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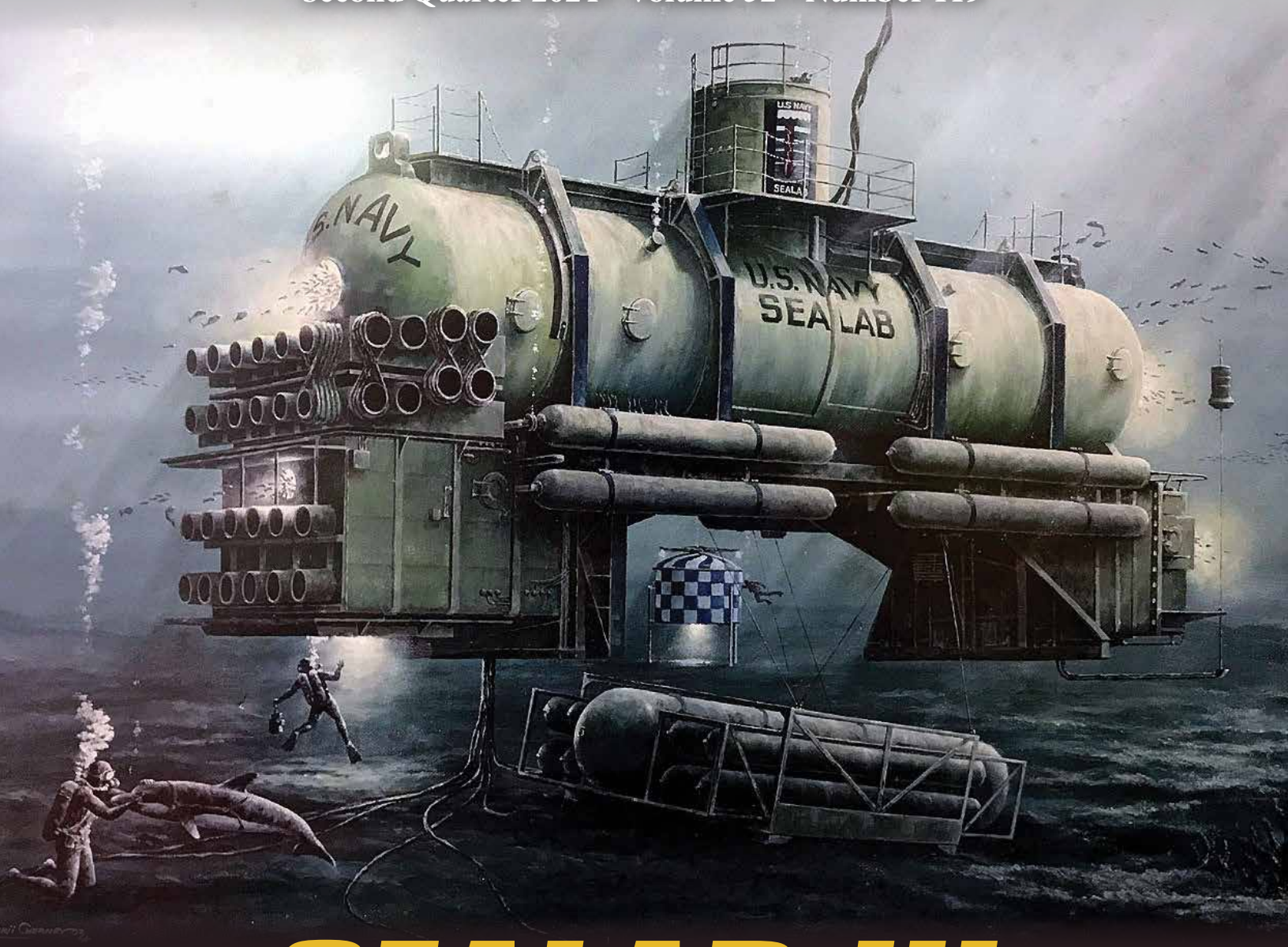


SEALAB III: (1969) The Divers' Story

Keeping The Faith. *SEALAB III* Divers' Story

In this issue, we finally present a very important article that has been a long time coming.

Author Kevin Hardy and I have discussed this issue's *SEALAB III* article on and off for about a decade, while the central figures in it, the divers, have discussed it among themselves for over half a century.

The discussions are now over, and the *SEALAB III* Divers' Story is at last here in print. For the *Journal* team, the seed of this article was planted back in New Orleans in 2015, at the Underwater Intervention Conference.

Kevin stopped by the HDS booth, and we got into a light conversation to connect. We recognized each other from the SEALAB/Deep Submergence Pilots Association Reunions that we both attended in San Diego. But we did not know each other well. Those Reunions were primarily for the participants of those programs, which we were not. Both Kevin and I were basically "interested supporters" of the participants and the history that they had made. We definitely sat at the back of the bus at every gathering, and our individual focus was on the program participants, not the members of their audience, such as we were.

In our conversation at the HDS booth, Kevin mentioned that he had written an article on the 50th anniversary of *SEALAB II*, which was that year, but at the last minute, the magazine publisher had backed out of publishing it.

Sensing a good story from someone whom James Cameron had recruited for his successful Deepsea Challenge dives, I invited Kevin for a cup of coffee in the conference lounge in the center of the hall, where he filled me in on the story details. He also expanded on his lifelong interest in the three SEALAB programs, and spoke about the end of *SEALAB III* with Berry Cannon's tragic passing, and how many on the team disagreed with the "official" opinion that P. A. Wells was in some way responsible for it.

I had become very close to Aquanaut Bob Barth, "the Dean of Saturation," and knew he too disagreed with the Wells assessment. Bob had joined the HDS Advisory Board along with Scott Carpenter, Andreas Rechnitzer, and James Cameron, and I would always run anything SEALAB by him. Without mentioning Bob as my ace authority SEALAB card, I asked Kevin how close he was to his Aquanaut sources for this *SEALAB III* story. He took out his wallet and handed me a business card. It was Berry Cannon's. "That close," he said.

One of the benefits of publishing a magazine on history is that you have the flexibility to move most content around in the print schedule, as there are only a few articles that are "time sensitive." And Kevin's *SEALAB II* was one. After discussing the opportunity with Bonnie and Nyle, we bumped Jan De Groot's article on SORIMA, which held the next available printing slot, and ran Kevin's *SEALAB II*'s golden anniversary article as the cover story in the 2015 third quarter, issue 84. The timing was excellent, as we had it available at the HDS booth at the important international MTS/IEEE Oceans'15 Washington DC Conference in October.

Kevin was very happy with his experience working with the *Journal* team, and, with his friend Ian Koblick, joined the staff as co-authors for "The History of Manned Undersea Habitats" column.

With the *SEALAB II* story in print and a dedicated column for the history of manned habitats, Kevin turned his focus to the issues of the *SEALAB III* story, and the Aquanauts' lingering unhappiness regarding the shadow cast over their shipmate P. A. Wells.

I shared his concerns regarding the age of the remaining Aquanauts who were gradually passing away without their valuable opinions of the Wells situation being given the light of day, and agreed to publish an article as soon as Kevin was ready to release it. He set out to record their story which we have now published here.

"*I feel like a Priest listening to confessions*," Kevin wrote to me as he interviewed the Aquanauts. "*These divers have been carrying their story for half a century without a vehicle to tell it to that they all felt they could trust.*"

It is to Kevin's eternal credit that his reputation is at a level where he was able to secure that trust and gather the Divers' Story of *SEALAB III*. He was trusted to Keep the Faith.

The *Journal* team is truly grateful to our colleague Kevin for trusting us with the story, which we are both honored and proud to publish. Kevin has Kept the Faith.

As we go to press, the Aquanauts who drafted the Introduction to the article are all alive and will be receiving a copy of the issue straight off the press.

Everyone on the *Journal* team is grateful to each and every HDS member for their support, which enables us to bring to light articles like this Divers' Story and to keep the flickering flame of diving history burning. Thank you, all.

Leslie Leaney
Founder and Executive Editor

To: Leslie Leaney, Publisher, *Journal of Diving History*, Historical Diving Society

Image courtesy of Bob Barth

A Foreword from the *SEALAB III* Aquanauts

Dear Leslie,

We *SEALAB III* Aquanauts convey our greatest thanks to the *Journal of Diving History* for its commitment to publishing the SEALAB III story. What really happened below the surface off San Clemente Island has never made it to printed pages in such a concise and readable fashion. It's about time it did. We are extremely grateful for the work Kevin has done to research, interview and transcribe our first-hand accounts of the events of February 1969, and for your support of both him, and us.

There are more stories to tell, and we are open to sharing those. While some of our memories may differ slightly on detail after so many years, we all stand 100% behind the article's main conclusion that Paul "P.A." Wells had no part in the death of Berry Cannon and the sudden end of *SEALAB III*. His name should be exonerated.

Aquanaut **Fernando Lugo**: "When Berry died, P.A. and I were at the dive control center, no master diver was at the dive station. I know from experience P.A. was given the dive control because he was a great supervisor/leader. For many years later when I would speak with P.A., I always felt he was never able to live with the stigma of being wrongly blamed."

Aquanaut **John Kleckner**, the last member from the Medical side of the project: "I would like to thank you for finally telling our (the Aquanauts) story of *SEALAB III* and bringing to light many of the issues, short comings and inadequacies of both the project itself and the preordained conclusion of the BOI. I have always said I believed Cannon died from electric shock, not due to an empty canister. Berry was electrocuted. PA was thrown under the bus. Let us hope P.A. Wells and his family get the closure they rightfully deserve."

Aquanaut **Dick "Blackie" Blackburn**: "Charts, mathematical formulas, gas laws, and chemical symbols just don't seem to convey the magnitude of the problems we faced. Only stating the conditions in plain language seems to help clarify the extent of the damage done and how it could have been avoided. If we had adhered to normal, accepted and approved diving practices the first dive probably would not have been made, let alone the second one. I think this article does a great job in articulating the divers' experience and scope of the problems."

