instruments included precision altimeters, barometers, aneroid manometers, anemometers, and a complete range of absolute, gauge, and differential pressure instruments. These represented some of the most accurate instruments used by the Weather Bureau, the U.S. Army and Navy, and the Coast & Geodetic Survey, as well as colleges and universities. In more recent years, some of these instruments have found their way to NASA and are now in use for space shuttle support operations. Although no longer manufactured in the U.S., many of these precision pressure instruments continue to be manufactured by Wallace & Tiernan in Germany.

THE FLOUR BUSINESS

In 1919, focusing on what they knew best, chlorine and chlorination, W&T researchers were trying to find a means for artificially maturing wheat flour. Naturally they started with chlorine. They found that chlorine, when combined with other chemicals, not only matured flour, but also partially bleached it. The process was named the “Agene Process.” The first Agene equipment was installed in a New York City flour mill in 1920.

When the Agene Process came along, mills were using a product called Novadelox to bleach flour. In 1928, W&T acquired the Novadelox Process and established an associated company named the Novadel-Agene Corporation. The responsibility of this company was to handle flour mill activities, including the flour maturing process invented by Dr. John Baker, which enabled flour mills to produce better, more uniform flour than had been possible before. Additional products and processes, such as Dyox for flour maturing, Beta-Chlora for conditioning cake and pastry flour, and N-Richment-A for enriching flour were developed that further improved the operation of the flour milling and baking industries.
The basic test for the quality of flour is to bake it. So, W&T baked bread. It sought the keys to flavor in bread. It pursued answers to the mysteries of fermentation. From all of this work came the first continuous dough-making process, and in 1952, a W&T subsidiary, the Baker Process Company was formed. The Do-Maker automated system produced bread dough at rates of up to 6,000 loaves per hour, fast enough to overwhelm even the largest ovens in just a few hours. This continuous dough mixing and panning brought complete automation to commercial bakeries.

THE DECCO DIVISION

The use of chlorine and ammonium chloride in flour treatment generated nitrogen trichloride. As W&T researchers discovered, this active ingredient did more than mature flour. It also killed mold spores and bacteria on citrus fruit, lengthening the fruit’s shelf life and getting it to market fresher. Starting in 1934 with this application in the fresh produce field, W&T’s Decco Division developed chlorinated and other washes as well as waxes for fruits and vegetables.

To go along with these processes, W&T acquired the American Machinery Corp. in 1955. AMC manufactured a complete line of produce handling equipment: roller conveyors, automatic counters, baggers, sorters, and graders. AMC produced some unusual equipment, such as a giant pulp dryer for making cattle feed from citrus peelings. These processes saved the growers and shippers money and, more importantly, Decco-treated produce kept better and therefore meant less moldy, rotten fruit, potatoes, etc., on the pantry shelf.
THE CHEMICAL DIVISION

When W&T acquired the Novadelox flour-bleaching process in 1928, an organic peroxide called Lucidol came along with it. At the time, it was being sold for bleaching fats and oils. W&T researchers discovered that Lucidol was an excellent catalyst in the production of a new material called plastics. Sales mushroomed and the Lucidol Division was formed. W&T was now a chemical producer of prime importance.

This success led to the acquisition of the Hardesty Chemical Co. in 1951. This was renamed the Harchem Division, which was a bulk supplier of such specialty chemicals as plasticizers, glycerin, and stearic acid. Harchem was the world’s largest supplier of sebacic acid, a main ingredient in the production of nylon. With this acquisition, sales of the W&T chemical division would exceed equipment sales for the first time. Thereafter, chemical sales were the leading business for Wallace & Tiernan and would have a profound impact on the W&T organization in a future merger.

THE KOLER-KEG

One of the more unique products produced by W&T was the Koler-KeG System. Although this did not have much in common with chlorination, some would argue that it rivaled chlorination in its importance to mankind. It provided for readily available cold beer on tap.

Koler-KeG Dispensing Systems provided for controlled temperatures of beer by recirculating cooled water through heat exchangers built into beer kegs. Now it was possible to have a continuous supply of cold beer on tap, at a cost less than bottled beer.

A number of different systems were produced to accommodate any type of tavern. In fact, one of the buildings in the Belleville manufacturing complex contained a bar, set up and operated as if it were a typical tavern of the day—featuring local beers on tap, including Hensler’s, Feigenspan’s, Sunshine beer, and Kruger. The bar was there to demonstrate the Koler-KeG System.

