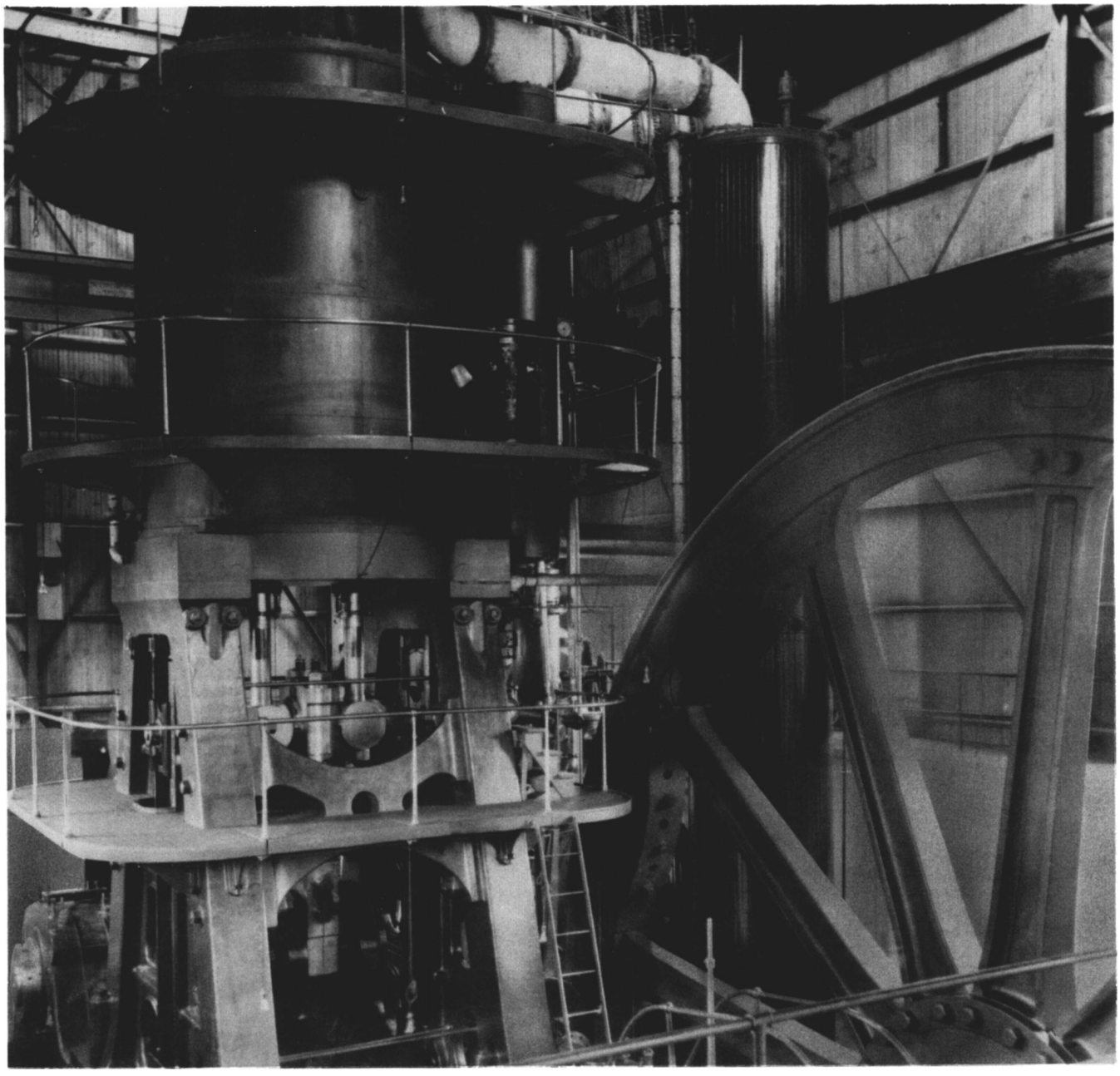
The American Society of Mechanical Engineers