Aquanaut **Larry Bussey**: "So many unfortunate occurrences with *SEALAB III*, and very definitely P.A. Wells was not negligent."

Aquanaut **Cyril Lafferty** (Royal Navy): "I was scheduled to be team leader of Team 3 and Nobby Clark and I were put in charge of training personnel in the operation of the Mk 8 diving system with the Kirby Morgan helmet and the hot water suits in San Diego. Commander Scott Carpenter and Philippe Cousteau were among those we trained.

"Both Nobby and I were invited to take part in *SEALAB III* because we were part of the Royal Navy team that had successfully dove to 600 feet. We were fully trained and experienced in the use of semi-closed and closed-circuit breathing systems. Those dives taught us a lot about the use of HeOx. In those HMRN dives we compressed very rapidly in the bell on the way down and we got very cold even before entering the water. One diver made a belt of small hot water bottles with which he could warm his hands! We also had to develop a rudimentary communication system because of the effects of He on our ability to make ourselves understood. We used the standard Dry Suit in conjunction with the addition of a Woolly Bear undersuit. This was a thick furry whole-body suit which helped to insulate us.

"Even with these we were well aware that half an hour exposure in the water was probably the safe maximum time. We realized that the development of some sort of heated suit was going to be required.

"On arrival in Washington DC, we joined in the Sat Diving Trials. We were surprised to find that separate masks and breathing systems, similar to those used by sport SCUBA divers, were being used along with standard wetsuits.

"One thing I can say is that there is absolutely NO evidence to support the charges against P.A. Wells. He should be roundly praised for the work he did on behalf of all of us. We were all in awe of him and of his work ethic."

Aquanaut **Andy Pruna**: "After *SEALAB* ended and things calmed down, I had an offer from Dimitri Rebikoff, a diving pioneer from the early Cousteau days who had developed some of the best underwater cameras as well as vehicles, to put together a surveying team comprised of some of the best divers I could think of. The first diver I had in mind was P.A. Wells and not because he was a fish in the water, but because he was the most meticulous and responsible diver I had ever met. If I was going to be working with experimental and complex equipment, that was the guy I wanted. There are obviously several possibilities as to why or how Berry died, but blaming P.A. is not one of them. Berry was a friend and a very seasoned diver. He paid the ultimate price for a botched-up project. In the end, all of us that participated probably owe him our lives."

Sincerely,

Richard Blackburn
Larry Bussey
Martin Harrell
John Kleckner
Cyril Lafferty
Fernando Lugo
Keith Moore
Jay Myers
Jim Osborn
Andy Pruna
Larry Raymond

SEALAB III (1969): The Divers' Story

By Kevin Hardy

GUEST AQUANAUT CONTRIBUTORS/REVIEWERS: Robert Barth*, Richard Bird*, Richard Blackburn, Larry Bussey, Berry Cannon* (archives), Larry Hallanger*, Martin Harrell, John Kleckner, Cyril Lafferty (Royal Navy), Fernando Lugo, Keith Moore, Jay Myers, Jim Osborn, Andy Pruna, Larry Raymond *(*now deceased)*

GUEST CONTRIBUTORS/REVIEWERS: Mary Lou Cannon, Mary Ann Martin Hallanger, Ben Hellwarth, Richard Long, Robert Wernli

FIGURE 1: The *SEALAB III* habitat was a heavily modified *SEALAB II* structure. Two additional lower rooms were added for buoyancy and work space. The habitat floated off the seafloor to solve the "Tiltin' Hilton" leveling problem. Legs were to be extended from the habitat to stabilize the habitat once it was level in all axes. Diver umbilical storage was added to one end. On deployment, Ballast Tanks 1 and 2, in and below the sail, were flooded at the surface. Ballast Tank 3, the large tank in the center of the ballast frame, was flooded on the seafloor. The checkerboard DIVERCON I construction project is seen in the distance. (Photo: Official U.S. Navy Illustration, courtesy of Bob Barth).

Background

It is to the enduring honor of the U.S. Navy that their medical dive officers first proposed, then advanced the principles of saturation diving. The implications of that breakthrough changed everything about military and commercial diving.

In 1942, Capt. Albert R. Behnke, a USN diving medical officer, first suggested the theory and application of saturation diving techniques to solving caisson's disease associated with bridge building.

In 1957, USN Diving Medical doctors George Bond and Robert Workman, and Medical Service Officer Walter Mazzone began to test Behnke's theories for enabling long duration deep-sea diving. The doctors first tested mice, chickens, then goats in recompression

chambers. Buoyed by initial success, they carefully began working with human volunteers. By 1963, encouraged by controlled chamber tests, Bond began making bold plans for a series of open ocean **sea**floor **lab**oratory experiments. *SEALAB* was born.

SEALAB I in 1964 was a success. Bond was Principal Investigator (PI). (See *JoDH,* Vol 22, #79). One team of four divers spent 11 days at 192 feet. It demonstrated the practicality of saturation diving in the open ocean, while revealing problems of high humidity, temperature control, and verbal communication in a helium atmosphere.

SEALAB II in 1965 was a success. Bond was PI. (See *JoDH,* Vol 23, #84). Three teams of 10 divers spent 15 days each at 205 feet. It demonstrated that ocean-floor habitation can be used to accomplish a wide range of salvage and scientific tasks. No significant short-term physiological changes occurred in the Aquanauts.

SEALAB III was initially scheduled for completion in summer 1967. Five teams of nine divers were to spend 12 days each at 400 feet testing new salvage techniques and conducting oceanographic and fishery studies.

In 1967, Bond wrote of the advancements in saturation diving and the challenges remaining for the USN's Man-in-the-Sea program in *Oceanology International Yearbook*, 1968. Bond wrote, "Advances have been made in several areas and present planning provides for … *SEALAB 3* to begin in the last quarter of 1967."

Following the *SEALAB II* project off La Jolla Shores in San Diego, Bond was ready to "extend the depth capability to below the 400-ft level." Bond was becoming familiar with the requirements of deeper depths citing chamber simulations to 1,000 feet. He tested "no-decompression excursion dives" in sophisticated chambers, with divers transitioning from 400 feet to 600 feet, working for an hour, then returning to 400 feet with no decompression stops. The laboratory tests validated his theory.

In that *OI Yearbook* report, Bond expected "that new developments will eliminate or minimize the problems of helium speech, inadequate protection provided by wetsuits, the need for the development of torque-free tools for underwater work, and the need for more efficient breathing equipment." Solutions for helium speech unscrambling were being developed for both inside and outside the habitat.

He noted that "industrial and non-profit organizations are working on the problems of heated wet suits…," and "two types of insulated suits, electrically and water heated will be tested during the experiment."

He pointed out the obvious, "the lack of adequate breathing apparatus becomes more crucial as greater depths are reached." He described the diving rig for the planned 400-ft deployment, "the Navy has developed a semi-closed SCUBA (Semi-closed Circuit Underwater Breathing Apparatus) rig known as the Mark VIII, for testing and evaluation." (SCUBA in popular terms stands for "Self-Contained Underwater Breathing Apparatus." In the context of this article, we'll refer to the Navy's development as High Pressure-Semi-closed Circuit Underwater Breathing Apparatus, or HP-SCUBA.)

Bond then added a caution, "At greater depths, however, it appears a closed system will be needed."

Change in command, plus ongoing and broad technical problems forced a series of postponements. As progress lagged, the mission depth was pushed to 610 feet. Bond lamented, "I had become an observer, chronicler, and occasional adviser to the project."

By late October 1968, *SEALAB III* was floating in the sea off San Clemente Island, tied to the USS *Elk River* (IX-501). Continued problems forced additional delays, and Bond wrote in his *SEALAB* Chronicles, "Long ago we abandoned hopes of a visit with our families on Thanksgiving, Christmas or New Year's. Even so, Morale is high. Whatever the Aquanauts may lack, it is certainly not a sense of humor."

On December 1, 1968, a representative of the Deep Submergence Systems Project (DSSP) flew out from Washington, DC, to assess the situation and decide what action should be taken next. Troubled by continued delays and system failures and its impact on other projects, with the habitat and surface support ship at sea, the DSSP directed deployment be made on February 15, 1969.

It didn't go well.

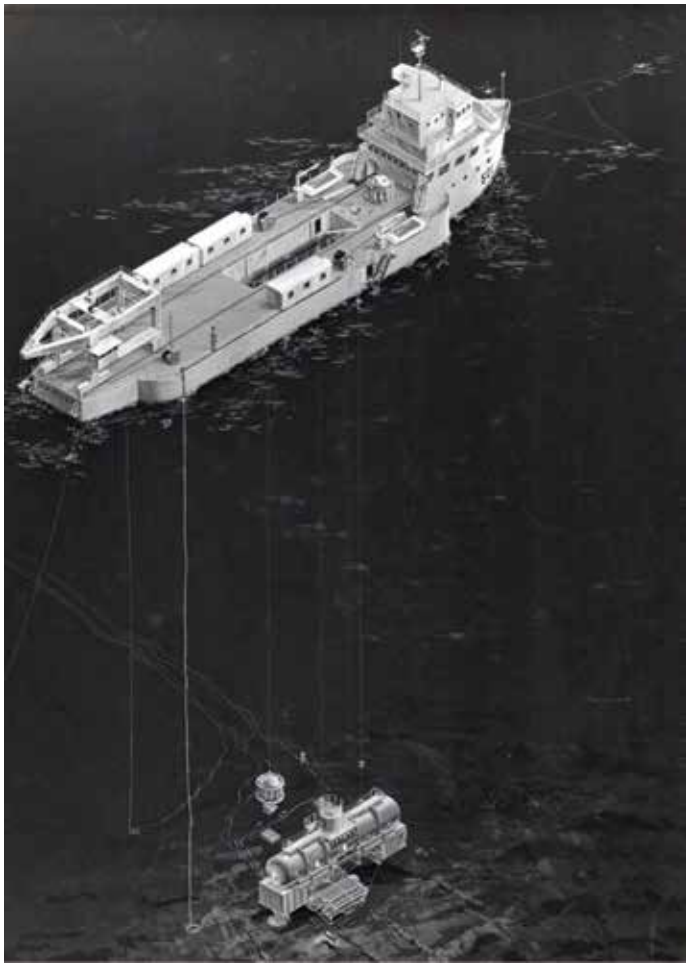


FIGURE 2: In this illustration, the *SEALAB III* habitat rests on the seafloor beneath the surface support ship USS *Elk River* (IX-501). The Personnel Transfer Capsule (PTC) is lowered to within 60 feet of the habitat. The main umbilical delivers power (440VAC, 3φ), compressed air, mixed breathing gas, water, and communications. (Photo: Official U.S. Navy Illustration)

In preparation for *SEALAB III,* 60 divers trained, 45 divers were assigned to five dive teams, four men rode PTC-1 (Personnel Transfer Capsule-1) to 610 feet twice, three emerged, two touched the habitat on the seafloor during two dives that lasted between 7-15 minutes, and one of them died.

