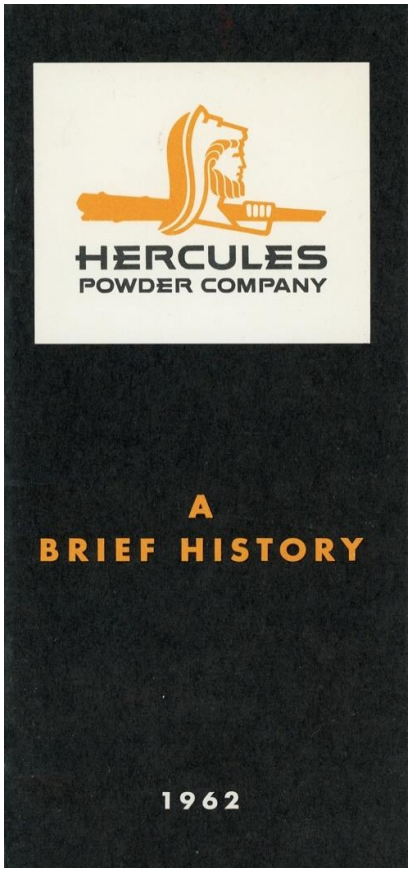
The Hercules Powder Company: A Brief History

and a Grandfather Who Worked for Hercules

by Douglas K. Miller

July 31, 2021

This is an abbreviated history of the Hercules Powder Company and a related story about the grandfather of a valued colleague of mine who worked with me in the Legal Department of the Central Arizona Project. I retired from the CAP in 2011, and my friend retired in 2019. He knew I was interested in mining artifacts and curious about the history of the explosives industry, especially the Hercules Powder Company, where my friend's grandfather had worked for many years. Out of kindness and consideration, my friend gave me several items of memorabilia from his father and grandfather. One of the things he gave me was a wonderful pamphlet from Hercules dated 1962, describing the history of Hercules. The following are some excerpts from this pamphlet.



"**HERCULES POWDER COMPANY**, producer of industrial chemicals and explosives, was incorporated on October 18, 1912, in conformity with a federal court decree against the E. I. DuPont de Nemours Powder Company, as it was then known, in an antitrust case. The new company began business in January, 1913, as an explosives manufacturer. It consisted of about 1,000 employees, two dynamite plants at Kenvil, N. J., and Hercules, Calif., and nine blasting and sporting powder units in various sections of the country. First sales offices for the new explosives company were located in Salt Lake City, Hazleton, Pa., Pittsburgh, Pa., Pittsburg, Kans., Chicago, San Francisco, and Wilmington.

"The company was still in the first stages of organization when World War I started. With it came a great need for military explosives. [Over the years following the War, Hercules diversified into many other areas related to the manufacture of chemicals and associated products.]

A Leader in Explosives

"While the company was extending its activities into other fields, it maintained its position as a manufacturer and distributor of industrial explosives. In 1914, it purchased Independent Powder Company, acquiring a plant at Carthage, Mo., and an office at Joplin, Mo. In 1915, a modern

new explosives plant was completed at Bacchus, Utah. In 1921, the company purchased the facilities of Aetna Explosives Company, thereby achieving complete national distribution of explosives. By the end of 1921, Hercules had secured an important part of the trade of the coal-, copper-, zinc-, and iron-mining industries, as well as a considerable part of the quarrying business. The company became the second largest producer of dynamites, blasting caps, sporting, and military powders in the United States."

My friend's grandfather worked at the Hercules plant in Carthage, Missouri, from 1936 until he retired in 1973. There, Hercules manufactured several forms of explosives, including dynamite. In the early to mid-1900s the manufacture of dynamite was a lengthy and difficult process. Reading about those early days and watching early movies of the process[1] gives one the impression that the process was crude, somewhat primitive, and extremely dangerous. Here is a description of a portion of the process, at an unknown factory, from a 1924 edition of *Scientific American*:

> The manufacture of dynamite itself starts with the nitration of glycerin. This operation, like all others in the plant which are subject to explosion, is carried on in a house remote from other buildings and surrounded by wooden cribbed earth barricades. A weighed charge of mixed nitric and sulfuric acid, approximately 7000 pounds, is brought to the nitrating house in a tank car and blown up from the car by compressed air into the nitrator on the second floor, a wrought iron cylindrical tank standing on end with several pipes leading into its cover and on the inside two overgrown ice cream freezer paddles in the center and coils of lead pipes near the shell. When the mixed acid is running in, the paddles, operated by a small steam engine, are set in motion to circulate it around the brine coils so that it will be cooled to the proper temperature before the glycerin is added. Meantime, the required quantity of refined glycerin, about 1400 pounds, is blown by compressed air from a heating tank, where it is warmed to a temperature which will facilitate flow, to a scale tank in the nitrating house whence it can run by gravity through a rubber tube into the nitrator. When the acid is all in and cooled to the proper temperature the foreman takes his seat on a high stool near the nitrator, places the end of the rubber hose leading from the scale tank in a funnel in the cover of the nitrator and by means of a valve on the end controls the flow of [glycerin] into the nitrator by hand. The glycerin runs first into a cast iron pipe just below the top of the nitrator and from there sprays down upon the swirling acid. The nitric acid combines chemically with the glycerin to form nitroglycerin and water, the sulfuric acid merely serving to facilitate the reaction and to take up the water formed. This reaction releases so much heat that unless it is carefully controlled there is great danger that the nitroglycerin will explode. Consequently, the charge is continually agitated around the cooling brine coils, and the operator feeds the glycerin to the acid gradually, keeping an eye fixed on a thermometer extending up through the cover of the nitrator. The most favorable temperature for nitration and the maximum allowable temperature have been determined by laboratory experimentation, and vigilant supervision is exercised to see that charges are run within this range.[2]

[1] One such movie is a 1925 silent film called "The Story of Dynamite," made by the Bureau of Mines. It may be found at: https://www.youtube.com/watch?v=rUP3IhbCuq8, accessed June 23, 2021.

[2] H. E. Davis, "The Blast Factory," *Scientific American* 130, no. 6 (June 1924): 386, 437–38. This entire article is well worth reading. It may be purchased as part of the June 1924 issue of *Scientific American*, available for

My friend provided me with this description of his grandfather's work at Hercules. This description is based both on his father's recollections and his father's knowledge as a chemist.

> "My grandfather, John A. McCann, worked at the Hercules plant near Carthage, Missouri, from 1936 until his retirement in 1973. He started off mowing grass, unloading trucks, and performing other basic labor. He later worked in the dope house, the powder line, the magazine, and ultimately served as shift foreman at the plant until his retirement. In the latter capacity, he compiled orders received from around the country and determined how much of each product the plant needed to produce.
>
> "The Carthage plant made nitroglycerin (later changed to nitroglycol) that it then turned into dynamite. My father is a former chemist, so he was quite happy to explain the process in some detail. This is how he says Hercules made dynamite:
>
> - On the **powder line**, nitric acid (HNO_3) and fuming sulfuric acid (oleum) was mixed with glycerin (or ethylene glycol).
> - Hercules obtained the acid from the Atlas plant between Carthage and Joplin.
> - The nitrate (NO_3) from the nitric acid combined with the glycerin molecule to yield nitroglycerin (or nitroglycol) and water (H_2O). The fuming sulfuric acid then drew the water back out of the compound.
> - Once the fuming sulfuric acid has absorbed enough water, it becomes regular sulfuric acid and is no longer effective at drawing the water from the nitroglycerin mix.
> - At that point, the spent acid was sent to an acid recovery house where the nitric and sulfuric acids were separated.
> - The nitric acid recovered from the spent acid was used to make ammonium nitrate prills (fertilizer).
> - The sulfuric acid recovered from the spent acid was sent back to Atlas to be remade into fuming sulfuric acid.
> - Meanwhile, in the **dope house**, various dry ingredients were prepared and mixed. Those included sugar, starch, bagasse, ground walnut shells, and ground almond meal.
> - Dynamite was a combination of nitroglycerin or nitroglycol and various dry ingredients. The specific type and amount of additive determined the burning rate for the dynamite. My father commented that these formulae were closely guarded trade secrets at Hercules. My grandfather apparently held them in his head but would never share them with my father. In fact, after my father received his degree in chemistry, he was no longer allowed anywhere in the plant other than the office, even though he had worked various jobs on the line before college.
> - The **shell house** is where paper was combined with hot wax to create the outer shell for the dynamite.

