The SS *Great Eastern*

The controversy over whether model ships are works of art or remarkable examples of human craftsmanship has been a topic of discussion for decades – if not centuries. As far as this writer is concerned, Webster's Dictionary doesn't really settle the question. However, when it comes to Bill Gatfield's remarkable SS *Great Eastern*, there is no doubt. Bill is not a model builder. He is an artist who specializes in stainless steel creations, and he refers to this beautiful piece as a sculpture.

A welder from the Technical Division at Fermilab, Gatfield created quite a buzz with his work at the recently held employee art show. Along with congratulations, he was assaulted with a barrage of questions: How long did it take? How much does it weigh? Is it to scale? Well, for the record, it took 10 years – working on and off – to finish, measures seven feet long, weighs 300 lbs, and is to scale, more or less.

A welder for 33 years, Bill wanted to create a model of this ship after reading a book about it. "It fascinated me. The building of it was such a major undertaking," said Gatfield. "I wanted one. Not being able to afford anything close – I decided to build one." Fabrication took place in his garage. To challenge himself, Bill decided to use small strips of steel, a quarter inch wide, for the hull. "They provided a better shape," he said.

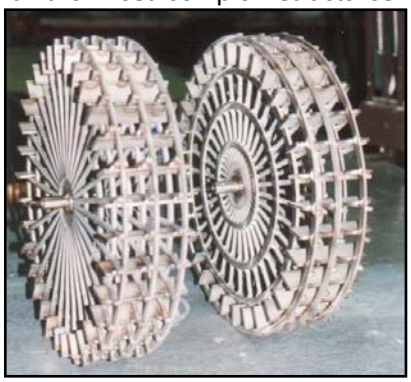
The *Great Eastern* was the largest ship ever built at the time of its 1858 launch. No vessel for the next 50 years would come close in size. Several inventions developed for the *Great Eastern* are still used on ships today, including the innovative steering gear. It was the first ship to have a double hull, a safety precaution now required, which was not built into another ship for 100 years! As far as it is known, she was the only vessel ever to employ a screw, paddle wheels, and sails as a means of propulsion.

The ship was named one of the seven wonders of the industrial world by Deborah Cadury in her book of the same name, along with the Brooklyn Bridge, the Transcontinental Railroad, and the London Sewer System. The ship could cross the Atlantic twice without refueling. Running on steam power, and utilizing her sails, she could reach 13 knots – fast for its time. The *Great Eastern* had five steam funnels and enough canvas in its sails to rival a clipper ship. Not particularly successful as a passenger vessel, its major claim to fame was the laying of the 1865 transatlantic cable between Ireland and Newfoundland, and the 1869 cable between France and Cape Cod, Massachusetts. It was sold for scrap in 1889 and took two years to break up!

Jules Verne loved the *Great Eastern* and described his 1867 voyage in *A Floating City.* Reportedly, while on board, he developed his ideas for *20,000 Leagues Under the Sea.* The ship undeniably breeds enthusiasm: "I wish I could go back," said Gatfield, "to a previous life and be on this ship."

As a professional welder, Bill understands the idiosyncrasies stainless steel possesses when heated or welded. Even so, he admits that he wasn't ready for the problems he had to overcome before the *Great Eastern* would be completed.

Not shying away from a challenge, Gatfield decided to start with the most complex structures first – the paddle wheels. These intricate pieces would measure over 13" in diameter! Each wheel was composed of 3 discs, which would be fabricated, and then joined together. Using an aluminum base plate, each component of the disc was clamped down and welded in place. The problems began when the disc was removed from



the base plate. The subassembly had developed a considerable amount of warp. The disc had to be clamped between two steel plates, and heated in an industrial oven before the piece would remain flat! This would be a problem that would plague Bill throughout the construction of the model.

Building a stainless steel hull presented its own unique problems. The "planks" would have to be welded to the frames and each other from the

inside. Gatfield's innovative approach allowed him to clamp the strips in place, and still reach the interior with his TIG welder. Since weight was a consideration, the frames were hollowed out as much as possible using an overhead mill. They were then welded to a base plate that was bolted to a fixture Bill called a "strong back." This was basically a series of 2'X4's. supported by two horses. Being suspended from above, it was now possible to access the inside of the hull. A shear was used to cut the "planks" from a 4'X8' sheet of 16 gauge stainless steel. Bill used full length strips as much as possible while planking the hull. When it became necessary to trim them, the tool of choice was

a mini-grinder. He estimated that the total cost of materials for the model was about $2,000!