CHAPIN MINE PUMPING ENGINE

National Historic Mechanical Engineering Landmark

June 6, 1987
Iron Mountain, Michigan

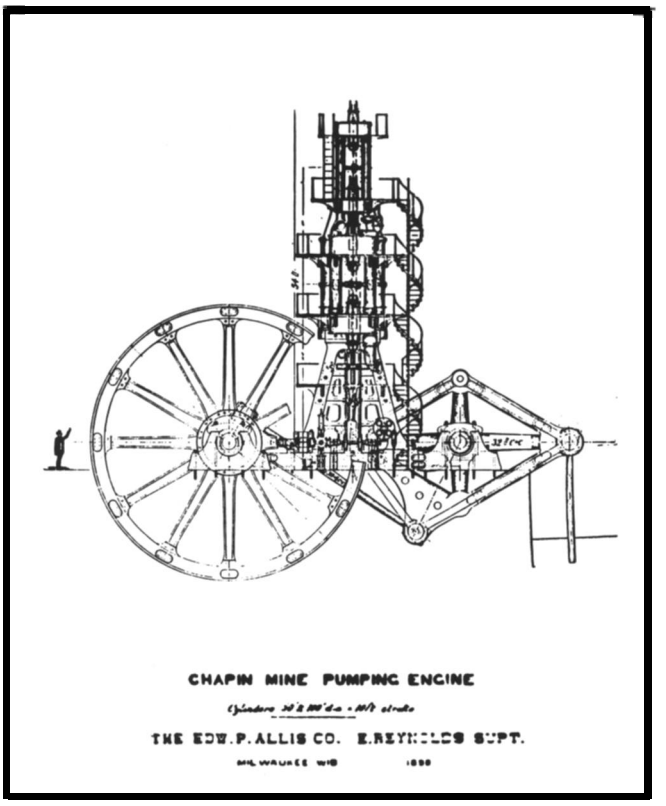


THE CHAPIN MINE PUMPING ENGINE

In that part of Iron County located in the Upper Peninsula of Michigan, where some of the wildest mining and logging camp tales have been spun, there is one true story that tops most of them. It is the story of the Chapin iron mine, which by being the wettest mine in the country, seemed to defy any effort to remove her treasure of ore. Yet, just before the turn of the twentieth century, this mine came to be known the world over as the largest underground iron mine in existence. The sloping ore body was a half-mile long and, at the Hamilton shaft, almost 1,500 feet deep. In 1889 it was known as one of the three great iron mines in the Lake Superior geological district, which includes Minnesota, Wisconsin, and Michigan mines.

An important part of the Chapin story is the mighty Chapin Mine Pumping Engine. It tamed her waters, making it possible to bring out high-quality ore for shipment to blast furnaces in the East, and the mine has been classed with the Norrie and the Minnesota ever since.

Located almost entirely under a cedar swamp, Chapin was a hazard to miners and investors alike. However, once it was drained, it was a workable mine and there were jobs to be had. Around the turn of the twentieth century Europeans by the thousands, suffering from poverty and fleeing the wars that plagued the Continent, came to the Menominee Iron Range seeking work. They stayed to establish a flourishing community.



On May 19, 1892, *The Iron Range* (a newspaper published in Iron Mountain) featured on its front page a line diagram of the Chapin Mine Pumping Engine, which was then being erected at "D" shah under the supervision of Charles Tyler, erecting engineer for the Edward P. Allis Company of Milwaukee.

This view of the Chapin Mine "D" shaft complex taken in the late 1880s shows the original building housing the Chapin Mine Pumping Engine. Measuring 36 by 42 feet and constructed of native red sandstone, the building towered over the landscape. The hoisting plant, winding half-inch-thick by four-inch-wide flat cables, was located in a sandstone building northeast of the shafthouse, at left in picture. The sandstone boiler house was an eastern extension of the engine house and contained a battery of Reynolds patented boilers.

