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Aug 9, 2002

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Dear Mr. Johnson:

I hope this will give you a clearer picture of how Submaray evolved and its capabilities in spite of its many crude features compared with today's technology.

I the early 60's our efforts were restrained by both a very limited budget and an almost total lack of "off the shelf" hardware. However, this may have been a blessing in disguise because it forced us to utilize simple solutions which worked. Other than a few electronic failures, safety was rarely compromised by mechanical problems.

It is unfathomable you never got to experience the joy of 'flying' over the ocean bottom in clear water while remaining physically comfortable. Perhaps you can still make it happen!

After reading the MS, please feel free to let me know your honest opinion along with any constructive criticism which might improve its acceptance by a general readership. My hope of publishing is by no means dead. With today's self-publishing technology, I may be able to produce a hard cover, or at least a soft cover, edition. Parts of the MS have already been published in magazines, and I may submit other material for publication in the hopes of attracting interest of a commercial book publisher. Bear in mind that over four years and many successful jobs remain to be described, perhaps in less detail.

Best Regards,

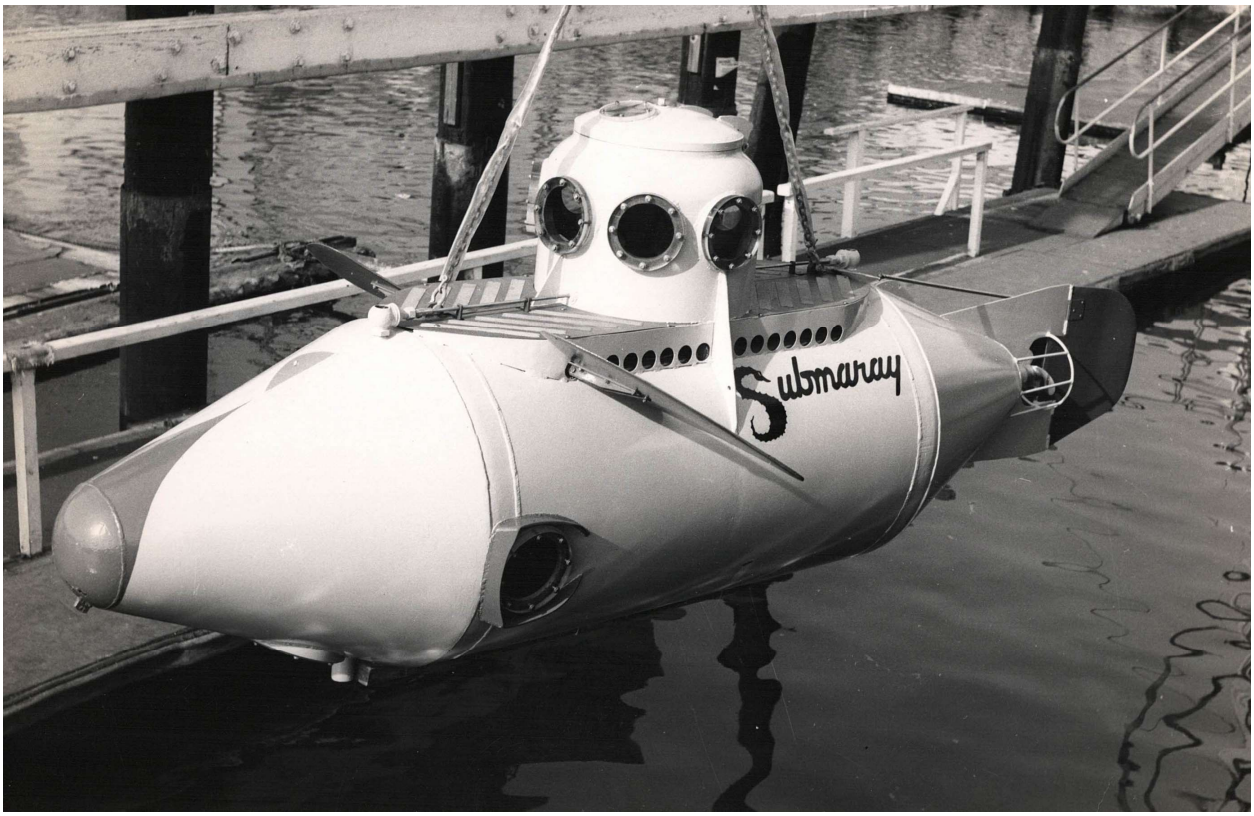
Mart Toggweiler

THE DRY DIVERS

by

Mart Toggweiler

Annotations, Pictures and Subtitles added by Kenneth Privitt



To paraphrase a quotation from L.R. Borland's book Shipshape and Bristol Fashion: A Sailor's Guide to Cruising in Comfort and Safety. What I know about working on and under the ocean with boats and small submersibles has been learned almost exclusively from two sources: Good books and a tremendous number of mistakes. Of these two possibilities I can heartily recommend learning from books, especially if it means avoiding some of the "mistakes".

My interest in the underwater business began by accident: built a 42 foot boat, wife did not like ocean – began taking charters in order to get some use out of boat and make it pay fpr itself- became a full time charter operator – saw advantages and demand for TV films on travel and adventure , also still photos and articles as a tool to expand business – developed a flourishing custom camera housing business – dropped the charter business and bought a partially completed sub hull, tried to create a demand for use of sub via film, still photos, articles, demonstrations, dramatic jobs, etc.

Out of all these enterprises, the sub was most rewarding, both to the spirit and the purse. The satisfaction and pleasure of providing fun for skin divers was great, but I was not really a participant. Sure, I could dive as well as the average passenger on all those trips to Catalina, but it was not my 'thing', it just happened to be convenient. I have never gotten up at 4 AM just to go diving for fun!

The sub was something else again. An assembly of fairly complex mechanical and electrical parts into which I could climb in, shut the hatch, and dive to far greater depths than with SCUBA, and in near perfect comfort. This 'comfort' thing, the 'shirt sleeve environment', is important. It will, l think, eventually attract a substantial following from that one fact alone: no wet suits, no heavy tanks add weight belts, no cold-water shakes, far less physical effort, and danger, at least for the mediocre diver. This was for me!

The fact that I had a boat ideally equipped for Catalina trips, with a willing and
and enthusiastic helper in Doug Privitt and working knowledge of the nuts & bolts part of it were coincidental, but vital.

At the time, in the early 60's the idea of an operating service providing a true dry sub, was totally new, except for a few research type deep submersibles. It was a struggle to not only build and equip a safe practical, working sub, but the hard part was convincing others that it was worth their while to hire its capabilities to accomplish certain types of jobs.

The following stories describe how those endeavors eventually resulted in success, with a few failures along the way.

October 1960

I awoke to the sound of a howling wind outside the cabin window next to my bunk aboard Maray. Something made a rhythmic tapping noise on the deck above, probably a boat hook left to roll back and forth. I glanced at my watch hanging from the overhead - it showed one-thirty. Damm! How I wished it was somebody else's boat so I could roll over, scrunch down in the sleeping bag and let them worry about It. Instead, I unzip the bag, swing down from the navy pipe frame bunk and try to hang on, fighting a nasty pitch and roll, while struggling into some clothes against the October chill.

Out on the after deck the fog of sleep is swept away as several alarming facts become apparent. First, its at least ten degrees warmer outside than below in the cabin, and that mean s this is a Santa Ana wind - not good. Secondly, the Catalina Descanso pier to port and adjacent to our mooring is much closer than it should have been. Also, the waves are at least six feet and appear to be breaking no more than 75 or 100 feet astern, very close to the little yellow one-man sub clearly visible In the moonlight, tied to a stern cleat and held in position by a stern anchor set the previous evening almost on the beach.

By now I am wide awake, adrenalin pumping, praying that the old 'Jimmy' diesel is still warm enough to fire up without going through the ether starting fluid routine. I punch the starter button and agonize while a marginal 12-volt system slowly cranks the engine over. It finally starts with an unmuffled roar almost drowned out by the wind and crashing waves. Just as I'm about to shove the clutch into forward gear, to ease the strain, the bow begins to swing rapidly to starboard, which can only mean the bow mooring line has parted! I decided this is an appropriate time to awaken my two sleeping passengers, (Why is the skipper always the first one to wake up when the night troubles occur) so I yelled through the door to the cabin below "Hey, everybody up", then jump back to the wheel.

It is now apparent we are in imminent danger of broaching, but fortunately the bow has swung away from the pier. I slam it in gear, turn the wheel hard to port and advance the throttle nearly all the way to try and kick the stern around so as to head out to sea, but I now realize we are still secured by a heavy stern mooring line, wrapped around a big cleat along with the smaller line to the sub. The stern has come around some, but we are not making headway and I waste a few precious seconds trying to decide whether to run back about twelve feet from the wheel to cut those two cursed lines, and God knows where the nearest knife is. No time. Full throttle ahead and damn the lines. Maray is still nearly broadside to the waves and rolling violently but picking up speed. Looking back, the lines around the cleat are slack, so they must have parted somewhere astern, leaving the4 sub adrift. Still, impending disaster rears its ugly head, for there is a continuous line of moorings dead ahead and between us and open sea. Fortunately, they are unoccupied. There is nothing to do but plow ahead while I visualize with horror all those mooring cans, spreader lines and pick up buoys entering the suction of a 22" prop throbbing below like a Mixmaster in a hairnet! Through glazed eyes I watch the line of white cans slide by, a couple of them bumping the side of the hull pretty hard, but in thirty seconds we are in the clear, miraculously pounding bow on into the waves, and I cut back on the throttle with a great sigh of relief.

A total of about five minutes has elapsed since I awoke and now my two sleepy crewmen stagger topside yelling stuff like "what's happening?" Speechless, I can only point back to the frayed ends of two parted lines bouncing in the wake and the disaster-area (receding astern) from which we had so narrowly escaped. As we cleared the cove the broken lines were hauled in and Maray chugged into the heavy seas at half throttle, gaining sea room. I flipped the Marine radio on to 2182 RC and a lot of excited chatter ensued, some of it pretty desperate, but the consensus of other skippers in the vicinity stressed the wisdom of getting the hell out of Avalon Bay before it got worse. Which it did, but now we were safe, I hoped.

The dreaded 'Santana' (or Santa Ana as some call It) is an occasional freak wind from the hot inland desert which spills over the coastal range of mountains and sweeps out to sea, head on to the broad, normally lee side of Catalina Island, and directly into Avalon hay, as well as Descanso Bay, where Maray had been moored, just around Casino Point.

My Passengers, Ed Armstrong, and Douglas Privitt, were the builders and sole owners of the little yellow craft named Aquasub, left behind. Naturally their immediate concern was for Its fate. I could offer little in the way of an optimistic prediction. Armstrong took it quite calmly and, by now, Privitt had a more urgent problem. He was violently seasick, and between heaves over the side, huddled on the deck back in one corner of the cockpit to soak up some fresh air and salt spray, both of which were there in abundance. I didn't feel too chipper myself what with chattering teeth, weak knees-and considerable apprehension about how much further the weather might deteriorate. It was already worse than anything the 42' Maray had encountered during ten years serving as a diving charter boat operating between the mainland and offshore islands, mostly Catalina.

I had made the conversion from a thirty-six-foot LCVP myself, adding a cruiser type bow, good sized cabin forward and wheelhouse aft. It was a rugged hull but the pounding she was' taking from those short, steep wave crests stirred doubts. A couple of the boats on the air were equipped with anemometers and reported the wind velocity at forty-five knots with gusts up to sixty.

We plowed on now at one third throttle until dawn, when the wind and seas started to ease up enough to bring Maray about. By the time we covered the six or seven miles back to the island it was practically dead calm and the coffee tasted good, even to Privitt, Approaching Descanso hay the binoculars showed a tiny yellow blob, bobbing about in the now gentle surf just off the beach in front of old St. Catherine's Hotel.

I picked up the closest mooring, and the two 'submariners' rowed the dinghy in for a look. Soon they were rowing back with the sub in tow, picking up the small stern anchor on the way. Apparently when Maray hastily evacuated the night before it dragged the sub's stern anchor out into slightly deeper water where it snagged on a mooring clump. Luckily the line between Maray and the sub parted rather than the sub's anchor line, and it rode out the storm, stern to seaward, (which made little difference anyway) just deep enough to permit no more than light bounces on the sandy bottom.

Ed and Doug checked the exterior topside parts of the sub and Ed also jumped in the water with a face mask on for a brief underwater check. Only minor fittings needed adjustment, quickly made, and all's well that ends well.

I didn't know it then [], but this adventure was just the beginning for me of a long series of variations of the same theme over a period of many years. The whole thing began a week or so before, in March of 1961, with a call from a local writer, Herb Shannon. Herb was doing an article on Armstrong and Privitt for True magazine and needed underwater photos of their sub. I'd been shooting underwater stills and movies for several years and another writer had used my services for an earlier True story about a record deep dive by John Clark Samazon. (Issue of Feb. '56) The writer of that article, James Phalen, knew Herb and steered him tome. I agreed to shoot the pix for True's standard rates, which were high enough to justify the use of Maray to tow the sub to Catalina where the water is much clearer than along the coast or in port. The Avalon area also offered a very picturesque background, of course, for topside shots. The plan was for Herb to fly over and meet us in Avalon so he could perhaps dive in the sub to enhance the story, plus getting the UW photos and topside shots.

So here we were groggy from lack of sleep and weary from our ordeal, but ready to carry out the plan. AS is usual after a Santana, the weather was bright, sunny and warm and this went a long way towards raising our spirits. Dropping the

mooring and with the sub in tow we moved around Casino Point into Avalon Bay where we picked up another mooring, tied up the sub alongside and went ashore in the dinghy for breakfast. The storm had taken its toll. Even in winter there were always visiting yachts, and about a dozen boats, all under thirty feet, were strewn along the narrow beach or partially sunk. Even the rock sea wall behind the beach had been damaged. At the height of the storm, only a scant few hours earlier, this must have been a scene of horror. From conversations, we gathered that some skippers had been ashore, unable to get out to their vessels; others were trapped aboard unable to either get their boats clear of their moorings or to make it ashore and had to jump clear as their doomed craft crashed on the beach in the raging surf. All the wrecked boats, except one, had been trapped on moorings in shallow water where the wave crests built up and broke at maximum height. The one exception had broken her mooring lines further out and smashed into a couple of boats further inshore, dragging them down too. A reminder of what Maray had almost suffered. We learned there had been several injuries and many harrowing escapes, but no fatalities.

Ed Armstrong driving the Aqua-Sub near the Casino at Avalon, Catalina Is.

Herb Shannon flew in on the Guman Goose amphibian about 11 A.M. and by shuttling the dinghy a couple of times we all got aboard Maray. Aquasub was really something to see close up. Painted bright yellow with red trim, it resembled a cluster of hot water tanks welded together with a maze of plumbing lines running haphazardly around the upper part of the structure. To add to the confusion, several small tanks were lashed around the stern with metal bands.

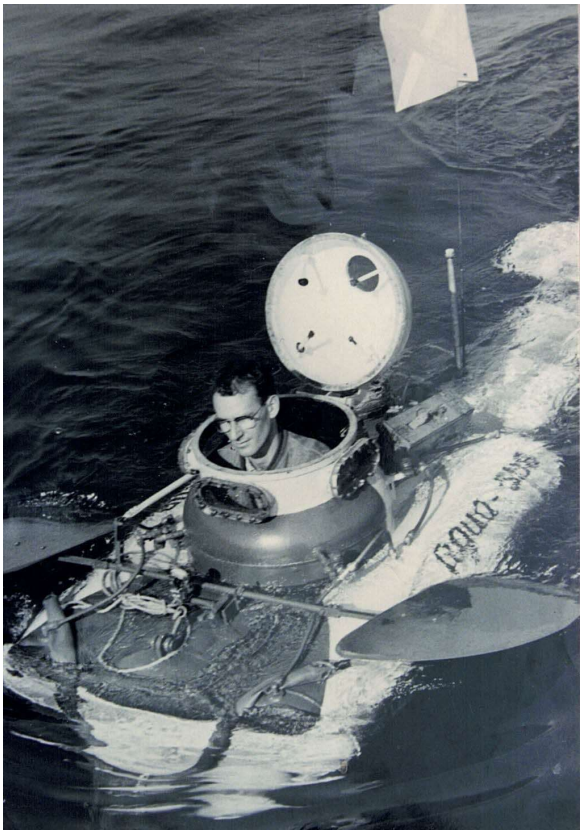
After hanging some old tires over the side of Maray for fenders, we pulled the sub alongside. Ed Armstrong jumped lightly down to stand on the deck forward of the conning tower and went to work with a wrench removing the small port on top of the hatch. Doug explained that there were four toggle bolts

inside to hold the hatch closed. Each time the sub was towed any distance or left in the water overnight, the Plexiglas hatch port had to be removed to reach in and secure those four bolts and rep1ace the port afterward. When Ed had made sure the hatch would open, he bolted the Plexiglas port back in place. Then, with the hatch fully open, he eased himself down the 17" diameter opening to check things inside. Since Ed was six feet four and weighed over two hundred pounds, his disappearing act down that small hole into a little tank was pretty impressive.

Now Doug and Ed went through a kind of rough verbal check-off list, passed some lead weights into the sub, and Ed announced he was ready to dive. I warned him about mooring lines and said I'd follow in the dinghy with Herb as long as his dive was shallow enough to spot the sub from the surface. Ed, not one to waste words, said 'OK' and leaned out of the conning tower to release the tie lines. We shoved the sub away with a boat hook and Ed leaned out again to fold down and secure the bow diving planes. Aquasub had spread her wings. With a laconic wave, Ed pinched his nose with one hand, reached back with his other arm and, still holding his nose, gently lowered the hatch. He had a great sense of humor, and we all needed a good laugh to break the mild tension. Under its own power, Aquasub maneuvered to a clear area a little seaward of Maray. Herb and I jumped in the dinghy to follow, taking a few photos of the sub on the surface as it began to blow bubbles and settle in the water. This was to be a short test dive only, with underwater photos to come later. The water was clear, and we had no trouble following the yellow blob around in thirty-five- or forty-feet depth for about ten minutes before Ed decided all was well and surfaced. Herb was really excited because he now had actually witnessed a successful dive, an important step in making his story authentic. We all regrouped back aboard Maray and decided to try for underwater pictures while the sun was still high.

I pulled on my old patched wet suit, strapped on scuba gear and, as

the sub began to submerge I rolled over the side of the dinghy with my Plexiglas housed 2-1/4 sq. single lens reflex outfit. Below the surface the water was not as clear as it appeared from topside. Still, by shooting from close angles I felt the shots would be OK and kept clicking away. Doug could see me through the ports and followed my sign language instructions pretty well. When the twelve shots on the roll of film were gone, I gave him a thumbs up signal and we all headed back to Maray once more. When I gave Herb the good news about the photos, he was delighted, but when Ed suggested that maybe this was the time for him to try a dive, a cloud crossed Herb's face and he politely declined, pointing out that he was not even a skin diver, let alone ready for a solo dive in a steel tank. Anxious to induct a new submarine pilot, both Doug and Ed now turned their persuasions on me. Intrigued by the apparent simplicity of Aquasub, I agreed to try a dive.



Doug Privitt driving the Aqua-Sub

After getting back into street clothes, an intensive briefing on the workings of Aquasub began. The hydraulic control system was simple - one lever operated both the bow planes and the horizontal tail fin; another lever turned the rudder. A three-way switch provided forward, reverse and power off. The four toggle bolts sealed the hatch. The ballasting system took a little longer to comprehend. There were four independent ballast tanks, two port and two starboard. Each tank was open to the sea at the bottom by means of a short length of hose hanging down. To submerge, the four flooding valves, when opened, allowed air to escape from the top of each tank, letting water enter the tanks through the bottom hoses. This reduced buoyancy until the sub would sink, at which point the flooding valves are closed. To surface, four other valves are opened, each feeding compressed air from a high-pressure tank into one of the ballast tanks, thus

forcing the water down and out the open hoses as the tanks filled with air. The trick was that each set of four valves should be operated simultaneously, otherwise the trim would be grievously affected. I was assured this was not really difficult, but the haphazard placing of the valves, without labels to identify them, created some doubts as I sat inside, trying to absorb the constant stream

of pointed and verbal Instructions coming down the hatch. It all kind of reminded me of my first solo flight, after six hours of dual instruction, in a Piper 1-2 Cub way back in 1941. Except that here there was no way to get dual instruction, it was all verbal and then go!

The inevitable moment came when I was asked if everything was clear. Glancing nervously around at the two levers, four toggle bolts, eight valves, the three-way switch, a pile of lead weights at my feet and several gages, I weakly asked how long the air would last inside the sub. The answer came back, "no problem, don't worry, you'll never be down that long." I fervently hoped so as the hatch was gently but firmly swung shut. Even today, alter hundreds of dives, the closing of the hatch is to me, a very significant point in submersible diving. The most noticeable immediate effect is the shutting off of all external sound and the awareness of close by ambient sounds like the scraping of side fenders against the hull and the slap of wavelets on the conning tower. The sighting of reassuring landmarks through the portholes becomes urgent. While engaged in the chore of tightening the hatch bolts, parts of the Casino, the steamer pier (now long gone), adjacent moorings, the boot topping of Maray, and a confusing series of hand signals were all vividly glimpsed through the small ports. I heard the thump of a boathook pushing the sub away and quickly reached for the per switch with one hand, the other hand on the rudder lever. Ah! this was better. I had control and orientation too. The hum of the DC motor was comforting.

Now the spot for descent was reached. Motor off. Flooding valves open, fumbling a little. A slight panic as water closed over the deck, rose above the ports and the bow sank too fast. Back to the valves, closing the forward ballast tanks until the trim was better, but overcontrolling so that now the stern wag way down. Open forward valves again and suddenly we were under and on a reasonably even keel. After the closing of the hatch, total submergence is the next significant stage. All surface turbulence ceases, the light drops to a dim glow' and the eyes try to

watch in fascination as particles in the water slide upward, faster and faster. Then a thump as the sub hits bottom. Now the sub and I are at rest, and I am still dry, warm, relaxed, able to think without a need for urgent action. Armstrong weighed 210 pounds; I weigh about 135 and we took on about 85 pounds of additional lead. A simple matter of being 10 pounds negative. So, I close all the flooding valves and, one by one, crack the air valves to blow a little ballast. Again, overcontrol, and the sub responds by shooting up 35 feet to break the surface. Ah! Ha! The trick is to gradually crack all four flooding valves until the water just barely closes over the hatch port. Now give it forward power with down planes, and sure enough, we are flying submerged. Just as when scuba diving, orientation is provided by watching the shading of light. I use the rudder to head for the darkest sector and narrowly miss a mooring line to port. Power off and glide awhile as a few strands of kelp drift by. This Is more like it! But the pockets of air in the ballast tanks contract as we go deeper, and negative buoyancy becomes pronounced. So, I bleed a tiny bit of air into the tanks to bring us back to neutral buoyancy. The depth gage reads 45 feet and now I can climb or descend with only a slight movement of the horizontal control lever.