Once a sufficient number of planks were attached, the hull was removed from the strong back and steel plate. The strong back assembly was then repositioned on the horses, and the hull was tack-welded to the plate in an upright position. In theory this would keep the hull straight and immobilized.

Unfortunately, as additional planks were now welded to the hull, incredible forces began to manifest themselves. On several occasions the hull

actually broke free from the steel plate with a resounding "bang" comparable to a .22 rifle shot! The increasing warp called for drastic measures. Bill employed four 1 ton straps equipped with ratchets to hold the hull down, but to no avail. The entire strong back began to buckle! Gatfield decided to forge ahead as best he could, and deal with the problem once the hull was completely covered. As more strakes were added, the deviation became greater. To say he had a seven foot long steel banana when finished might be an exaggeration, but it wouldn't have been by much!

Bill understood the forces that had been at work, and his solution was ingenious and simple … if you're a professional welder. Three clamps were fabricated and anchored to the garage floor. With the hull forced into the correct shape, he then heated the side opposite the warp with a rosebud torch. (A rosebud is the oxy-acetylene big brother of the propane torch.) This allowed the hull to assume the correct shape, and Bill to breathe a little easier!

Portions of this article were derived from the Fermilab *Today* newsletter. Photos by Bill Gatfield and George Wyatt.

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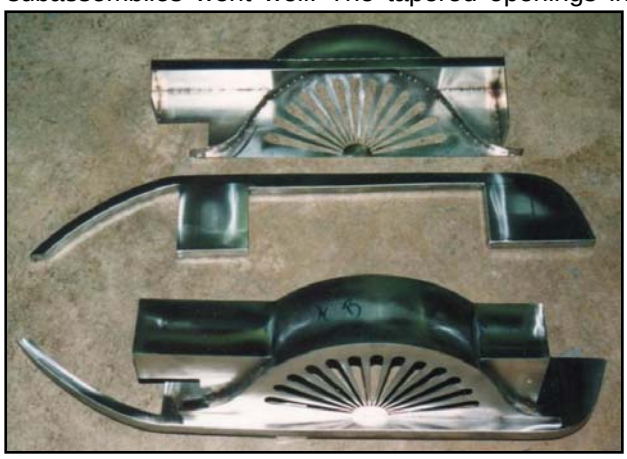
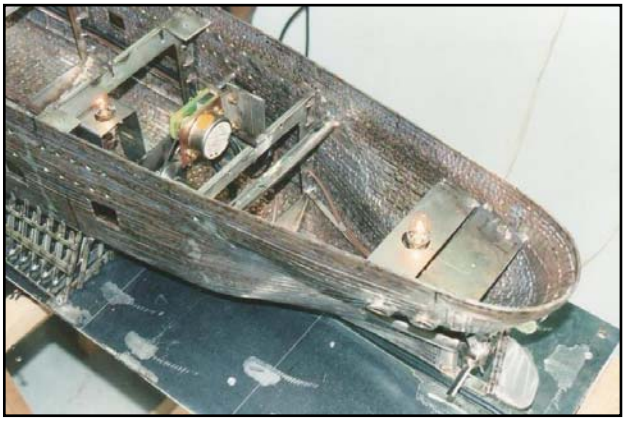
Part II

With the trials and tribulations of constructing the hull behind him, Bill turned his attention to fabricating the paddlewheel housings. In spite of their subtle curves and intricate carvings, these subassemblies went well. The tapered openings in the



housing face were cut with the help of an overhead mill, which would be used extensively throughout the construction of the model. Right angle bends, in many cases, were accomplished by pre-scoring the piece at the correct location, and forming it in a break. Corners were then welded together and ground smooth.

Prior to installing the paddle wheels and housings,



Gatfield completed all the necessary hull work that included portholes, hawse pipes, and loading ports. He also fabricated the rudder and propeller. Not content with a static display, Bill wanted to add more visual excitement by driving the propeller and paddle wheels, as well as installing interior lighting. He employed an assortment of 5 watt bulbs and LED's for the lighting, which worked quite well. The same couldn't be said for the

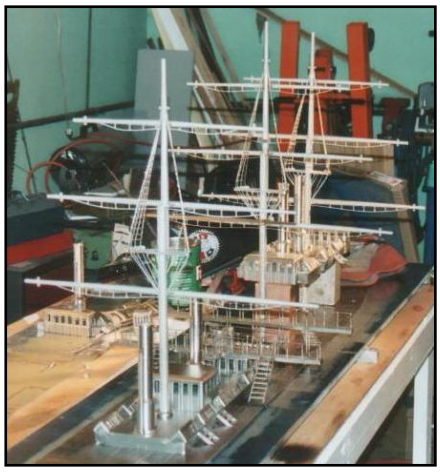
motors. A number of different drives were employed, including some barbecue spit motors, which did not hold up well when operated continuously over an eight to ten hour period. Bill would go through three different drives before finally settling on some McMaster Carr units.