Down through the years since 1935, when the engine house over the pumping engine was removed, travelers passing along US-2 through Iron Mountain frequently have stoppe to inquire about the gigantic mining artifact standing on the hill to the west, beside the abandoned Ludington "c" shaft of the Chapin. Long before it was placed on the National Register of Historic Places in 1981, many visitors already were making "a trip to see the pump" an annual event.

The pump stands some 54 feet high and has an overall length of 75 feet, the estimated weight being 725 tons. A 20-foot-deep pit accommodates the flywheel of 40-foot diameter that turned at speeds up to 10 rpm. When pumping from 1,500 feet the engine developed perhaps 1,250 horsepower.

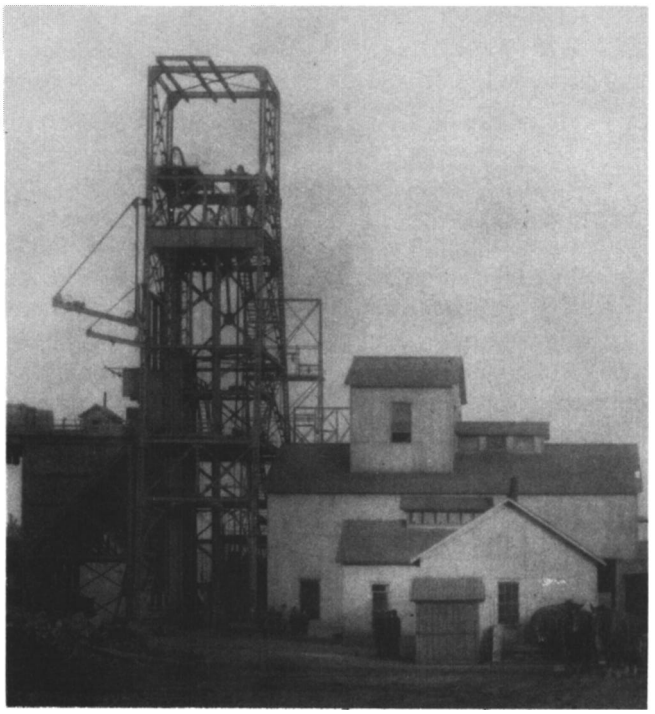
From the day Chapin was discovered in 1879 and even before the behemoth of pumping engines was put into operation, the story of the Chapin Mine was filled with unusual engineering problems and heroic solutions.

Ore on the Range

It wasn't until almost 30 years after the feverish search for iron ore had started along the Lake Superior shoreline to the north that the Menominee Iron Range was seriously explored, even though evidence of ore there had been reported in the U.S. geological survey of 1848. In 1866 the brothers Thomas and Bartley Breen, timber cruisers from Menominee, Michigan, discovered an outcropping near Waucedah at the eastern end of the range and are credited with being the first on the range. The

remoteness of the central part of northern Michigan accounts for the delay in mining her ores. It required a dire need to find high grade ore in this country for investors to be willing to risk the high cost of exploration and development with so little promise of ready profit.

The dramatic story of Chapin began on a day in 1871 when James J. Hagerman, general manager of the Milwaukee Iron Company, read a pamphlet from the Chicago and Northwestern Railway detailing reports of the possibility of ore deposits of excellent quality in northern Menominee County in Michigan's Upper Peninsula. Hagerman, en route to Detroit from a business meeting in the East, was facing a business dilemma. His company manufactured iron rails for sale to the railroads. For materials they used worn-out rails and other wrought-scrap iron. England was producing a new type of rail made of Bessemer steel, up to fifteen times as durable as iron. Railroad companies, rapidly expanding their lines westward across America, needed these harder rails, but they had to be imported since there were very few steel mills in this country.