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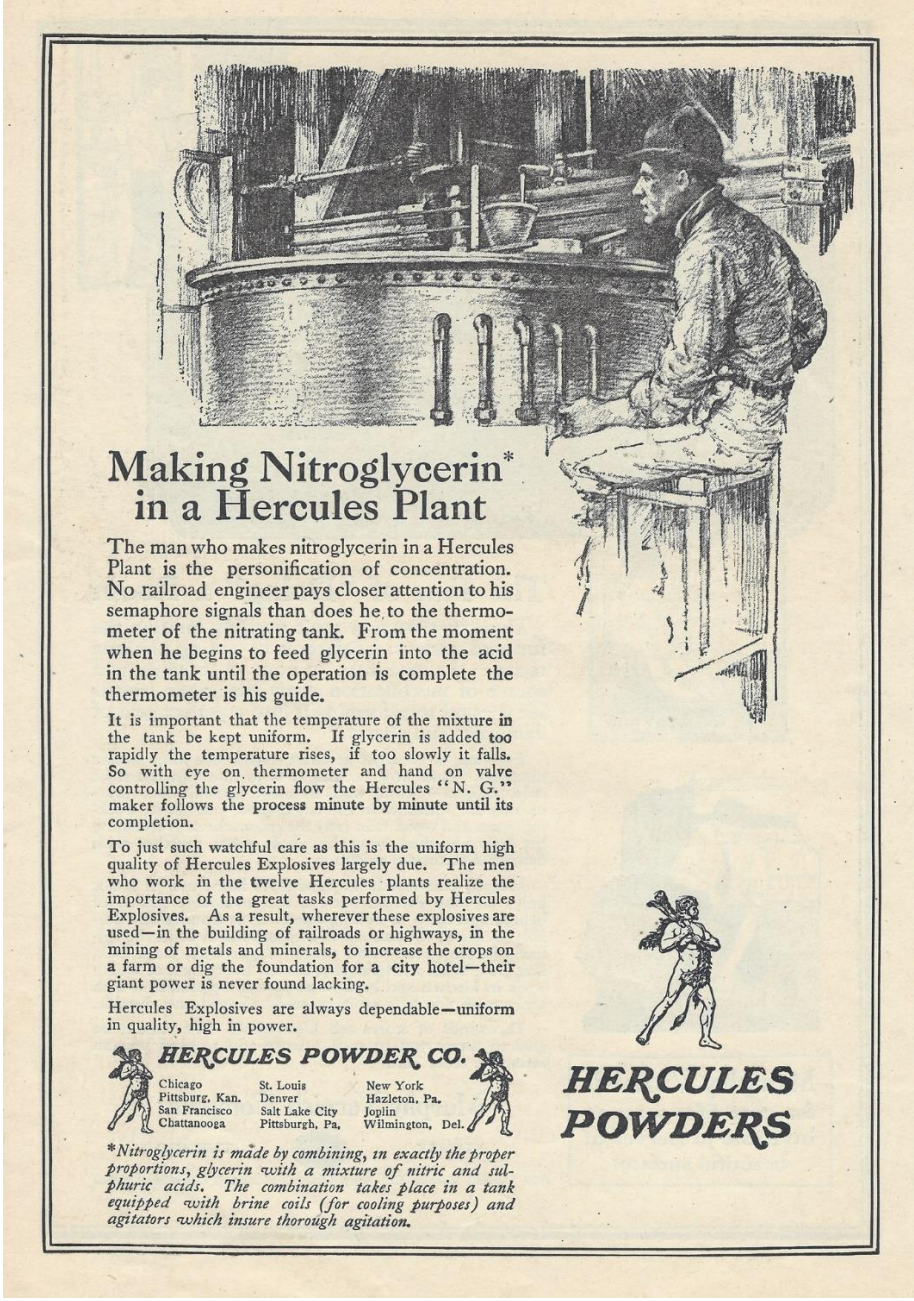
download at the magazine's website: https://www.scientificamerican.com/magazine/sa/1924/06-01/, accessed June 23, 2021.

- After the nitroglycerin was combined with the appropriate dry ingredients, it went to the **Hall house** (named after the person who developed the process) where the dynamite was packed into the shells."

My friend added that, "Whenever my grandfather worked on the production line, he would come home with horrible headaches and lie down on the dining room floor. My father [who also worked at the plant from time to time] said he also had terrible headaches whenever he worked in the Laundry House due to all the nitroglycerin residue on the clothes."