Construction of all the deck structures for the model pretty much followed the procedure developed for the paddle wheel housings. Cabin windows and doorways were milled out after the steel strips were fastened to plywood bases, and clamped in place.

Like the hull, Bill wanted to simulate the deck planking by welding strips together. The fact that he would need to get below decks to change bulbs and drive motors presented an interesting challenge. After weighing the options, he decided to make the deck, deck structures, masts and rigging into one large removable assembly!

Using a template, Gatfield was able to fabricate a deck that closely conformed to the hull shape. It would take 40 full length strips and 7,200 tack welds to complete this task!

Have you ever tried to turn down a tapered mast or yard on a lathe? Well, try stainless steel. This phase of the project really taxed Bill's patience. Unless a light touch was applied, and the tool was very sharp, the work had a tendency to ride up on to the cutting bit, which invariably resulted in a bent, useless piece. Other circular objects, such as the stacks, mast coats, and ventilators didn't present as much of a problem since they were made out of stainless pipe or tubing.



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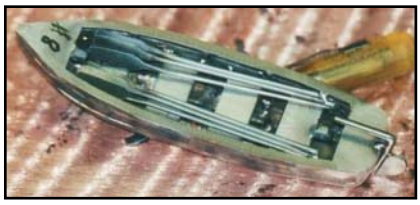
If working with stainless steel offered Gatfield one advantage, it was that it would not be necessary to step the masts at the keelson. The strength and rigidity of the deck allowed him to weld the masts right to the deck surface. The seams were covered by either deckhouses or mast coats.

As far as the rigging is concerned, various diameters of stainless wire were used. When heavier sizes were required for lines such as the stays and shrouds, Bill twisted pairs together. Like the rest of us, he tried to do as much rigging off the model as possible.

The photo on the right illustrates something we could never do. After the masts, yards, and deckhouses were welded in place, the assembly was flipped over, and a wiring harness was installed for the interior cabin lighting. It was now time for the sails.

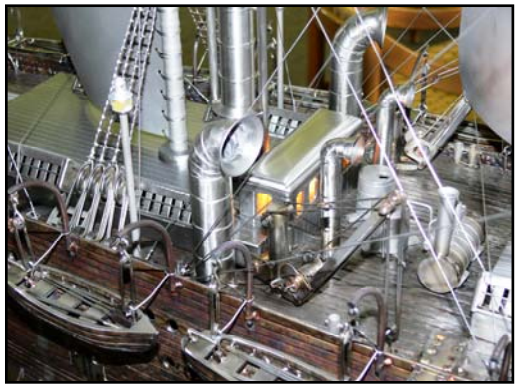
Utilizing cardboard templates, Gatfield cut out the 14 sails he would mount on the model. He wanted to portray the courses on the third and fourth masts in a semi-furled state, so these required some additional thought. Although cut to the shape he wanted, showing them flat would not project the desired effect. So, using a marking pen, curves representing the folds were drawn on the back side of the two sails. A small chisel and hammer were then employed to crease the metal along the lines. The results are quite evident in the photo! All the sails were then sandblasted to remove any sheen, bent to shape and mounted.



We all know how challenging ship's boats can be. Try making 18 of them out of stainless steel! Bill found out that straight strips don't bend well on a tiny hull. Without realizing it, he actually came up with the concept of spiling, which solved the problem. The oars were made from pieces of rod that were flattened with a hammer and shaped … do you think that might work with wood?

It took Bill Gatfield a decade to build his *Great Eastern*, and caused him nearly as much grief as Isambard Kingdom Brunel suffered back in 1858. Never the less,

Brunel affectionately referred to his creation as the "Great Babe." We don't know if Bill also has a pet name for his *Great Eastern*, but the same pride must surely be there!



Photos by Bill Gatfield and George Wyatt.