Peering ahead, fumbling with the controls, and trying to dodge around the kelp and mooring lines, I suddenly spotted two big fish ahead and to starboard. They were angling lazily downward, seemingly unaware of the sub. Seeing big fish in California waters is not as common as might be expected by the non-diver. I knew that only a small fraction of all the skin divers I knew had ever seen either a white sea bass or yellowtail underwater. Yet, here I was, inside a noisy steel contraption, clearly watching two 40-pound white sea bass 20 or 25 feet away who were apparently not the least bit spooked. But speed and distance is deceiving UW, and within seconds, allowing only just enough tune for one good hard look to be sure they were real, and they were fading into the hazy gloom of deeper water without giving the slightest impression of trying to escape. In perhaps a hundred sub dives around Catalina since then, I never saw another white sea bass.

Finding my way back to the Maray was easy. Scuba diving teaches one to watch for underwater landmarks, keep a check on the slope of the bottom and thus maintain a sense of direction. As I planed up the slope from about sixty feet, ‘flying' about ten feet off the bottom, familiar mooring clumps appeared like a marked trail. In a few minutes I recognized the bottom of Maray and surfaced off her stern. The crew was all smiles, with Ed and Doug justifiably proud of their submarine. I'll admit that originally this trip had been looked upon as just another interesting photo assignment. Now I was an enthusiastic convert.

I had never been a truly gung-ho diver. Due to my spare build, I became chilled quickly and rarely exceeded thirty minutes in the cold California water. If conditions were right, I enjoyed taking a little seafood occasionally and was especially keen on UW photography, but to be honest about it, I probably would never have gotten into diving had I not stumbled into the sport through my charter business. I started advertising Maray trips to Catalina in Skin Diver Magazine and with the very first issue (Dec. 1951) and have been a regular advertiser for many years, later switching to the camera housing business. It was late in 1952, that a need for rental equipment aboard Maray led me to acquire two complete Aqua Lung outfits from U.S. Divers and a dry suit for myself. Those dry suits with long johns’ underneath were great and I never really adjusted to wet suits later although I wore out several. The brand-new gear proved tempting, and I made my first cautious scuba dive during a trip to the island alone.

At this point I can imagine today's reader crying out in horror at the folly of running a boat to the island alone, anchoring, and jumping in with scuba for the first time. Well, things were different then; besides, I didn’t exactly jump in. I lowered a line with a weight on it right alongside the ladder, then climbed down and kind of hung on to the bottom step awhile, getting the air out of the suit. After adjusting my weight belt, I swam down the line, holding on to it, and sat on the bottom about fifteen feet down. Like I said, I was never a gung-ho type of diver, however I did have the advantage of having seen all kinds of divers in action, including some of the best in the sport, for well over a year.

I had also helped rescue enough divers in trouble (from the dinghy) to have a very healthy respect for the "man beneath the sea" thing. Anyway, the point is that both my first scuba dive and first sub dive were solo, and I survived.

Right here I must confess to not being a 'purist'. Sail boats have never turned me on. I like vehicles, and Aquasub now stirred my imagination as scuba diving never had. The concept of adapting a mechanized vehicle, rather than physical prowess, to explore underwater, intrigued me. The really exciting thing about it was that I had stayed warm, dry and comfortable, in ordinary clothing while cruising around at sixty feet, able to see about as well as while wearing a face mask. I had remained at one atmosphere of pressure, therefore suffering no nosebleed or ear popping, and the physical exertion had been approximately the same as driving a manual shift car.

Getting back to the scene at Avalon, I climbed aboard Maray and discovered that I was the first 'outsider' to dive Aquasub, although Armstrong and Privitt had made many dives (no log was kept) In Los Angeles harbor and off Redondo Beach, some of the dives exceeding two hundred feet. They checked gauges in the sub and found that the high-pressure air tanks were low, and the batteries needed recharging. Fresh air tanks were strapped around the stern and a gas driven generator fired up while we had lunch in the galley. Herb took notes and statistics for his story, listing Ed Armstrong, age forty-four, an aircraft sheet metal worker, as builder of the sub in his back yard in Torrance. Doug Privitt, age twenty-nine, his partner, is a tool and die maker, also from Torrance, who is designing a two-man sub based on what they had learned from Aquasub. With the air supply replenished and batteries recharged, Ed and Doug each made another dive in the afternoon during which I took more UW pictures before calling it a day. Herb was put ashore for his flight home and the rest of us buttoned up the sub for the long tow back to the mainland where a custom-built trailer awaited to transport the sub to its home base in a back yard garage. The story, along with []

underwater photos appeared in the Sunday supplement of the Long Beach Press Telegram of Feb. 5th, 1961, prior to our Catalina trip. Herb Shannon as at the time, travel, and aerospace editor for the Long Beach Press Telegram. Plus doing some free-lance work from time to time. (Died July ’97)

Maray had provided me with a living for over ten years, but the high cost of insurance and the growing difficulties of passing Coast Guard certification with a converted LCVP (Landing Craft, Vehicle, Personnel) made it clear that it was time to stop running charters, at least on a regular basis. A piece of income property plus the sale of still photos, movie footage and a magazine article now and then, kept my financial ship afloat and permitted the indulgence of a self-employed lifestyle to which I had become adjusted.

I kept in touch with Ed and Doug. They had taken on a third partner, Ron Blevins, and were busy building a two-man sub to be put on the market called the Sportsman Dry Sub. A company was formed, brochures printed, and advertising placed to promote sales. It was a good-looking sub, with two conning towers and most of the clutter so prominent on Aquasub had been stuffed inside, out of sight. Instead of flat ports, each occupant had a cylindrical section of Plexiglas to look through which completely surrounded the conning tower. Although all three had families to support and full-time jobs, a lot of spare time energy and enthusiasm soon had the first prototype operating. Diligent promotion and plenty of free publicity shortly piled up orders, complete with cash deposits. The only fly in the ointment was a totally unrealistic price of $3600. Over a period of only a few months the price rose steadily until it reached $10,000 as the real costs of labor, material, advertising and overhead, plus a reasonable profit, became apparent. Orders were withdrawn, but others came in, and five or six subs were in various stages of construction,

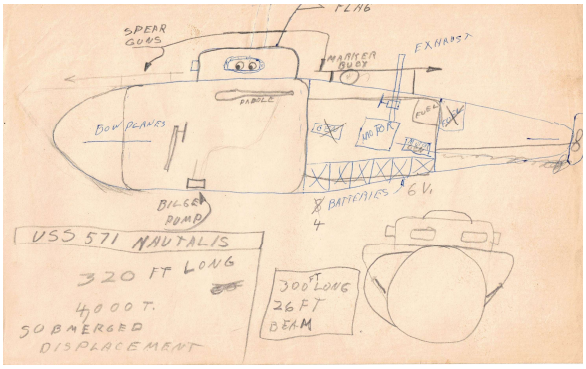
A minor setback occurred shortly after delivery of one of the first models to the California Dept. of Fish & Game at Tiburon Marine Lab. near San Francisco. The buyers were anxious to show off their new tool, paid for by taxpayers, and how it could be used for the study of marine life. A demonstration was set up with press and TV coverage and two marine biologists climbed in the sub, tied to a dock in San Francisco Bay. With [] with the hatches open to maneuver

around on the surface. Someone asked them if they would please rise up so their faces could be seen. As the two inexperienced submariners stood up in their respective conning towers, the delicate balance of surface stability was disturbed, and the sub assumed a sharp list. Instead of sitting back down, the two unfortunate scientists grabbed on trying to maintain their balance, adding to the factors causing the list, and water began pouring into the open conning towers. After a few agonizing seconds of indecision two men scrambled out in unison, adding more topside weight in the process. They swam clear, just in time, as the shiny yellow Sportsman Dry Sub sank beneath two large bubbles, all recorded in glorious color and duly shown that night on all the six O'clock network news shows.

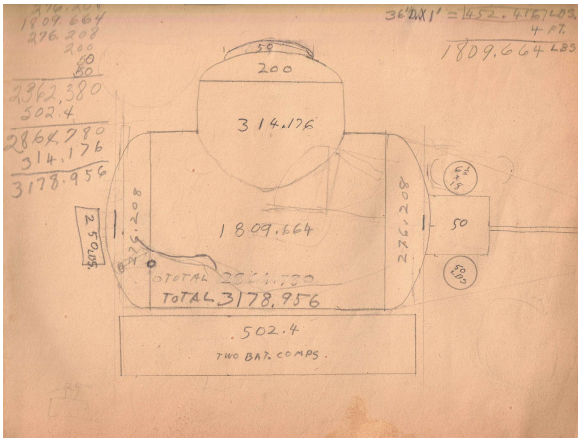
Fortunately, the water was shallow, and the sub easily recovered, dried out and eventually put to useful work in Baja California, far from the prying eyes of network TV. However, the incident pointed out a basic design flaw. The weight of the two conning towers could not be adequately compensated for with keel ballast due to a limited displacement, therefore stability on the surface was very critical. (This is not a problem underwater because all submarines have ballast along the keel and the hull hangs in the water exactly like a balloon with a weight on the bottom.)

Meanwhile the three entrepreneurs forged ahead undaunted. A few more sales were consummated along with press releases, and a deal was made with American Shipbuilding Co. in Chicago to buy out the company. Armstrong and Privitt were to go with the business and supervise production.

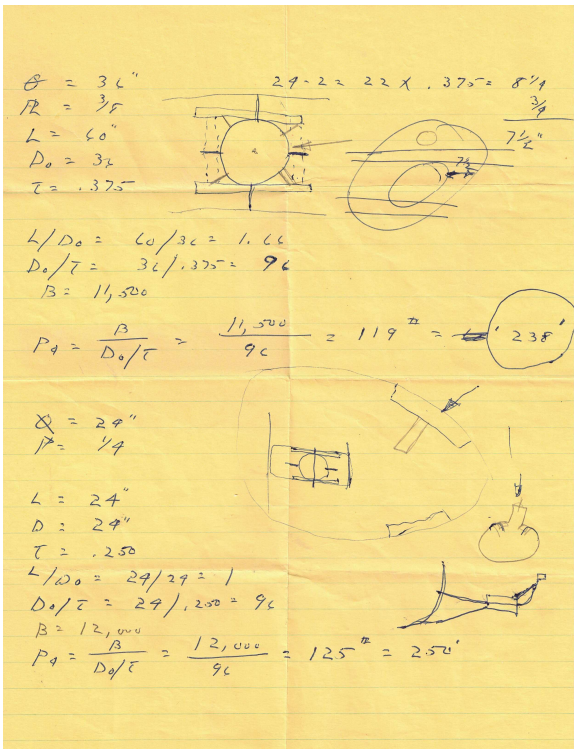
At this point it is necessary to go back a few months. In spite of his involvement with the Sportsman sub, Doug had managed to fabricate the hull of his own two-man sub, already named Dolphin, which was a completely different design. Essentially it consisted of a larger diameter hull, with one conning tower for the operator and room for a passenger to sit or lie n the lower forward portion of the



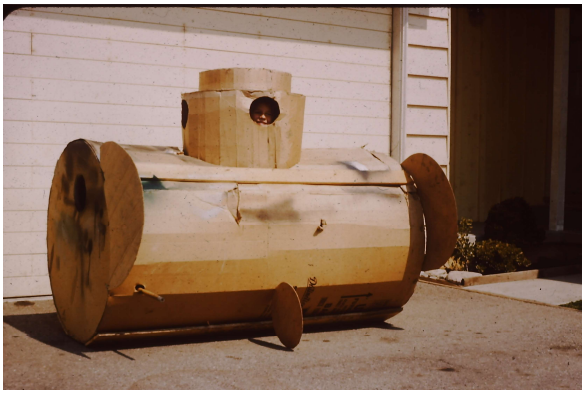
Fanciful drawing by Doug Privitt, ~1957

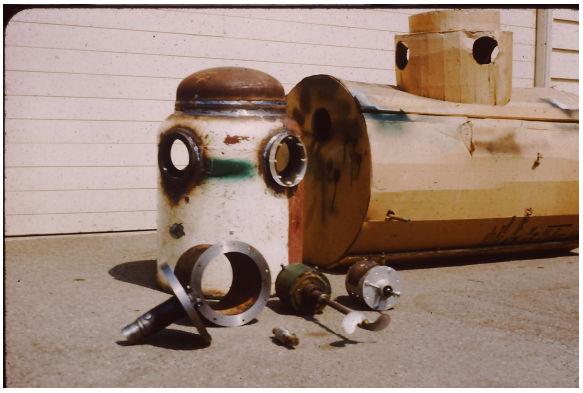


Weight calculations for Dolphin, by Doug Privitt, ~1957



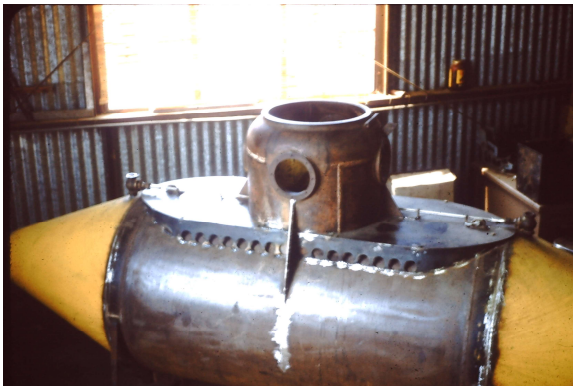
Collapse depth calculations for Dolphin, by Doug Privitt, ~1957


Cardboard mockup of Dolphin, by Doug Privitt, 1957

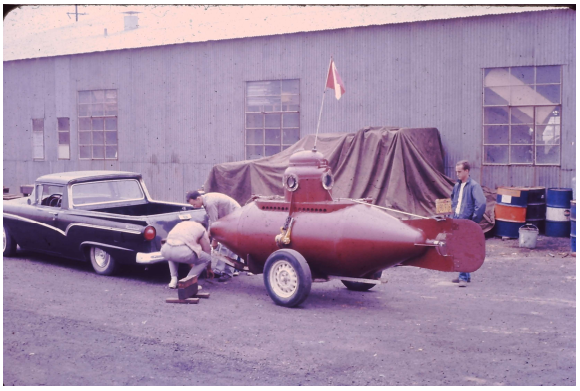


Initial construction of Dolphin, by Doug Privitt, 1958

Initially Dolphin had ballast tanks on the side but that was scrapped for front and back cones. (Remember the sinking of the Sportsman Dry Sub, due to a lack of stability)



Dolphin with the front and back ballast tank cones installed.



Hitching up the completed Dolphin to Doug's Ford Ranchero for the first time.
Behind Research Tool and Die, the shop where it was constructed for an out-of-pocket cost of $753.98 (we still have the receipts!)

Hoisting the Dolphin for its first bath in the ocean.
We believe this is the Long Beach harbor boat hoist,
(It is not the Redondo Beach boat hoist.)

The initial launch of Dolphin in October 1961

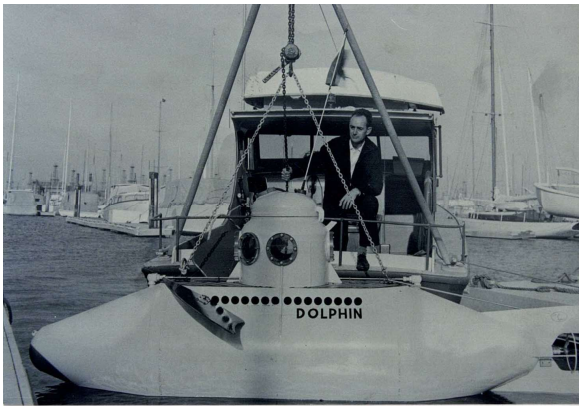
main hull, thereby eliminating the port and starboard ballast tanks of previous designs. With an astonishing amount of sheer energy, along with the cooperation of the tool and die plant where he worked, Doug completed the hull and essential controls. I helped out on several test dives, one at Catalina with Maray, and they all were successful, confirming the validity of this concept. There was no question In my mind that this was a superior arrangement for a small submersible. It had good surface stability plus the advantage of a more streamlined cigar shaped configuration. Without fragile, light metal ballast tanks along the sides, it was safer to bring alongside a surging dock or rolling boat. The main hull consisted of 3/8" mild steel with smooth sides free of protrusions. However, Doug's first priority was protecting his interest in the Sportsman Sub Co., so further work on Dolphin was set aside.

Mart in the Dolphin, 1961

During this period, I had sold my income property moved to a rented apartment and acquired a VW camper van. With my son, Ray, I made a trip to the East coast and Key West, Fla. for some great diving and UW photography. Then another trip to Mexico City and Cabo San Lucas via the ferry from Mazatlán. On the way home, in La Paz, the camper was loaded aboard a converted 110 ft. ex-sub chaser named the San Jorge for the run across the Sea of Cortez to Topolobampo on the mainland of Mexico. During this trip I met a Mexican girl, traveling with her cousin, who had been visiting her uncle on a ranch near La Paz. Elisa and Magda rode with us in the VW all the way to Tecate, on the border, and romance bloomed. During the courtship I made many trips to Mexico visiting Elisa and we were finally married in Tijuana, surrounded by her many relatives, in September of 1962.

Happily married, but without a reliable source of income, I wrote and published a little booklet entitled "How to Build Your Own Underwater Camera Housing", A catalog section in the manual listed parts and materials from which a kit could be ordered. Thus, a mail order business was born.

However, it was a limited market, undemanding of my time, so when Doug called to tell me of his move to Chicago and offered Dolphin for sale, I sensed opportunity knocking. We quickly worked out a cash deal and on Nov 1st, 1962, the sub was mine along with a trailer, some tools, spare parts, and a lot of lowkey but sincere instructions concerning the care of Dolphin. Below my apartment I had the use of a small garage workshop barely large enough to stow the sub on its trailer. I also had an understanding landlord and a slightly bewildered but sympathetic bride.



Mart Toggweiler with the Dolphin aboard the Maray

Lacking any solid, long-range plans, I contented myself by tinkering with the sub and just getting acquainted with all the nuts and bolts it contained. Doug was a very methodical mechanic, always willing to listen to the advice of others and capable of sorting out all the input in order to achieve the best results. Without any formal training in engineering, he had managed to become a first-rate machinist. He was a good welder too, but wise enough to realize that the hull of a submarine demanded the talents of a full time certified expert welder, so the hull of Dolphin had been fabricated in a shop specializing in tank building.

This was the kind of thing I could appreciate. My own background included four years as an apprentice shipfitter for the Navy before the war, then several years as a lofts man - instructor, and finally, seven years as a hull planner & estimator at the Terminal Island Naval Shipyard. Building and repairing combatant ships is a tough, complex process. Combined with ten years of charter work off the Pacific coast plus considerable exposure to the field of diving, provided a unique amount of experience with which to cope with the problems of how to perfect and utilize the capabilities of this little twelve-foot two-man sub sitting in my garage. At least it would seem that way.

About two weeks after Doug left for Chicago, he cal1ed to tell me the situation at American Submarine Co. had turned sour and he was back with his home and family in Torrance, and working at the same tool & die plant. Ed Armstrong had remained, but as it turned out, the entire Sportsman submarine enterprise was phased out by American Shipbuilding Corp. within a year and Ed later also returned to California. I was not too surprised. Long before buying Dolphin, I had given a lot of thought to the idea of building and selling subs and discarded it. First, there was no mass market and establishing dealerships for such a complex piece of equipment could take years, skimming off much of the profit, even at a price tag of $10,000. Secondly the risk of incurring product liability lawsuits resulting from mishaps (perhaps fatalities) involving the general public, was considerable. Even if insurance could be obtained, the premiums would be prohibitive.

Someday, when enough people know how to build safe, reliable, small subs and modest but growing demand exists, a new industry may develop just as the private aircraft business grew after the first world war. Meanwhile, I planned on a commercial operating service for Dolphin, not the sports aspect. I had drawn up a long list of tests, modifications, and improvements and now with Doug back to help out they would be a lot simpler to implement.

The first major improvement was replacing the high domed hatch, secured by the same crude system of inside toggle bolts as Aquasub. Watertight hatches on Naval ships and submarines are built and serviced by shipfitters (my trade) and they were no mystery to me. Months before, I had drawn a rough sketch of a quick acting type of hatch for Doug. He immediately recognized its advantage and started building one but became sidetracked with the sports sub project. When Doug left, I took the hatch parts to a local welding shop for assembly, then to a machine shop for milling of the 'O' ring grove in the outer rim. After Doug's return I recal1 the two of us spending half the night pounding and grinding away, getting the three dogs to lock properly and bring pressure to bear evenly around the perimeter so that the 'O' ring would seal.

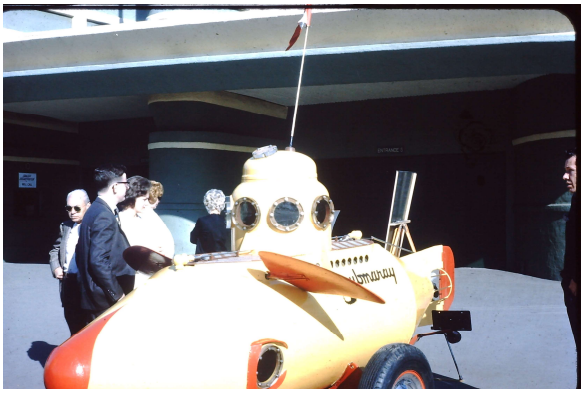
against the top of the conning tower. Now the hatch could be opened or closed with the half turn of a wheel inside, or with a wrench on the square end of a shaft protruding from the outside center of the hatch.

The reason another wheel was not placed outside Is that it could become entangled while underwater. Both Doug and I had long recognized that the primary danger of sub diving was getting trapped on the bottom by fouling some part of the sub around a line, cable, net, wreck, debris, etc. The floor of the sea (and lakes and rivers too) is littered with junk, much of it a potential death trap for submersibles. It is absolutely essential that the hull be as 'clean' as possible, and the prop protected by a shroud. Dolphin even had a 'weedless' type prop, although later a standard three blade propeller was installed because of its much greater efficiency.

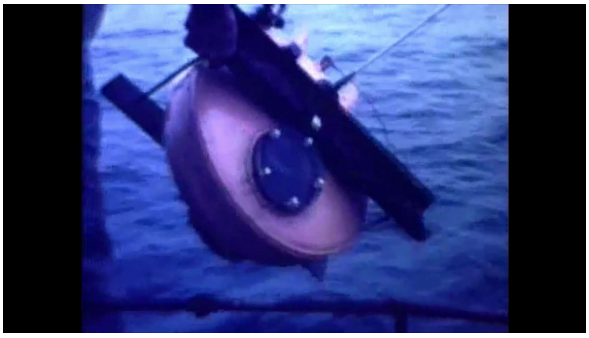
Two other additions were the Installation of a stainless-steel gland in the bottom of the hull to permit the dropping of a forty-pound lead weight from inside in case of emergency, and two more viewing ports, one on each side of the lower hull, for the passenger-observer. Originally there had only been one 7” diameter port for the observer, on centerline, looking down and slightly forward. Doug machined the two porthole rims and the gland, and I installed them, hauling the sub to the local welding shop. Doug was paid for his machine shop work, although he put in plenty of free time on the sub too. However, the question of a formal partnership arrangement never arose.