Recently, I saw an early advertisement for Hercules that describes in colloquial terms the work of the man who watches over the making of the nitroglycerin, as my friend's grandfather did.



Making Nitroglycerin* in a Hercules Plant

The man who makes nitroglycerin in a Hercules Plant is the personification of concentration. No railroad engineer pays closer attention to his semaphore signals than does he to the thermometer of the nitrating tank. From the moment when he begins to feed glycerin into the acid in the tank until the operation is complete the thermometer is his guide.

It is important that the temperature of the mixture in the tank be kept uniform. If glycerin is added too rapidly the temperature rises, if too slowly it falls. So with eye on thermometer and hand on valve controlling the glycerin flow the Hercules "N. G." maker follows the process minute by minute until its completion.

To just such watchful care as this is the uniform high quality of Hercules Explosives largely due. The men who work in the twelve Hercules plants realize the importance of the great tasks performed by Hercules Explosives. As a result, wherever these explosives are used—in the building of railroads or highways, in the mining of metals and minerals, to increase the crops on a farm or dig the foundation for a city hotel—their giant power is never found lacking.

Hercules Explosives are always dependable—uniform in quality, high in power.

HERCULES POWDER CO.

Chicago	St. Louis	New York
Pittsburg, Kan.	Denver	Hazleton, Pa.
San Francisco	Salt Lake City	Joplin
Chattanooga	Pittsburgh, Pa.	Wilmington, Del.

**HERCULES POWDERS*

**Nitroglycerin is made by combining, in exactly the proper proportions, glycerin with a mixture of nitric and sulphuric acids. The combination takes place in a tank equipped with brine coils (for cooling purposes) and agitators which insure thorough agitation.*

This advertisement is from the October 1920 issue of *Harpers*. It predates John McCann's employment with Hercules by some 17 years. However, the process for manufacturing nitroglycerin can't have changed much, if at all, between 1920 and the date John McCann joined Hercules in 1936. Notice that the advertisement emphasizes that the man making the nitroglycerin must be "the personification of concentration." The thermometer is his guide, "from the moment he begins feeding glycerin into the acid tank until the operation is complete." My friend added the following to the description of the process that his father had given him, information he took from Wikipedia.

> "The addition of glycerin results in an exothermic reaction (i.e., heat is produced) . . .. However, if the mixture becomes too hot, it results in a "runaway," a state of accelerated nitration accompanied by the destructive oxidation of organic materials by the hot nitric acid and the release of poisonous nitrogen dioxide gas at high risk of an explosion. Thus, the glycerin mixture is added slowly to the reaction vessel containing the mixed acid (not acid to glycerin). The nitrator is cooled with cold water or some other coolant mixture and maintained throughout the glycerin addition at about 22 °C (72 °F), much below which the esterification occurs too slowly to be useful. The nitrator vessel, often constructed of iron or lead and generally stirred with compressed air, *has an emergency trap door at its base, which hangs over a large pool of very cold water and into which the whole reaction mixture (called the charge) can be dumped to prevent an explosion, a process referred to as drowning. If the temperature of the charge exceeds about 30 °C (86 °F) (actual value varying by country) or brown fumes are seen in the nitrator's vent, then it is immediately drowned.*" The vat into which the charged was dumped contained soda ash to neutralize the acids.

John McCann, ca. 1926

My friend highlighted the last part of this description, "because my father said at one time my grandfather sat in a special chair overlooking the mixing vat. The chair had levers and stirrups that would allow him to open a large trap door in the bottom of the container and dump the contents of the mix into a chamber below. My grandfather once told my father, 'if you see it start to fizz, let me know.'"

Despite its importance, there is much more to the manufacture of dynamite than simply producing nitroglycerin. In 1949, the Hercules plant included a number of "Houses." This is a list provided by my friend's father:

- **Yard House**. Also housed the carpenter shop. Responsible for repairing tracks for small locomotives used on site; cutting grass and weeds off barricades; unloading incoming boxcars.
- **Laundry House**. Responsible for washing and drying the coveralls worn by line workers.
- **Change House**. Where men had lockers for their street clothes and showered after work.
- **Cafeteria**.
- **Dope House**. Where all dry ingredients were weighed and mixed. The choice of dry ingredients affected the burn rate of the nitroglycerin, which was important to the specific intended use. The formulas that Hercules used were among their most closely guarded trade secrets. My dad says his father kept the formulas in his head and never shared them.
- **Nitrator.** Where acid and glycerin were mixed to create NG (the commonly used acronym for nitroglycerin). Because glycol could freeze, at some point they switched to ethylene glycol (essentially anti-freeze).
- **Hall House**. Where NG was mixed with dry ingredients and packed into shells.
- **Box Factory**. Where boxes were made for storing finished product.
- **Magazine.** Held finished product until shipping. Inventory was turned over every few days—i.e., not long-term storage.
- **Office.** Admin. Also housed the laboratory.
- **Shell House**. Where different sized shells were made for filling.
- **Cotton House**. Where nitrocellulose (guncotton) was dried for use in Vibrogel.
- **Boiler/Powerhouse**. Provided the steam that operated machinery throughout the plant.
- **Acid Recovery House**. Where "spent acid" was recovered/separated to be shipped back to Atlas.

To my friend's and his father's knowledge, John McCann never worked in the Laundry, Shell, Cotton, Boiler, or Acid Recovery houses.

The manufacture of explosives is inherently dangerous work, and accidents were not infrequent in the early- to mid-1900s. My friend's grandfather told his father that when he started working for Hercules, they did not have electric lights there and the nitroglycerin production line was illuminated by kerosene lamps! By the 1960s, however, no one was permitted to take matches into the manufacturing plant, much less smoke in the plant. All of the lightbulbs were shielded

with wire cages to prevent them from breaking and producing a spark. Despite the precautions taken, the Carthage Plant suffered a catastrophic explosion on July 14, 1966.

The *New York Times* wrote: **Powder Plant in Missouri Is Rocked by Explosions**

"CARTHAGE, MO, July 14 (AP) – Explosions rocked a Hercules plant near here today, but workmen had a 20-minute warning and officials said all had escaped death."[3]

Thankfully, most workers were at lunch at the time and managed to evacuate safely. The damage to the plant, however, was substantial.

"Seventy of the buildings at the 1,200-acre plant site had to be rebuilt and another 36 had to be repaired. Damage estimates to the plant exceeded $6 million. Reports carried in *The Joplin Globe* estimated that 85 percent of the buildings on the Carthage square sustained broken windows, while 40 homes near the plant were destroyed."[4]

City Final

The Joplin Globe

Several Hurt as Explosions Rock Hercules Complex

Damages to Plant, Area Homes Heavy

At Carthage . . .

Fear Grips Many During Explosions

Area Man Dies in Grass Fire

Another Hot Day Predicted

Assessments Hiked on Cars, Trucks

In Today's Globe

Here's how my friend describes the explosion as his grandparents experienced it:

> "In 1966, my grandparents lived in Carthage, about a half-mile south of the square. The plant was about six miles west-southwest of town. No homes in central Carthage were destroyed, to my knowledge, just a lot of broken glass, perhaps some cracked plaster. At that point, John McCann was the Number 3 man at the plant. As my dad describes it, there was (1) the plant manager who dealt with the corporate politics etc., (2) an assistant plant manager who was typically a recent college grad being groomed for higher positions, and then (3) John [my grandfather], who was the shift foreman who supervised the work at the plant.
>
> "My grandfather had left work at lunch to be a pallbearer at a funeral. He was just getting home and opened the front door when the main explosion went off. [As a result,] their front window was saved."

[3] *New York Times*, p. 12, col. 5, July 14,1966.

[4] *Enid News and Eagle*, "SLIDESHOW: Hercules explosion July 14, 1966," July 13, 2016 (Updated July 15, 2016), available at https://www.enidnews.com/slideshow-hercules-explosion-july/collection_09ee180c-dc99-5046-b136-013e7a680ae3.html#1, accessed June 23, 2021.