Dated October 19, 1912, this view of the Ludington "C" shaft, looking east, shows the shaft housing, which rose 114 feet above the collar The chutes to the left allowed ore cars to be loaded directly as the ore came up in the tram cars on the hoist. The cage in which the men descended can be seen at lower left of the shaft housing. The Chapin Mine Pumping Engine pumphouse was sheathed with corrugated metal and rested on a red-sandstone foundation. The steam pipe that carried steam from the boiler house to the gigantic engine can be seen.

Hagerman knew that the days of iron rails were numbered and that the soft, phosphorous-free iron ore needed for successful Bessemer steel production was scarce. Inspired by the information in the pamphlet, he enlisted three iron companies to engage in extensive explorations for high-grade ore in the area described.

Explorations in Section "30," where Iron Mountain is located, were placed in the hands of Dr. Nelson P. Hulst, a young graduate of Yale's Sheffield Scientific School and a geologist, metallurgist, and chemist. He came to be regarded as the greatest authority on iron ore in his day and was known as the father of the Menominee Iron Range.

Fortunes rose and fell as exploration and mining were pursued along the range and the story of the Chapin kept pace, with the operation changing hands a number of times in one of the most dramatic stories in mining history Hagerman survived the financial panic of 1873 and the demise of the Milwaukee Iron Company He became an organizer of the famed Menominee Iron Company

Other companies were also operating on the range, but it was through Hagerman's and Hulst's perseverence that the rich Chapin strike was made. Prior to 1871 ore was mined at Waucedah, Vulcan, Norway; Quinnesec and Metropolitan, and the railroad was pushed through the Menominee Range as far as Quinnesec. It took a long time before the Menominee Mining Company was able to secure a lease for exploration on land in Section "30" where Hulst was sure ore would be found. The ore-rich land was owned by Henry Austin Chapin of Niles, Michigan. The circumstances under which Chapin became owner of the land in question still remains largely a historical mystery, but the mine bears his name, and he profited handsomely from it.

THE CHAPIN MINE

Although it was one of the greatest strikes in the Lake Superior region, getting the ore out was very expensive because of the mine's location under a swamp. In 1880, its first year of shipping, the Chapin produced 15,000 tons of ore and the next year did better. But shortly the owners determined that the most efficient way to get the ore out was to sink a deep shaft in the swamp. This meant going through 90 feet of quicksand, putting in enormous pumps and the best hoisting machinery available, and using compressed air for power.

The operators purchased the mighty Quinnesec Falls on the Menominee River, 2½ miles from the mine and hired the best engineers they could find. They soon found out their plan would cost some $800,000 and to proceed with only a ten-year lease on the property would be foolish. It was years before the Chapins would extend their lease another ten years.

The method of sinking the "D" shaft involved freezing 90 feet of rock and loose, wet sand. Two of the largest refrigeration compressors ever made were constructed, to be driven by Quinnesec Falls. With these, Poetsch-Sooysmith Company of New York froze the ground to stabilize it, until a crew could sink the shaft and line it with a water-tight, cast-iron circular shell. This sectional complicated process had never been employed in America. The procedure took two years to complete and then the celebrated Chapin mine was on its way

Ore production at the Chapin continued high for the next ten years with conventional pumps able to take care of water. But at deeper levels, the problem was unsolvable. For the extensive dewatering needed, the Chapin Mining Company contracted with the Edward P. Allis Company of Milwaukee to build a gigantic pumping engine capable of taking all the water from the 1,500-foot-deep mine for years to come.

Reynolds' Mine Pumping Engine

Edwin Reynolds

Edwin Reynolds, the Allis Company's chief engineer, was known throughout the world wherever machinery was used. His Chapin Mine Pumping Engine became world famous as one of the mechanical wonders of the age. It was also a major investment. George Eisele, superintendent of the Oliver Mining Company which operated the Chapin at a later date, placed the cost of the above-ground plant at $82,500. The portion of the shaft cost much more, he said, bringing the total installation to an estimated $250,000.