What went so wrong right from the start?

U.S. Navy Board of Inquiry

The U.S. Navy convened a formal Board of Inquiry (BOI) after the death of civilian Aquanaut Berry Cannon, electronics engineer with the U.S. Navy Mine Defense Laboratory (Panama City, FL). On the Board of Inquiry were Capt. John D. Chase, Capt. Tor Richter (Medical Corps), and Cmdr. William R. Liebold.

At the same time in San Diego, another BOI was reviewing the capture of the USS *Pueblo* by North Korea. It was a bad news cycle for the U.S. Navy.

The *SEALAB III* BOI was looking for a single point of failure. Initially it was attributed to Cannon himself, reporting he had had a heart attack. Then it was claimed a CO_2 scrubber canister was left unfilled by negligence and Cannon died of carbon dioxide poisoning. That conclusion was not supported by autopsy as the toxicologist's report of tracheal air was performed many hours after the accident, and if based on pathology findings alone, no causation could have been determined. It was also variously suggested that an unnamed "helper" made a mistake, or an unnamed disgruntled contractor was committing acts of sabotage.

The *SEALAB III* BOI chose to focus on the empty CO_2 scrubber canister theory.

One of four Mark IX (a Mark VIII modified for use from the PTC) semi-closed rebreathers was believed to have had an empty CO_2 absorbent canister after the second dive. It was not established that the specific unit was worn by Cannon, nor how it was emptied. Reasonable alternative explanations for one being empty were apparently not of interest to the BOI, including that three of them had been left outside of the PTC in the urgency to return to the surface, and were dangling 100 feet below the PTC on ascent.

Nevertheless, the findings of the BOI cited carbon dioxide poisoning as the official cause of death.

The BOI ultimately fixed sole blame on an enlisted man, Senior Chief Torpedoman Paul "P.A." Wells, a decorated World War II Marine Corps veteran. There was talk of court martial. He was invited to leave the service. Wells carried the burden of shame until the day he died.

Capt. George F. Bond wrote in his journal, "Not one of us believed that Paul Wells would ever load an empty canister into a Mk IX rig." And again, "To a man, we were certain that Paul Wells had made no mistake when he loaded and certified the diving gear." That sentiment was repeated by every Aquanaut this author has spoken with about this topic.

To this day, that one diver was killed, and another diver was blamed has never set well with the Aquanauts. Warrant Officer Robert A. Barth, Aquanaut #1, wrote, "We lost two good divers that day, Berry Cannon and Paul Wells."

New evidence, new story

In the fullness of time, logs, journals, and reports by those directly involved in the *SEALAB III* habitat have come to light. In addition, new in-water hazards have been identified.

Like an alternate camera angle on a contested football play, together they tell a different story, a fuller and more complete story, than we've heard until this accounting of facts.

Now, almost six decades since that fateful day, we have the *SEALAB III* Divers' Story as told by the men below the keel, the divers themselves, and placed here in print as they want it told.

The *SEALAB III* Divers' Story is substantially different from the official *SEALAB III* BOI story.

The old story claimed one man failed to fill one canister with granules, and the entire Man-in-the-Sea program collapsed because of it.

There is now a strong argument for a new and better, cohesively more accurate story by the team divers who were there.

Leadership

John Craven, head of the USN's Deep Submergence Systems Project (DSSP) of which *SEALAB* had become a part, claimed *SEALAB III* "was plagued with strange failures at the very start of operations."

Bond had a clearer assessment: "…of the thousand-odd people involved with the new experiment, only two naval officers had previous experience with the habitat and with saturation diving procedures—Walt Mazzone and I. We were vastly outnumbered by well-meaning persons who had acquired sudden intelligence of matters that had taken Walt and me our entire naval careers to develop. I was startled to find that the records of previous *SEALAB*s, meticulously maintained, were generally ignored. It is difficult to pinpoint a given source of incompetence, but *SEALAB III*, scheduled for completion in 1966, was stalled in its tracks."

Bond continued, "We had too long been delayed by unrealistic planning, constantly revised documentation, and arbitrary changes that were not always passed on to the three hundred-odd personnel."

Helium

The noble helium atom is smaller than the diatomic hydrogen molecule. Ocean engineers are familiar with the helium leak detector. "Helium is an elusive and pervasive gas that will leak into and out of any enclosed cavity," said Bond.

"Although almost every error of design and fabrication that could be made had in fact emerged in the *SEALAB III* habitat, we also were at fault for failing to impress on each of our contractors that they must design components that could cope with helium under very high pressures. Quality control was left to the vendors without supervision. The vendors did not do their job and we were constantly ignorant of the fact," concluded Bond.

In addition, helium has a thermal conductivity 5.8x that of air. The increased gas density of helium at 18.5 Atm pulls proportionally more heat out of a diver's body. Hypothermia is a grave danger.

Helium became the root problem on deployment.

Contractors

The project begins with a head start. The fully tested *SEALAB II* habitat is to be modified into the *SEALAB III* habitat. Budgets are increased 10x to $15 million. Deep pockets lure government contractors. Unfortunately, Oversight and Quality Conformance (QC) is undisciplined.

Wrote Bond, "In light of our past experience, I am persuaded that most of our hardware contractors actually believed their own advertisements, which guarantee performance of helium unscramblers, thermal protective suits, diver communication devices, helium reclaim systems, and, above all, underwater connectors.

"Even worse, is the Department of Defense (DoD) policy of forgiving and forgetting performance failures of the same contractors that have let us down time and again."

Bad moon rising

In November 1968, PTC-2 cannot be certified because of a "series of electrical grounds and battery and cable flood-outs." A few days later, PTC-1 floods on its only test dive to 590 feet. Cables, connectors, and all interior instruments and equipment are ruined. A patched together PTC-1 is brought back into service, but the CO_2 scrubber now blows cold HeliOx directly onto the divers because the deflectors are not replaced, thus increasing the effects of hypothermia. The electrical heater inside the PTC does not work.

PTC-2 is found to have a bad seal and cannot dock with the Deck Decompression Chamber-2 (DDC-2). It is useless.

On February 13, Aquanaut-NCEL engineer Dr. Larry Hallanger recalls a training dive on site off San Clemente Island using the prototype Mk 2 Deep Diving System's PTC 2, making the log entry: "Yesterday (February 12) was a PTC swim out and training dive with Eggar, McDole, Raymond, and Schmidt. We suited up about 0930 and then various problems delayed the dive until afternoon. Broke for lunch about 1130 and then returned to the DDC to await commencement of the dive. About 1330 we were pressurized and about 1430 actually entered the PTC. Depth was 35' and Larry Raymond and I made about a 5-minute swim. After locking back in, we started an "unconscious diver" drill where I was the "victim." In raising us up, the latching fingers wouldn't lock completely on the capsule pick-up mechanism."

Aquanaut Fernando Lugo recalls that same training dive. Four divers were lowered to 35 feet to train on the use of their modified Mark VIII semi-closed dive rigs. With the training session completed, the Aquanauts returned to the PTC, closed and dogged the hatch, and the bell was hauled back up to the USS *Elk River* (IX-501). The method of securing the bell in the gantry utilizes three latching dogs on a probe at the top of the bell. The electromechanical cable (EM cable) goes slack once the load is taken by the gantry. However, only one dog was engaged. Recognizing the problem, the four divers were called out of the PTC, and Lugo and Van "Tinker" Bell were to get in the bell, close and dog the hatch. They were to be lowered back to 35 feet, then recovered to re-engage and set the three dogs. Lugo and Bell had just closed and dogged the hatch when the one dog holding the PTC released and the bell dropped

FIGURE 3. The PTC mated to the DDC. The PTC has a "lifting cage" used to manage movement of the PTC when lifted by the gantry. It remains with the ship when the PTC dives. Upon recovery, the red probe above the PTC is engaged by three latching dogs, clearly seen in this photo. (Official U.S. Navy photo)