The *Joplin Globe* of July 15, 1966, reported:

> "CARTHAGE, MO. – A series of explosions rocked the Hercules Powder Company plant here yesterday [Thursday] afternoon and officials warn more blasts are anticipated. Three fires were burning early Friday morning.
>
> One plant employee, Maurice Crowell, who officials earlier had listed as missing in the explosions, was rescued from the flaming complex early Friday morning . . ..[5]
>
> More than 30 persons were injured in the blasts, which caused extensive damage to buildings and homes within a five-mile radius. No fatalities were reported.
>
> Fires continued to rage throughout the plant area Thursday night as the threat of additional explosions kept firemen away. Residents of the area were evacuated. . . .
>
> The downtown business district of Carthage about four miles away was severely hit by shock waves . . ..
>
> An aerial survey of the plant site was made by R. E. Good, plant manager, late Thursday afternoon. He estimated between 60 and 70 per cent of the total complex was destroyed by the blasts and the resulting fires. . . . Two large craters, about 100 feet wide and 25 feet deep, and charred ground indicated where the blasts took place. Trees surrounding the site were burned and leafless.
>
> The initial explosion occurred about 12:45 o'clock Thursday afternoon and the final blast was reported at approximately 3:45 o'clock. . . .
>
> A fire in a trailer unit in the explosive loading area was blamed for the blasts, according to Good. Cause of the fire has apparently not been determined.
>
> An emergency warning system, called the 'panic button' by company officials, was sounded when the blaze was discovered, and the area evacuated. . . . One official said when the warning system is sounded 'everyone is supposed to run like hell.'
>
> Good said the major explosions were caused when three of four storage magazines containing dynamite and nitroglycerine blew up. The top of the fourth magazine was blown off by the blasts, but it did not explode."[6]

My friend's father told my friend that the explosion occurred as a result of the ignition of canisters of nitrocellulose that had been shipped to the plant to be used in the manufacture of the proprietary product Vibrogel, a stable combination of nitrocellulose and nitroglycerine that was used by the petroleum industry in exploring for oil. Shells of Vibrogel were dropped into bore holes, and when set off, the resulting vibrations from the explosions were measured with seismographs. My friend's grandfather told his father that as many as 26 semi-trailers full of canisters of nitrocellulose were parked on the plant site not far from the magazines where dynamite and nitroglycerine were stored. Nitrocellulose is very unstable and highly explosive when dry, so it is stored in water. The canisters that it was shipped in were small and the nitrocellulose was kept wet inside them. However, the outside temperatures were hot (100 degrees). It was one man's job to open vents in the semi-trailers to cool them down. When he left

[5] He later died in the hospital of his injuries.

[6] "Several Hurt as Explosions Rock Hercules," *Joplin Globe*, Joplin, MO (July 15, 1966), p.1, accessible at newspaperarchive.com, https://newspaperarchive.com/joplin-globe-jul-15-1966-p-1/, accessed June 23, 2021.

work the night before the explosion, however, he closed the vents and neglected to tell anyone that he was going on vacation the next day. As the semi-trailers heated up the next day, the water in the nitrocellulose evaporated, forcing the lids off of the cannisters. Once exposed to the air, the nitrocellulose dried out and eventually caught fire and exploded.

When I asked my friend about the cause of the subsequent explosions of the magazines, he wrote:

> "As to how the magazine could have exploded in 1966, if you are like me you think of a magazine as an earth-covered bunker . . .. But the buildings at Hercules were protected laterally—that is, they were designed with vertical barricades around them to control any explosion and direct it upward, away from any other structures. Thus, the magazine was protected around its sides, but not from the top. When the nitrocellulose canisters in the trailers began exploding, it was like fireworks going off, with canisters shooting into the air. Most probably, one of those canisters came down into the magazine[s] from above and set off the explosion[s]."

My friend's father lived in Carthage with his parents until he went to school, joined the service, and eventually moved away to start a career of his own. My friend visited his grandparents many times in Carthage when he was young, but never lived there.