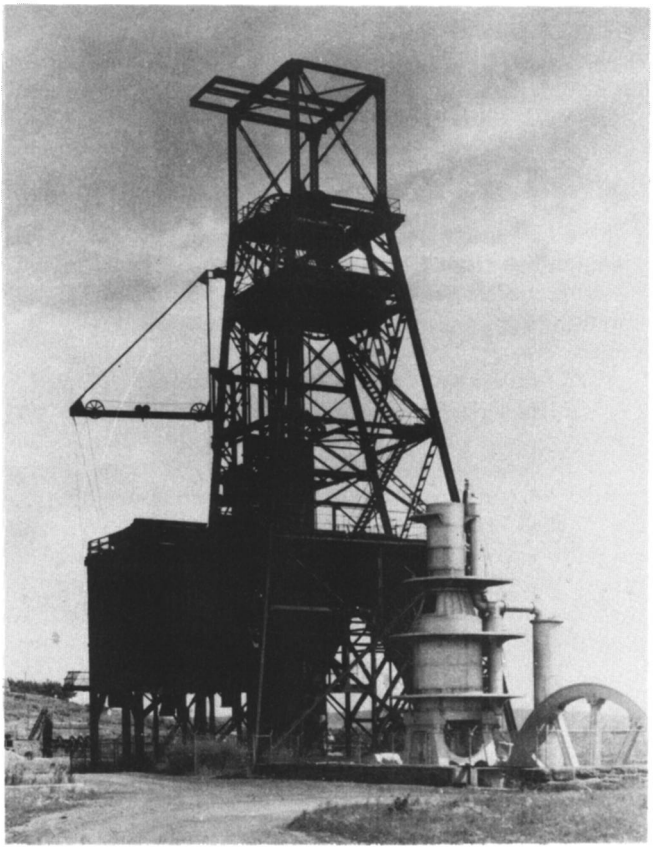
A report published in May 1892, less than a year before the giant pumping engine went into production, gave the following statistics:

"The Chapin Mine Pumping Engine is a steeple compound condensing engine capable of lifting 200 tons of water per minute, 1500 feet, 100 feet flow, equivalent to 4,000,000 gallons in 24 hours. The Chapin Mining Company would be prepared to handle any contingency likely to arise as the mine is deepened to 1500 feet from the surface.

"The length from end of the bob to the back of the flywheel is 75 feet and the height above the engine room floor is 54 feet. The high pressure cylinder is 50 inches in diameter and the low pressure cylinder 100 inches and 10 feet stroke. The pumps, located about 200 feet apart in the shaft, are 28 inches in diameter, with 120 stroke. The bob weighs about 120 tons and the fly wheel about 160 tons. The fly wheel is 40 feet in diameter. The rim of the wheel is 24 inches thick and 24 inches wide. The shaft on which the fly wheel revolves is 24 inches in diameter. The bob is made in seven pieces and firmly held together by 21 wrought iron links shrunk on to the lugs. It is further strengthened by eight wrought iron tension rods, 8 x 16 inches, shrunk on to the sides and held in place by pins.

"The engine is fitted with a surface condenser with 1049 one inch tubes, and a Reynolds patent air pump. Mine water was used in the condenser for cooling purposes. The boilers were charged with water, As the water evaporated and the steam performed the job of driving the pumping engine, the steam exhausted into the condenser and there cooled to a liquid state and then was pumped back into the boilers by a pump attached to the air pump. This was considered the most economical method for use of water and the making of steam. To provide for any problem arising from possible leakage or waste of any kind, a small pipe was connected with the City Water Works.

"The engine was placed on the surface close to the boilers so that there was comparatively little loss of steam by condensation, nor could the engine be damaged or stopped by a sudden flow of water into the mine. In an emergency of any kind, the mine could be completely shut down and allowed to fill with water without damage to the pumping equipment. The engine's boilers required 11,000 tons of coal annually to operate.. ."