This was the leading method of chilling beer at a time when beer was drawn from wooden kegs. It was a successful product and a money-maker, but it went out of business in the early 1960s with the advent of the aluminum keg.
SOME W&T PRODUCTS FROM THE 1930S

Bell Jar Chlorinator

Dry Chemical Feed System

Chlorine Residual Comparator

Water-Operated Hypochlorinator
THE PHARMACEUTICAL BUSINESS

In the early 1930s, W&T chemists tried to find a stable, slow-release chlorine-containing compound. The compound would have been used in very small water supplies, cisterns, cesspools, etc. The chemists didn’t find what they were looking for, but they did discover the active ingredient for Azochloramid, a powerful antiseptic, which put W&T into the drug field. By acquisition of Maltbie, Strassenberg Labs, and Pharmacraft in the '50s and '60s, Wallace & Tiernan became a major producer of pharmaceuticals with such popular over-the-counter remedies such as Allerest, Desenex, Cruex, and Caldesene, as well as a host of well-known prescription drugs.

CATHODIC PROTECTION

In 1946, the Electro Rust-Proofing Corp. was acquired. This company manufactured cathodic protection systems for the corrosion control of water tanks, elevated water towers, and treatment structures, as well as any other metal structure exposed to water such as buried pipe lines, docks, piers, and the hulls of ships. This was done with either an inexpensive, replaceable sacrificial anode or an automatic potential control system. The existing W&T sales force was already covering the municipal and industrial markets where this equipment was used, so it was natural to absorb this into the product mix. ERP or CP Systems as it was later named was a profitable business for W&T. In the mid 1980s, however, the line was sold so that the company could focus on the core disinfection and chemical feed business. Ironically, the USFilter acquisition of Electrocatalytic Inc. in 1999, included the CAPAC cathodic protection product line, which is primarily used on ships.
During World War II, Wallace & Tiernan was a prime contractor and supplier to the armed forces of the U.S., Canada, and the UK. The following are just a few of the contributions that W&T made to the war effort:

- Field and truck-mounted portable water purification systems.
- Individual water treatment kits, Dessenex foot powder, and a special skin cream for use in the event of chemical attack.
- Surveying and meteorological equipment.
- An adaptation of the Kooler-KeG design, used to help process aerial reconnaissance photos.

In addition, Mr. Wallace helped to improve a high-speed photography process that was used for ballistics studies, utilizing an actual ballistic test range located in the basement of the Belleville facility. Also, one of the more security-sensitive items developed and manufactured during the war was the new SONAR equipment. Although not a W&T invention, this was improved and manufactured by W&T under license from the U.S. Government.
In recognition for all of this production effort, W&T received the prestigious Army-Navy “E” award. This award is given for exceptional performance on the production front in times of national crisis, such as war.
SOME W&T PRODUCTS FROM THE 1950S


Frozen Food Convention Promotional Display


Early weighbelt feeder - Used to make chocolate and now on display at the Hershey Museum in Hershey, PA.

A-619 Self-Powered Gravimetric Feeder
Here's a typical 1956 installation of W&T chlorination equipment at a produce supplier. The W&T “Bell Jar” chlorinator is used to provide chlorinated water for the water sprays to wash and disinfect the fresh produce brought in from the fields.

The chlorinated water is used to washdown the plant and all of the equipment to prevent bacteria growth and improve employee safety by eliminating health hazards.
SOME W&T PRODUCTS FROM THE 1960S

Series 150A Plunger Pump - Grandfather of today's Chemtube 200 Pump.

Paste-Type Lime Slaker - Still sold today!

A-690 Volumetric Screw Feeder - Father of today's 32-050/055 Screw Feeders.

A-741 V-Notch Chlorinator - Father of today's V10k Chlorinator.
SOME W&T PRODUCTS FROM THE 1970S

Electronic Weighbelt Meter


V-100 Chlorinator - Forerunner of today’s S10k Chlorinator.

V-800 Chlorinators - Father of today’s V-2000 Chlorinator.
SOME W&T PRODUCTS FROM THE 1980S


Metering Pumps and Gas Feed Equipment
CURRENT PRODUCTS

V-2000 Chlorinator - for high capacity chlorination requirements

Depolox 3 plus Analyzer - for measuring chlorine residuals

Varea-Meter Flow Measurement - for liquid and gas applications

Encore 700 Mechanical Diaphragm Metering Pump - for metering and transfer of a variety of chemicals.

Series 32-050/055 Volumetric Screw Feeder - for dry chemicals.
WALLACE & TIERNAN AND THE GLOBAL MARKET

The products and services produced by Wallace & Tiernan were not limited to applications in the U.S. Mr. Tiernan recognized that the issues concerning safe drinking water were a global problem. Therefore the company began to look for opportunities in the global market.