The drop weight mechanism: a box end wrench was used to unscrew the tab that was bolted to an emergency drop weight or to a “Drag Snake”

We were now ready for another trip to Catalina in order to test the new hatch, view ports and emergency drop weight, as well as a portable marker buoy and reel mounted behind the conning tower. Hopefully, this buoy could be released to the surface by unreeling the buoy, attached to nylon parachute cord, and then cranked down again. There was three hundred feet of line, and this device could not only be a life saver but might also prove a useful procedure during certain types of work situations. I also planned two pressure drop tests – one for the new hatch and it [] a drop test [] that is [] that checked out. Or another test of the Dolphin with the new hatch, both tests to 500 ft.



Submaray with the original domed hatch and the new slim line hatch


The two hatches bolted together for the 500-foot test

In other words, Dolphin would he lowered unmanned on a rope to a depth of five hundred feet. For this job Ma ray was fitted out with a portable 'A' frame overhanging the stern and a one ton electric cat head winch installed on centerline inside the transom. I scrounged around and managed to pick up a 530-foot spool of slightly used 3/4" polypropylene rope, which had a breaking strength of about 7500 pounds. The sub weighed about 3200 pounds in air when ballasted for diving, and rough calculations indicated that its maximum weight in the water, completely flooded, should be about 2400 pounds. Just to be on the safe side I located a lot of wooden blocks of various sizes ranging from 14" X 14" to 6" X 691, to be stuffed inside the hull during the test. In the event of disaster, I wanted to minimize the chances of losing my submarine. Several sets of informal calculations by engineer friends indicated a collapse depth for the hull varying from 800 to 1300 feet, (lots of room for error there.)

For an extra hand on this trip, I called on an old friend, George Martin, who owned a dive shop. He was delighted to accept my Invitation. One of the last steps taken in preparation for the test trip was another precautionary measure. It was assumed that any hull collapse under pressure would begin to occur around the conning tower opening in the main hull. So, I made up two 'spreader bars' out of 1-1/2" pipe and welded support cleats in the tower part of the conning tower so that one bar would be held fore and aft on centerline and the other at right angles, transversely. The pipes were deliberately cut 1/4" short so a small piece of cardboard could be slipped between one end of each pipe and the conning tower. Thus, if any squeeze occurred, one of the pieces of cardboard would be crushed and I would then at least know which way the hull tended to go. During the test I could also take comfort in the knowledge that any squeezing action would only proceed 1/4" before being stopped by one or the other of the spreader bars.

Both Doug and I were well aware of the existence of strain gauges, a much more scientific way of measuring stress and direction of squeeze during the test. However, at this time my funds were very limited and strain gauges are [].

Submaray was launched at the usual spot; the small boat hoist at Pierpoint Landing in Long Beach, where I had run charters from for so many years. It was the afternoon of Saturday, Dec. 1st, 1962. Elisa and I had run Maray eight miles from the Long Beach Marina while Doug pulled the sub from my garage with his Ranchero. George Martin met us at Pierpoint, and we embarked on the long, four-hour tow to Catalina aboard Maray. A few days earlier, and without any ceremony, I had painted out the name Dolphin and applied the new name with pressure sensitive letters on both flanks of the sub. I hoped Submaray would provide me with as many adventures and be as profitable as her namesake.

Our destination was Long Point, where there is a good, protected anchorage and deep water nearby. The hundred fathom line (600 ft.) showed on the chart only one-half mile off the Point. The twenty-six-mile trip across the channel ended in late afternoon and we anchored in a favorite cove just east of Long Point light. During supper the conversation centered around Hannes Keller's widely publicized attempt to dive in a bell to one thousand feet, exit the bell, and swim around, breathing a secret mixture of gases, the formula for which he hoped to sell to the Navy and others. His dive was scheduled for Monday off Avalon, and I had arranged to meet several people there and possibly demonstrate Submaray. Practically every prominent person in the field of diving would attend this event, sponsored by the Saturday Evening Post and unofficially. supported by the Navy.

The next morning a bright sun and calm seas cheered us as we loaded the sub with lead weights and a huge steel bar, necessary ballast to compensate for the approximate weight of two men. The bourdon tube type depth gages were removed and replaced with plugs to prevent damage to them. Then the wooden blocks were packed in as solidly as possible. This left the aft cockpit of the Maray clear for the hatch test. Both the old and new hatch were bolted together with an angle iron frame so that they sealed tight against each other. Submaray had to be left behind, parked on a calm mooring (with an open conning tower) while we moved out to deep water for the []

The end of the line around a thimble was threaded through the ‘A’ frame snatch bloc pully and secured to the angle iron frame with a shackle. Both hatches were wired to the shackle as an added precaution. When the test assembly was lowered into the water it proved only slightly negative, so three weight belts were looped around the descending line to provide more weight and speed up the drop. Currents were sometimes strong in this area, and I wanted to insure a near vertical test.

Now the line was quickly unreeled, and the assembly sank down out of sight. Code markings on the rope had previously been applied with green tape every fifty feet while the rope lay stretched out to its full length. These marks passed through the pulley and into the depths as I maneuvered Maray into the slight breeze to counteract drift. The drop went smoothly as my crew eased out the line until the five-hundred-foot mark was at the surface. At this point the end of the line was secured to a cleat and the test assembly left to dangle below for a 'soak' period. Due to the lighter density of the polypropylene rope, it had a tendency to reduce the negative buoyancy, but there was still a moderate strain on the line. Alter a soak period of fifteen minutes we started winching the line hack in. The winch took a heavy drain from the batteries, and I had to increase the main engine rpm's while in neutral gear so the generator would help feed more amps into the electrical system. With about two hundred feet still out I became concerned about the battery situation, so the winch was shut off as we all turned to, hauling hand in hand over hand until the assembly finally hove into sight. Hoisted aboard and swung over the stern into the cockpit, we peered through the parts for signs of water. It seemed dry, so the iron frame and weight belts were removed, a dry rag was used to wipe off the two hatches and they were separated. Much to my relief only about a cup of water had seeped in. Doug and I agreed that this probably [] ?escaped? through the base of the CB antenna and would have no effect on the validity of the pressure test of the hatches themselves. This was especially

gratifying to Doug because I had expressed some doubts regarding the relatively shallow dome contour of the new hatch. This low profile added a sleek appearance to the conning tower but obviously was not as pressure resistant as the old high dome hatch.

One down, one to go. Apprehensive about leaving Submaray without a hatch, it was a considerable relief to find it bobbing gently in the quiet cove. (My concern was primarily with the possibility a passing boat might stop and begin fooling around out of curiosity) We reinstalled the new hatch, locked it tight with a wrench and towed Submaray slowly seaward to the test area. The slight leak at the antenna fitting was of no concern. If only a cup of water penetrated during the test it would be a total success. A little inside the hundred fathom line we drifted awhile, securing the rope end shackle to another shackle, used for the hoisting sling, on the sub's forward deck. I reached down over the stern and quickly opened both ballast tank vent vales with a pair of pliers. As water flooded the tanks, Submaray began to submerge. But again, the negative buoyancy was not enough, so the three weight belts were again looped around the lowering line. Checking the pull by hand, the tension now seemed to be about seventy-five pounds and the long descent began with me at the boat controls, Elisa unreeling the line and Doug and George holding a loose turnaround a stern cleat. In between periods of maneuvering the boat to keep the line vertical I ran back to feel the tension on the line, testing its pull. Up to this point the deepest Submaray had been, was about one hundred and fifty feet during a previous one-day trip to Catalina before I bought the sub.

Now, as Submaray sank deeper, I wondered at the incongruity of our “mickey mouse” test when compared with the sophisticated achievements of aerospace programs.

The government would have simply built a pressure chamber so a hull test could be accomplished safely under controlled conditions. I recalled that Captain Cousteau had lost the completed hull for his first 'saucer' during a similar drop test in 1957. Far out in the Mediterranean, with the bottom 3300 feet down, the steel lowering cable had become fouled in a pulley during heavy swells. A sudden jerk as Calypso rose on the crest of a swell snapped the cable. How heartbreaking that must have been for Cousteau to helplessly witness the death plunge of his brand-new saucer hull, built at a cost of many tens of thousands of dollars, and no way to retrieve it. Immediately, another hull was built and in l95 Soucoupe made many dives exceeding one thousand feet. Others had been down several thousand feet in spherical diving bells, dangling from a cable, and the Navy's Trieste reached the deepest part of the oceans seven miles down, manned by Jacques Piccard and Navy Lt. Don Walsh, in 1960.

However, they were men of science with different objectives than mine. I only wanted to get down to about three hundred feet, a depth sufficient to include 95% of all the real underwater work going on in 1962. If this test surpassed a depth of 450 ft (a factor of safety of one and a half to one) I would feel safe at three hundred.

The line slowly unreeled, past the 400-foot mark, 450, and then the 500-foot mark passed through the snatch block and the line was cinched tight on a cleat. Submaray presented a much larger profile to the currents than the two hatches, and I had to maneuver much more vigorously than before while attempting to keep the rope vertical. The breeze picked up as noon passed and a little chop began to build. The tension on the line was difficult to judge due to the stretch of the rope but seemed much greater than at the start. I decided the maximum depth had been reached and told the crew to begin winching up. The line came in slowly and I worked at the wheel, using engine power to pull ahead, while the line was tied off, then quickly back down as slack was, taken up by the winch. This maneuver had to be repeated many times before we regained the 400-foot mark. Now the winch gave out again as the batteries were depleted and I experienced a slight moment of panic. Something was wrong – Submaray seemed []

to a course toward the nearest shore, just west of Long Point. Soon we could feel that Submaray had touched bottom, and it became more of a dragging operation rather than a hoisting procedure. I applied more power while pulling ahead and backing down, to gain line. This had to be done carefully to avoid tangling the line in the prop. Even so, the poly rope did get caught around the rudder at one point but was freed with a boat hook. We saw the 300-, 250- and 200-foot marks pass and still Submaray seemed heavier. I had to assume that a major leak was in progress and the time factor was now essential. Longer periods of nearly full throttle ahead were attempted in a desperate race against that leak. The line quivered in protest, stretching like a bowstring as the sub was dragged up the steeply sloping bottom. I prayed there were no rock outcroppings in its path. We were now only a hundred yards off the gravel beach, and I knew that the bottom did have rocks in this area. With about 150 feet of line still out, the advances shortened but progressed relentlessly until we were inside the kelp. A few more pulls and the sub was barely visible about 40 feet down. We could go no further the shore was too close.

Hastily, the anchor was dropped by my weary crew, and I tugged on my wet suit. Strapping on scuba gear and grabbing a spare tank with a hose attached, I jumped over the side. At the last-minute Doug yelled and handed down a pair of pliers. Grateful for his quick thinking, I finned down to the sub and closed the fore and aft ballast tank vent valves. The sub was hard on the bottom, but by shoving and pushing I managed to insert the hose into the forward ballast tank bottom opening and cracked the SCUBA tank valve. High pressure air hissed into the tank and the bow of the sub came up a little. Switching to the stern ballast tank I blew in more flotation air and Submaray rose to the surface. By alternating between the forward and after tanks, all the water was finally forced out and the water line tapped the deck at the base of the conning tower. Before going back aboard I checked the bottom of the sub and it seemed OK, having suffered only some deep scratches in the centerline Plexiglas port and a lot of paint rubbed off. By the time I climbed aboard Doug and George had secured fore

and aft tie lines and we were ready to open the hatch. The entire ordeal had taken a little over two hours. The hatch wrench required considerable force to turn, and as it came free, the hatch popped up releasing trapped air. I looked inside and it was a watery mess. Removing the spreader bars, I checked both pieces of cardboard but they showed no mark.

For an hour or so we removed wood blocks, ballast weights and bailed water. A rough estimate put the volume of water removed at about forty gallons - a little over 300 pounds. I would have sworn it was a lot more, watching that line stretch during the lift. Climbing into the sub with a big sponge, wiping off the residual dampness, I clearly saw droplets forming around the two new side view ports, indicating gasket failure. I tried the motor switch and it responded, so the sealed battery box and motor were OK. During a quick lunch Doug and I decided to try a dive later L? and confirm our assumptions.

We agreed that Submaray had probably reached a maximum depth of at least five hundred feet, especially since the poly rope must have stretched about 5%. But allowing for some internal pressure resulting from leakage, the actual pressure differential had most likely been equal to about 475 feet. So that made the hull test successful in that it verified a factor of safety of better than one and a half to one for manned dives to three hundred feet. The antenna fitting and the motor shaft gland must have leaked slightly but they were of no significance. The major leak had been through the new ports where I used sheet neoprene gaskets rather than the cemented 'corkprene' Doug had used on the other ports.

After lunch the depth gages were reinstalled and Doug and I made a dive to 120 feet, confirming the port gaskets as the root of the problem. We could actually see the rubber stretching inward at each bolt around the ports as the depth was increased. However, this seepage was easily controlled with the big sponge, so not wanting to disappoint our crew, Doug made brief dive with George, and I took Elisa for a relatively shallow but thrilling first dive (for her) in clear water off Long Point area, a very picturesque bottom.

In late afternoon we secured Submaray, headed for Avalon, and picked up a mooring in Descanso Bay. The tests of my marker buoy system and the new drop weight were postponed till another trip, since I intended to shoot UW film during those operations, and the scuba tanks were about empty. We had two standard 70 Cu. ft. tanks, nearly full, in the sub to blow ballast, and one full spare tank to take care of a few dives for tomorrow. The two 70's, when full, provided just enough air to blow the ballast tight times. Having already spread the word that Submaray was for hire, I hoped a few prospective clients would show up for demonstration dives the next day.

So here we were. Less than a year after the near disaster with Aquasub and the storm I had returned to the same spot with my own sub and experienced another near disaster. This time the weather stayed placid, and we all enjoyed a dinner ashore in Avalon meeting some of the people awaiting tomorrow's dive by Hannes Keller.

The following morning turned out warm and clear. I checked Submaray, sponging out a small amount of water, and left the hatch open so the sun would help dry out the interior while we had breakfast. An hour or so later we secured Submaray and the four of us rowed ashore in the dinghy and walked around casino Point to the pleasure pier in Avalon.

The pier was a scene of hectic preparation for what would turn out to be a very dramatic day. The Shell Oil Co. vessel Eureka had been especially rigged to handle Keller's large diving bell Atlantis, plus tons of support gear crowding its deck. I greeted several friends and acquaintances on the pier and learned that the Eureka would be embarking soon to a spot about two miles offshore where the sea floor awaited Keller and his passenger, Peter Small, one thousand feet down. Writer Peter Small would have an exclusive story for his paper, the London Telegraph, and also prove that a non-professional could survive exposure to that depth on Keller’s secret gas mixture. No diver had ever

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been that deep before.

Some of the people to whom I had hoped to demonstrate Submaray were in the party aboard Eureka. To others I gave our location and invited them over for a dive. We watched Eureka pull away from the pier and head out to sea. In the course of conversations, I learned that Dick Anderson and a young English diver, Chris Whittaker, were the two safety men assigned to the project. I knew Dick (the Daring Diver) Anderson casually then but had no way of knowing that he would play a major role in my work with Submaray in the years to come.

My crew and I returned to Maray. Doug and 1 took the sub down for the first dive as a precautionary measure. As usual, I piloted the sub. Doug actually preferred to ride down in the bow as the observer, and that pattern lasted throughout our long association. We were not far from the wreck of the Valiant, a 120 Loot steel hulled yacht that had sunk in the late 1920's as the result of a fire. I had been down to this wreck near Casino Point several times with scuba and knew the depth to be between 65 and 110 feet. By following the bottom contour in the cove while keeping a depth of about 100 feet, we easily found it and Doug was delighted at the sight of his first real underwater wreck. Not wanting to waste battery power, we circled Valient once and returned to the surface near Maray. Everything seemed to be working OK. Shortly after the dive a shore boat pulled alongside and John Houchen, a diver employed by the Naval Electronics Laboratory in San Diego, stepped aboard. Eager to see the wreck again, Doug volunteered to take John clown. After almost an hour I became a little worried, but then Doug surfaced far out off Casino Point and ran the sub back on the surface. Somehow, he had missed the wreck, however John enjoyed the dive and expressed enthusiasm for the capabilities of our little sub operation. John said there had been some problems with Keller’s dive and had to return to Avalon. After a good deal of kidding about Doug getting lost, I had suggested he try again with George along. This time he found the wreck quickly and spent considerable time maneuvering around the rusted hulk. Back on the surface he reported a slightly reduced amperage reading and this meant the batteries []

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were giving out. However, I very much wanted Elisa to see this wreck, the only one of any size at Catalina, so we dove, using motor power sparingly. Doug and I weighed about the same, but the weight of the passengers varied, so I had to keep track carefully, adding or removing lead to keep trim within the limits of the five gallon (40 pounds of water) trim tank inside Submaray. I had guessed right with Elisa, who only weighed 110 pounds, and we glided easily along the length of the gutted steel hull, around the deepest part of the bow and back up to the overhanging stern. Here I rested Submaray on the bottom alongside the stub ends of Valiant's two propellor shafts and recalled how Mel Fisher, years before, had blown off and salvaged one of the bronze props by using explosives after trying in vain to loosen the huge nuts with a wrench, not realizing that it was a left-hand thread. (Many years later Mel had better luck off the coast of Florida, where he would recover sunken Spanish treasure worth millions.)

While maneuvering away from the stern I noticed a drop in power and a greatly reduced ammeter reading. We got clear of the wreck and part way back to where Maray was moored when it became obvious that the batteries were just about dead. Even the high-pressure air was marginal as I surfaced and barely managed to blow the ballast tanks empty. At this point, to avoid giving the reader the impression I had been extremely negligent in making this dive, I must point out that the electrical system in Submaray had nothing to do with surfacing by vertical ascent. This was strictly a plumbing function, using high pressure air. Furthermore, a 20 cu. ft. tank of oxygen, used to freshen the air occasionally during dives, could easily have been hooked up to the HP air manifold, thus providing an emergency backup supply for blowing ballast. However, the need for some means of charging the batteries between dives was obvious, and I made a note to bring along a charger for the next trip.

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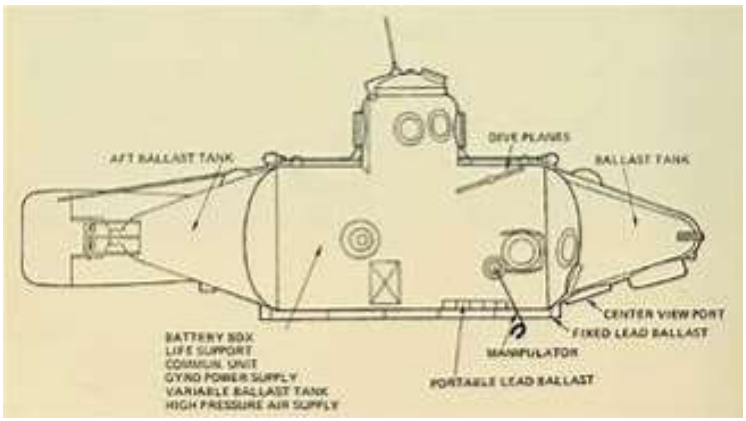
I got Doug, on the CB radio (self-contained batteries) and advised him that Submaray had ‘run dry’. He and George rowed over in the dinghy and towed us ignominiously back to Maray. This was a good lesson in logistics which I would not soon forget. It was safe enough in a calm, shallow, familiar cove, but I could readily imagine how different the circumstances would be in a rough, exposed location []

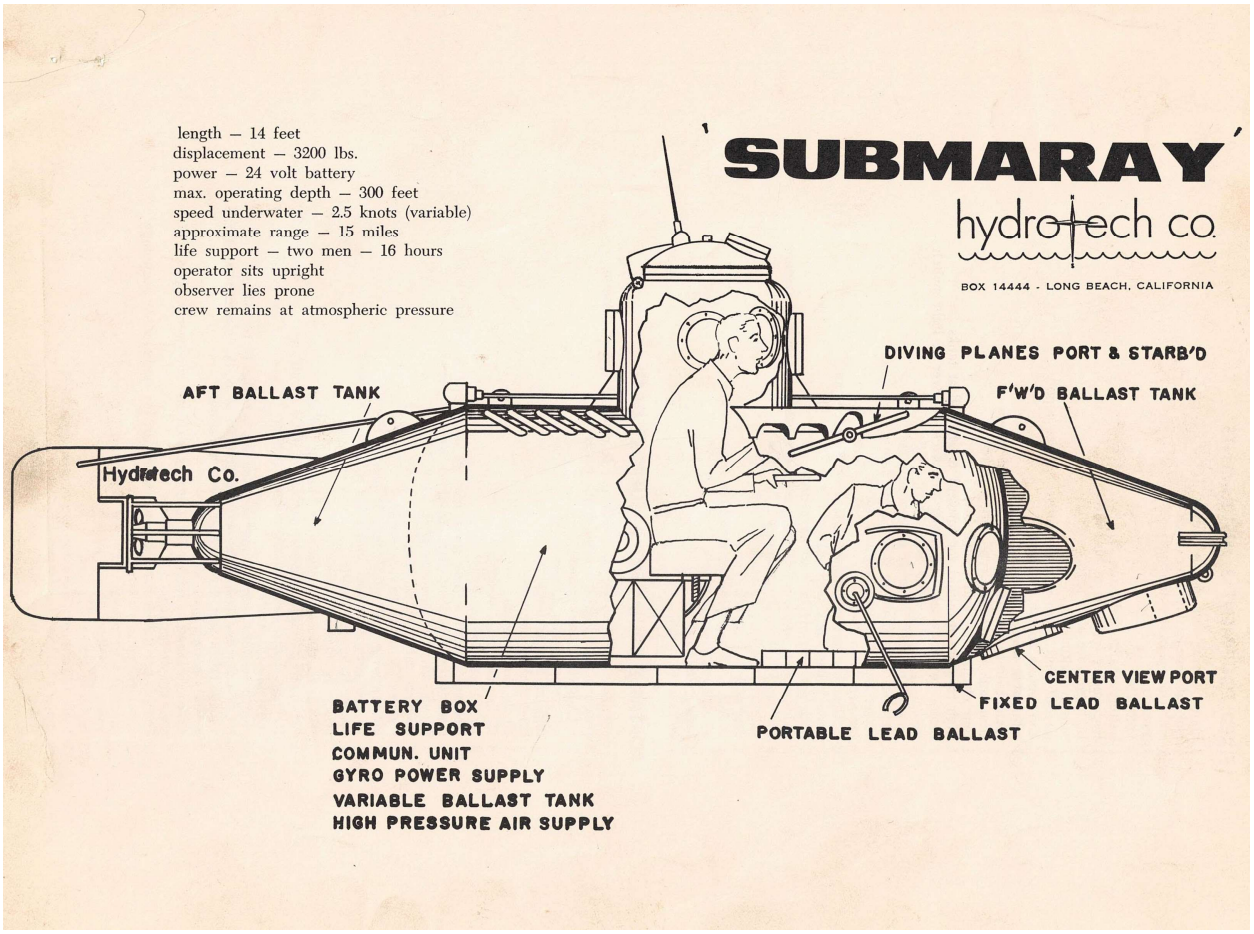
It was time to head home, so the bow planes were removed, most of the portable ballast taken out so the bow would tow high, and the towing bridle rigged for the trip back across the channel to the mainland. Doug and George had been listening to the radio during my dive with Elisa and had heard reports of an accident connected with Keller's deep dive. After we were under way, I turned on the Coast Guard channel and we listened to fragmented conversations concerning rescue attempts but could not make out the details. We plowed on, reaching Pierpoint Landing after dark, where the Sub was tied up for the night because the boat hoist operator had gone home. Doug and George left in their cars, anxious to get home and back to their jobs the next day. Elisa and I ran Maray back to the marina. For us, the three days had been a successful adventure, but the headlines Tuesday morning told a story of tragedy for the Hannes Keller dive.

