“The World’s Largest Derrick”

(located at the C.E. Tayntor quarry in Graniteville, Vermont)

By Andreas Kuehnpast

(Andreas Kuehnpast is an industrial engineer from Germany. In his spare time he researches the Barre granite industry and the railroad that served it, the Barre & Chelsea Railroad.)

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"**This circa 1895 photo of the C.E. Tayntor quarry shows the largest derrick in the world in the center**."
(Photo from the collection of Todd Paton.)

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GRANITEVILLE — The Barre granite industry has always been good for superlatives: “The world’s largest granite quarries”, “The largest single piece of granite ever quarried in this country.” Another superlative that even local granite industry historians are not aware of is: “The largest derrick in the world.”

This derrick was erected at the C.E. Tayntor quarry in Graniteville in 1891. The derrick was unusual in its size and also in the material it was constructed of: steel. While steel is the material of choice for modern-day derricks, it was highly unusual in the 1890s. Back then and up to the 1960s the quarries on Millstone Hill and the manufacturing plants in the Barre Granite District solely relied on boom derricks using wood for their booms and masts. There were only two known exceptions, a steel boom derrick installed at a granite manufacturing plant in Goldsbury Meadow in Barre and a larger version of the same derrick at a quarry in Graniteville. Both the manufacturing plant and the quarry were owned and operated by the same man, Charles E. Tayntor, a New York City-based monument dealer.

The steel boom derrick at the C.E. Tayntor quarry was a giant. And a giant was what C.E. Tayntor had been looking for. After the mast of one of his wood derricks had broken under a high load, he started looking for a derrick with a higher capacity. In 1892 the industry magazine “Stone” described the period’s wood derricks as follows: “These derricks have masts and booms of wood measuring from 50 to 75 feet, and are intended for lifting about 20 tons with a single line.” This was not enough for C.E. Tayntor who required more capacity to lift the heavy granite blocks that were occasionally quarried at his Barre quarry. C.E. Tayntor finally found what he was looking for: a steel derrick following a patented design offered by New York City-based Milliken Bros. This company designed a derrick to fit Tayntor’s requirements. The mast of the steel derrick finally built in 1891 was 99 feet high and the boom was 70 feet long. Both were constructed of Phoenix columns and were heavily trussed to increase the stability of the derrick. The mast was trussed in five planes and the boom in three planes. To support the derrick, 10 guy wires were run from the tip of the mast to anchoring points set in solid granite. In total over one mile of steel rope was used for the rigging of the derrick. Hoisting the granite blocks from the quarry was done using a 1¼-inch steel wire rope, while the boom was operated using a ¾-inch steel wire rope.

The derrick was rated at 40 tons. This limit, set by the derrick's builder, was gradually exceeded more and more as trust in the steel giant's capacity grew. For testing purposes a load of 57½ tons was lifted, and according to an article in "Engineering News" from November 1, 1894, it was "estimated that the derrick itself could be worked with safety to carry loads of 80 tons; but it was decided that the wire rope was not quite equal to this enormous strain." Tayntor pushed up the limits step by step. A photo of monument dealers visiting his quarry in 1895, for example, shows the group proudly standing on a quarry block weighing almost 70 tons. And on Feb. 16, 1896, the prestigious "New York Times" would state: "Mr. Tayntor has the only derrick in America large enough to handle a single piece of granite weighing over 150,000 pounds."

The steel derrick was operated by a 4-ton hoisting engine. This engine was large compared to the typical hoisting engine employed for derricks in the 1890s. Even so, slow multi-part lines had to be employed when lifting some of the very heavy blocks of granite often quarried at the C.E. Tayntor quarry. In the July 1892 issue of "The Monumental News" it was reported that a "shaft of granite weighing 37 ½ tons was lifted at the rate of nearly 4 feet in 18 seconds."

After C.E. Tayntor acquired the steel derrick the machine was determined to be the largest derrick in the world. It made the news and it was still covered in various publications years after its installation. In 1895 "The Morning News" wrote: "A piece of mechanism like which there is none other in the world, is the gigantic steel derrick at the C.E. Tayntor granite quarry at Barre, Vt. The mast, which is ninety-nine feet high, stands higher than any similar one yet erected."

Milliken Bros. followed a design by Foster Milliken, that had been patented on May 26, 1891. The patent number is 453,087. The key feature of this patent is the use of Phoenix columns for the mast and the boom. By using the hollow Phoenix columns, several of the ropes used to operate the derrick could be run through the inside of the columns.

The Phoenix column had been invented and patented by Samuel J. Reeves in 1862. The columns were hollow cylinders constructed by riveting or bolting together four, six, or eight wrought-iron profiles to form a large tube-like column with flanges that allowed attaching ties and braces and easy connection between several of these columns. The Phoenix columns were lighter and stronger than the solid cast iron columns of the period. They revolutionized bridge and building construction in America. About 800 bridges were built using Phoenix columns.