Wallace & Tiernan Canada Ltd., was established in 1920 with the head office in Toronto. At one time, many of the W&T products sold in Canada were manufactured or assembled in Canada. In recent years, a more streamlined operation was established with the office located in Markham, Ontario, along with other USFilter operations.

Wallace & Tiernan Ltd. of London was the first overseas operation for W&T, established in 1926. The company thrived from the start so that W&T equipment became ingrained in the Untied Kingdom and other European countries. Such famous landmarks as the fountains in Trafalgar Square and the celebrated cruise ships of the time, the Queen Mary and the Queen Elizabeth, rely on W&T chlorinators for clean operation and pure drinking water. In 1957, having outgrown their London facilities and having just acquired E.C.D. Ltd., a manufacturer of chemical proportioning pumps, it was decided to relocate to the E.C.D. property in Tonbridge, Kent southeast of London. This remains the present-day location of the UK operation.

W&T activities in Germany started in 1929 when a subsidiary was formed in Berlin to introduce the Agene flour-treating equipment to the milling industry. The business prospered until wartime when the office was moved to the Black Forest. After the war, in 1947, W&T’s senior remaining employee in Germany started to pick up the pieces. In 1955, 30 acres of land were purchased in Günzburg, Germany near Ulm. In 1971 the size of the company was considerably enlarged and the local development and production of analyzer instruments and controllers for the treatment of potable water, pool water, and waste water was started. Today, this remains the site of a very active manufacturing and engineering center for W&T.
Wallace & Tiernan Pty, Ltd. was formed in mid-1954 in Sydney, Australia. Although a local manufacturer was already building chlorinators, W&T soon captured a share of the market. Australia imported some parts from the U.S., the UK, and Germany, and manufactured other parts locally to give their products a distinctive Australian look. Today, the Australian operation is split between an assembly plant in South Windsor and a headquarters sales office in North Ryde.

In 1964, recognizing the huge market potential in Mexico for water treatment equipment, W&T established a warehouse just outside of Mexico City. Two years later, a manufacturing facility was constructed to build chlorinators and other equipment for the Mexican market. Today, this facility is a major supplier of metering pumps and parts to the rest of the W&T business centers.

**THE MERGER**

By the mid 1960s Wallace & Tiernan had grown into a multinational conglomerate with sales approaching $100 million. With the passing of Charles Wallace in 1964 and Martin Tiernan in 1968, the Board of Directors, which included the sons of Martin Tiernan, felt that the time was opportune to merge with another manufacturing organization. Viewing chemicals as future of the company, Wallace & Tiernan merged with another chemical manufacturer in 1969 to form the Pennwalt corporation headquartered in Philadelphia, PA. The name Pennwalt derives from **Penn**, for the Pennsylvania Salt Co. and **walt** for Wallace & Tiernan. The new company was organized into three divisions: Chemicals, Pharmaceuticals, and Equipment. The Belleville manufacturing operation would continue to produce the W&T chemical feed and disinfection equipment as part of the equipment division. The other W&T lines were either merged into the chemical and pharmaceutical divisions, or were sold off.

Over the next 20 years, W&T continued to operate under the Pennwalt leadership, but it was clear that chemicals, not equipment were the primary focus of the corporation. Despite the lack of financial support for new products, W&T management was able to develop new chlorinators, controls, and analyzers by focusing on the core municipal water and wastewater markets. These products included the V-2000 and Micro/2000 products we make today.

Starting in the mid 1980s, Pennwalt decided to focus more on their core chemical business and sold off their pharmaceutical operations. With another merger on the horizon, Pennwalt started breaking up the equipment division and sold the Wallace & Tiernan group in 1989 in a management-led, investor buyout. Shortly thereafter, Pennwalt was acquired by a French company, Elf Aquataine and renamed Atochem American.

**THE INVESTOR YEARS**

The management-led, investor buyout in 1989 was a historical event in itself. At the time, it was the largest buyout of this type and also the most complicated since it involved properties in seven countries, with funding from multiple financial institutions.
THE BRITISH ARE COMING

In 1991, the venture capitalists found a buyer for Wallace & Tiernan in the UK—a water company called Northwest Water. This was a regional water company that was recently privatized and was interested in the equipment manufacturing business. W&T would become part of the Process Instrumentation Group. Other NWW acquisitions, including Envirex and General Filter, became part of the Process Equipment Group. While never quite realizing sales and earning expectations, NWW was instrumental in performing a product rationalization to eliminate duplicate products and coordinate the development of new products among the three major W&T manufacturing centers (U.S., UK, and Germany). The results of this effort are the V10k and S10k chlorinators, the Encore and Chemtube pumps, and the SCU and PCU controllers that we continue to sell today.