Peter Small had died in the chamber and Chris Whittaker, one of the safety divers, was missing. Keller had managed to exit the chamber at 1000 feet and return inside, but a swim fin had jammed the lower hatch. Dick Anderson and Whittaker: descended twice after the chamber was hoisted to 200 feet, in an effort, finally successful, to free the jammed hatch so the men inside could decompress on board Eureka. Chris Whittaker disappeared during the second rescue dive and was never found. Hannes Keller became unconscious shortly after reentering the chamber but recovered later to take over the decompression program. Peter Smalls death was attributed mainly to exposure and shock, probably caused by not being in top physical condition, as was Keller. In retrospect, the entire episode seems symbolic to me. Man is not built to survive in the pressures of the deep, but man within steel can go to any depth.

TECHNICAL STUFF – Nuts & Bolts

Before going any further, it might be a good idea to really get into the "nuts and bolts" of Submaray and describe her construction and features (as of this point in the story) in detail. That way, it will be easier for the reader to understand (and for me to write about) the technical modifications and additions to come later. In connection with this discourse, it will be helpful to refer to the cutaway drawing and list of on-board equipment.





Cutaway diagrams of Submaray

FIXED EQUIPMENT & INSTRUMENTS

3 bourdon tube type depth gauges
1 elapsed time 8 day aircraft clock
1 ambient sea water thermometer
1 ammeter
1 voltmeter
1 battery charge indicator
1 hygrometer (percent of humidity)
1 high pressure air gauge
1 sensitive altimeter
1 aircraft elect. gyro w/transistorized power supply and remote course indicator
1 adjustable height pilot seat
1 main battery box (sealed) w/two vent valves
1 trim tank w/two ball type teflon valves
1 four circuit fuse and switch box
1 high pressure manifold for forward & aft ballast tanks
1 motor switch panel w/charging receptacle, blower & light switch
1 rack & pinion steering assembly
1 bow plane shaft & lever control assembly
3 stainless high pressure flexible air lines
1 three circuit 12 volt terminal block
1 interior dome light
10 camera bracket mounting nuts (1 under each port)
2 main ballast tank vent valves
2 high pressure air tank stowage racks
1 quick acting hatch w/"O" ring seal, overhead port & CB antenna
4 190 ampere hour six volt main batteries
2 external sun gun bulbs & fixtures
1 rubber bow bumper
1 stainless towing pennant w/rubber snap hook
1 electrolysis zinc
2 lifting shackles
1 lead bow weight

PORTABLE EQUIPMENT & SUPPORT GEAR

complete CC TV system w/internal & external camera mounts
3 pressure type bourdon tube depth gauges
1 set plywood bow planes
1 set plexiglas bow planes
1 drag snake (six foot)
1 drag snake (four foot)
1 40 lb. drop weight
8 45 lb. lead bilge weights
2 10 lb. lead ballast balls
mechanical arm w/tong grab, toothed grab, saw & cutting blade, steel fixture blanking plate, plexiglas fixture port.
1 24 volt charger (operates from 110V AC)
1 stainless cable lifting sling
1 stainless & nylon towing bridle
1 marker buoy reel w/300 feet of line & buoy
1 24 volt reversible gear motor for marker buoy reel
1 10 cu. ft. oxygen bottle
1 38 cu. ft. oxygen bottle
3 70 cu. ft. H.P. air bottles (for blowing ballast)
1 two quart plexiglas canister w/blower (CO_2 scrubber)
1 five quart can fresh baralime for scrubber
2 inflatable life vests
1 submarine ultra sonic communication set w/mike & transducer
1 topside communication set w/both directional & omnidirectional transd.
2 walkie talkie sets (for surface communications)
2 nylon mooring lines w/snap hooks
1 Ross combination flasher & recording sounder w/power supply
3 standard transducers for sounder
1 special 4x4 transducer array w/pan & tilt for horiz. sonar scanning
1 sonar transducer switching box
1 medical type oxygen metering regulator w/gauges
3 spare propellors of various sizes
1 highway trailer (licensed)
2 hold down turnbuckles for securing sub to trailer
1 spare wheel & tire for trailer
1 box of misc. spare parts, tools & fittings
1 wooden case for accessories

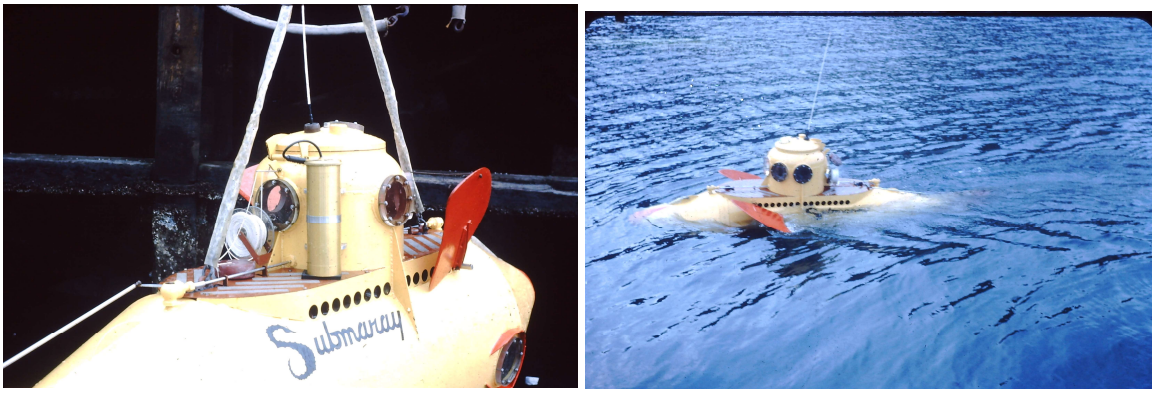
The main hull is 3/8" mild steel, fabricated from three pieces: a center section of plate, rolled up into a cylinder 5 feet long, with a welded seam at the top, and two end sections of standard 36" diameter, 3/8" thick, boiler tank 'heads', welded to the cy1inder, and extending its length to just under 7 feet. Located in top dead center, the conning tower is of 1/4" mild steel, 2 feet in diameter to a point 15" above the hull where another section of a tank head rises to a hatch rim 1" wide, cut from 1-1/4" steel plate with an inside diameter of 17". All welds are 100% penetration.

Two reinforcing bars of 1" X 4" steel and about 4 feet long are welded flat inside the hull on each side longitudinally just below the conning tower opening. A motor compartment of 10" diameter heavy wall pipe, open to the interior, is welded to the center of the aft head. This steps down to a 'shaft alley' of 3-1/2" pipe running through the aft ballast tank and capped off with a stainless-steel packing gland for the 5/8" diameter prop shaft. Gusset plates surround the conning tower at intervals and a 1/2" X 2" outside keel bar, complete the main structural parts of the hull.

The ballast tanks are conical sections of 1/8" steel. ¾" Teflon Ball valves, one at the uppermost point of each ballast tank, are operated by stainless rods passing through 'O' ring glands in the conning tower, with handles inside. Short sections of 2" pipe are welded to the lowest point of each ballast tank and are open to the sea permitting flooding or blowing ballast. The centerline observer's viewport is of 1-1/4" acrylic bolted to a flat machined rim with 7" clear opening, welded into the hull at an angle so the view port is down and forward, through the ballast tank, where another 12" downward facing port is located to permit a fairly wide-angle view.

ballast tank. The side ports are identical in size to the centerline port and located slightly below center so that the view is also downward. Six ports surround the conning tower, all of them 6" clear opening and of 1" acrylic. The hatch port is 4-1/2" opening, 1" acrylic.

Power is provided by a reversible 24-volt DC motor, similar to those used in golf carts, driving a three blade 7" diameter prop. The motor switch is operated by the left hand, adjacent to the rudder control wheel. Steering is actuated through a rack and pinion gear train. The rack continues aft as a push rod supported by guides and is connected to a lever on a shaft penetrating the top of the hull aft. Another lever atop that shaft operates another push rod connected to the rudder. Got it? The bow planes are controlled by the right hand on a lever attached to a transverse shaft penetrating two 'O' ring glands in the upper forward part of the hull. The diving planes are folded up while alongside the surface tender and secured in the down position with thumb screws prior to diving. They are removed entirely while towing any distance on the surface.



Submaray with the bow plane stowed up and in the down position for running.

For instruments, there are two depth gauges, one reading 0 to 130 feet, and one 0 to 400 feet. The shallow gage provides a more accurate reading but must be closed with a valve when exceeding 130 feet. A small panel on the left side of the hull contains the motor switch, ammeter, voltmeter and a receptacle for plugging in a battery charger. The CB radio is hung on a clip in the conning tower and its antenna wire leads aft around the conning tower to a connector close to the hinge point of the hatch. 300 pounds of fixed lead bars are bolted to both sides of the outer keel bar. Another 300 pounds of molded lead weights are available for placement in the forward bilge, held in by a notch in the bottom fitting over a 1/2" X ½" steel bar welded to the inside bottom centerline of the hull. The number of bilge weights used is varied depending on the weights of the pilot and observer. They form a relatively flat area for the observer to sit on, and a piece of carpeting plus a small pillow help provide some comfort.

The top of the trim tank, located on the battery box just behind the pilot, is vented out the top of the hull behind the conning tower. Sea water enters or is expelled from the lowest point of the trim tank through a line running out the starboard side of the hull. Each of these top and bottom lines is valved. An air line from the HP manifold is attached to one end of the trim tank. The HP air tanks (standard scuba tanks) are located on each side aft and are locked in their brackets by a threaded hand wheel. The battery box is of 1/8" steel with an airtight lid and contains four 6-volt Trojan J-190W batteries connected in series. Two small valves in the lid allow venting while charging but are kept closed at all other times.

Overall dimensions are: length - 14 feet, height - 5 feet (without antenna), width - 3 feet six inches (without bow planes). Several loose items include a small tank of oxygen, a sponge, a towel for wiping condensation off the ports, a 60-minute timer, a handheld compass, a flashlight, a box of tools with spare parts, a plastic pee bottle and, just for fun, a can opener. The total gross weight in air, ballasted for neutral buoyancy in salt water, is about 3200 pounds, Including weight of pilot and observer.

The only through hull penetration requiring periodic servicing is the prop shaft gland. Due to its relatively high RPM, an ‘O’ ring would wear out quickly. Therefore, this gland is similar to those used in marine water pumps. Several rings of graphite impregnated lead called 'chevron packing' circle the shaft and can be squeezed tight with a bolted stainless-steel plate located just forward of the prop. The object is to tighten this packing only enough to stop leakage, and not enough to cause excessive drag on the shaft. Obviously, some water would seep through under pressure, so a 'stop water' in the shaft alley prevents water from traveling along the shaft to the motor bearing. A drain hole in the bottom of the shaft alley collects the seepage and feeds it through a short piece of copper tubing to a pet cock in the main hull, just below the motor compartment. A small drip can is wired beneath the pet cock to collect seepage and requires occasional emptying. This concludes (happily) as much technical description as it is practical [].

The mode of operation begins by towing Submaray on its custom-built trailer to a boat hoist or clock side crane. Launching ramps are not normally used because the trailer lights cannot be removed, and also because the trailer is not designed for it. A special hoisting sling of 1/4" galvanized chain is shackled to fore and aft lifting pads welded to the hull. A steel ring at the apex of the sling is large enough to slip over most crane or hoist hooks. The chain is covered by vinyl sleeves, mainly to prevent scratching the viewports. Once in the water, the sling is removed and replaced with fore and aft nylon dock lines spliced to snap hooks. At this point a check for leaks is made. A little water is splashed in the top of each vent valve to ensure that no air is escaping from the ballast tanks. The inside of the sub is inspected, usually by Doug, to make sure I have not forgotten something.

A stainless-steel cable, called the towing pennant, is always left shackled to a pad eye welded to the bottom of the bow. This short pennant is normally pulled up over the bow and secured to another pad eye near the top of the ballast tank, above the water line, with a piece of shock cord so that the pennant will be in tension and lay snug against the ballast tank. The apex of a 'V' shaped towing bridle is shackled to the pennant by squatting on the small forward deck and reaching down to release the shock cord hook. Eye splices in the ends of the towing bridle are then secured to port and starboard cleats on the stern of the towing vessel. Rigged in this manner, 'fishtailing' is minimized while under way. The procedure is reversed after the sub is towed to the diving area. Thus, a diver is not required in the water during operation of the sub. This system of handling on the surface is more significant than might be imagined by the layman. Later operation proved its success, even in rough water with waves up to five feet and a sea state three condition.

Submaray under tow with the towing pennant and towing bridle

I trust the rather lengthy descriptive matter has not been too dull, for it will be useful in understanding the terminology to follow without the necessity of interpreting the flow of the story to explain terms.

The drop test at Catalina and our many dives afterward called attention to []

remedied immediately. The next item was fairly simple too. I installed two overhead dome lights inside the top of the hull, one forward and one aft. A toggle switch on the instrument panel operated the aft light and the forward light had a built-in switch so the observer could reach up and turn it on to check his watch, take notes, etc. without bothering the pilot. This feature delighted Doug.

The next goodie was entirely my idea and Doug expressed some skepticism about it (a pattern to be repeated frequently). I bought a length of tubular speargun rubber, installed stainless wire hooks in the ends, and threaded it through the pad eye atop the forward ballast tank. Then a hole was drilled in the leading edge of each bow plane. By hooking into the holes, the tension of the rubber kept the bow planes horizontal (in neutral), yet they could easily be controlled by the hand lever with slight pressure. There are times when the pilot is quite busy and must release the lever to do something else. I had noticed that at those times the bow planes tended to flop one way or the other, (even though they were balanced) and this seriously affected vertical control. I hoped this would correct that problem, and it did. It's like the steering wheel of a car, - when released it tends to return the wheels straight ahead, at least on a level road. There was no similar trouble with the rudder. The high ratio of the rack and pinion steering provided enough resistance so that the rudder stayed put when the wheel was released, even when hard over.

The rudder control (horizontal wheel) that was turned with your left hand

That took care of the relatively simple improvements. The next item on my priority list (and I had a long one) concerned the life support system. Cracking the valve haphazardly on a bottle of oxygen now and then not only lacked style, - it could be dangerous. We needed to know when and how much oxygen to squirt into our tiny world. Beckman Instruments and Mine safety appliance each had beautiful meters which could indicate percent of oxygen in a closed compartment, but they were too expensive.

About this time, an old friend and marine geologist, Bob Dill (one of those extended for a dive at Catalina) called to invite me down to San Diego for a

look at Trieste I, now undergoing an overhaul at the Naval Electronics Lab. This was a wonderful opportunity, and I took him up on it immediately. I should mention here that I had built a Hasselblad Super Wide camera housing for Bob's section, the Sea Floor Studies Group at NEL. They liked the housing well enough to build several more, based on my design, so this was a kind of repayment. Trieste was not really Bob's project, so he introduced me to Dr. 'Andy' Rechnitzer, a well-known diver and oceanographer for the Navy, who headed up the Trieste project at the time. The facility was not new to me, in fact I'd been there on business years before while working as a planner and estimator. Still, the welcome and the circumstances were a little overwhelming. Here I was, the owner of a small backyard submarine, being given the red-carpet treatment and, best of all, the opportunity of borrowing ideas from some of the Navy's best engineering brains assigned to a multi-million dollar deep submersible program.

The spherical chamber of Trieste would later be replaced but I was shown the old chamber. I can't possibly recall all of the instrumentation and equipment it contained, but three features were of particular interest. One concerned the monitoring of the percent of oxygen within the sphere. The simplicity of it amazed inc. An ordinary aircraft type sensitive altimeter had been installed which was set to zero on the surface. During a dive the bodies of the occupants absorbed oxygen, reducing atmospheric pressure within the chamber, and unwinding the needle of the altimeter. From time-to-time oxygen would be released manually until the needle returned to zero. That's. all there was to it! (minor errors caused by changes in the humidity and temperature were ignored). Also, they had a CO_2 scrubber consisting of a canister containing baralyme and a blower to suck air through baralyme pellet, a powerful chemical absorbent of carbon dioxide. It would be simple to make a similar device for Submaray. I was aware of this system, as it had been used by divers for many years, but actually seeing the mechanics of the gadget simplified the process of duplicating one in my little workshop.

The third item that caught my eye was an electrically driven aircraft gyro

powered by a rotary inverter supplying 110 volt, three phase, 400 cycle current from an input of 24 volts DC. The inverter ran at a high speed and emitted an annoying whine, so they had encased it in a one gallon can lined with sound absorbent glass wool. Even the Navy improvised occasionally. Of course, it was explained that the modified sphere would contain far more sophisticated instrumentation, but these items, available at any war surplus store at a tiny fraction of their original cost, intrigued me immensely. Thanking Dr. Rechnitzer, I made the rounds with Bob Dill, greeting Tohn Houchen and meeting several others, mostly geologists, who were to become very familiar with Submaray in a few years. I drove home with a whole new set of concepts whirling around in my mind.

The next day I wandered around the hangars and repair shops at Long Beach Airport. At one of the instrument shops, I lucked out and bought a used altimeter, in reasonably good condition, for $5.00. On the way home I drove up to the top of Signal Hill to check it out and it seemed to work fine. It was immediately installed under the lip of the conning tower, above the rudder wheel. One mission accomplished. A few days later, after haunting a lot of surplus stores, I acquired a Bendix gyro and rotary power supply for a few dollars. These, I turned over to Doug for a check out because he knew a little about electrical circuits and electronics. While he played with the gyro, I went to work on a CO_2 scrubber.

Again, fate intervened in my favor via the Navy Dept. Another old acquaintance and a well-known figure in the world of diving, Commander Tommy Thompson, expressed a desire to see the sub and show it to his team of EOD divers, at the Terminal Island Naval Station. Happy to spread the gospel, I trailered Submaray to the base where a small but keenly interested group inspected it while I explained to Cdr. Thompson my plans for a CO_2 scrubber, by a stroke of sheer luck they had a large quantity of baralyme pellets, used in UW rebreather units, which had turned partly dusty. This made the chemical unsuited for use in the rebreather because the fine dust might clog the system. However, it would be fine for use in my submarine. So, I was given the stuff packed in airtight five-pound cans.

I also met Lt. Bart Stephano who wanted to accompany us on our next trip to Catalina. Barts hitch in the Navy was about up and he planned to get into the commercial diving game, or possibly work with me if any jobs came along. I promised to call him and pulled the sub home, stuffed with a long supply of expensive pink baralyme. The bright pink would change to a blue gray color when the chemical became saturated, thus it was a color indicator type, a very important feature.

By scrounging the surplus stores again, I bought a 24-volt cylindrical impellor type blower about 4" in diameter. This was bolted to one end of a Plexiglas cylinder of the same diameter and 12" long, with removable fine mesh screens at both ends. I mounted the scrubber assembly in brackets installed on the port side HP air tank support. I wired the blower with another on-off toggle switch on the instrument panel and a two-conductor breakaway connector near the blower. Thus, the scrubber could be quickly removed and recharged with fresh baralyme outside the sub.

Meanwhile Doug had the gyro working and furthermore, he had devised an ingenious accessory. The whole object of a gyro is to facilitate steering a straight course without landmarks or external references of any kind. Doug's invention consisted of three tiny neon lamps wired to an etched pattern within the gyro so that, as long as the center lamp remained lit, the sub would be on a preset course. If the sub veered off course about two degrees, either the right or left lamp would light up and the center lamp would go cut. By appropriate rudder action the center lamp would again light up and the pilot would know he was back on course. I made up a crescent shaped piece of Plexiglas to contain the three lamps which fitted into the bottom ledge of the centerline port in the conning tower. The gyro itself was mounted under the lip of the conning tower, inboard of the altimeter, and the rotary inverter bolted to a shock mounted chassis on the battery box, behind the trim tank. All this was necessary because a regular magnetic compass will not work within a steel hull.

Now we had a truly useful navigation instrument. The pilot could scan the bottom []

of the three neon lamps without having to duck down and check the gyro below. As Doug said, "it's beginning to look like a real submarine inside". He also suggested a dry land test, so we hooked up the car and drove around the streets, taking turns playing pilot in the sub. The etched pattern in the gyro cut in at 90-degree intervals, so by making turns at street intersections, this feature also was checked. Everything worked fine except that the rotary inverter did make a lot of noise. So, I made a sheet metal box, lined with fiber matting to fit over the inverter, and it did cut down the noise considerably.

One other condition demanded attention. The pilot's seat consisted of a board about 10" wide, resting transversely on port and starboard support brackets welded to the hull. This was not only uncomfortable but took up too much space. I found a padded seat, about 12" in diameter, with a threaded shaft under it, like a piano stool. A bracket with corresponding threads was bolted to the forward end of the battery box. This provided a more comfortable seat, with adjustable height, and far less intrusion into the side areas. All of these changes involved nuts, bolts and screws. In every case I used stainless or brass fastenings, I even to the extent of replacing the battery box lid screws with stainless ones. The battle against corrosion would prove constant; I knew it and vowed not to compromise in that area. Anxious to test out all the new gadgets, I scheduled another trip to Catalina at the earliest opportunity.

However, the holiday season had arrived, and Elisa wished to visit her family, now living in Rosarito Beach, so we drove to Baja for a few days. On the way home I stopped at San Diego Divers Supply to say hello to Bill Johnson and a couple of other friends. Naturally the talk got around to my sub, and Bill mentioned Jon Lindbergh had a big contract on a new sewer outfall job off Point Loma. Jon was a highly respected commercial diver and he Lindbergh name carried a lot of weight in San Diego. His fathers' famous plane, The Spirit of St. Louis, had been built in Ryan Aircraft. The dive shop did business with Jon, and Bill suggested

it might be worth a call. Luckily Jon was at home and invited mc to drop by for a chat. Elisa and I drove to his pleasant ranch style home in Point Loma and met his gracious wife and four children. Jon showed a keen interest in all the features of Submaray, and with good reason. He disclosed that Hughes had retained him as an advisor on the design of a 1000-foot sub. (I never did learn what became of that project)

But Jon's immediate interest concerned the laying of huge sections of concrete sewer outfall pipe for about two miles off Pt. Loma and to a depth of over 200 feet. Jon had completed the preliminary bottom survey and now had a contract to inspect each section of pipe as it was laid, especially the massive 'O' ring type joints, using scuba gear. The outfall now extended to a depth of 180 feet and hard hat divers were forced to stay on the bottom for relatively long periods of time while a special barge on the surface lowered each section and rammed it into the bell joint of the preceding section with hydraulic cylinders. A combination of long bottom time and deep water was costing the contractor thousands of dollars a day for diving services. If I could provide some kind of two-way communication between the sub and the surface, I could sit on the bottom and direct the critical operation of making up each joint. Jon gave me the name and number of the man in charge, Jake Case. I thanked Jon, who said he too might have need of my services during the periodic inspections required after completion of the sewer outfall.

