

## TALES OF TWO SPHERES, OLD AND NEW



Poking out of *Alvin*'s original steel sphere is Raymond Pechacek Jr., whose father supervised the sphere's construction. The photo was signed by Bill Rainnie, who led the program to build the sub and was *Alvin*'s first pilot.

*A gem of an email landed in our inbox, accompanied by the photo at left.*

To the Editor:

My father, Raymond Pechacek Sr., was vice president for engineering at Hahn and Clay in Houston, Texas, and personally designed the original pressure hull for *Alvin*. My Dad talked quite a bit about designing and building *Alvin*, and it was an important part of his career.

I interviewed him concerning *Alvin* shortly before he died. I heard bits and pieces of the account throughout my life and wanted to learn the full version.

He was always amazed that a cereal company (General Mills) was the prime contractor for *Alvin*. He told me the Navy and other "conventional" contractors were not able to develop a design for the pressure vessel that would meet the depth requirement specifications—too much risk.

My Dad told me that General Mills negotiated the subcontract with Henry Clay, Hahn and Clay's owner at the time. General Mills asked Henry for a performance clause to mitigate its risk. They requested Hahn and Clay pay "X" amount of money in penalties for each "Y" amount of depth if the pressure vessel failed before meeting the depth specs.

Henry thought about it and countered General Mills should pay Hahn and Clay a bonus for each "Y" amount of depth if the vessel exceeded the depth requirement. Apparently this was a novel feature for contracts of the day. I understand General Mills did not like it but ultimately accepted it.

The objective was to design, develop, and build as perfectly round a sphere as possible, so the extreme pressure of the ocean would be equally distributed on all surfaces. He explained that existing technology allowed Hahn and Clay machinists to fabricate the two perfectly formed sphere halves he designed to withstand the extreme deep ocean pressure.

In June 2012, a new titanium personnel sphere for *Alvin* passed a significant milestone at a Northrop Grumman facility in Annapolis, Md. The sphere was placed inside a 10-foot-diameter chamber that was sealed with a massive plunger, filled with water, and pressurized (below). Sensors measured how materials reacted to pressures simulating depths between 6,500 and 8,000 meters.

The sphere was then transported to WHOI where *Alvin* Group engineers and pilots fitted it into a metal frame (below right) and attached new syntactic foam—a material strong enough to withstand extreme pressure, yet lighter than water to provide buoyancy to lift the 45,000-pound vehicle back to the surface.

The new thicker and wider sphere extends *Alvin*'s operations



Bruce Strickrott, WHOI



Advanced Imaging and Visualization Lab, WHOI

## WHOI'S NEW SHIP: NEIL ARMSTRONG

However, the challenge was how to join the two halves together. Standard room-temperature welding practices of the day would create a weak link when joining the hull seam, and *Alvin* could fail at far less depth than the desired requirement.

My Dad pondered this dilemma in great detail, since it was the core of the entire design and success (or failure) for *Alvin*. He knew he could not follow standard practices. So after much thought, he invented a unique manufacturing process to solve the problem.

He directed Hahn and Clay fabricators to heat the two pressure vessel halves evenly by rotating them on a rig around torches. This action caused all surfaces to expand evenly. Upon reaching the desired temperature, the two sides were connected, and the seam welded. Most important, as the two halves cooled, the weld also cooled, contracted, and completely integrated with the rest of the pressure hull, forming a perfect, seamless sphere.

Pressure testing exceeded all expectations. My Dad said Henry made some good money on the contract when the test chamber failed before the sphere did.

I had the privilege of hanging out at Hahn and Clay many times when I was a kid and also worked in the factory during summer breaks from college. I remember seeing the heating process for *Alvin* when my Dad took me to the shop one evening. Obviously he was very concerned about every aspect of *Alvin's* building process.

One of my most prized mementos is the picture taken of me in *Alvin*. And my Dad had Bill Rainnie, *Alvin's* senior pilot, personally sign it for me! My family and I followed *Alvin's* amazing exploits through the years (and still do).

Best regards,  
Raymond Pechacek Jr.  
Wentzville, Mo.

for another 40 years and its depth capacity from 4,500 to 6,500 meters (2.8 to 4 miles). It has 18 percent more interior space, better ergonomics, and two more viewports, for a total of five. With other improvements, including a new command-and-control system and new lighting and imaging systems, *Alvin* is scheduled to resume deep-sea research missions in 2013.



Tom Kleindinst, WHOI



Photo courtesy of United States Navy

WHOI President and Director Susan Avery (left) welds her initials in the keel of the new research vessel *Neil Armstrong* at the ship's authentication ceremony Aug. 17, 2012, at the Dakota Creek Industries shipyard.

The nation's newest research vessel will be named the R/V *Neil Armstrong*, after the renowned astronaut and first person to set foot on the moon. The ship will be operated by Woods Hole Oceanographic Institution (WHOI).

"We are honored," said WHOI President and Director Susan Avery. "Neil Armstrong is an American hero, whose 'small step' provided humanity with a new perspective on our planet. When he stood on the moon and looked back at the Earth, he saw mostly ocean—the last unexplored frontier on Earth. The R/V *Neil Armstrong* will carry on its namesake's legacy of exploration, enabling the next generation of oceanographic science and discovery."

R/V *Neil Armstrong* is the first oceanographic research vessel named for a space explorer, but the link between space and ocean exploration is not new. Each of NASA's space shuttles was named for a famous oceanographic vessel: *Challenger*, *Columbia*, *Endeavor*, *Discovery*, and *Atlantis*, whose namesake was built by WHOI in 1930 to be the first U.S. ship created for ocean research.

In May 2010, the Office of Naval Research selected WHOI to operate one of two new research vessels to be built by the U.S. Navy. The ships, now under construction at the Dakota Creek Industries shipyard in Anacortes, Wash., will be known as "Armstrong-class" ships. Armstrong died on Aug. 25, 2012.

"The 238-foot R/V *Neil Armstrong* will serve a pressing need for a new general-purpose research vessel based on the East Coast of the United States and will be deployed for a wide variety of oceanographic and ocean engineering missions," said WHOI Vice President for Marine Operations Rob Munier. "The R/V *Neil Armstrong* is also expected to support new initiatives in ocean observing in high latitudes, as well as new efforts to study North Atlantic ecosystems and their sustainability."

R/V *Neil Armstrong* will provide a number of enhanced capabilities for scientists, including advanced over-the-side handling systems and state-of-the-art hull-mounted bottom mapping and acoustics transducers. These systems were designed to improve the safety of scientific operations and enable the ship to operate effectively in higher sea states than existing vessels of this size.

The vessel is scheduled to launch in early 2014 and be ready for service in 2015.