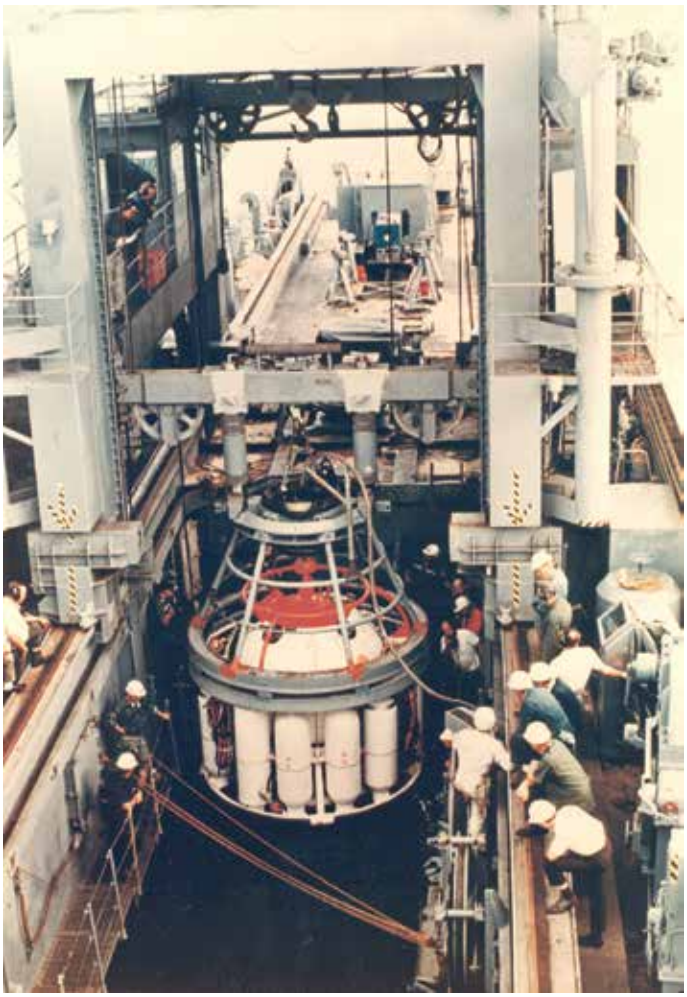


FIGURE 4. The load of the PTC is supported by the gantry over the moon pool of the USS *Elk River* (IX-501). Note the slack in the EM cable. (Official U.S. Navy photo)

several feet in free fall. The EM cable went tight with a sudden jerk. The 2,500-pound lowering weight below the bell broke the wire to the downhaul winch and fell 610 feet to the seafloor. Lugo recalls getting slammed around inside. Only 12 strands of the overbraided steel strength member remained unbroken, most having parted with the sudden stop. Lugo and the crew realized that had the remaining 12 strands parted, and the clump weight remained attached, the bell would have fallen 610 feet to the seafloor with the two divers unrestrained inside.

PTC 2 was secured to the gantry with chains where she was. Lugo and Bell exited the PTC and headed for sickbay to be examined. Luckily, both men suffered only contusions. Repairs began. The EM cable termination was remade.

Navy Diver and Aquanaut Keith Moore, USN, recalls work being done to repair the PTC-2 Strength-Power-Communications cable at Mare Island shortly before the habitat was barged to Long Beach then to San Clemente. Junior Seabees were assisting, and the lead repairman was complaining of not being given enough time to do a proper job before transport to the experiment site. The late delivery meant a lack of testing and training. "The PTC was a disaster," recalls Moore.

Moore recalls PTC-2 as not fully functional, so the five divers in DDC-2 couldn't have transferred to the seafloor had Barth and Cannon opened the habitat anyway, except using PTC-1.

Less than an hour after PTC-2 dropped, an electrical fire broke out on the gantry. Lugo was back on deck assisting with firefighting efforts, passing fire extinguishers to fire fighters. The fire, presumably electrical, might have been a result of the sudden jerk when the PTC dropped. It might also have been the fault of poor design and a lack of equipment testing. Lugo does not suspect sabotage.

On Thursday, February 13, in preparation for lowering the habitat, Hallanger made the log entry: "This evening starting about 1700 the habitat umbilical was removed from its reel and placed on a barge ready for lowering the *SEALAB*. This was necessary because the reel had no slip rings and the cable had to be plugged in prior to lowering. (Somebody goofed because this was first noticed as a problem last Sunday.)"

As *SEALAB III* was ballasted to descend to the seafloor off San Clemente Island, it was reported, "At the pre-lowering inspection, several gas leaks had been observed when the habitat was submerged and the interior pressurized to 12psi. The leaks were considered minor, and, according to On-scene Cmdr. J. M. Tomsky, not sufficient to warrant aborting the lowering."

A helium leak test could have been done in the dry dock when submerged tests were done in September 1968 at the San Francisco Bay Naval Shipyard. Such a test would have confirmed the capability for emergency decompression within the habitat as noted in the *SEALAB III* Operating Procedures. "The capability of the main cylinder of the habitat to be pressurized to 125psig has been retained in the *SEALAB III* design." That system flaw alone could have killed everyone inside the habitat.

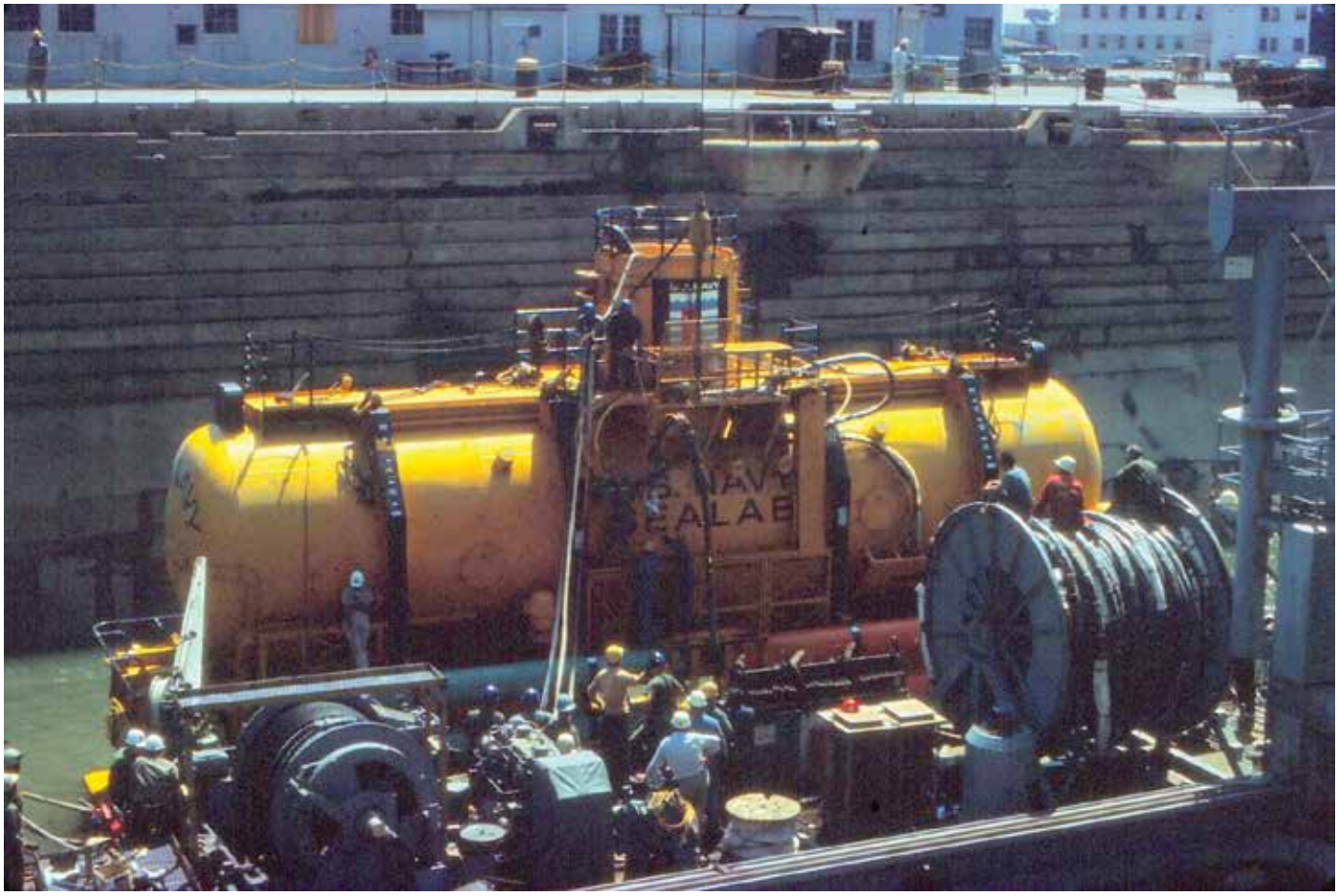


FIGURE 5: *SEALAB III* undergoes submerged testing in a drydock at the San Francisco Bay Naval Shipyard in September 1968. Divers tested entry and egress in the dry dock setting. An interior overpressure helium test of cables and connectors, later found to be a critical problem, might have been discovered eight months earlier. (Official U.S. Navy photo)

But right there, right then, off San Clemente Island, the problem was evident. The prudent, competent decision would have been to pause the lowering and send divers in to seal the leaks from the interior when ambient pressure is low, the water is warm, and repair materials easily available. At 610 feet, the scfm leak rate would increase by 18.5x due to the compression of the gas.

As described in the *SEALAB III* Operating Procedures, the "Heated Diving Suit System has been designed to provide supplemental heat to eliminate the motor loss and lowered mental capability normally associated with diving in cold water." However, a few days before the first dive to open the habitat on the seafloor, the electrically-warmed wetsuits were pulled from service for electrical shorts.

There is no hot water for the hot water suits. There is no back-up thermal protection suit or system for the Aquanauts. On the two dives to open the habitat, Aquanaut Dick "Blackie" Blackburn wears a custom-made 3/8" neoprene wetsuit he ordered from Voit. The other three divers wear miscellaneous wet suits or hot-water suits.

FIGURE 6: Aquanaut Richard "Blackie" Blackburn gears up for a dive a year after *SEALAB III.* He is wearing the same 3/8" thick Voit wetsuit he wore on both 610-foot dives. He recalls the suit "was made with Farmer John bottoms, the top and bottom were all one piece with shoulder straps. I put a vest over that with 8" sleeves. Very little skin was exposed and my head, underarms and chest were well protected. Still, the divers in the *SEALAB III* PTC would have been much better off had there been heat." (Photo: Richard Blackburn)

There is a lack of testing and in-water training of the Mk VIII and Mk IX semi-closed rebreathers at depth.