In early January of 1963 I began a desperate search for a wireless communication system. For a while it looked like Straza Ind. had the only system developed for Trieste, but it cost thousands of dollars, far out of my reach. Then I heard about a unit being worked on right in my own back yard, Log Beach. A prototype had been built by a group consisting of an electronic engineer for Hughes Aircraft, a salesman for IBM, and a machine shop owner, Bob Farnum. Bob specialized in highly sophisticated oil well surveying instruments and had a beautifully equipped shop, full of expensive machinery. The electronics man designed and breadboarded the circuitry and the IBM man would handle the business and sales end. I arranged a meeting and explained about the San Diego job,

but they were having difficulties with the prototype. Bob had made a very classy looking package for the unit, a gold anodized cylinder about 4" in diameter and 14" long. The price had not been fixed, but they realized I could help them with a lot of sales contacts. I agreed to provide any help needed in testing and perfecting the system, including a trip to Catalina with one mounted on the sub. They promised to get busy.

A couple of other leads (for UW communications units) were tracked down, but for a variety of reasons, mostly due to a failure to work, these led nowhere. Doug kept insisting he could build one. He had found a circuit diagram in some electronics magazine. I was very doubtful, but reluctantly agreed to buy a few dollars' worth of components for him to give it a try, I know he spent many long hours struggling with this project, and 1 was grateful, but I had seen too many attempts fail, backed by some pretty sharp experts. Even the best and smallest emergency two-way system used by the Navy, the AN/BQC-1, occupied a huge box 16" X 16" X 20", and cost thousands of dollars. Doug was not an electronics engineer and I hated to see him wasting so much time when so many other things needed attention. Like making a living. Both our incomes were marginal and spare time at a premium, so he finally had to give it up.

In the interim I continued to promote interest. The annual boat show would be opening in Los Angeles soon, and I offered to put the sub on display. With a shiny new paint job, a large poster listing Submaray's features, and a stack of business cards, l parked the sub outside Pan Pacific auditorium. The press took pictures, people stopped and gawked asking cute questions like "Where do you wind it up?" and kids by the thousands, it seemed, climbed over, and tried to get into Submaray. Nothing came of it, but the experience was worthwhile, and it led to many other displays later. Wherever crowds assembled, Submaray could upstage most anything.

Submaray at the Pan Pacific Auditorium

Finally, Bob Farnum called to say the unit could be installed and tested if I would arrange a Catalina trip. I'd been itching to get back to the island anyway and set it up for a few days later. This time of the year Avalon would be relatively

deserted, and since I still did not have a gas driven portable charger, perhaps we could tie up the sub at the fuel deck overnight and plug in my 110-volt charger to shore power, after the first day's diving. I called Bart Stephano and he could make it, so on a rough, late afternoon in January the four of us, Elisa, Doug, Bart and I, towed the sub across the channel and parked on a mooring for the night. Bob Farnum and the electronics man, Larry, would fly over in the morning. The next day the shore boat pulled alongside and the IBM man, Bill Jackson, had joined Bob and Larry for the test.

The shiny gold cylinder had to be secured outside the sub, behind the conning tower, because its transducers were built into the case. A cable for the microphone and earphones passed through a gland in the conning tower. I made the first dive with Bob as a passenger while the others dangled an identical unit over the side of Maray. Sitting on the bottom 30 feet down, we were able to engage in two-way talk with the surface, but it was a little garbled. We figured the kelp and shallow bottom may have interfered, so the topside unit was transferred to the dinghy as we cruised the sub out to deeper water, beyond the kelp. At about 100 feet the transmission improved, but only when the dinghy was close by, directly overhead. As soon as the dinghy pulled away any distance the signal faded. Another dive, with Doug and Bob in the sub, produced the same results. The unit simply lacked power, or as Larry admitted perhaps the alignment of something in the circuit was out of kelter. We all felt let down and disappointed, especially Larry, since he had sole responsibility for the electronics end of it. We removed the unit, plugged the hole in the conning tower, and the three guests flew home with their units, promising to correct the problem.

Mart and the UW communications unit (gold Cylinder) attached on the conning tower

Now I wanted to make a deep dive and give the gyro system a good checkout. I had the conning tower spreader bars along, just as a precaution, for a dive to 250 feet. During the two previous dives the bow planes worked well with the new rubber neutralizer. The new seat provided comfort and the dome lights lit up the interior with a warm glow of security. Doug and I had long ago decided that for a dive

with any risk involved, one of us should remain topside to direct the rescue, so Bart volunteered to go with me. I transferred Maray to one of the most seaward moorings in Descanso Bay, and while on the surface, warmed up the gyro. After being sure it had reached full RPM, I lined the sub up, so it pointed directly out to sea, and engaged the gyro control. Then I submerged, planing down in a slow spiral while adjusting trim, to the bottom at about 100 feet. There, the bottom was virtually flat, making it difficult to visually determine the direction of slope. The gyro hummed away and 1 started off, holding a zero heading, skimming over the bottom. Through beautiful1y clear water Bart stared in fascination at the scenery sliding by the ports as we slowly increased our depth. At about 200 feet, I placed the spreader bars in their supports which really crowded the conning tower, but I managed to get my head up around them enough to see the bottom. There were few signs of life, - an occasional sand shark would shoot up in a cloud of silt at our approach, a few small fish, and the usual debris of civilization discarded from boats on the surface.

By the time we reached 250 feet, a lot of bottom had been covered. Resting for a while, I checked the spreader bars, and they were both free, so I removed them. Apparently, the hull could easily take this pressure. We turned the outside lights on and were surprised at the sudden brilliance. Our eyes adjusted gradually, and we had not realized it was so dark outside. Bart and I then carefully checked the entire interior for leaks. Dry as a bone! Our slight negative buoyancy remained constant throughout the dive. About 30 minutes had elapsed, so I switched on the scrubber and bled a little oxygen into the atmosphere to bring the altimeter needle back to Zero. The slightly stuffy air freshened immediately, and I experienced some euphoria at how well all systems performed. Bart too had a mildly excited glow. This was deeper than he had ever been, even after years of EOD experience. (The deepest for me too.)

I wanted to see how far we had gone to sea, so with a two or three second blasty of air into the ballast tanks, Submaray lifted off the bottom and the depth gauge began unwinding, in less than three minutes we broke the surface into a blaze of

sunshine, then settled back down a little. There was no need to blow all ballast I only wanted to get oriented with the Maray and check the gyro. Frugal with the air, I stopped blowing ballast when the decks were awash and saw that were indeed a long way out from shore, perhaps a mile. I called Maray on the CB and alter a few seconds Doug came back, saying he could just barely see us. I reported all was well and that I would submerge again for the return trip. Now I checked the still running gyro, heading directly toward Maray. The reciprocal should have been 180 degrees. The gyro read 174. Not bad, only a 6-degree drift in 40 minutes. Better than might be expected from a war surplus instrument.

After resetting the gyro to zero, we submerged again, but not to the bottom. I held the sub at 100 feet on the gage, and tried to keep the center neon lamp lit. It was spooky, staring out at nothing but water, the little red lamps blinking in front of my nose. Bart sat huddled in the bow trying to get comfortable, perhaps a little apprehensive, but saying nothing. I cracked the oxygen again to freshen the air as we plowed smoothly ahead. By very delicate rudder control I learned to keep the center lamp lit for long periods of time. The coloration of the water changed imperceptibly, and soon the bottom came into view, about 35 feet below. When we reached bottom at 100 feet I surfaced and saw Maray less than 100 yards on our right. The gyro had a small consistent drift to the left. Delighted with my navigational prowess, Bart and I boarded Maray after the most satisfying dive to date. We had been gone an hour and twenty-five minutes without opening the hatch.

Doug was the first to suggest keeping a log. I had been jotting down a few notes occasionally since buying the sub, but now realized how important a logged record of each dive would be later. I gladly delegated the chore to him. The amount of concentration and effort it required to run the boat and handle the sub left little time, even for pictures. I'd been shooting a few stills and movies and already had in mind making a 16mm film about Submaray for showing prospective clients. We still had some equipment to test, so I checked my 16mm K-100 UW movie outfit and got into scuba gear.

The marker buoy would be the first subject to be filmed. I secured It to its bracket behind the conning tower and threaded the line through a wire guide just above the reel. The buoy itself was a toilet tank float, and it dangled capriciously from the wire guide. I instructed Doug to stay within a clear, shallow area near Maray. After the marker buoy shots, I would signal him when to release the emergency drop weight and get a shot of that too. Everything worked fine. When the rewind gear was released upon my signal, I filmed the float as the reel unwound and it rose to the surface. Then a brief shot of it being cranked back down until the float rested against the guide. With the sub just barely negative and its bow resting on the bottom, I stretched out on the sand with the camera and focused on the 40-pound chunk of lead along the keel as Doug worked inside with a wrench, unscrewing the gland shaft. I could watch and film the weight as it slowly came down until the threads ran out and the weight plopped into the sand. After a moment of hesitation Submaray began to rise as I followed it up until the hatch surfaced. Only a few inches of the conning tower were on the surface, but the CB antenna cleared the water enough to transmit and receive OK.

Next, I had another device to test, put together at the last minute prior to the trip. A heavy vinyl sleeve, 2" in diameter and six feet long, was filled with lead shot and the ends clamped shut. Then I made a zinc plate, drilled, and tapped to match the threads of the same gland shaft used for the drop weight, and secured one end of the 'drag snake' to the zinc plate. (I used zinc because it worked easily and would also serve as an electrolysis inhibitor for the hull) The idea was to trail the snake along the bottom so that the sub would maintain a constant distance above the bottom without the pilot having to visually judge that distance and compensate for variations by use of the bow planes.

Ed Armstrong had developed the same device for Aquasub when murky water off Redondo Beach made it impossible to see the bottom from the conning tower except his snake could not be released from within Aquasub. Obviously, there was [] in a rock crevice, or otherwise becoming

fouled. For Submaray this would not be a problem, since it could be released in the same way as the 40-pound emergency drop weight. The snake also weighed about the same amount, 40 pounds.

Bart had his diving gear on and went down to secure a line to the drop weight so it could be hauled back aboard. Then he attached the threaded zinc plate by holding it in place while Doug turned the gland shalt from inside, and the snake was released to dangle in the water. I was reminded of the fact that the same principle had served balloon pilots at least a century earlier when hundreds of feet of rope were trailed along the ground, hanging from the balloon basket, keeping the craft at a more or less constant altitude.

With Doug arid Elisa in the sub and Bart and I in scuba gear, I managed to get some good footage of Submaray circling around, weaving in and out of the kelp with about 18" of the snake, trailing along the bottom or sliding over rocks. Then, some more filming as Bart hung on to the conning tower while being towed along at a good clip, I shot a roll of still photos, and this completed my schedule of events. Other than the major disappointment with the communications system, it had been a good trip. Naturally I had hoped to head for the sewer outfall job in San Diego and all that daily charter money. Now that would have to wait.

There followed a brief period during which I 'changed hats and furiously pursued the fictitious role of 'Vice President in charge of Public Relations and Sales'. Through a friendly tip I learned that the Naval Purchasing Office in Los Angeles was soliciting proposals for a 'submarine search vehicle' to be used in Enewetak Lagoon, located in the South Pacific. Details of the project were sketchy, obviously due to the classified nature of the work. However, it was fairly common knowledge the Enewetak Lagoon served as the impact area for missiles fired from various localities, some perhaps thousands of miles away. The lagoon consisted of a body of water probably ten miles in diameter with a maximum depth of less than 300 feet.

U. S. NAVY PURCHASING OFFICE
929 SOUTH BROADWAY
BOX 3090, METROPOLITAN STATION
LOS ANGELES 55, CALIFORNIA
TELEPHONE: RICHMOND 9-4711

IN REPLY REFER TO:
OS6:dc
Schedule 30719/63
Serial 5135
16 November 1962

Gentlemen:

You are invited to submit your proposals for furnishing the necessary services and materials to design, develop and fabricate an Underwater Search Vehicle in accordance with the following specifications, for delivery to the Pacific Missile Range, Point Mugu, California.

A. INTRODUCTION:

This specification describes an Underwater Search Vehicle which will search areas of the ocean bottom at depths ranging from approximately 10 to 50 fathoms. The system shall have the capability of locating objects on the ocean bottom and releasing a clump and buoy to mark the object.

B. TECHNICAL SPECIFICATIONS:

1.1 General Considerations

1.1 The minimum area over which the vehicle must be capable of maneuvering shall be 360 degrees about the "mother" ship, with a radius of 300 feet and a depth of 300 feet.

1.2 The system shall include a fathometer with a full scale accuracy of two percent on each scale. The preferred scales are 500 feet, 100 feet and 50 feet.

1.3 The vehicle shall operate in a slightly positive buoyant state or have equivalent fail-safe features.

1.4 The vehicle shall be capable of operating in the following sea condition: Wind - 13 to 18 knots, wave height - 5 to 8 feet.

1.5 The primary area for intitial use of the search vehicle is the Eniwetok Lagoon.

The bottom conditions of the Eniwetok Lagoon consist mostly of a sloping fine sand bottom with coral heads varying in size from a few feet in diameter to one mile in diameter. The large coral heads

Excerpt from the U.S. Navy Purchasing Office, Underwater Search Vehicle, Request for Quote (RFQ)

are numerous close to shore and becoming scattered to about one per every three square miles. The bottom area in the north part of the lagoon around island Mack, which is out of the recovery area, consists mostly of fine silt.

1.6 The entire system shall be capable of disassembly and reassembly without impairing the effectiveness of any system components. This will be demonstrated by the contractor in the following manner:

1.6.1 The system shall be assembled and operating at the contractor's facility at the time of preliminary inspection.

1.6.2 The system shall be disassembled and shipped to Point Mugu, Calif.

1.6.3 The system shall be assembled and operated at Point Mugu. (Note: PMR personnel shall be instructed by the contractor during this period.)

1.6.4 The system shall be disassembled and shipped to Eniwetok. (Disassembly and shipping by PMR personnel with contractor assistance.)

1.6.5 The system shall be assembled and operated satisfactorily at Eniwetok for system acceptance. (Assembly and operation by PMR personnel with contractor assistance.)

1.7 The vehicle and all systems shall be capable of operating for a minimum of 500 hours between major maintenance overhauls.

1.8 Throughout system development, operational or already qualified subsystems and components shall be used where possible without limiting or restricting overall system capabilities.

2. Alternate Bid Items Desired

Separate proposals shall be submitted for a manned vehicle and/or an unmanned vehicle in accordance with the requirements stated below.
Selection of type of vehicle to be procured may be determined by vehicle cost.

2.1 Unmanned Vehicle: Shall utilize a television system to search for articles to be recovered.

2.1.1 The television system shall be image-orthicon type or equivalent.

2.1.2 The television shall be capable of discerning objects comparable to a diver's visual acuity, or better, consistent with water conditions.

Excerpt from the U.S. Navy Purchasing Office, Underwater Search Vehicle, Request for Quote (RFQ)

OS6:dc
Sched 30719/63

I. SUBMISSION OF PROPOSAL: Your proposal should be submitted, in quadruplicate, in sufficient time to insure receipt by this office no later than 3:00 P.M. on Thursday, 27 December 1962, and should be addressed to the Officer in Charge, U. S. Navy Purchasing Office, 929 South Broadway, P. O. Box 5090, Metropolitan Station, Los Angeles 55, California, and should reference Schedule 30719/63, Attention: Code OS6.

Very truly yours,

R. I. BROWN
Contract Negotiator
By direction of the
Officer in Charge

Encls:
(1) Additional Information, Conditions & Requirements
(2) NAVEXOS 3445
(3) 11ND-NPOLA 4270/14
(4) Non-Discrimination Clause
(5) Form DD-633
(6) Late Proposals Clause

-9-

Excerpt from the U.S. Navy Purchasing Office, Underwater Search Vehicle, Request for Quote (RFQ)

The primary purpose of a submarine search vehicle would be to locate missiles on the bottom of the lagoon after splash down. The whole idea seemed such a natural for Submaray, I could hardly believe it. The first thing I did was to buy a chart of Enewetak Island. Doug and I poured over this fascinating chart until the wee hours, dreaming of crystal-clear water, over 100 feet of visibility, and how we could run search patterns to locate missiles, run up the marker buoy and thus pinpoint their recovery. I spent days preparing a proposal, stressing Submaray's functional features, but also pointing out our need for a Straza communications system, priced at a mere $3600.

The proposal offered an outright sale, with our services at so much per diem to operate Submaray or train others in its operation. I included the 'Buy American' certificate, safety factors already incorporated, detailed descriptions of instrumentation life support, surface handling characteristics, emergency escape procedures, coordination with PMP (Pacific Missile Range) personnel, airlift data for transport to Enewetak, support requirements, the accomplished drop test to 480 feet, calculations predicting a collapse depth in excess of 1000 feet, a location marking system using 'pingers' (available from Clevite, etc.), crew requirements for launching, submergence and recovery, maintenance schedule, conversion of critical components to Navy Mil Specs. , operation and maintenance manuals, and a negative opinion of any tether' type of operation. I think the latter did me in. At any rate I never heard a direct word on the outcome. Much later I learned that another submersible had been shipped there and was not altogether successful.

> It is rather ironic that Doug Privitt and Richard Slater later won a 'similar bid' with the US Department of Energy to survey the nuclear blast craters OAK and KOA on the Enewetak Atoll, Marshall Islands. From June 17 to September 20, 1984, the physiographic and subsurface effects of thermonuclear explosions were studied in two submarine craters created during nuclear testing in 1958 at Enewetak Atoll, Marshall Islands. The reason that these craters were selected was because these were the only 'surface bursts' that existed and the DOE wanted to use this information to determine if the US continental based missile silos could survive a surface burst from a Russin Missile intact.
>
> OAK crater is a large circular depression that has a maximum radius to the 5 m (16 ft) isobath of about 600 m (1 ,970 ft) and a maximum depth of 60 m (197 ft). The geometric center of the crater lies about 100 m (328 ft) southeast (lagoonward) of ground zero where the 8.9-megaton device was exploded on a barge located at the lagoonward edge of the reef in 4 m (13 ft) of water.
>
> KOA Crater crater was excavated entirely from reef rock, reef plate, and beach rock by a 1.4-megaton device mounted in a water tank on Teteiripucchi Island. Five other nuclear tests were conducted nearby including the largest (10.4 megatons) exploded in the atoll. The radius of KOA crater from ground zero to the 5 m (16 ft) isobath averages about 500 m (1,640 ft), and its maximum depth is 33 m (108 ft).

Perhaps it was just as well. Already a few hints of conflict between conventional hard hat commercial divers versus maimed submersibles had surfaced. The last thing I needed was a situation involving a direct confrontation with the established diving community. Those

practitioners jealously defended exclusive area of underwater work and had decades of experience in the art if influencing the purveyors that be. The stakes were very high, as a rough estimate I guessed that fully a quarter of all commercial diving could be accomplished at less cost by a manned

vehicle. If engineering concepts were slightly altered, it could amount to a much greater percentage, especially with work at depths in excess of 200 feet, and this, remember, was only early in 1963. At this time there was almost no competition. Cousteau's saucer, the Perry subs, and a few Sportsman subs, along with Submaray, were, for all practical purposes, the only manned UW work subs in operation in the world. We had a long road ahead. In spite of the Enewetak rejection. I still had a warm spot in my heart for the Navy. As an ex-planner & estimator I knew about the many traps encountered whenever a new and different approach is taken. Sticking one's neck out is a definite no-no.

The Navy proposal had one positive result; it improved my typing ability. About that time I began corresponding with several well-known figures in diving. One of these, E.R. Cross, had been a top-notch diver in the Los Angeles area who moved to Hawaii. He had sold his business in Wilmington and sailed his own vessel to Honolulu a few years earlier. E R. had been in the commercial diving business for a long time and was among the first to utilize scuba in his work. Our letters were chatty and honest. He knew of a projected county sewer outfall project off Honolulu and suggested writing to them direct. However, he also expressed some practical assessments of the limitations of using a sub for inspection work.

In response to an inquiry from Dr. Richard Terry of Autonetics, a division of North American Aviation, I supplied a file of photos and data on Submaray for a book he was pulling together entitled, “The Case for the Deep Submersible" North American has just started on their ill-fated Beaver program. Along with Westinghouse, they were the first of the aerospace companies to ‘get their feet wet’. Later, as his large and comprehensive book took shape, I gave Dick Terry a dive in Submaray, and it was written up in the book, although definitely not a ‘deep submersible’. There were letters from Jon Lindeberg reporting good progress on the San Diego sewer job and expressing his regrets not being able to attend my last series of dives at []

The necessity of obtaining insurance coverage raised its ugly head about this time, and batches of correspondence testified to the difficulties I would encounter for years to come in that area. I wrote to several commercial diving companies, without too much hope, describing Submaray and quoting terms in case they had a need for it. Early on I arrived at a figure of $350. per day for the sub and a crew of two, plus travel expenses. Some of the companies I wrote were in Santa Barbara, where a lot of offshore oil work was in progress, much of it in fairly deep water.

Bill Hardy, of San Diego Divers Supply, kindly advised me of an interest in Submaray by Frank Hester, a marine biologist with the U.S. Bureau of Commercial Fisheries. I wrote Mr. Hester in San Diego, including the usual data and photos. Out of all the flurry of correspondence, this would be the only one to bear fruit.

The first job came front a totally unexpected source and turned out to be the weirdest experience Submaray would ever put me through. I'd been busy with the bread-and-butter camera business and occasionally checking on the progress of the communications unit. A test of the unit in the harbor finally worked out OK, but the San Diego contractor was not ready to go ahead yet. Then one day late in February 19633, I received a slightly mysterious call from a stranger in nearby Orange County, Richard Halt. We met and he explained that he represented a group interested in the logging of submerged timber located in the Pacific Northwest. No sunken logs but standing trees in the bed of a lake formed by the construction of a dam, Iran some film of Submaray in action at Catalina and he seemed impressed. We discussed the project in some detail and later arrived at a 'meeting of the minds' in the form of a letter of agreement dated March 6,1963, "to determine the location, apparent condition, and possible methods of harvesting standing timber submerged in Ross Lake, Wash."

> This letter of-agreement between Mart Toggweiler, submarine contractor, and Mr. Richard Hall representing Dixie Enterprises, concerns a project to use a two-man submarine for the purpose of surveying the bottom area of Ross Lake, Washington state. More specifically, to determine the amount of submerged timber stands for logging purposes.

The letter signed by Dick Hall, representing Dixie Enterprises went on to delineate the terms per operating day travel expenses, plus lodging to be provided at the lake. There was a guarantee of two days' work, in eight-hour shifts, and a stipulation that crane service, handling, and a suitable surface tender vessel would be provided at no expense to me.

I explained the deal to Doug, offering him a reasonable daily rate, plus a bonus for each diving day, plus milage for the use of his Ford Ranchero. He accepted immediately, ecstatic at the prospect of participating in an adventure made possible by his creation. We lacked one item essential to a period of sustained dive in a [] a means of recharging HP air tanks. A former dive shop expense.

Bill Hogan had a two Cu. ft. gas driven Cornelius compressor for sale, and after a little dickering, I bought it. Don worked it over Some while I shaped up Submaray for the long haul. We headed for Washington on March 9th, 1963.