In designing the derrick Milliken Bros. went to great length to reduce wear and effort required for the operation of the derrick. The massive derrick that weighted about 25 tons without ropes could be swung by quarriers using a sideways pull force of only 300 lbs. on the hook while carrying a load of almost 40 tons. This was considered low by the period standards, but as too laborious by innovative Charles E. Tayntor. Therefore in 1892 he ordered a "turning apparatus" for his derrick from Milliken Bros. An article in "Engineering News" from November 1894 describes in detail how this apparatus worked: "In order to further improve the efficiency of this machine, it was decided to revolve the derrick by power. A third drum on the engine was employed to operate a wire rope running continuously in one direction and travelling at a rate of about 200 ft. per minute. This operates a rubber line sheave moving in a vertical plane, which in turn operates a right and left friction clutch operating a horizontal shaft. This shaft operates a worm and gear which turns a sheave in a horizontal plane, and this sheave connects with a sheave 8 ft. in diameter on the mast of the derrick by means of a link-belt chain. The wheel on

the turning apparatus carrying the chain is further connected with the vertical shaft by means of an independent friction clutch. The operation of this mechanism is very simple. The operator, by means of the friction clutch, can give right or left hand motion to the machinery, which then swings the derrick either to the right or left.… In other words, two men, one at the engine and one at the turning apparatus, are able to operate this derrick without the aid of any other person. This is extremely useful where light loads are concerned, and it saves pulling the boom around by hand, which is often a very slow operation in a very deep quarry." An article in the magazine "Stone," though, showed that even this "apparatus" had its limits and was not really fast: "The rope will move at the rate of 200 feet per minute, thus revolving the derrick without load one complete turn in eight minutes."

The complicated "turning apparatus" that did require a second engineer to operate the derrick did not catch on and within a few years large diameter bull wheels attached to the bottom of the masts became standard for turning derricks. A wire rope was wound around these wheels and driven by a separate hoisting engine that controlled the swinging of the derrick from the engine house. This allowed complete control of all derrick movements by a single derrick engineer.

On the photo accompanying this article the steel derrick is in the center of the photo. The engine house from which the derrick was operated is right behind it. Wire ropes run from the hoisting engines in the engine house to the bottom of the steel derrick. There is a small shack for the operator of the "turning apparatus" and additional "shacks" to protect the sensitive turning machinery. An article in the June 16, 1895 issue of the "Logansport Pharos-Tribune" describes the operation of the derrick with the turning apparatus as follows: "At the foot of the Tayntor derrick, heavily planked over to protect it from flying stone when blasting out refuse granite, is the turning gear connected by a wire rope with the engine-house, where, by means of a lever similar in its workings to the reversing lever on a locomotive, the engineer alone is able to lift from the bottom of the quarry, swing around to the side track and place upon a flat car a block of granite weighing forty tons." An article from the February 1894 issue of "The Manufacturer and Builder" gives additional details: "Double tracks of the Barre railroad are within reach of the boom, so that material taken from the quarry can be loaded at once from the derrick upon the cars."

In addition to the steel derrick at the quarry, C.E. Tayntor ordered another steel derrick from Milliken Bros. for his manufacturing plant in Goldsbury Meadow in Barre. This derrick followed the design of the quarry derrick, but was somewhat smaller. Obviously the Tayntor Company was not completely satisfied with their steel derricks for long. In 1896 they announced that they would move the smaller steel derrick from Barre up to their Graniteville quarry and replace it with a wood derrick. At the same time they informed that "they intend to put up two auxiliary wooden derricks at the quarry in the near future…" The success of their steel derricks must have been limited as any additional derricks were of the traditional wooden design. As far as current historical research has shown, no additional steel derricks were acquired by Barre quarriers and manufacturers in the 1890s. The two Milliken-built derricks remained loners and it is unlikely that they were used long after the C.E. Tayntor quarry was acquired by Jones Bros. in 1898. At least one photo of the quarry under Jones Bros. ownership though still shows one of the steel derricks in operation in the early 1900s.

For a long time wood derricks remained the standard at both the quarries on Millstone Hill and the manufacturing sheds in Barre. Among experienced derrick engineers and riggers some felt that steel derricks would buckle without warning, claiming that wood derricks would give a warning sound when overloaded. In addition the quarries on Millstone Hill obviously were reluctant to switch to steel derrick because the wooden derricks could better absorb vibrations and thus were safer to operate. This reluctance has been overcome, with no problems in steel derrick safety experienced in half a century of using steel derricks in Barre.

Today steel derricks have completely replaced the wood boom derricks once common in the Barre granite industry. The last wood derrick in Barre stood along a long-abandoned side track that once served the old Alex Milne Granite and South Barre Granite sheds on Circle Street. It was taken down in 2003. The modern-day steel derricks at the E.L. Smith quarry in Graniteville can lift up to 250 tons, over six times of what their 1891 antecedent at the C.E. Tayntor quarry was rated for. And, at 175 feet high, they far exceed the 99 feet of Tayntor's derrick.

While the unusual steel derricks acquired by C.E. Tayntor in the early 1890s soon fell out of favor, they were a proof of the innovative nature of the Barre granite industry — a nature that often leads to superlatives.