- In-water training dives are to a maximum of 70 feet.
- Heavy umbilicals sink and become easily entangled.
- Breathing resistance is very high due to an untested hose modification intended to prevent the inhalation bag from collapsing.
- The Aquanauts must continuously press the system by-pass to get gas. Anoxia is a major concern.

"Testimony from *SEALAB* participants indicated the Mark IX had not been previously used in training dives deeper than 60 feet, and late modifications, designed to prevent breathing gas cutoff, were not tested at EDU (USN Experimental Diving Unit) to ascertain any breathing restrictions they might cause under heavy work." (*Ocean Industry*, May 1969)

Aquanaut Richard "Blackie" Blackburn explained, "Semi-closed and closed-circuit breathing systems require the lungs to do all the work of recirculating the gas through the Apparatus and CO_2 absorbent. There is a small flow of fresh gas being metered into the inhalation breathing bag. The least amount of breathing resistance in or out will have a devastating effect on the diver."

Following the first dive to 610 feet, Blackburn wrote a note and sent it topside with the Mk IX's to P.A. "because Berry and Bob had such a hard time breathing and both had mental problems after their first dive." Blackburn identified a problem with the Mk IX breathing rig in an after-dive report, writing a caution for P.A. during dive rig preparations for Dive 2: "Check that buddy breather slide valve is on when rigs are sent down. Because the second stage + hose between the slide valve and second stage will be squeezed if not left on. I think there is a great restriction in the inhalation hose because of the stiffener in between the two bag fittings. Take a look, that is a small hole to have to suck through at 600 feet."

Cmdr. M. Scott Carpenter was assigned "Deputy On-Scene Commander," "Special Assistant for Aquanaut Operations," and acted as the Navy's "Senior Aquanaut" due to his rank. He was tasked with, among other duties, "the administration of the *SEALAB III* experiment, and as advisor for Aquanaut safety, operations and equipment." Carpenter might have leveraged those positions more effectively to serve as ombudsman for the divers.

Problems are seen early

With *SEALAB III* on the bottom, helium leaks increase to 3,000 scf/hour. A half-million cubic feet are lost before salvage dives begin. The amount of gas leaking out is a little more than 2.5 ft^3/minute at 610 feet, consistent with filmed images of the leaks. The gas expands 18.5 times on the way to the surface.

At 610 feet, *SEALAB III* is beyond the range of surface support divers. Robotic Remotely Operated Vehicles (ROV) are not common. The Westinghouse manned submersible, Deepstar-4000, was brought on site to carry observers to the habitat in a pressure-proof hull. "Leaks are seen from the Deepstar-4000 after the habitat is on the bottom. Cmdr. Scott Carpenter, who was the observer on the Deepstar-4000, reported seeing seven streams of gas apparently coming from cable penetrators." (*Ocean Industry*, May 1969)

The rate is unsustainable, and dooms the mission if repairs can't be made in a short amount of time.

Pressure inside the habitat is increased to +6 psi over ambient to prevent seawater leaking in.

Instrument cable jackets are seen rupturing at the surface due to expanding helium gas that has leaked through habitat penetrators and into the cables.

"Gas loss was further increased by gas hosing up through the main electrical cable, causing the sheathing to burst in several places." (*Ocean Industry*)

Power surges and ground-fault alarms on the main power cable to the habitat (440VAC, 3φ, 152kVA) confirm main electrical cable jacket failures causing shorts to seawater.

The Two Dives

Team 1's nine men are divided into sub-groups of four and five. The 4-man group consists of Warrant Officer Bob Barth, civilian electronics engineer Berry Cannon, Aviation Ordnanceman First Class Dick "Blackie" Blackburn, and Photographer's Mate First Class John F. Reaves. They are assigned to DDC 1 and pressurized to an operational depth of 610 feet at a rapid rate of four hours instead of 15 hours, pushing the edge of High-Pressure Neurological Syndrome (HPNS), one of the significant limitations of deep diving.

The 5-man team: Engineman First Class Richard C. Bird, civilian research engineer Richard A. Cooper, civilian research physicist George B. Dowling, Machinist's Mate Second Class Jay W. Myers, and Medical Corps Lt. Cmdr. James Vorosmarti, Jr., M.D., are assigned to DDC-2 for the 15-hour compression. They are to join the 4-man team after they have opened the habitat.

Dive 1

The four divers enter PTC-1 for its first trip to the seafloor since its repair following the flooding incident. The descent to the habitat takes two hours, considerably longer than the 30 minutes anticipated. The wind chill of the unbaffled fan creates further heat loss in the divers.

The divers must wear a standard skindiving face mask and use a bite-type mouthpiece because the commercial clamshell full facemask and Navy designed facemask do not provide a satisfactory seal when used with the positive-pressure Mark IX system.

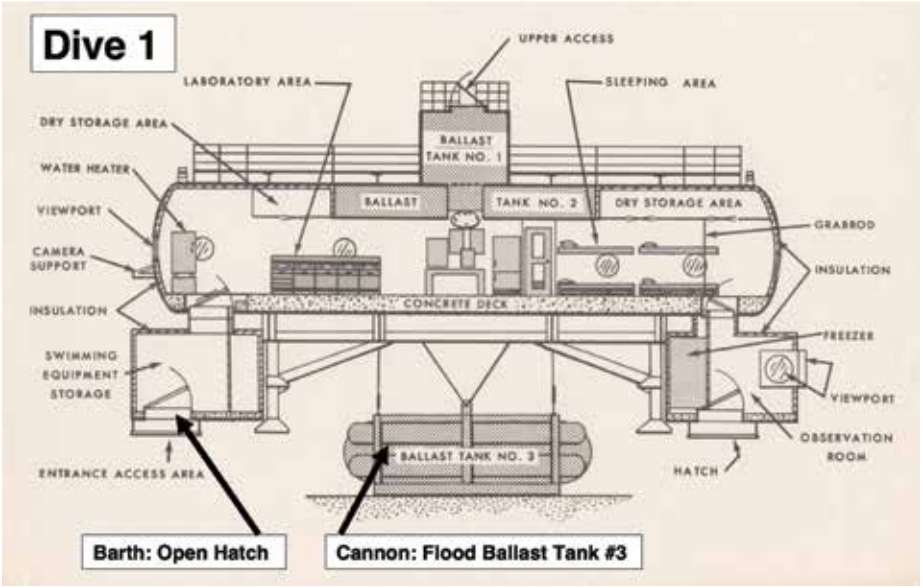


FIGURE 7. The goals of the first dive to *SEALAB III* are for Cannon to flood Ballast Tank 3 on the seafloor ballast frame and secure the habitat in its level position by opening the hydraulic valve to the cable clamps, while Barth opens the main entrance hatch. (Official U.S. Navy Illustration)

On station on the bottom, Barth and Cannon open the PTC hatch and haul in their umbilicals. They connect them to their Mk IX breathing rigs kept inside the PTC. They exit the PTC and head for the habitat to make repairs.

Cannon completes his task of flooding Ballast Tank 3 and releasing the hydraulic system pressure to the leveling cable clamps thereby securing the habitat in its level position, then heads back to the PTC. He is out for 13 minutes. He tells Blackburn when he returns, "Cold. Very Cold." His teeth are chattering. He is reported to have a dazed look, and is breathing extremely hard.

Barth is fighting to open a 4-ft-square hatch inward against an interior pressure of +4psi. While the dead weight of the hatch is 150 lbs., the positive interior pressure creates 4.6 tons of force holding it shut. Topside has a TV camera looking at a differential pressure gauge and knows the interior pressure is too high, but fails to equalize the pressure.

The *SEALAB III* Operating Procedures describe "equalizing lines extending from each of the lower rooms to their respective skirt.…The atmosphere inside the habitat is thereby equalized with the surrounding sea pressure, and the interface between the habitat atmosphere and the sea water is established at the bottom of the skirts. This provides a safety volume below each hatch, necessary for expected fluctuations in the water level due to tidal variations and changes in internal volume. The Aquanauts then swim into the skirt area, open the 48-inch-square hatch, and climb a ladder into the room." It says a second time, "Prior to entering the *SEALAB III* habitat, Aquanauts from the transfer capsule open a valve to an equalizing line extending from each room to its respective skirt. The slight over-pressure inside the habitat blows the water from the skirts." In reality, the input gas supply to the main habitat exceeds the amount that can be effectively exhausted through the equalization valve into the skirt. Without any means to communicate between Barth and topside, Barth has no way to know the true interior overpressure.

Navy Diver Keith Moore, USN, worked in the "gas shack" on USS *Elk River* (IX-501) during PTC-1's two dives to the seafloor, along with USN Diver Mike Ruden. He had his hand on the valve that controlled the air flow into the habitat while it was on the seafloor. He understood the problem of the habitat interior pressure being over ambient, creating a positive pressure holding the entry hatch shut, the same understanding that Bond and Mazzone were trying to convey to Tomsky in the control van. Moore recalls dive #1 habitat interior pressure was +4psi differential. On Dive #2 the interior pressure was bumped up to +6psi.

Moore asked Tomsky three times during Dive #1 to allow him to lower the interior pressure in the habitat to allow Barth to open

the entry hatch by partially closing the valve to lower the air flow into the habitat. The helium leaks in the habitat would have bled pressure down reasonably soon, and Barth could have opened the hatch and gained entry. Moore recalls being directed all three times by Tomsky to "hold pressure."

There is no comms between the divers and the PTC, so comm with topside is impossible.

Barth swims back to the PTC, and describes his condition as "dizzy, weak, about to pass out and in need of assistance." His dive lasts under 15 minutes. The four divers report they have never been so cold.

Hypothermia plagues divers in the PTC, leaving them shaking uncontrollably, teeth chattering. Their faces are so cold they have difficulty speaking.

No progress is made on opening the hatch or sealing the leaks.

PTC-1 is returned to the USS *Elk River* and the men transfer back into DDC-1 to rest and warm up.