Dick Hall had a deal with Evans Products, a lumber company with headquarters in Portland, to back Dixie Enterprises by buying the timber rights in Ross Lake from the Seattle Power and Light Co. provided sufficient proof of the timber's existence and a practical method of recovering said timber, could be ascertained. The purchase of cutting rights to standing timber in open country was expensive. However, the rights to log trees still standing beneath the waters of Ross Lake would be relatively inexpensive. When the dam was constructed several years earlier, logging operations were under way. However, it was decided to go ahead and flood the valley rather than wait for all the logging to be completed. They needed the power and could not delay certain phases of construction which required the presence of water behind the dam. As the water rose to within about fifty feet of its maximum height, crews of men in boats cut off the tops of most of the exposed trees. This was also to be a recreational area eventually, and there were some places where the tops of trees came very close to the surface, presenting a hazard to boating. Seattle Power and Light therefore had another incentive, perhaps more important than the money from cutting rights, to get the trees out of the lake. Harvesting all that cheap timber was the objective of Dixie Enterprise, and potentially could run to millions of dollars. A few trees had already been blasted up by divers and the quality of the wood seemed good.

Three days of driving and about four blowouts on the unsprung trailer supporting Submaray, got us to Portland where we received detailed instructions on making our approach to Ross Lake. A more remote area can scarcely be imagined. Almost 100 miles Nort east of Seattle, in the Cascade National Park, the lake showed on the map as a long, narrow body of water extending 26 miles downward from Ross dam penetrating into Canada a short distance. Three miles below Ross dam was another dam, Diablo. We were to rendezvous with Dick Hall and his party in the

village of Diablo, near the base of that dam, where Seattle Power & Light would provide quarters for the night.

Passing through Seattle and cutting east at Burlington, we soon reached the long stretch of road running parallel to the Skagit river. Wide at first, the Skagit narrowed to a swift running stream about 100 yards wide with the road on its west bank. This was water from Ross Lake, and we grew a little apprehensive at how murky and cold it seemed. Dick Hall had said the water in the lake was 'crystal clear'. I had already discounted that description somewhat, knowing how a non-diver is often deceived by the fact that pebbles can be seen along a shore through 3 or 4 feet of water and might apply the term 'crystal clear' on that basis. We needed a minimum visibility of between 15 and 20 feet to operate with any degree of safety, and what might appear sharp and clear through four feet of water could easily fade out entirely at 15 feet, especially in still, fresh water, where the presence of some algae could certainly be expected.

As we approached Diablo in the late afternoon the road climbed perceptibly toward the mountains beyond, and tall, stands of fir and pine lined the road. The branches in the upper portions of these trees sloped downward at a sharp angle, nature’s way of shedding the weight of a heavy snowfall. As the light diminished, the descending branches stood out in stark relief against the sky, and I realized what it would be like to cruise beneath those limbs in the sub. They would be like fishhooks, waiting to trap us, during any attempt to surface within them. As I remarked to Doug: “It could be a one-way ticket to the bottom." He replied, "Ahh, don't worry about it”. Good ol’ Doug, the eternal optimist. As for me, the chill was not only in the darkening evening.

Nightfall came early in these latitudes and as we pulled int the village the darkness made it difficult to follow direction, but after a few wrong turns, we found the barracks-like building Seattle Power had provided for their construction

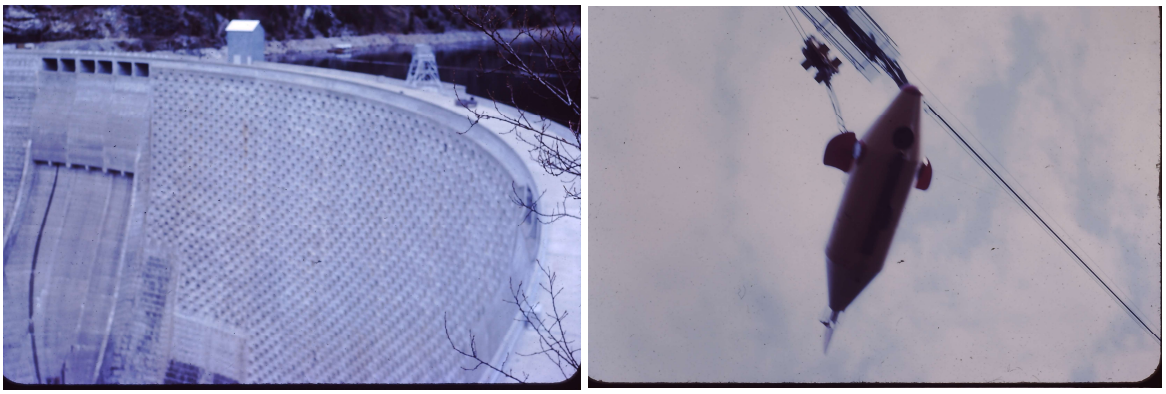
and maintenance workers. We met Dick Hall with his associate and enjoyed a hearty dinner whipped up by the resident cook. The rooms were austere but comfortably warm and we turned in shortly after dinner, for it would be a very early start in the morning. Doug and I had at least one thing in common; an aversion to getting up early which would forever plague us in the field of operations. At 5.30 AM, with daylight still about two hours away, the inevitable banging on the door interrupted our period of soundest sleep. The breakfast was unbelievable. A noisy, cheerful gang of lumbermen forked down huge servings of pancakes, fruit, eggs, bacon, sausage, and coffee while we tried to keep our eyes open and plan the schedule ahead.

Alter breakfast the rest of the crew departed in pick-ups and four-wheel drive vehicles to take the steep, winding dirt road leading to the top of Ross dam, a road in poor repair and much too risky to tow the sub over. Dick Hall accompanied Doug and I in the ranchero to the base of Diablo dam, where an inclined cable railway on the face of the dam would lift us to the top. I drove the car and trailer on to a level wooden platform at the base of the lift, and we were pulled sideways up the 400-foot high, 70-degree slope, to a ramp at the top, then drove to a clearing on the bank of Diablo Lake where a mobile crane awaited. Shortly a small but powerful tugboat pulled alongside the bank and the crane lifted Submaray aboard, still on its trailer. Doug drove the ranchero containing our support gear up the jeep road while Dick and I boarded the tug and lashed down the sub with chains for the three-mile voyage upstream to the base of Ross dam. As the tug moved up Diablo Lake the scenery changed to spectacular cliffs, forming a narrow gorge and the lake became a river with rapids as the skipper skillfully stayed within a slender deep water channel winding upstream.

Soon a roar of cascading water drowned out the tug's engine and we rounded a point into the basin at the foot of the dam. The din was deafening, and I wondered how we could possibly make an approach through turbulence so strong that huge whirlpools formed at the base of the spillways. Within minutes however, the basin had calmed down to a relatively gentle flow. The tug skipper had radioed

our arrival and the huge gates controlling the flow of water through the generators and down the spillways were closed. Now the tug maneuvered to a spot very close to the dam and a large, heavy hook descended, seemingly from out of the sky. From the deck of the tug, looking straight up, I could barely make out a trolley assembly, suspended from a cable stretching diagonally across the canyon.

Dick Hall casually suggested that we ride in the sub, explaining that it was the fastest way up for us. Wide awake now, I grabbed my camera realizing the fantastic photographic opportunities afforded by this event. Dick said he preferred to squat on the deck, holding on to the sling, so I climbed into the sub, standing in the conning tower to attach the crane hook. Upon a radio signal from the skipper of the tug, the unseen high line operator lifted us, trailer and all, off the deck and we began a smooth ascent. With the 16mm Bolex I shot straight up against the waffle iron pattern of the face of the dam, then down at the receding tug below. It was eerie, but not frightening, except for the wind. As we arose it became a blast of icy air and 1 ducked down to rewind the camera while Dick hung on grimly. I admired his guts. Cautiously leaning over the side of the conning tower, I shot straight down again, filming all of the basin area, with a tiny tug boat in the middle, 450 feet below.



Raising Submaray up the face of the Ross Lake dam

Within minutes we were over the top of Ross dam, our descent delicately controlled by a rigger speaking into a handheld phone. The trailer wheels touched down and I silently voiced a 'well clone' to the unseen high line operator. It had been the most bizarre ride I would ever experience in Submaray.

While waiting for Doug to arrive with the support gear I removed the turnbuckle holding the sub in its trailer cradle, opened the hatch and looked things over. The bottom outside port had a few nicks from road gravel and bouncing rocks suffered during the 1500-mile trip, but otherwise everything appeared fine. There ad been one important new instrument installed just prior to the trip, From Ross Laboratories in Seattle, I had purchased a combination flasher and recording type depth sounder and I hoped the sounder would pick up traces of treetops or other objects

beneath the sub as we passed over them, indicating their distance.

The sounder's transducer was attached to the removeable hand hole plate in the bottom of the aft ballast tank, so it aimed straight down. The coaxial cable from the transducer led inside the ballast tank and entered the main hull through a packing gland in the tank head and from that point was clipped to the inside of the hull at intervals, ending in a standard coaxial connector adjacent to the observer's 'nest'.

Doug arrived and we began transferring all the lead weights, tanks, CO_2 scrubber, tools and all the other paraphernalia into its proper place in Submaray. Practically everything portable had been removed in order to lighten the load on the trailer wheels, and also to prevent loose objects from bouncing around when traveling over rough roads. With the sub back in proper ballast, the high line operator lifted it off the trailer and lowered it gently into the water behind the darn. This was Submaray's first baptism in fresh water. I climbed in and powered all around on the surface for a few minutes before bringing it smartly alongside the dock to impress the small group watching from atop the darn. A small tug named Skagit, identical to the one which had brought Submaray up Diablo, pulled in and tied up. The Skagit would be our surface tender during operations.

The tug boat Skagit, the surface tender for Submaray and underway to the dive site

Since we had a few hours of daylight left, Dick Hall suggested a test dive to which I agreed, so we all boarded the Skagit and towed the Sub up the lake to an inlet three or four miles north of the dam on the east bank. We had a contour chart of the former valley, now the lake bottom, and this showed an area not too deep and far enough from the dam to be still water, free of any current flow. Doug and went through our routine dive preparations and cast off the lines close to shore. After checking out the CB radio and setting the gyro, I opened the vent valves, and we began to submerge. Watching closely, I noticed some acceleration in the flooding process as the surface closed over the hatch port a few seconds before bubbles stopped escaping from the vent valves. We were too heavy, but I let it go until Doug yelled "ROCKS" and then I got a glimpse of what appeared to be a cliff sliding up rather

fast on the starboard side. It could not have been more than ten or twelve feet away. We were dropping down a former waterfall and picking up speed. Hastily I closed the Vent valves and reached for the HP air valves to arrest our descent.

Momentum carried us to about 75 feet down and 1 could have reached out and touched the rocks before we stopped our plunge. By careful manipulation of the valves, I managed to bring the sub to near neutral buoyancy. Our main object was to determine water visibility, and by making a couple of turns, it seemed to be between 15 and 20 feet, right on the margin of safe operation, at least in these circumstances. We also noted that at 75 feet the light faded considerably. The sounder showed a clutter of targets below and at various distances, so I set a course by the gyro away from the cliff, and planed up, surfacing well out from our original point of descent.

Back on the Skagit we all held a briefing, with me acknowledging my miscalculation of the difference in density between salt and fresh water. Fresh water has a specific gravity of 62.43 pounds per cubic ft., - salt water is 64.30, thus the approximately 52 cubic feet of Submaray's displacement amounted to a differential of about 100 pounds less buoyancy in fresh water. Not bothering to sit. down and calculate this formula, 1 had simply guessed and ballasted about 30 pounds too heavy. Still, it had been a useful dive and no harm done, except to Doug's nerves, It was one of the few times I ever saw him slightly flapped watching that rocky cliff slide up at close range.

We called it a day and Skagit towed the sub back to a floating log camp, not far from the dam, on the east side. The camp consisted of a series of wooden buildings containing barracks, a cook house, workshops, and storage shacks, all supported by huge logs lashed together by cables, close to shore, but designed to accommodate variations in the level of the lake amounting to as much as 50 feet.

With electric power available, we hooked up the charger to top off the sub’s batteries. As in Diablo, a residence cook prepared a substantial meal for all.

The elevation of the lake was only a little over 1500 feet above sea level,

but we could see plenty of snow on the surrounding mountains. A huge wood burning potbellied stove kept the barracks warm, but when we turned in on individual cots, the fire was allowed to go out. I awoke with chattering teeth a few hours later and piled a couple of blankets over my sleeping bag. The damp, cold air from the lake seemed to penetrate everything.

I almost welcomed the six O'clock call, ringing out on the traditional steel triangle. Even Doug, although years younger than I, complained about the cold as we huddled around the freshly started fire, warming socks and piling on all the clothes we had brought along. After breakfast I climbed in the sub, basking in the warmth generated by the charger resting on the pilot's seat during the night. We were ready for Submaray's very first working day amid the trees of Ross Lake.

Despite the cold, the scenic beauty of the lake was magnificent. Other than the dam itself, and the log camp, nothing of man's creation could be seen. As we moved northward aboard Skagit, through the early morning mist clinging to the glassy surface of the lake, a ring of snowcapped mountains, reaching a height of 9000 feet surrounded the banks on both sides. As far as the eye could see, forests of evergreen trees covered the terrain, sloping up to the timber hue thousands of feet above. It was as though the lake had existed forever.

Dixie Enterprises (what an incongruous name!) had done some research on the pre-dam logging activity, and determined certain areas where the timber was supposedly untouched, so we proceeded to one of these spots about six miles north of the dam. By any standards, this had to be relatively high-risk diving. The depth of the lake exceeded 400 feet and presented several unknown factors. But I could not insist that one of the group go down in the Sub with me, leaving Doug topside, and there were no volunteers.

Doug had brought along a musty old quilt which he used to form a kind of nest in the bow, thus providing him with some comfort during dives. Running

parallel to the, shore at a depth of about 65 feet, both of us stared out of alternating ports, swiveling our heads from side to side, looking for trees. We spent an hour, running a fairly straight course by the gyro, without seeing a thing except pea green water. The second dive was back along the same route, at the same depth, but closer to shore. After a few minutes we both got a glimpse of a dark grey tree trunk looming above us. I turned off the power. gliding along, and clearly saw the top of another tree, about two feet in diameter, sliced off neatly by a chain saw. The cut looked as if it had been made yesterday. I tried to circle, but we were in the midst of a thicket of trees and as the stern moved around, it bounced off one of them. I headed out a little deeper and we saw nothing for several minutes, then suddenly a huge tree loomed ahead, directly in the path of Submaray, with no hope of swinging around it. We rammed into it with a frightening thud, bouncing back slightly. Rounding the tree and resuming course, we traveled a short distance and slammed into another tree trunk, with the starboard bow plane taking the blow. Looking downward, Doug kept reporting other trees, some with branches, as we proceeded through the submerged forest. I began to see some trees with limbs above us and felt a twinge of apprehension as they passed overhead. It was impossible to dodge anything because of the limited water visibility. I had to maintain headway by switching power on and off in order to retain some measure of control. Finl1y, one large tree limb swept in, just above the deck, striking the front conning tower port inches in front of my eyes, and stopping us dead. I had been operating with slightly positive buoyancy, using the bow planes to maintain depth. Now we hung there, trapped by a 6" branch lying across the top of the forward deck. I backed off, praying there was nothing behind, and managed to get clear. Doug was elated that we had finally found the forest, and when I expressed some doubts about the sanity of our mission, he gave his standard reply, "Ahh don't worry about it". However, I figured we had proved a point. The trees were there all right, and in abundance. So, I prudently edged out to deeper water to put the remaining 15 minutes of our scheduled one-hour dive, then surfaced.

As Skagit plowed over to where we lay on the surface, I reflected on the procedural conditions, of the []

was the enemy, usually rough and dangerous, especially while entering or leaving the sub, but once below, there was little to fear. (at least from my experience so far) Here the surface scarcely contained a ripple, and I could stand in the open conning tower, breathing unbelievably fresh air, while in the water below, there lurked all kinds of entanglements.

The group on board Skagit were delighted to hear of our tree sightings and marked the location of our traverse on their chart. After a brief lunch break and replacing one partially empty air tank with a full one, Doug and I made three more dives in various locations, some as deep as 100 feet, where the light faded out almost completely. Only one dive turned up any trees and the sun had passed behind a mountain so we headed for the log camp, where the battery charger and air compressor were put to work.

After dinner, Dick Hall took me aside and suggested some kind of dramatic act for tomorrow, perhaps go all the way to the bottom. He felt something of the sort was necessary to get the project off 'dead center' as he put it. I could see his point all right, but for my part, staring through the ports at a dim, sickly green haze hour after hour, bumping into trees at 80 feet, was dramatic enough for me. I promised nothing, realizing that the sub was merely a pawn in a much larger scheme, and I was keenly aware there was no future in getting hung up on the bottom of the lake, staring up at all those lovely, valuable trees with sightless eyes. When I told Dick that the sun barely penetrated to 100 feet, he again brought up the subject of lights. Patiently I tried to explain that the only way to see anything in that murky water was to have a dark object in the foreground, silhouetted against a lighter background. A powerful light in dirty water simply bounces off the suspended particles, projecting a hopeless glare back into the eyes of the viewer. A divers light used in these conditions would light up objects three or four feet away at the most, regardless of the candle power. It is very difficult to conceive non-divers (and even some divers) of the facts concerning UW visibility. Dick was no exception, but I stood firm against trying to install exterior lighting []

down, knowing it would be a useless gesture.

In the morning the first dive proved unproductive, however, during the dive a small boat had delivered another visitor named Bob Rasmussen Bob was a logger employed by Evans Products, and he would replace Doug as the observer for the balance of the day. In order to ensure that he would see enough trees to form some evaluation of their condition, we dove in the same place where Doug and I had cruised the forest during the previous days second dive. Again, Submaray bumped its way among the trees and Bob got a good idea of what conditions were like. I was grateful for having an impartial observer confirm my reports of previous dives.

It all seemed so hopeless. Sure, we saw a few trees, but any accurate survey of their density, height, condition of bark at the base, etc. was out of the question. There was no way we could get down to the base of the trees with any degree of safety. In spite of the general feeling of frustration, Bob and I made three more dives, spotting some more of the standing timber so coveted by my employer. Throughout what must have been a somewhat frightening experience, Bob remained cool, admitting to some apprehension, but that was all. However, it seemed pointless to continue.

The partners of Dixie Enterprises were disappointed, but undaunted. They discussed several ideas like sending a diver down to secure a cable to the tree trunk near the top and yanking them out by the roots with a kind of floating dry dock. Or making a massive robot with huge hydraulic jaws to be lowered to the base of a tree and cut it off. To me both these proposals seemed impractical and vastly expensive. In spite of the gloom, they all agreed we had done the best we could with the sub, within reason. I handed over the chart paper from the sounder, recording each dive and marked with its location. These would have some value when transferred to the general chart of the lake.

Back at the dam Doug and I packed all the gear into his Ranchero and the transport of Submaray proceeded efficiently, retracing the route taken on the way up,

the high line lowered the sub, without passengers this time, to the deck of the tug, and by early evening we all regrouped at the bunkhouse in Diablo. We spent the night there. showing my 16mm film of Submaray to a small but fascinated audience after dinner. The next day we got off to all early start and headed home, stopping for a pre-arranged and pleasant lunch near Portland with Will Ritchie, an executive from Evans Products. Mr. Ritchie was very keen on hearing our firsthand account of the venture and wanted to be certain I had been adequately paid. I assured him that the financial arrangement had been satisfactory and promised to send him a print of all movie footage taken.

Doug and I had an uneventful trip home, except for one police car, sirens wailing and lights blinking, pulling us over to the side of the road. It turned out the officers were merely curious and just wanted to take a look inside the sub. Two days later we were home, with all gear intact and undamaged. We had been gone eleven days and the size of the fee would never make me rich, but I came out with a few dollars ahead. A modest start. About two weeks later I received a call from Dick Hall his group had stayed on at the lake and had hired a Seattle diver, Tommy Amerman, to bring up a few trees, using explosives, for sampling in in one Evans Products lumber mills. Amerman would wrap gelatinite around the trunk, near its base, then surface with the detonating wire. Some of the trees were sinkers, but most floated. During this operation he made five bounce dives in one day to depths averaging 180 feet, and on the last dive, came up badly bent. In agony, he was transported to Seattle, but the unexpected emergency met with many delays, and it was the next day before he finally reached a recompression chamber, close to death.

According to Dick Hall Amerman was still critical, most of his body paralyzed, and the doctors prognosis indicated he would be crippled for life. A terrible price to pay for a few trees, which turned out to be unsuitable for ‘peelers’ (plywood quality) after all.

During the Washington trip, a number of calls had come in regarding all kinds of projects, but the most important concerned the San Diego sewer job. They were ready for a try at using the sub. I checked on the communications unit, and it had been improved to the point where they were sure the system would perform. With a series of phone calls, arrangements were made, and I worked long hours installing lights and servicing Submaray for more work. Only two days after returning from Ross Lake, Doug and I were on the road again, this time heading south, elated at the prospect of really getting our teeth into a solid job.

Arriving at Harbor Island, along San Diego Bay, in late afternoon, we launched the sub at a dockside crane in preparation for a tow to the offshore sewer job site in the morning. Jon Lindbergh dropped by after dark and suggested a test dive alongside the dock. I believe he wanted to be certain the sub could perform before committing the construction company to the expense of towing us out and possibly delaying the project. The brief dive went well, although I could not maneuver on the bottom because of the extremely dirty water. Doug and I talked clearly to Jon on the dock, with the ultra-sonic communication, and switched on the new lights for a brilliant display, lighting up the green water for many feet around the dock. I had mounted 30-volt Sylvania Sun Gun lamps, in small reflectors, under each bow plane. Although only 24 volts could be supplied from the sub's battery pack, the lights were quite intense, producing 250 watts each. Jon seemed satisfied, so we locked the hatch and left the sub in the water overnight.

The following morning a strong southeast wind buffeted the car as we drove to the dock. A storm had come up during the night and the project was postponed. Alter getting the sub back on its trailer, we hauled it to the staging area where the construction company had stored dozens of sections of concrete pipe, nine feet in diameter and twenty-four feet long, each weighing sixteen tons. It was fascinating to see these huge pipes and visualize the problems involved in laying them on the ocean floor, 200 feet down. A former Navy LST, over 300 feet long, had been equipped with a custom-built assembly on one side to lower the pipes

very precisely, while tied to a four-point mooring, so that each section would land within inches of the previous section, then rammed home with hydraulic jacks, operated from the deck of the LST. At the time it was the largest and deepest sewer outfall project ever attempted and received worldwide attention from the construction industry.

By early afternoon the weather had worsened, and reports indicated full gale conditions for at least two days. After consulting with Jake Case, the superintendent of San Diego Constructors, it was decided that we would leave the sub and return after the storm abated. Somewhat deflated, Doug and I drove home to Long Beach to wait until we were called back. As it turned out, the storm developed into the worst in years. Even the LST had to drop its moorings and seek shelter in port, and it was five days before I received a call to return to San Diego.

As before, we made the trip down the coast in late afternoon, launched the sub and turned in for The night. Early in the AM a tugboat, supplied by San Diego Constructors, towed Submaray to the work site off Pt. Loma where we transferred to a small diving barge tied alongside the LST. The tug left. for other duties. Lindbergh introduced us to Kenny Knott, the master diver in charge of underwater operations. The reception was a trifle cool, understandably so, since his divers stood to lose a lot of work if the sub proved successful.