After a long evaluation, Northwest Water (now called United Utilities since their acquisition of a UK power company) decided that it was time to relocate the inefficient Belleville manufacturing facility to a new location. After investigating sites in Florida and Virginia, it was decided to keep W&T in New Jersey and relocate to Vineland. This would be a purpose-built site designed to meet the needs of the revamped manufacturing/assembly operation.

THE AMERICANS ARE BACK

In October of 1996, it was announced that a new company by the name of USFilter would acquire all of the equipment manufacturing operations of United Utilities. This would put W&T back under the control of a U.S. company. The move to Vineland was accelerated and in January 1997, Wallace & Tiernan became part of the growing USFilter corporation.

THE FRENCH HAVE ARRIVED

In 1999, USFilter was acquired by Vivendi, a Paris-based French water company. In subsequent years, Vivendi would make a number of large acquisitions including the Universal Studios and Entertainment assets. In 2002, Vivendi separated the water business from the rest of the corporation into Vivendi Water. This name was changed to Veolia Water in 2003. These days, Wallace & Tiernan is part of the Chem-Feed Group of USFilter, which in turn is part of the Veolia Water organization.

After 90 years, the business of Wallace & Tiernan remains strong and vital to taking care of the world’s water. The words of Martin Tiernan, expressed in 1919, ring true to this day:

“It has always been my conviction that one’s work, to be really worth while, should not only afford a reasonable return for the effort involved, but should also constitute a direct contribution to the welfare of mankind.

It has been with the thought that our apparatus, wherever installed, was protecting the lives and health of the population, that our organization has been built up.”

We all look forward to the challenges and opportunities that await us in the next 90 years.
TODAY'S EMPLOYEES THAT CARRY ON THE WALLACE & TIERNAN TRADITION
ESTABLISHED 90 YEARS AGO...

Fifty-Five Years

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Thirty-Five Years

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Thirty Years

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Twenty-Five Years

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Twenty Years

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Ten Years

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<td>Alberto Garibi</td>
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</table>
Tune: Solomon Levi
Oh! We are Wallace & Tiernan,
And our shop's on Centre Street,
Here's where we train the sly chlorine
To make the sewage sweet!
We back bacteria off of the map
And everything else that's slime,
The office force is at Broadway,
Three Hundred Forty-nine.

Oh! Wallace & Tiernan,
Tra la la, la la la, la,
Poor Wallace & Tiernan,
Tra la la, la la la, la la la, la la la.

Oh! We are Wallace & Tiernan,
And our shop's on Centre Street,
Here's where we train the sly chlorine
To make the sewage sweet!
We back bacteria off of the map
And everything else that's slime,
The office force is at Broadway,
Three Hundred Forty-nine.

Tune: Smiles
There are jobs for AUTOMATICS,
There are jobs for MSAS,
There are jobs with features quite erratic,
That Wallace solves in many devious ways.
There are jobs for pumps and valves and pits,
There are jobs for testing outfits, too,
But the jobs that make us all go crazy
Are those that Johnstone would have us do.

Tune: Bubbles
We're forever chasing orders,
Chasing orders all the while,
The quota is high,
That's why we try,
To knock the score right in the eye,
The totals ever climbing,
So that's why you see
We're forever chasing orders
For good old W-T.

Tune: Down on the Ohio
Down on the Passaic,
That's where the smells in summer
Make you sick,
And there it is you see,
That W-T have their factory,
And everyone's as happy
As happy can be,
Down on the Passaic,
That's where we work and strive
The whole day long you see,
Now Mr. Tiernan says to one and to all,
You weren't hired just to play volley ball,
Down on the Passaic,
Down in our factory on the Passaic.

Chorus:
Yes! Today is our Birthday,
The Birthday of W-T,
And Freddy and Marty will be at our party
As happy as they can be.
For they have always stuck together,
In fair and stormy weather—
Yes! Today is our Birthday,
The Birthday of W-T.

Tune: Old Ambers
Come on and fight for W-T,
Shoulder to shoulder—winners we'll be.
Stand by that shield, boys,
We'll never yield, boys,
Three cheers for W-T.

Rah-Rah-Rah!
Come on and fight for W-T,
Shoulder to shoulder—winners we'll be.
Stand by that shield, boys,
We'll never yield, boys,
Here's health to W-T.