Electrical grounds

Inside the habitat, "All electric circuits are ungrounded to eliminate shock hazards. However, since an accidental ground in the system could create a shock hazard, the cases of all portable electric equipment must be grounded to the hull. Wherever equipment is to be plugged into a receptacle, the grounding is best accomplished by using a three-conductor cable between the plug and the equipment. One of the conductors must connect the grounding pin to the frame or case of the equipment." (*SEALAB III* Operating Procedures)

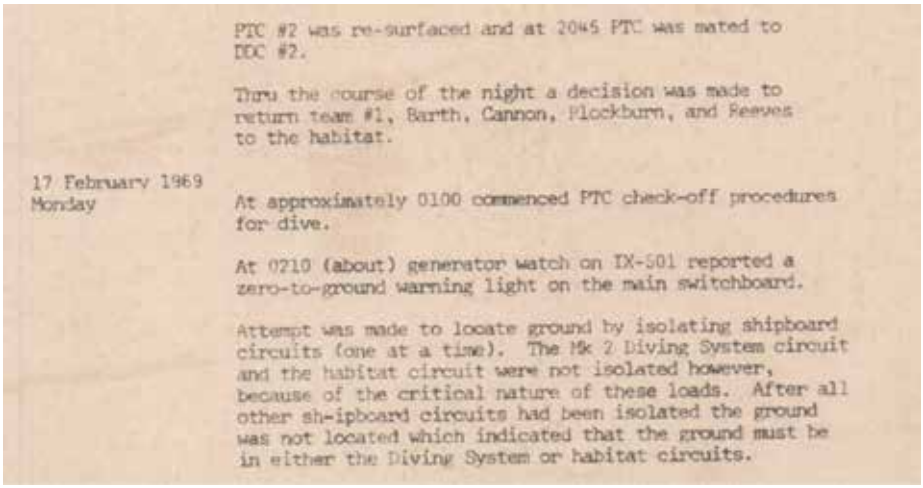
Thus, it is shown, the hull was the electrical ground.

Electric Shock Drowning (ESD)

With Electric Shock Drowning (ESD), there is no way to tell if water is energized with fatal levels of electricity.

An ESD victim's muscles become paralyzed by the electrical current, he or she is unable to swim, and ultimately drowns. In the vast majority of Electric Shock Drownings, the victim's autopsy shows no signs of electrical injury.

Because of the increased conductivity of seawater, ESD is less common in the ocean. Normally, the higher voltage and current with lower resistance would pop breakers first. However, the *SEALAB* habitat has no breakers on its main power cable, only ground fault alarms that are going off.



PTC #2 was re-surfaced and at 2045 PTC was mated to DDC #2.

Thru the course of the night a decision was made to return team #1, Barth, Cannon, Plockburn, and Reeves to the habitat.

17 February 1969
Monday

At approximately 0100 commenced PTC check-off procedures for dive.

At 0210 (about) generator watch on IX-501 reported a zero-to-ground warning light on the main switchboard.

Attempt was made to locate ground by isolating shipboard circuits (one at a time). The Mk 2 Diving System circuit and the habitat circuit were not isolated however, because of the critical nature of these loads. After all other shipboard circuits had been isolated the ground was not located which indicated that the ground must be in either the Diving System or habitat circuits.

FIGURE 8. A portion of a report titled, "*SEALAB III* Sequence of Events," compiled by NOSC after the event, likely typed from handwritten logs, is shown. It incorrectly states "PTC #2" instead of "PTC-1", and "DDC #2" instead of DDC-1." However, the text notes the shipboard effort to locate an electrical short to ground by isolating various shipboard circuits. They conclude the ground is in either the PTC (Diving System) or the habitat. At this point in time, both PTCs are on deck, and PTC-1 is being checked off for the next dive. Therefore, the short must be in the habitat. (Scan of personal log, Howard Talkington, Head, Ocean Technology Branch, NOSC-San Diego.)

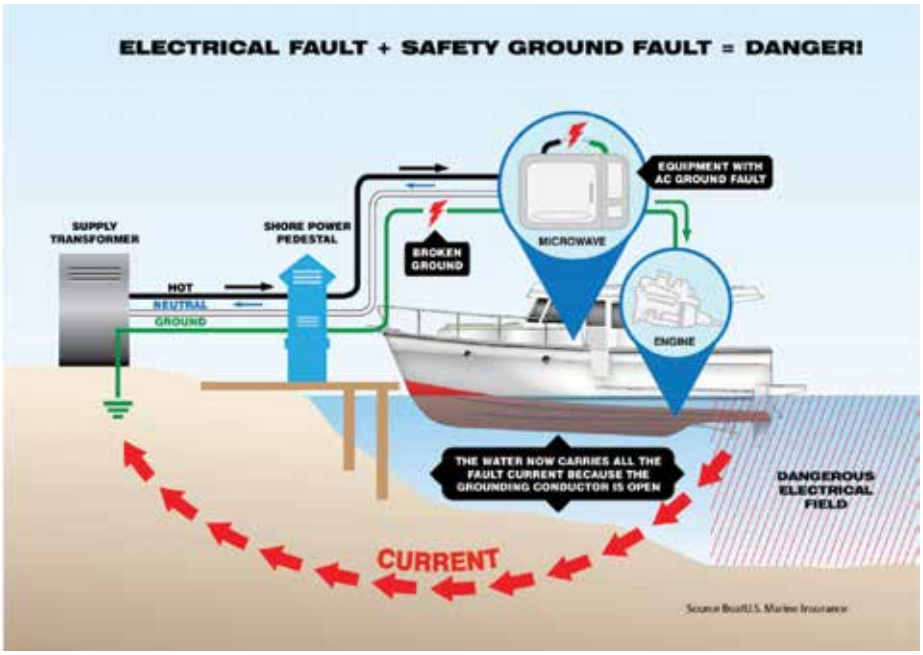


FIGURE 9. Every year, deaths in marinas are associated with Electric Shock Drowning. (Photo: Electric Shock Drowning Prevention Association)

Dive 2

Only four hours after returning to the DDC, and one hour of sleep, Team 1 is asked to dive again. The divers are given amphetamines (speed) to keep them awake. Barth puts on a blue jumper under his hot water suit before the dive to help with insulation, plus a neoprene hood, gloves and booties. Cannon wears a hot water suit without under insulation, no gloves, and no hood. Hot water suits are baggy to allow hot water to circulate. Bottom water temperature is 47°F.

Just prior to the second dive, "the flood gauge in the habitat sounded the alarm: Water had reached a depth of six inches due to a slight negative differential pressure (DP)

presently being maintained within the habitat." Before Team 1 returns, however, the interior pressure is bumped back up to a positive DP to provide the sealing force that also precludes Barth from opening the hatch the second time. (Bill Bunton, *Death of an Aquanaut*)

On the bottom, a jury-rigged hot water system for the divers' suits fails to work. Barth and Cannon are greatly disappointed, but decide to dive anyway.

On dive 2, Barth requests the other two divers (Blackburn and Reaves) go out as he and Cannon are still quite cold. Request denied by Tomsky.

Barth works again to open the hatch against positive interior pressure, now raised to +6psi over ambient, resulting in 6.9 tons of force holding the hatch closed.

Cannon is assigned to check helium leaks and umbilical connections.

Barth is underneath the diver station working to open the hatch while Berry goes to check on the helium leaks from the penetrators.

We know the pieces. Some conjecture ties them together.

As seen in Figure 12, Berry's direct view of the penetrators is blocked by the protective cover plate. It is further obscured by a curtain of helium bubbles. There is no direct illumination by exterior lights. He works in the shadows. He must bring himself in close to view the leaks. Contact with the habitat is unavoidable. He is without a neoprene hood and gloves, needed for both thermal and electrical insulation. He is dangerously cold, physically exhausted, and mentally fatigued. Grabbing the habitat, he is now grounded and becomes part of the electrical path. The hot side is lurking. He might grab a connector body to see if squeezing it will tell him about the pressure behind the leak. He may pull on a cable. There is one cable water block towards the habitat interior, and two upstream towards the main umbilical. There is a solid chance the cable jacket has split from helium leakage from the habitat.

In the PTC, Blackburn and Reaves report they hear a scream through the water.

Like a lightning bolt, a burst of high-power electricity rips through Cannon's body. Every muscle violently contracts. He spits out the regulator, his arms contract,

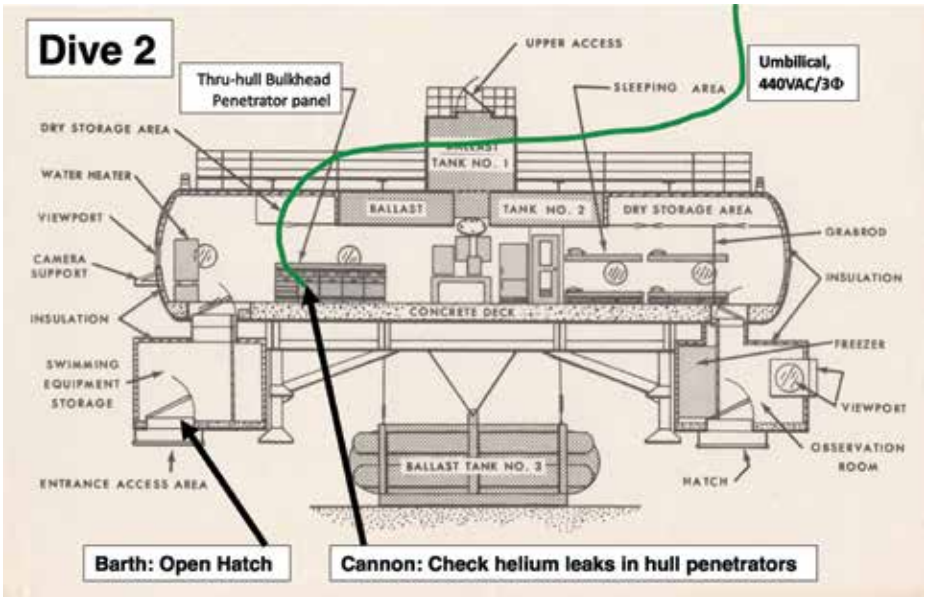


FIGURE 10. The goals of the second dive to *SEALAB III* are for Cannon to look at the leaking penetrators, while Barth will try again to open the hatch. (Official U.S. Navy illustration)