Due to the circumstances, I decided to make the first dive alone, leaving Doug topside to control handling on the surface and relay instructions. Also, there would also be no need for an observer, since a better view of the pipe joining operation would almost certainly be coming from the conning tower ports. With extra ballasting aboard, I ran Submaray to a point inshore and away from the LST mooring cables, submerging directly over the pipe from instructions given over the CB radio. After carefully setting the gyro, I then planed down in a port ward direction, perpendicular to the pipe, until touching a flat sand bottom at about 190 feet. Making a 180-degree turn, I ran south until the rock pile supporting the pipe []. The light was dim but water visibility

good, and the pipe seemed gigantic as I made a 90 degree turn and sat alongside it to check communications. Pushing the mike button, I reported my position and depth and awaited an answer. Clear as a bell came the reply, "your signal garbled, repeat, your transmission not understood" I sat there stunned at the impact of those words. I tried again and again while tightening the cable connectors, hoping it was merely a loose connection, but only getting the same clear reply. Finally, I recognized Doug's voice suggesting a crude simple yes or no signal. Since they could easily make out the carrier signal each time I hit the mike button, I managed to convey that I was OK and that their transmissions came through loud and clear. Meanwhile I had run the sub offshore along the pipe. Kenny Knott came back suggesting that I surface so they could resume operations with a hard hat diver standing by, (no doubt praying for failure) I hated to surface and kept on following the pipe for a few minutes until I saw a tremendous glow ahead, and there was the lowering assembly, lit up like a Christmas tree by multiple high intensity lights. In spite of urgent appeals to surface, I couldn't resist moving closer to the base of the assembly at 205 feet. There I sat for two long minutes contemplating what might have been if only my transmission had been readable topside. Although the visibility had decreased due to silt stirred up by the cradle assembly, I could still easily make out the end of the pipe and the structure supporting the next section of pipe. Only a few minutes had elapsed, and I hated to accept defeat, but reluctantly turned Submaray inshore, signaling with the mike button that I would surface shortly. After moving a couple of hundred feet to get in the clear, I blew a little ballast and left the bottom, the pipe dropping away along with all my hopes. The dive had tasted exactly thirty minutes.

Back aboard the LST, I was given a curt lecture about the cost per hour of this operation and told to stay out of the way until the tug could return to take us into port. 1 could hardly blame them. We had failed and San Diego Constructor had lost some time and money as a result. Doug carefully checked the unit over but could find nothing wrong from a simple visual inspection. Disassembling the unit was out of the question, it was purposely put together so that special tools were required to open

up that dastardly geld cylinder, and besides, I had promised not to. The secrets within were safe. Infuriated by frustration, I worked off some of it by tossing out 400 pounds of lead ballast to my subdued associate. Then Doug and I sat around glumly for two hours until the tug arrived and hauled us back to Harbor Island.

Upon our return to Long Beach, I delivered the units to Bob Farnum. I had agreed to an informal lease agreement for the use of the units, which of course was now null and void. A few days later Larry, the electronics man, called to tell me that the transmitter transducer had leaked a few drops of water, enough to upset the delicate ultra-sonic frequency. A minor mechanical, not electronic, failure had blown the whole deal. It was easily corrected, so I wrote Jake Case describing the dive in detail and our subsequent solution of the problem, but there was no second chance. Indeed, I had been very fortunate to have been given one chance through the influence of Jon Lindbergh and Jake Case. For that I was grateful, and I regretted letting them down.

There is an old saying among commercial divers, "No one is going to pay you for making bubbles", and the same maxim applies to a sub. Just to be able to submerge, cruise along the bottom, look around a little and get back up, is not enough to justify a customer paying $350 per day plus expenses. Neither are they going to pay for a 'learning period' or experiments with hardware. From now on I would have to be more certain of performing adequately before expecting payment for services rendered.

There is an epilog to the story. Many weeks later I saw an article in one of the trade journals describing in detail how San Diego Constructors had so1ved the problem of using high cost divers in laying the deep water interceptor legs of the sewer pipe A chamber had been built (looking suspiciously like the bare bones hull of Submaray) and attached to the lowering assembly so that a man in the chamber could observe the positioning of the pipe sections and report maneuvering instructions over a telephone cable to the LST above. I wondered how long that simple and fairly obvious solution had been []

The Spring of 1963 slipped by without much further activity on the submarine frontier. A Mr. Norman Harvey, owner of an import-export business in Los Angeles, contacted me during March regarding a small one-man dry sub made in West Germany called the Delphin, which he hoped to distribute in the U.S. Along with an impressive list of many accessories (total retail price was proposed at less than $1500) an interesting brochure but obviously printed in Germany accompanied Mr. Harvey's covering letter. 1 quote verbatim:

> “The Sport Submarine for Different Kinds of Use, "DELPHIN° for sport-diving, sport-fishing, as a lifeboat, for use in the line of research, for shipbuilding, for inspection of bridge-pillars, water streets and harbors. But also, as a satellite-boat with unlimited possibilities of use it can be of good service."
>
> "DELPHIN" makes you independent of water temperature and gives protection against many kinds of hindering under water by its glass fiber body. In the "DELPHIN" you can drive on or under water wearing any normal suit even an evening dress. The plastic top gives the driver a good observation. Making pictures and even motion pictures on difficult objects is easily possible and without any special outfit. If wanted you may have the "DELPHIN" with installed harpoon as per your special instruction."
>
> For use in public service, for instance inspection of urban canalization, the "DELPHIN” gives best protection against drowning if sudden cloudbursts occur. For this kind of use the glass fiber top is protected by iron profiles.
>
> Two “DELPHINS" can be connected as a unit in a simple manner. By this you will get a so-caI1ed "two-seater" which can be used for training. Two boats can as well be changed into a swimming island. (?)
>
> You can even leave the "two-seater" under water by means of diving equipment. In this case the second boat will be delivered without motor or batteries. After settling your tasks under water, you can get in again, close the top and press the water out of the boat by means of pressed air.”
>
> It goes about saying the possibilities of using the “DELPHIN” are []

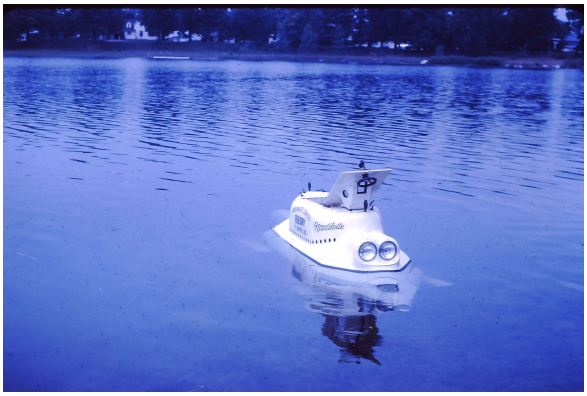
boat to be fitted for any individual purpose" (end of quote)

Photos showed the Delphin resting on a trailer for towing, and also on top of a small sedan. (it weighed about 500 pounds) I marveled at the sheer audacity of the German builder in trying to crack the U.S. market with such a crack-pot product brochure, and tried to convey that impression to Mr. Harvey. But he had been to Germany and seen the sub at a trade show and thought Delphin had great possibilities. He planned to have a demonstrator shipped over and I agreed to have a look at it upon arrival. That was that, but I was to hear much more from Norman Harvey later.

The Sportsman Sub was still in business, having come out with a second design, a single conning tower model capable of reaching 600 feet. American Submarine Co. ads appeared in several magazines during this period, but by the end of '63 it ended. A mass market, or even a modest one, simply did not exist.

Meanwhile, John Perry of West Palm Beach, Fla. was busily promoting the Perry Cubmarine. The publisher of several newspapers, Mr. Perry easily obtained lots of publicity and a vast amount of interest but was not having much luck in trying to sell them. However, he stayed with it, opening a good-sized shop on the waterfront, and eventually became the only successful submersible builder of any importance in this country.

No account of the submarine situation at this time would be complete without mentioning the Annual Submarine Rodeo at Pleasant Lake, Indiana, an event dreamed up by B.L. Dickman, owner of a huge multi-passenger monstrosity named The Goldfish. Sub owners from around the country converged on Pleasant Lake briefly each summer to dive in the thirty-foot-deep lake and swap tales. Doug and Ed Armstrong had been there with Aquasub one summer and had a ball. No one took the rodeo too seriously, -it was just an eye-popping fun thing. A get together for sub freaks. I think it would be great to reestablish something like it again. Perhaps a submarine jamboree at Catalina.




The Goldfish, Nautilette and unknown submarine at the Submarine Rodeo at Pleasant Lake, Indiana

Also, this time the Navy also had a high speed two man sub operating in

California called the Moray TV-IA. Thirty-three feet long and weighing ten tons, it had a top speed of over sixteen knots, powered by a bank of 240 silver zinc cells driving a 95 HP motor. There were no ports for viewing arid the pilot 'flew blind' on instruments only, just like a large military type sub. It must have been great fun tooling around in that exotic machine. After the San Diego fiasco, and during the month of April, there were a few minor improvements made to the sub. The old steel bow plane bolts and hinge pins were changed to stainless, and polypropylene line substituted for the nylon parachute cord due to its buoyancy. The inside of the ballast tanks showed some corrosion, so I managed to wire brush, prime, and paint those areas through the bottom access openings. The plywood rudder, which had become worn and waterlogged, I replaced with 1/8" sheet steel.

Doug had returned to his job at the tool and die shop, but after a month ‘on the beach' we became a little restless. So, the first weekend in May, the four of us, Elisa, Doug and his wife, Jaunita, and I took off for Catalina with the sub in tow. During the charter years in the 50's I had anchored Maray many times in the Goat Harbor-Twin locks area with a load of divers aboard, and I wanted to see what it looked like in the deeper parts of that cove, and off the point.

I took Jaunita down for her first submarine dive, cruising along the steep drop off between Goat Harbor and Twin Rocks, then down to where the rocky cliff merged with gently sloping sand bottom at 85 feet. This was jewfish territory and several of these big fish, also known as black sea bass, had been speared here by divers. Going deeper, we came to a large saucer shaped depression in the bottom, and there were at least six of these giant fish, some over 200 pounds, milling around the center of this strange crater. I eased the sub over the lip and stopped momentarily, watching those fat beauties swimming in slow circles, apparently unaware of our presence. (could it have been a kind of breeding ground?) Applying power, I lifted off the bottom and flew directly over the school, watching closely as they warily moved aside. One pair lagged behind and as the sub approached to within a few feet, they suddenly took off in a swirl of sand, their broad fins beating the water, generating a sudden and violent burst to speed. It was one of many missed photographic opportunities.

Inexplicably I had left my cameras aboard Maray.

This was a fun excursion - a rare occasion with nothing to test or record. I had made a bracket to secure the 16mm K-100 camera above the bow, (in a housing of course) with a triggering cable running to one of my standard camera controls cemented to a conning tower port. From inside the sub I could start or stop the camera. On the surface the bracket could be tilted up or down, and during the next dive I took footage of the bottom sliding by under the bow of Submaray and while gliding through a sparse patch of tall kelp. It was all very relaxed, with no pressure to accomplish any specific goals - just fun dives. The four of us made at least two dives each for a total of five dives for the day.

It would be nice to report here that Doug and I then donned scuba gear and bagged lobster and abalone for a delicious evening meal. The fact of the matter is, Doug could barely dive, and was a poor swimmer. As for myself, the sub had spoiled me for sport diving, it was just too much work and the cold water made it dammed uncomfortable. We headed for Avalon and had a delicious dinner at the Flying Yachtsman.

I had previously told Bob Farnum that we would be in Avalon Sunday morning in case they wanted to test the communication units again, and sure enough, Bill Jackson (the IBM man) arrived on one of the early amphibian flights, lugging a bag containing two units. For the sake of accuracy, perhaps I should have mentioned earlier that these units had been designed basically as a diver-to-diver system with the cylinders clamped to scuba tanks. The partners rightly felt that the most profitable market would be the military divers, where a high price would not be a deterrent to sales if good, reliable, long range voice communication device could be provided. (The system was designed to meet Navy Mil Specs.)

We attached one of the units to the specially made brackets bolted to the conning tower and plugged in the microphone and earphone connections. The other was simply dragged in the water a few feet below the surface with a []

to the cylinder. I towed Submaray a short distance off Lovers Cove and Doug took the sub clown with Bill as a passenger while Maray drifted on a dead calm surface. The two-way conversation went well until the sub reached about 150 feet, then became garbled at both ends. I ran the boat in slow circles without any improvement. This time it had to be an electronic failure.

Doug surfaced and Bill emerged from the sub with a long face. He thanked us for our cooperation, packed up the units and I ran Maray in to the pier for his flight back to Long Beach. There were no further attempts at tests as far as I know, and I believe the partners eventually gave up on the project. It would be almost a year before I finally managed to succeed in getting Submaray equipped with underwater communications.

By noon we were anchored off Pebbly Beach, about a mile east of Avalon. Al Hanson, a longtime resident of Avalon who operated the mooring service there, had described a curious mystery to me at some time in the past. He had found the end of a large chain while working on a sewer pipe outfall for the city. The chain led down a steep slope near the quarry adjacent to Pebbly Beach, and Al followed it down to almost 200 feet before giving it up. Old timers in Avalon thought it might be the anchor chain from a large barge which sank during a storm many years earlier, loaded with rock from the quarry.

While the girls sunned themselves on deck, Doug and I took the sub down at a point just offshore from where the sewer pipe entered the water. The kelp was thick and it took a while to find the pipe, with Doug spotting it first through the lower port, The sea floor sloped down at a steep angle and the tail of Submaray dragged bottom as I tried to stay alongside the descending pipe, but near it's end we found the chain with chain links at least 10” long. I let water into the trim tank, making the sub heavier, in an effort to stay close while following the meandering chain. The slope was so steep the water on the downside appeared dark, and I thought for a second it could be the barge. Half sliding, half powering down the escarpment

we came upon a confused pile of the chain links and could not find any continuity to follow. The depth was well over 200 feet, and I hesitated at going deeper. After a few circles we gave it up. If there was a barge down there, the chain must have entered the sandy bottom and continued on down the slope. On the other hand, perhaps there is no barge, and the chain simply ends in the heap we saw. In any case the mystery remains unsolved.

Around the middle of May, Norman Harvey called to suggest a meeting concerning a large project he had stumbled into. I drove to Los Angeles and listened to his story with fascinated attention. Through a friend working at the U.S. Consulate in Venezuela he had learned of a pending government contract to lay 2700 feet of 24" diameter steel sewer pipe off the coast near Caracas. The prime contract would almost certainly be awarded to a Venezuelan diving company, C.A. Vosica, with headquarters in Caracas. This company desired the services of a competent American diving group, using advanced techniques due to the maximum depth of 200 feet. Most of their own divers had worked only in Lake Maracaibo, where depth' rarely exceeded 50 feet.

Mr. Harvey had done some previous business with Vosica and knew the director. If we could form a company, gather together a few top-notch divers and submit a fair bid, he was sure the director would award us the sub-contract for the underwater portion of the job. Submaray would not be essential but might prove useful during the work. Within two weeks I had registered a new company with the county of Los Angeles under the fictious name of Hydrotech and signed an agreement with Norman Harvey naming him as the exclusive foreign representative for all future Hydrotech business. Meanwhile Norman got off a few telegrams to Caracas and obtained a set of blueprints and specifications for the project. I looked them over and it felt like my old days as a planner and estimator except that the plans and specs were in Spanish. However, the was no problem since Elise could translate every word, even though the overall picture was beyond her grasp.

After I had a working knowledge of the plans, I called in Dick Anderson, offering him the job of diving supervisor. He would be delighted to participate but suggested Al Hanson as our superintendent and dive master. Al had a lot of commercial diving experience and would be better qualified to ensure efficient completion of the job. I agreed, and got Al interested in the operation, which by this time had progressed to the point where Norman insisted, we take steps to obtain passports and visas. My estimate for the sub-contract work came to S40,000. and I drew up a detailed bid to complete the underwater part of the project for that figure. All materials, including the pipe, were to be provided by C.A. Vosica.

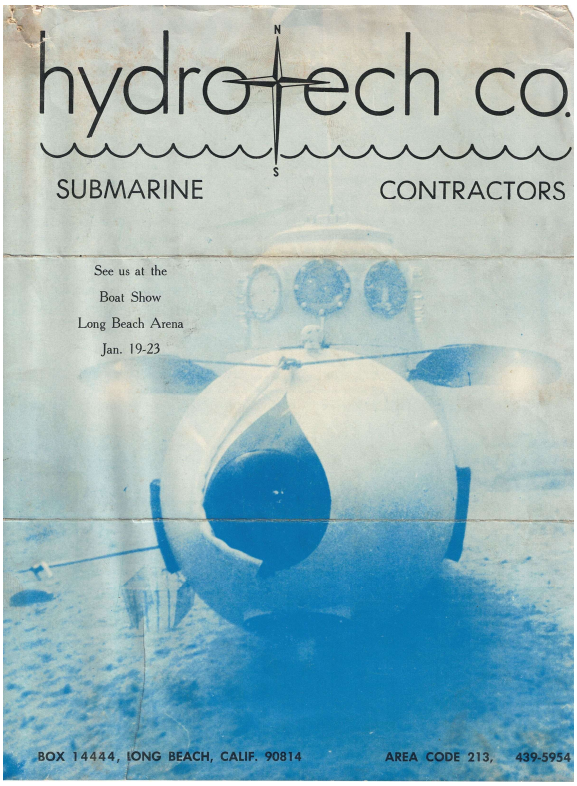
The director of the company arrived in Los Angeles with his wife and daughter, staying at the - Beverly-Wilshire Hotel. I invited them for a trip to Catalina along with Dick Anderson and my daughter, June, (a high-fashion model), hoping to establish congenial relations and demonstrate Dick's skill as a diver. We pulled out of the slip on a gloomy, overcast day in late May. The channel became increasingly sloppy and after pounding along for an hour or so, some of the passengers looked a little peaked. Considering the late start and the prospects of an even rougher return trip, I reluctantly turned back in mid channel, much to Dick's disgust. He had been looking forward to making some solo dives at the island for his favorite Sorenson abalone.

Back at the slip we all had a few drinks and I foolishly acquiesced to making a scuba dive under the boat. With full gear on, I made what can only be described as a classic belly-hop off the stern of Maray. It was so bad my teeth rattled. There is a low rail around the stern, and I had planned a tuck and roll over I, but neglected to tuck under, therefore the flop. As Dick commented after the laughter died down, “Mart that was the most spectacular water entry and subsequent recovery I’ve ever seen.” Meaning I had defied the gods by remaining conscious.

I’ll never have any way of knowing for sure, but I think that [] flop determined the future of the entire adventure. The director later bought a custom camera housing

and $5000. worth of closed-circuit TV equipment, but the sewer pipe sub-contract never materialized. Nevertheless, I now had a new business name (Hydrotech) and it was the best thing that developed out of the whole episode.

There followed a slow period, although during the summer 1 had two or three charters with Maray and made a couple of uneventful trips to the island with the sub. Mostly, I changed hats again, trying to drum up some business for Hydrotech. Doug and I figured that Submaray had logged a total of about 140 dives over a period of approximately two years. From this fact and a general description of our capabilities, I made a kind of press release on new letterheads, promoting Hydotech as a 'submarine operating service'.



Attention:

Gentlemen:

We are pleased to forward to you this literature concerning SUBMARAY. Hydrotech Co. is an established commercial operating service offering on a charter or contract basis a completely equipped two man submersible with related support and follow up capabilities. During the past four years we have successfully participated in a very broad variety of projects for both government and industry.

The sub, along with all support equipment, is easily hauled on its own trailer and may be launched by boat hoist or crane, then towed by boat to the diving area at normal cruising speed. A large tender vessel with crane is not necessary. Stability on the surface is excellent and although reasonably calm water is desirable, we have operated many times in a moderate sea. Handling and boarding are comparable to any small craft.

Special procedures have been developed to cope with poor water visibility and in fact most jobs to date have been accomplished under less than ideal conditions. Invaluable experience gained from a total of over 300 dives logged assures consistent performance. All Hydrotech personnel have had many years of exposure to the problems encountered both on and under the sea. We offer a safe, versatile tool and a realistic approach for search, observation and inspection to depths of 300 feet.

The basic charter rate with crew is $450 the first day and $350 each consecutive day thereafter. Travel time and layover days are of course additional. Guaranteed performance or 'no cure, no pay' contracts are also accepted. The normal crew consists of an operator and two communications–safety men. Passengers other than crew members are often carried aboard in the observers position. Control of the sub itself is entirely a one man operation, leaving the observer free for other duties.

Adequate interior space and weight capacity permits installation of instruments and equipment for special jobs. Ample battery output and compressed air for blowing ballast tanks is carried aboard for a normal operating day. Recharging of both batteries and HP air tanks is accomplished with portable units.

It is our sincere belief that a manned vehicle can more efficiently and economically perform most work requiring sustained bottom time, distance runs, communication with the surface and visual contact. A resume of your project needs will receive prompt consideration. Usually a letter of agreement covering the terms, conditions and a detailed description of the work involved is made a part of the contract. Following is a partial list of companies using our services one or more times:

Evans products, Seattle	submerged timber survey
Review Studios, N. Hollywood	McHales Navy TV show
U.S. Bureau of Comm. Fisheries	UW scientific studies
Catalina Channel Airlines	sunken plane search
Richfield Oil Corp.	UW pipeline inspection
Aloca	UW pipeline inspection
Bonneville Power Administration	UW power cable inspection
Louis Q. Sims, marine surveyor	sunken boat search
Ocean Systems Inc.	sewer outfall inspection

Hydrotech, Co. Press Release

Along with a covering letter, this was mailed out to all kinds of water-oriented periodicals, TV stations, movie and television studios, the Coast Guard, U.S. Army Corps of Engineers, and every Navy facility I could think of. I received a tip that MGM had started production on a movie titled 'Flipper' in Florida and submitted a proposal for the use of the sub. Nothing. However, late in September one of these mailings hit pay dirt in the form of an inquiry from Revue Studios. They thought the sub might be useful during the shooting of a Mc Hale's Navy episode. By now I had a nice ten-minute film on Submaray put together, so on an invitation from the producer I drove to Universal City towing the sub, for a consultation. We had a brief meeting, showing the film and inspecting the sub, with the writer, an art director and other interested parties attending.

The title of the episode was "Creature From McHale's Lagoon". When I learned that it would all be shot in Universal's back lot lake (five feet deep) and that my valiant Submaray would only

serve as a prop, it was a little deflating. On the other hand, they would pay me $400. for one day's work and a half day to fit the sub with a dragon superstructure. That's right, Submaray would play a dragon! The silly plot involved the discovery by McHale's crew of an abandoned Jap sub which the then camouflage as a dragon to discourage the natives from diving for pearls in a bay near the base. Here is a brief quote from a pink copy of the manuscript.

Gruber

Kara-who?

McHaIe

I'm surprised at you, Grube!
Karatonga. The serpent of the
lagoon -- he's an island legend.

Urulu

(nods)
When him see people make profit and not cut him
in - - him flip lid. Punish whole tribe. Take
away all pearls forever. (shakes head)

Karatonga terrible monster. Also big fink.