This postcard view of the Chapin Mine Pumping Engine with the steel shaft housing still standing was taken in 1935 at about the time the famed steam pumping engine was acquired by Dickinson County. During World War II the steel frame was dismantled for scrap as part of the war effort, but the pumping engine itself was considered more valuable as a historical relic and the amount of iron in it not sufficient to justify its destruction.

Proof of the manufacturer's statement that the pumping equipment could not be damaged should the mine be completely shut down and allowed to fill with water is evident in the condition of the Chapin Mine Pumping Engine today, for that is exactly what happened. The pumps were stopped in the early 1930s and the mines allowed to fill with water; yet the pumping engine is safely above ground today

The engine house for the gigantic pumping plant was several years under construction. A 23-foot thick foundation of stone and concrete was laid. The extreme thickness of the foundation was necessary to accommodate the slot for the flywheel, which extended 20 feet below the bed of the engine. The massive engine house measured 36 by 42 feet and towered over 60 feet in height. Built of native sandstone quarried not much more than a mile away on Iron Mountain's northside, the building had the appearance of a three-story office building and dominated the local business section.

The Chapin Mine Pumping Engine worked well at "D" shaft until underground conditions caused it to shift and the equipment was forced out of alignment. By mid-1898 ominous cracks had appeared in the engine house as the ground in the surrounding area had subsided. In the spring of 1899 the engine was dismantled, with the parts carefully "larded" and placed in a storage building at a site called "The Sandbanks," which was halfway between "D" shaft and the pumping engine's present location at Ludington "C" shaft.

In 1891 the Ludington Mine, owned by the Lumbermen's Mining Company, and the Hamilton, owned by the Hamilton Ore Company, were drowned out by a large flow of water from the Hamilton No. 2 shaft. Joint efforts to dewater the mines were finally abandoned. In 1894 the Chapin Mining Company acquired the properties. By bailing and other methods they dewatered the mines and underground connections were made with the Chapin. This was before the U.S. Steel Corporation acquired the property in 1901. Its subsidiary, the Oliver Mining Company, was the longest operator of the mines, continuing until suspension of operations was announced in 1932.

O. C. Davidson was superintendent and George J. Eisele was assistant superintendent when the Chapin Mine Pumping Engine was erected at "C" shaft. At its new location, the pumping engine was housed in a conventional corrugated-metal building and rested on a red-sandstone foundation. The foundation remains today The engine served well at "C" shaft, pumping from a depth of 1,513 feet. At its first location, "D" shaft, it had pumped from a depth of approximately 600 feet.

Experts and writers from every branch of engineering came to the Menominee Iron Range to examine the pumping engine and a concerted effort was made to compile statistics on it. It was learned that the manufacturer's records were no longer available. However, the July 1915 issue of *Power* magazine noted that: "During a 12-month period this pump operated 99.5 percent of the entire time at a rate of 6.63 rpm, pumping 1,922 gallons per minute against a head of 1,513 feet. The average delivered horsepower was 736, and the average indicated horsepower 831, making the mechanical efficiency 88.5 percent. The duty performed was 86,200,000 feet-pound of work per 1,000 pounds of steam, including all auxiliaries."

Between 1912 and 1914 the Oliver Mining Company rebuilt the Hamilton shaft, installing electric centrifugal pumps at the twelfth and then the sixteenth level. The era of the Chapin Mine Pumping Engine and the age of steam was over at the Chapin Mine.

Edwin Reynolds. Chief Designer, Chapin Mine Pumping Engine

Edwin Reynolds, the Chapin Mine Pumping Engine's chief designer, trained as an apprentice mechanic in a small machine shop in his native Mansfield, Connecticut, where he was born in 1831. In later years he credited his success to having learned the rudiments of mechanics at a time when accuracy depended on the skill of the mechanic, not on the refinement of the tools.