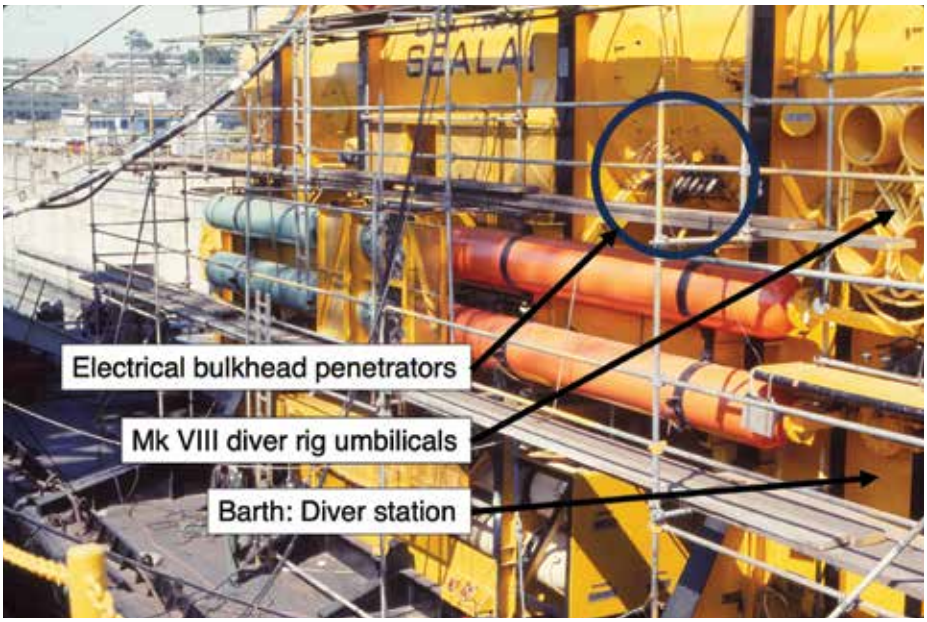


FIGURE 11. The bulkhead habitat penetrators are seen above the orange gas tanks on the side of the habitat. The protective cover plate is removed. Short electrical cables bring the terminations up to the top of the habitat where the electrical-gas-water umbilical can be connected while the habitat is floating on the surface. The Mk VIII diver umbilical storage racks are seen to the right. Barth and Cannon are not far apart. (Official U.S. Navy photo)

striking his face and knocking off his face mask. He collapses, slides over the high-pressure gas tanks, and sinks towards the seafloor.

Cannon's body settles a few feet from Barth, who quickly diverts to help his buddy.

Wearing neoprene gloves, Barth is not grounded to the habitat, and avoids electrocution himself.

Though convulsing, Cannon is already dead. His teeth are clenched so tightly Barth, and then Blackburn, can't get the regulator mouthpiece into his mouth.

The dive lasts seven minutes.

Blackburn is outside the PTC when Barth makes it back, exhausted. Barth is helped by Blackburn and Reaves into the PTC. Barth says if the PTC had been 20 feet farther, he

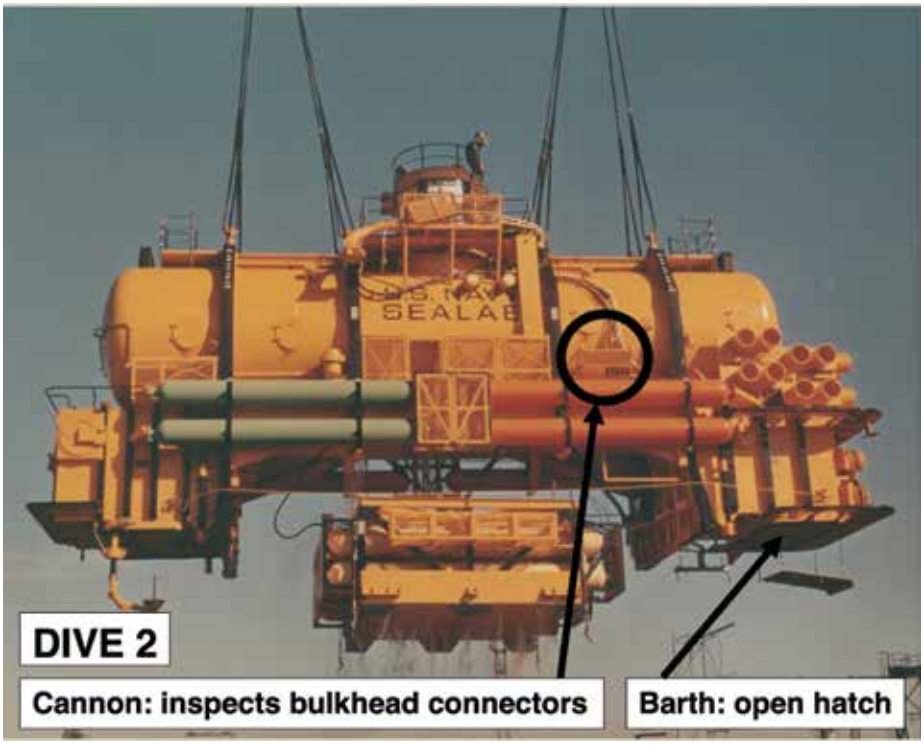


FIGURE 12. The main electrical-gas-water umbilical cable connects to the pigtails on the platform next to the sail above the name "SEALAB." The pigtails run down above the orange gas tanks to the bulkhead penetrators, now behind a protective cover plate. The diver wet room is also to the right, as indicated by the Mk VIII diver umbilical storage racks. (Official U.S. Navy photo)

would not have made it. Blackburn then recovers Cannon and brings him to the PTC where he is lifted up into the PTC.

In the urgency to get Cannon back to the surface where medical doctors are onboard, Barth, Cannon, and Blackburn's rigs are left outside the PTC. Both Blackburn and Moore recall the three Mk IX dive rigs return to the surface on the exterior of the PTC, dangling 100 feet below the bell.

Because PTC-2 is damaged, Lt. Cmdr. James Vorosmarti, Team 1 medical doctor in DDC-2 cannot be transferred to DDC-1 to meet the Aquanauts ascending from Dive #2. It doesn't matter. Cannon is pronounced dead on the way to the surface.

Hallanger's log states that Captain William M. Nicholson, *SEALAB III* Project Manager, directs Cmdr. Jack M. Tomsky, On-scene Commander, to get another dive team ready. That did not happen.

Aquanaut Blackburn recalls, "If we had adhered to normal, accepted and approved diving practices, the first dive probably would not have been made, let alone the second one. There is always to be communication with the divers. In our case there was no communication with the divers outside the bell, not to the bell nor to topside where it was imperative to coordinate the opening of the hatch with the reduction of pressure in the lab which was monitored topside through a closed-circuit TV camera system. This CCTV system had a clear view from the control van and the main diving console on the support IX-501 showing both the diver in the water on the bottom under the hatch and the Differential Pressure Gauge (DPG) in the Lab. The pressure was never reduced on either dive 1 or 2, thus there was no way a human could have opened the hatch. Then there was the additional problem of the power umbilical (440 volts) from the support ship IX-501 shorting out against the hull of the Lab."

The empty canister

Other explanations for an empty canister were offered to the BOI, but dismissed.

When Barth, Blackburn, and Cannon's Mk IX units returned to the surface on the outside of the PTC rather than inside it, as they normally would have on an uneventful dive, the units could have free-flowed on ascent. Baralyme residual was found in the rebreather exhaust path of the rig with the empty canister, indicating it had been flushed out.

Aquanaut Lt. Cmdr. Martin Harrell, *SEALAB III*, Team 5, recalls his "own experience that caused the carbon dioxide absorbent canister of my Mk XIII HP-SCUBA to empty its baralyme into the sea during a training dive. This confirms an alternate explanation for how the CO_2 canister of a Mk IX HP-SCUBA could have been emptied."

It is also Standard Operating Procedure (SOP) to empty canisters of wet baralyme to keep the chemical from corroding the interior components of the rebreather, though this was not an SOP situation.

In addition, it was never established that the rig with the empty baralyme canister was Cannon's.

Aquanaut Moore recalls helping Paul "P.A." Wells load the Mk IX dive rigs after Dive 1. The rigs were to be used on Dive 2. He recalls the dive locker was mayhem, but he and P.A. were focused. Moore called P.A. Wells "my mentor." Moore recalls the use of a strap wrench needed to open and close the dive rigs' baralyme canister. Moore carried the refurbished rigs to PTC-1 to be loaded in for Dive #2. He is certain he would have noticed if one was empty of baralyme due to the difference in weight. He absolutely believes none was light. He describes the Aquanaut checkout procedure before a dive, and believes any empty rig would have been found in their pre-dive checkout, too.

Aquanaut Andy Pruna, Team 5, said, "P.A. was the most capable guy, the most meticulous. I'd dive a rig he prepared any day." A dozen other identical quotes from his fellow divers could be appended here.

Following Cannon's death, Hallanger wrote: "I have been assigned to assist Marty Harrell in investigating the umbilical and habitat for damage. The main power cable has dead shorts on two legs and a higher resistance short on the third. Thus, even if we had fixed the gas leaks, we probably would have had to abort anyway."

O_2 toxicity is unlikely as the HeliOx gas was pre-mixed and all divers breathed from the same source.

Fernando Lugo says that pressing the by-pass, which the deep divers had to do often with the untested system, provided pre-mixed gas from pre-filled tanks. The semi-closed system would have exhausted the CO_2. The chance of carbon dioxide poisoning is thereby further reduced.

Responsibility

There were far more problems with *SEALAB III* than this column has space to list—serious problems for which Paul "P.A." Wells had no involvement or responsibility.