CERTIFICATE
OF
SERVICE

THIS CERTIFIES THAT

John A. McCann

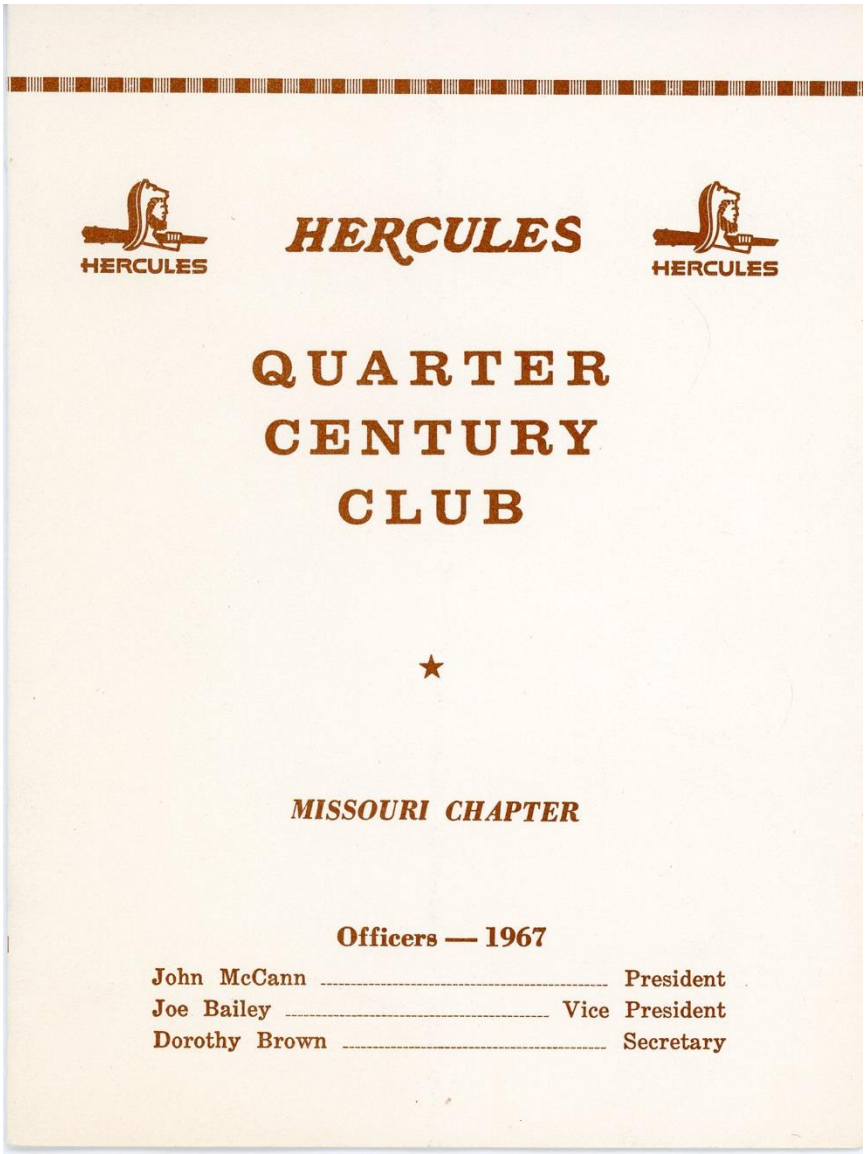
HAS COMPLETED ~15~ YEARS OF EMPLOYMENT IN THIS COMPANY AND IN RECOGNITION OF FAITHFUL AND LOYAL SERVICE THIS CERTIFICATE IS AWARDED

September 4, 1951

HERCULES POWDER COMPANY
INCORPORATED

Charles A. Higgins
PRESIDENT

In 1951, John McCann received this Certificate of Service from the President of Hercules Powder Company.



HERCULES

HERCULES

HERCULES

QUARTER CENTURY CLUB

★

MISSOURI CHAPTER

Officers — 1967

John McCann ..... President
Joe Bailey ..... Vice President
Dorothy Brown ..... Secretary

By 1967, John McCann was President of the Missouri Chapter of the Hercules “Quarter Century Club.”

HERCULES INCORPORATED
WILMINGTON, DELAWARE 19899

WERNER C. BROWN
PRESIDENT

February 28, 1973

Mr. John A. McCann
511 East 14th Street
Carthage, Missouri 64836

Dear Mr. McCann:

March 1 will mark the beginning of your retirement from Hercules after completing over thirty-six years of very faithful service, and I send you best wishes from all the officers of our company for the future.

The very fine assistance and cooperation you have given have been most appreciated, and we thank you sincerely for your long loyalty and interest. We hope you are taking with you many pleasant memories of your association with our company.

In the years ahead we hope you will enjoy good health and much happiness.

Sincerely,

Werner Brown

WCBrown/ec

When John McCann retired in February 1973, he received this letter from the President of Hercules.

John McCann died in Carthage, Missouri in 1988. His son, Wayne McCann, and grandson, Tom McCann, live here in Arizona.

John Ayer McCann

This article is dedicated, first and foremost, to my friend and colleague, Tom McCann, to his father, Wayne McCann, and to his grandfather, John McCann, and second, to all of the men and women who have worked over the years, sometimes at great personal risk, in the explosives industry.