After working in machine shops in Connecticut, Massachusetts and Ohio, he became shop superintendent for Steadman and Co. of Aurora, Indiana, building engines, sawmills, and drainage pumps for Mississippi plantations. Back east during the Civil War he reportedly worked on the machinery for the famed iron-clad warship, the *Monitor.* After the war he joined the Corliss Steam Engine Company in Providence, R.I., as general superintendent.

In 1876, at the nations Centennial Exhibition in Philadelphia, the Corliss Company's "Centennial Engine" was the mechanical marvel that drove all the exhibits in the exhibition building. Enormous for its day, the 1,400 horsepower condensing steam engine had a pair of 40-inch cylinders, a lo-foot stroke and a flywheel 30 feet in diameter Impressed, Milwaukee's Edward I? Allis hired Reynolds, promising him freedom and financial support to apply his mechanical genius for the benefit of the Allis Company Reynolds became superintendent of the Reliance Works. Since the patent on the Corliss engine had expired in 1870, he was now free to make adaptations.

By 1878 the Allis Company was advertising Reynolds improved Corliss engine. In 1880 Reynolds designed large blowing engines to produce large volumes of air for blast furnaces in steel mills. He also designed his first pumping engine. Within another few years his engineering genius produced new types of pumping engines remarkably simple in design yet able to permit a reasonably uniform flow of water.

In 1884, his nephew, Irving H. Reynolds, joined the Allis Company Experienced with marine engines and working with pumps Reliance had produced since 1874, I. H. Reynolds developed his own engine, calling it the "triple expansion engine."

In 1889 the Allis Company was in the process of contructing a mammoth pumping engine designed by the Reynolds team to dewater the Chapin Iron Ore Mine. This would prove to be the largest steam-driven pumping engine ever built in the United States and would bring engineers and mine developers from all over the world to Iron Mountain to see it in operation.

In 1893, shortly after the Chapin Mine Pumping Engine went into operation, the Worlds Columbian Exposition opened in Chicago and President Grover Cleveland pressed the button to start the Reynolds-Corliss horizontal quadruple-expansion engine. Supplying current for thousands of 16-candlepower incandescent lamps throughout the fairgrounds, the engine that produced the power became a memorable attraction and brought added engineering fame to Edwin Reynolds. Soon the Reynolds-Corliss engines were powering electric railways the world over, including London's underground

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In 1903 Edwin Reynolds became a consulting engineer. He died in 1909 at his home in Milwaukee at the age of 78.

Recent History

In 1934 the Oliver Mining Company offered Dickinson County the pumping engine "as a relic," for sightseers to visit. The Keweenaw Land Association leased the land around the pumping engine to the county for one dollar with the provision it be fenced and tax free. The next year, county highway workers razed the building housing the pumping engine. The pump was painted with aluminum paint to make it more attractive for tourists.

It remained that way until 1978 when Dickinson County sold the pumping engine to the Menominee Range Historical Foundation for the sum of one dollar with the understanding that the foundation would assume all responsibility for developing a permanent historical mining site. Plans were made to restore and preserve the artifact and work was begun. It was housed in a metal building and became the focal point of a mining museum established by the Foundation through the cooperation of individuals, businesses, and industries interested in preserving the mining history of Michigan's Upper Peninsula and the Menominee Iron Range. The mining museum is open to the public from May through October. Continuing attention toward preservation is given to the historical relic each year.

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Resource Material

The resource material for preparation of the brochure includes an 1895 and other annual reports, Commissioner of Mineral Statistics, State of Michigan; reports of proceedings of various annual meetings of the Lake Superior Mining Institute; historical paper on Chapin Mine prepared in 1923 by George Eisele, Chapin Superintendent; articles by David N. Skillings in issues of Skilling's Mining *Review; Power* Magazine, July, 1915; *Compressed Air* Magazines; early newspapers published on the Range; booklet titled Iron *Mountain's Cornisb Pumping Engine and the Mines it Dewatered,* by William Cummings; early research paper and other research by Beatrice Blomquist, Menominee Range Historical Foundation Museum.

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