In hindsight, it is ridiculous to think that one man not filling one canister could have imploded the entire U.S. Navy's Man-in-the-Sea program.

Bond stressed, "The Principal Investigator decides where to draw the line between acceptable risk and excessive hazard; the responsibility for the decision belongs to that person alone."

Responsibility for the failure of the *SEALAB III* experimental habitat rests with Captain William M. Nicholson, *SEALAB III* Project Manager. A post-accident interview with Nicholson, published March 17, 1969, by the *National Observer*, details his disconnect from the reality the Aquanauts faced on the seafloor, referring to the fatal dive as "a simple process," and "a perfect example of Murphy's Law." He added that "the mishap could have happened at 60 feet as easily as 600 feet," and the danger of hypothermia was no worse than "gulping frigid air while skiing."

Nicholson was advised by **Northrup Corporation's Nortronics Division** as Systems Engineering Support Contractor for the USN's Deep Submergence Systems Project. Nortronics was paid to perform a number of activities in support of *SEALAB III* including: monitoring of the design, development and fabrication of the *SEALAB* system to identify potential problems and recommend solutions; Man-in-the-Sea program evaluation and analysis for Navy Management; preparation of interface control drawings for the *SEALAB* system and deep diving system; preparation of test plans and policy documents, technical review of test procedures; development of a scenario for pre-operation testing; preparing safety certification plans for Aquanaut equipment; and related technical support. (*SEALAB III* Press Handbook)

If Northrup provided good and timely advice, it was largely ignored.

George Bond said afterwards, "Perhaps I am biased, but I believe that topside bureaucrats should be qualified divers, just as firmly as I believe that proofreaders should complete at least three grades of elementary education."

SEALAB III, Team 1, Aquanaut Dick Bird, believed "Chief Wells was kicked under the bus," and hoped, "One day someone will stand at a podium and the real story will be told."

Within the files that have resurfaced is an *L.A. Times* article by Susan Stocking, published March 23, 1969, titled "*SEALAB* Tragedy: Despite Navy Inquiry, a Host of Questions." Numerous specific problems were identified at the BOI, with no clear answers as to "Why?" She asked then, only a month after the habitat was raised, "And if the decisions to make the deadly repair run were made precipitously, who was to blame—the divers, or the commanders aboard the *SEALAB*'s surface support ship?"

It is reasonable to conclude that Paul "P.A." Wells had no culpability in the abrupt end of *SEALAB III*.

The first manned moon landing was just four months away, and these young and daring Navy saturation divers were swept up in the enthusiasm of their own quest to step on unknown worlds. Lt. Cmdr. James Osborn, Team 3, Team Engineer, thoughtfully reflects on those days some years later, "As an aside, I'm convinced that IF the habitat had been opened and dives conducted, there would have been deaths. Our training on the habitat itself was minimal, and I was supposed to be the Team Engineer! The cold and the lack of adequate protection, I'm convinced, would have killed people if nothing else!"

FIGURE 13. Captain William M. Nicholson, *SEALAB III* Project Manager, (left), his hand on the model habitat's main umbilical cable, owns primary responsibility for the many design flaws, poor contractor performance, deficient project control, and lack of testing of the *SEALAB III* sub-systems. Cmdr. Jack M. Tomsky, On-scene Commander, and Cmdr. M. Scott Carpenter, Deputy On-Scene Commander, share in the responsibility, given Capt. George F. Bond and Capt. Walter F. Mazzone were not empowered to intercede. John Craven, head of the USN's Deep Submergence Systems Project (DSSP), clearly missed several red flags that the project was in serious trouble. (Official U.S. Navy photo).

FIGURE 14. Senior Chief Torpedoman Paul "P.A." Wells on deck with his dive buddies. P.A. received a Purple Heart for wounds received as a Marine in World War II. He spent the bulk of his Navy career working with explosive ordnance and in diving. (Official U.S. Navy photo)

Conclusions

There is greater evidence that Berry Cannon died from electrocution than CO_2 poisoning.

Paul "P.A." Wells should be formally exonerated, now posthumously, by the United States Navy, if only to clear its own name, and restore honor to both.

Epilogue

Simultaneous with *SEALAB III*, other branches of the U.S. Navy were working with NASA, the U.S. Dept of the Interior, and other pathfinders on the *Tektite* manned habitat program in Great Lameshur Bay, USVI. The *Tektite* missions were well thought out and all successful. (*Journal of Diving History* issues 91, 92, 93, and 106)

With multiple books published on the subject, including by participants no less senior than John Craven, and 55 years since the events of February 17, 1969, the statute of limitations has certainly passed. The surviving Aquanauts, like World War II's Easy Company, this Band of Brothers should be free to tell their story.

Aquanaut John Kleckner writes, "After *SEALAB III* was discontinued, I spent several years on the IX-501 and the MK2 DDS doing a lot of modifications and testing of the system. During this OPEVAL/TECHEVAL there were a lot of corrective measures taken to eventually get the system certified."

Following *SEALAB III*, the U.S. Navy regrouped and considered the applications of saturation diving in covert operations. It was carried forward with astounding results, in particular the clandestine projects known as "Operation Ivy Bells" in the Sea of Okhotsk, USSR, 1970s-1981.

In October 1971, the Deputy Chief of Naval Material, Thomas Davies, signed the order for the disposal of the *SEALAB III* habitat. "Final disposal instructions shall prohibit its use as a pressure vessel or display." Like a scene in *Les Misérables*, it was stripped of any usable parts, then flame-cut into scrap. However, in 1991, one of the distinctive explosively-formed habitat end bells was discovered in a San Francisco scrap yard by *SEALAB II* Aquanaut Bob Sheats. Sheats brought that to the attention of Ron Roehmholdt, Exhibits Manager at the Naval Undersea Museum in Keyport, Washington. In 2001, Ron's passionate commitment resulted in proudly placing that last remaining piece of the *SEALAB II/III* habitat on permanent display. A few years later, San Diego master model builder, Jerome McAuliffe, built and donated an Aurora model of *SEALAB III* to give context to the end bell display. *SEALAB* will never be forgotten.

The *SEALAB* Aquanauts, all of them, will forever remain towering giants of history whenever stories of man's advance into the vast depths of the sea are told.

Acknowledgements

SEALAB II and *III* Aquanaut Bill Bunton first challenged the USN BOI conclusions in his book, *Death of An Aquanaut*. He was on the right trail.

Sincere thanks to Mary Lou Cannon for sharing Berry's archives, and for bravely permitting the re-examination of her husband's death at 610 feet. It's easy to see why Berry fell for this lady. Aquanaut Dick Bird poetically referred to the Aquanauts' wives as "The Woman behind the Man-in-the-Sea."

The authors are deeply indebted to Aquanauts Bob Barth, Dick Bird, Richard Blackburn, Larry Bussey, Leo Gies, Larry Hallanger, Martin Harrell, John Kleckner, Fernando Lugo, Keith Moore, Jay Myers, Jim Osborn, Andy Pruna, and Larry Raymond for their encouragement, hints, contributions, and review. Their achievements are legendary. There are few of their caliber.

The authors express their gratitude to those who were kind enough to share their memories, knowledge, and primary source materials in their possession. Greatest thanks to Mary Ann Martin Hallanger for sharing Dr. Larry Hallanger's archives. Dick Long, Diving Unlimited International, shared his expertise in wet suits and hot water suits from *SEALAB II* and other means of thermal protection necessary at great depth. Robert Wernli, with a profound sense of history, saved the files of Howard Talkington, Head, Ocean Technology Branch, NOSC-San Diego that included the minute-by-minute sequence of events relating to the heroic, yet futile, attempts by Barth and Cannon to open the *SEALAB III* habitat. Talkington's log contained the key insight, the electrical ground faults, which fueled this story.

This material was presented twice to members of the Undersea and Hyperbaric Medical Society for their thoughtful consideration.

References include: "Press Handbook, *SEALAB III* Experiment, The U.S. Navy's Man-in-the-Sea Program (September 1968)," and "*SEALAB III* Habitat Operating Procedures (October 1968)." This article also benefited from Capt. George Bond's book, *Papa Topside: The* SEALAB *Chronicles of Capt. George F. Bond*, Bob Barth's *Sea Dwellers: The Humor, Drama and Tragedy of the U.S. Navy's* SEALAB *Program*, Miller and Koblick's *Living and Working in the Sea*, and Ben Hellwarth's SEALAB: *America's Forgotten Quest to Live and Work on the Ocean Floor*. All give very readable accounts of the birth and evolution of the U.S. Navy's Man-in-the-Sea program. Numerous commercial and trade publications of the time were used for research.

About the Author. Kevin Hardy

Photo: Christian McDonald, Scripps Institution of Oceanography

Kevin Hardy was inspired in his youth to study the technologies used to explore the ocean depths by the U.S. Navy's Project Nekton (bathyscaph *Trieste*), and its Man-in-the-Sea program (Project SEALAB). A lifelong fascination began.

In 2011, following a career that spanned 40 years in ocean engineering at the Scripps Institution of Oceanography/UCSD, Hardy was personally recruited by James Cameron to join his ***DEEPSEA CHALLENGE* Expedition**, with a goal to dive the Mariana Trench Challenger Deep with a manned submersible and two unmanned landers.

Following the Cameron adventure, Hardy founded Global Ocean Design LLC to develop undersea vehicle components and unmanned ocean lander systems. He holds important patents in the field of ocean landers.

In recognition of his contributions to the ocean engineering community, he was awarded a Doctor of Science (honoris causa) from Shanghai Ocean University in 2018, the first honorary degree awarded since their founding 116 years ago.

Since 2015, Hardy and Ian Koblick have written on the subject of manned undersea habitats for the HDS *Journal of Diving History*. For his contributions, Hardy received the HDS "E.R. Cross Award" in 2022. Hardy also writes a column on unmanned vehicles, "Lander Lab," for the *Marine Technology Reporter*.