And that's the way it went for 48 pages! I thought, what the hell, it should be fun. The art director had one of his men take measurements of the sub so they could make up a lightweight pipe frame covered with painted canvas, and a balsa wood sea-serpent head, all of which could be dropped over Submaray, leaving only the hatch exposed for access. The day before shooting was scheduled I towed the sub to the lot so painters could block out the name Submaray and apply Japanese lettering and flags to the hull and conning tower.

Early the next morning I picked up Doug for some help and he thought it was great; how could we drown in five feet of water? At the studio they lifted the sub into the lake with a crane and I ran it around to the set where the fake PT boat was tied to a pier, also fake. We met the cast and crew including Ernie Borgnine and Tim Conway and got through the scenes where the sub is discovered out in the lagoon and pulled into the dock with a fishing line. (never mind the details, - it's not important)

McHale's crew examining the 'captured" sub


Ensign Parker with his new command

Now the dragon assembly was lowered over the sub, and it looked fine except the rear end did not reach the water. I tied a bag of lead weights around the stern to bring it down, then another, before it looked right. There was some debate over whether to use the submerged cables in the lake to move the sub, but I assured them I could maneuver the sub under its own power, so we proceeded on that basis. This []

and frighting roars. I climbed in and ducked down into the observers' nest, from where I could operate the rudder and power switch, following instructions received over the CB radio. Tim Conway entered, sitting in the conning tower, and our combined weights brought the sub down a little. Someone handed down a bag of fireworks and a wicked looking kerosene smoke generator. Then the hatch was closed so it would not show. Instructions came over the radio and I tried to steer a course. Rudder response was negligible, and I realized the weights must be dragging bottom. Men in a rowboat towed us back to the pier where I managed to fish up one of the bags with a boat hook. Conway and I started off again, this time with poor, but adequate rudder control. We began the run with the hatch closed while pre-ignited smoke bombs inside the dragon's head did their thing. Then the CB ordered smoke inside the sub, and Conway flipped the switch on the smoke generator as I fumbled with Power and rudder to stay on course.

The Sea Monster Karatonga

The smoke began to fill the sub and I wondered why I had not thought to have a SCUBA regulator handy, or better yet, let them have their way and pull the sub along with a cable. Finally, the order came to open the hatch. Tim stood up in the conning tower tossing firecrackers through the cloud of smoke while I choked below as the cameras rolled. I began to ease up alongside Tim for some air, but his sotto voice told me to stay put a few seconds more while he did his coughing and choking act per the script:

> close up of sub conning tower.
>
> as Parker's head pops up above the monster, he waves and
> calls to shore: "Sorry Captain, the monster and I both apologize."

Then the rowboat came alongside to take Tim off, and I clawed my way up through the dense smoke, tossing the stinking generator out to the men in the boat.

The director said it was a take, which was a relief. We towed the smoldering sub to the docks so the crew could remove the dragon assembly. While Doug checked the sub and removed ballast, I spoke briefly to Ernie Borgnine who was leafing through a brochure on houseboats. Our job done, Doug and I hung around watching the action as other sequences were filmed, until the crane arrived late in the afternoon to lift Submaray back on the trailer. It had been a fun day in tinsel town.

For some time now I had been obsessed with achieving three important improvements to the sub: UW communications, a variable speed control and a mechanical arm. The first item was bogged down again. The two or three systems which were more or less available either cost too much or suffered from a chronic failure to function properly. For a while I thought the variable speed idea would be a cinch. A manufacturer of electric shopping and golf carts in Long Beach claimed. he was about to produce an electronic system of 100% efficiency to replace the old resistance type speed controls.

To explain briefly, the resistance method merely shunted some of the battery current through a series of resistors in order to lower the DC current reaching the motor, thereby slowing it down. The total drain on the batteries remained the same regardless of speed. On the other hand, I knew that a system had been developed which varied the battery drain in direct proportion to motor speed, without any loss of efficiency. A simple solution would have been to wire the batteries to switches so that one or more batteries could be tapped to apply various voltages to the motor, but this method had several flaws, the most obvious being that the batteries would be discharged unequally.

The golf cart maker never did come through, but I learned that Allis-Chalmers", had perfected an electronic means of providing an infinitely variable speed control for their fork hits. I contacted the local company representative and found that the system might be available for about $2000. He did not seem too keen and of course the price was totally out of my reach anyway. The system, known as pulse width modulation, is probably in fairly common use by now, but at the time I understand Allis-Chalmers held most of the patents. In any case, I dropped the variable speed idea and concentrated on the arm.

Actually, the basic idea had been in my mind for some time. Years before a custom camera housing I'd built required a flexible ball and socket control to operate one of the cameras settings. By drilling a hole in the ball and using a metal shaft with

an ‘O’ ring, the shaft could be moved in a limited arc and also rotated. Like most of my brainstorms, the application of this basic concept to a workable mechanical arm came late one night. I stayed up until the early hours drawing a detailed full-scale sketch of the assembly and its parts. At first, I thought of using a large ball bearing, but then realized the difficulty of drilling and machining an 'O' ring groove in hardened steel, plus the corrosion factor. Then the thought occurred, why not use a billiard cue ball. It would be about the right size, and they were made of a very hard phenolic material. The two halves of the socket to retain the ball and seal it with an ‘O’ ring, could be of brass. I picked up a new cue ball and turned it and the sketch over to Doug for the machine shop work early in November of 1963.

At the end of the month, I scheduled another weekend fun trip to the Island. Doug had made some progress on the socket assembly, but it was not ready to be installed on the sub. Dick Anderson and his wife, Mary, accepted my invitation to go along, and we all took off early Saturday, Nov. 30th, with Submaray in tow. I hoped to get some more UW footage, and Long Point had always been my favorite spot. Due to consistent currents there, the water generally was clear, especially in the tiny cove just inside the point and below the navigation light.

Doug took Mary for her first submarine dive, and I shot film of her face pressed against the side port, with Dick in the water alongside, making with sign language. Then Doug and I dove, towing Dick in scuba, down off the outside of the point to his special I bed of Sorenson abalone. Dick is a little color blind, but for some reason, that made his perception of objects underwater sharper than persons of normal vision. Perhaps its because of a more acute sensitivity to light contrasts. In any event, he filled the sack with abs, plus a few scallops, in no time, slung it across the after deck of the sub, and gave me the “home James” sign. While he hung on I [] back to Maray anchored in the small cove behind the point. Dick peeled off the sacked goodies near the boat and climbed aboard. It had taken less than

thirty minutes, so I extended the dive by cruising in the shallows under the light, an area very familiar to me from many past photo assignments shot there. Doug and I gawked at the profusion of swaying kelp and eel grass for a while, then I made the mistake of surfacing too close in. Fifteen or twenty feet down, the surge was barely noticeable, but on the surface, there was a good two-foot change in the water level as each swell rolled in. One of these caught Submaray just as we hit the surface, sucking us toward the rocks. Hastily I blew more ballast and tried to power away, but it was too late. The crest of the next swell carried us broadside right under the cliff above and set us down with a frightening crash on the partly submerged rocks lining the shore. Doug could see nothing topside of course, and he sat in his nest, rigid with apprehension, expecting one of the ports to be smashed in at any moment. I tried again to bring the stern around to head out into deeper water, only a few feet away, but it was hard aground. Another swell lifted us up and I could see Dick standing on the stern of the boat, not 25 yards away, anxiously watching. This time I managed to get the stern around, but as the swell subsided, we crashed again and I wondered how much Submaray could take as we rolled over like a log, almost high and dry on the rocks below. Still blowing ballast, I was ready for the next swell, and applied power just as we became water borne. The sub slid over the last rock ledge and we were in the clear as the thrashing prop and receding swell carried us into deep water. Shaken and wiser, Doug and I boarded Maray. Dick checked the bottom of the sub, but could find nothing damaged, just some scratches in the paint, so we resumed diving the rest of the day. The incident forced the realization that relaxed fun dives could quickly become just as dangerous as working dives.

We all spent Saturday night in Avalon, visiting briefly with Al Hanson and his wife Norma. Later, Doug and I made a night dive under Maray's mooring. The lights on the bow planes were brilliant but the clarity of the water not too good, and we stayed within a small area, skimming the bottom in circles around a mooring clump. When we surfaced, the rest of the group said the underwater lighting effect had been exceptional with a big area of the surface lit up with an emerald glow, all the []

This time of the year Avalon was dark and deserted. Because of the off- season I had easily obtained permission earlier to plug in the battery charger at the fuel dock and leave Submaray tied alongside overnight while Maray lay on a quiet mooring nearby.

Sunday turned out warm and sunny. Doug gave Dick a 'pilot training' dive, and he did very well indeed at handling the sub, exclaiming that it had been "a bitchin experience." As everyone in sport diving knows from his articles and hilarious films, Dick has a droll sense of humor which made his company much sought after. Later I was to enjoy the pleasure of his company and efficient services for many days at a stretch on several submarine jobs.

The evening before, I had invited Al Hanson to make a dive. Sure enough, he came by in the early afternoon with his old, beat up, mooring service boat, loaded with young girls from town out for a gay Sunday boat ride. Besides being a top-notch diver and mechanic, Al was an incurable tinkerer and be really appreciated the technical details of Submaray. In spite of our occasional competitive relationship on UW photo assignments, I have always liked and admired Al. His total honesty in business deals gleamed in a field not noted for that attribute.

After my dive with Al, a couple of other guests were given brief dives. Then we reluctantly decided to rack it up and head for the mainland, four long hours away. There had been a total of 14 dives logged during one of the most enjoyable weekend trips made so far with Submaray. As usual, I switched on the radio to the Coast Guard channel, once under way, and we all listened to some dramatic talk between the CG and a diving charter boat at Long Point concerning a search and rescue in progress therefore a missing diver. As is always the case, the talk was brief and difficult to piece together, but I soon determined that the missing diver had last been seen in deep water, possibly 200 feet. During a lull in the transmissions, I broke in with a call to the CG, explaining my presence in the area with a sub capable of searching for the missing diver and offering our service. After a long "stand by" delay, during which the CG radioed []

obviously consulted with the officer on duty, the reply came back, "negative, your services not required at this time". Not wishing to argue the point, I set a course for Long Beach and turned the helm over to Elisa, who by now had become a good sailor, often spelling me at the wheel while I grabbed a little sack time. By the time Maray and the sub were tied up in my slip at the Long Beach Marina, we were all, pretty tired and went our separate ways home.

The morning headlines told another grim story: SKIN DIVER DROWNS, SECOND MAN LOST AT CATALINA (in those untroubled days, every diving accident seemed to merit front page coverage) The story went on to describe how a scuba diver had suffered a bad case of nitrogen narcosis at 120 feet. His buddy tried without success to bring him up, having to fight him off in the end and surface for help. Several other divers jumped in and eventually the body of the raptured diver was recovered. Then it was discovered that one of the rescue men had not returned. Larry McWhirter, 20, was missing and presumed drowned, but county lifeguards and volunteer divers were still searching for him off Long Point. It all seemed like an incredible replay of the Hannes Keller incident.

Late that afternoon I got a call from Dave Podewitz who had been in charge of the charter group and had listened in on my chat with the Coast Guard the day before. Dave had chartered Maray many times in the past and wanted to know my terms for taking the sub over to search for the body. I suggested a modest figure to cover expenses and he shortly called back, stating that the father of the boy would like me to give it a try. I then called Doug and Dick, both of whom agreed to meet me at the boat around one AM. Fortunately, I had already put the battery charger on at the slip, so Elisa and I got a couple of hours sleep before starting out, in the middle of the night, on Submaray's first grim mercy mission.

Again, Elisa graciously offered to take the wheel after we were in the channel and on course. I could have kissed her hand. (and wished I did) Long Point [], red in the distance [] before [] and by daylight we were anchored in

Pirate's Cove, consulting with the official county lifeguard team and Dave Podewitz. The light was still too faint to provide much visibility underwater, so we decided to have some breakfast while the sun got a little higher off the horizon. Over coffee, Dick, Doug, and I discussed procedure and decided that Dick would join the diving team on their boat after tying a large magnet I had aboard under the bow of the sub so that it hung down about two feet, in case we found the body in a position so that the magnet could he attached to the scuba tank. Drowned scuba divers are very heavy on the bottom with their weights, suit squeezed thin, and lungs full of water. Over Dick's objections I insisted on a fairly light cotton line which could be broken by blowing ballast, in case the magnet got hung up in rocks.

Doug and I loaded the bilge ballast in the sub and submerged about 9.45 AM. Within ten minutes Doug spotted the body at a depth of 155 feet on a steep slope. The boy was lying partly on his back, with full gear on, and can only he described as resembling a black suited mannequin, except for the face. I tried to ease the sub into a position so that the magnet would make contact with the scuba tank, but misjudged and the magnet suddenly went 'thunk' as it gripped the underside of the sub. There was nothing to do but surface straight up to show the diving team our location and radio that we had found the body. They came out in their small boat and I suggested that they follow the sub down, to which they agreed. After Dick released the magnet from the sub so it hung free again, I submerged, descending the slope at an angle against a slight current until we reached the body again. Carefully maneuvering the bow to a spot above the tank, I planned to adjust the trim ballast to settle down slowly, when a diver suddenly grabbed the magnet, trying to bring the sub down enough to attach the magnet. I could not see much from the conning tower, but Doug yelled, "he broke the line!" and we arose from the scene, 15 pounds lighter. (I should have taken Dicks advise about using stronger line)

Through the bottom port Doug could make out the magnet gripping the SCUBA tank on the back and two divers struggling to raise it off the bottom while the third diver

recorded everything on film for the county water accident investigators. The other two divers, Dick Anderson, and Bob Howard were wearing life vests and by popping them, they managed to get the body of the boy to the surface, with the magnet still gripping the tank.

This may have been the first recovery of a drowning victim made possible by a submarine, and it would be hypocrisy to pretend that I was unaware of its publicity value. The unique search and recovery did in fact receive wide coverage through the wire services, but the best bonus came from the grateful look on the father's face as he thanked all of us before leaving for Avalon with his son.

A tempting offer came along, before year's end, to exhibit Submaray at the Seattle boat show in March for ten days. At first the negotiation called only for prime floor space, free of charge, so the producers could use the sub as a drawing card to boost attendance. Without too much hope, I held out for a flat $600. in expenses, plus the free space. Surprisingly, the OK came through. I would receive $200 in advance, another $200 upon arrival, and the balance at the end of the show. It would be a nice vacation and a delayed honeymoon for Elisa and I. However, the trip would be a gamble, towing Submaray 2500 miles round trip. I wondered how much more fame without my shaky financial status could take.

In preparation I began assembling photos and news clippings from the Ross Lake job, McHale's Navy, and the body recovery plus several other published items on the sub. The 16mm film had begun to take shape as well, with a narration soundtrack for a professional touch. A sign painter made up a display poster listing the features, specifications, and accomplishments to date. Who could tell, maybe a show biz approach would turn up some real action. Although my VW managed to haul the sub around locally, it would not do for this trip, so I sold it and bought a used Corvair Greenbriar camper with only 95 HP, but a tough little vehicle if treated right.

Meanwhile, the [] was [] there, with a round of family get togethers on

both sides of the border, and one very special event, my daughter's wedding. The time flew and 1964 would, I hoped, be a big year for the submarine business.

Doug completed the mechanical arm assembly and it appeared very business-like with his usual professional job of machining. The ball and socket worked smoothly, and the arm itself consisted of a length of 1/2" diameter stainless tubing passing through the ball, sealed by an internal ‘O’ ring. Inside the tubing a corresponding length of 3/8" stainless rod was sealed by another ‘O' ring gland at the outer end of the tube. A 'claw' beyond the outer end could be opened or closed by rotating the rod within the tube by means of handle grips at the inner end, inside the sub.

I hauled the sub to a welding shop and had the steel mounting ring welded into a hole cut in the hull below and aft of the starboard side viewing port. I had designed the assembly so that a Plexiglas port, 3-3/4" in diameter, could be substituted for the arm and serve as an extra viewing or camera port in situations where the arm would not be needed. There were other options too. A steel disc could be installed from the inside to seal off the ball and socket in case they leaked, and this blank, along with the proper screws, was placed in the on-board parts box. Another 1/2" tube welded to a double-edged blade, sharp on one edge and with saw teeth on the other edge, could quickly replace the claw arm. Doug also made a second arm with tong shaped ends. Except for the knife-saw each of the arms could be retracted so that they were almost flush with the hull, protected by the steel guards around the view port.

Delighted with this ingenious invention, Doug and I practiced picking up objects and tying knots in rope on dry runs inside the garage. Aside from the intrusion of the arm into the observers’ space when retracted, there were no apparent bugs, but we were anxious to try it out under actual conditions.

On the afternoon of Friday, January 17th, the three of us, Doug, Elisa, and I, headed for Catalina again. Arrangements had been made for a few people to meet us at Avalon Sunday, but our first stop was Long Point for pictures. We lucked out on the weather [] This was the first time that we

attempted a trip to the island with the sub without additional help.

Saturday morning Doug and I made a check out dive and everything went beautifully. Doug played with the arm on the bottom, picking up rocks and testing back pressure. At about 150 feet the ball became a little stiff and a definite amount of effort was required to extend the arm against water pressure, but this had been anticipated of course. We changed places (no easy trick in the narrow confines of the hull) and I got to practice with the claw, grabbing at everything within reach. Depth perception is tricky underwater due to the refraction factor. Objects appear closer than they actually are, and I repeatedly closed the claw 6' short of target in spite of an awareness of the distortion. However, the arm proved a huge success mechanically, with only a few drops of water leaking in around the ball, easily corrected by tightening down the bolts securing the brass socket.

Anxious to shoot some film, I got into my gear and directed Doug, with Elisa in the observers' position, to submerge in an open area about 30 feet deep. With a bucket full of weights and a diver's knife in one hand and my K-100 camera in the other, I sank to the bottom alongside the sub. Meanwhile Doug and Elisa had switched positions and I shot footage of Doug loading a bucket with weights and the knife, the arm working in quick jerky movements. Then Doug showed how the arm could pick up the bucket with its contents. Satisfied with the photo session, I signaled Doug to surface.

Back aboard Maray I sipped a little wine and thought of another film sequence. We all submerged again and I placed the near full bottle of wine on the bottom about 15 feet ahead of the sub. On my signal, Elisa powered the sub ahead and Doug neatly picked up the wine bottle on the fly, as the sub rose off the bottom and faded into the distance. We did a couple of more takes, but the first one proved best. Back on the surface, Elisa emerged from the sub all smiles, thrilled at her prowess as a submarine pilot, perhaps another all-time first!

We then moved four miles down to Descanso and picked up a bearing. Seaward of the [] especially off Casino Pt., last air base []

On the first dive Doug spotted a new-looking chain which could not have been down long. We followed it for some distance, hoping to find the anchor, but instead found a pile of frayed rope, indicating that some unlucky boatman had pulled too hard and parted the line. The depth was about 120 feet, and without thinking about it, I moved in close so that Doug, who was quite excited at the prospect of our first salvage operation, could wrap the short piece of line around the arm. I then blew ballast, and we started up. The weight on I arm became heavier and heavier as the chain came off the bottom. I grew alarmed at the possibility of bending the arm, but Doug said, “Ah, don’t worry about it”. He pulled the claw in close to the hull, but even so, as we neared the surface the sub took on a considerable list from all the weight of over 100 feet of chain dangling from one side. After blowing all ballast and bobbing around on the surface for a while, I realized we had a problem. I wondered why I had not thought to check the other end of the chain to see how the anchor was fouled. Now the sub was firmly anchored, and Elisa could not operate Maray well enough to drop the mooring and bring it over.

It was an absurd situation, and I suggested to Doug that he try to unwind and drop the line. Like a bulldog with a trouser leg in its teeth, he grudgingly agreed, but could not turn it loose. He had welded teeth in the claw, and these were entangled in the strands of rope. Getting a little desperate, 1 considered submerging again to see if releasing the tension would help, then I sighted a skiff headed our way. It was Phil Jackson, who operated a diving and salvage service out of Avalon. We exchanged greetings and he explained that someone had told him about a funny looking submarine diving off Descanso, and out of curiosity he fired up his outboard to take a look. As I leaned out of the conning tower on the high side, I told him of our predicament. With a sly smile, he offered to help, at the same time suggesting that he might buy the anchor and chain if the price was right. Under the circumstances this seemed reasonable, so I requested a lift over to my boat so I could run it out to eh sub. While climbing out of the sub into the skiff I told Doug, “Hang in the partner, I’ll be back in a jiffy.” The ‘jiffy’ turned out to be a quarter of an hour by the time I got aboard and started the engine, dropping the mooring and pulled alongside the sub with a boat hook. After a lot of fiddling around [] end of the []

from the claw. Doug scrambled aboard, obviously relieved, nursing a pair of blistered hands and assorted aching muscles. With Phil's help we just barely managed to get the end of the chain snubbed around a cleat. By powering Maray ahead, the anchor finally broke loose, and we hauled it aboard, the flukes badly bent.

Phil wasn't too interested in a bent up surplus Danforth anchor, even with the chain, so I gave him a dive in the sub for his trouble and he showed considerable enthusiasm at its performance. Before the day was over Doug and I salvaged two more anchors of dubious value, but without complications. I gave one old heavily encrusted anchor to Doug which he later planted in his front yard as a souvenir of our day's work.


Doug with the three anchors that were salvaged.

The next morning, I concentrated on getting some still photos of Submaray on the bottom. During one of these dives Frank Hester, of the U.S. Bureau of Commercial Fisheries, arrived with his wife and Don Ahsted, an associate. Frank (mentioned previously) had a project in mind which could make use of the sub and had flown over for a demo ride at my invitation. We gave them each a dive and although Frank must have topped 6'-4", he folded neatly into the bow of the sub and enjoyed himself immensely. Both he and Don were skilled scuba divers and understood the underwater world very well, especially from the fish's point of view. They left for San Diego, Frank promising to make an early attempt at getting funds allocated for the [] project.

Dick Terry, who was still gathering material for his book, "The Case for the Deep Submersible", also dropped by for a demo dive so he could write up something about Submaray in the book. The batteries died out during the 16th dive of the two-day excursion, most of them relatively short. I had shot 200 feet of film, two rolls of still photos, salvaged three anchors, inducted four new submarine passengers, and one new female pilot. Not a bad score for a winter weekend.

Late in January 1964, I was asked to display Submaray during a two day "Governor's Conference on Calif. and the World Ocean", held at the Los Angeles County Museum of Science and Industry during which Jacques-Yves Cousteau would appear. Parked in front of the museum steps, Submaray looked good, I thought, with a fresh coat of golden yellow paint. Several people queried me about its details while Cousteau stood nearby, engaged in conversation with a small group of press reps. I anticipated a meeting, but he strolled away, seemingly oblivious to what he may have felt was a rival submersible. (years later I did meet him and also constructed an underwater camera housing for his son Phillipe, to be used in the arctic.)

The trip to the [] Seattle Boat Show went smoothly. Elisa and I rented a furnished apartment two blocks from the show buildings for the incredible sum of S4.00 per day. (Seattle was in the midst of one of its periodic economic slumps) We set up the sub and its related display material in a designated area adjacent to the main aisle connecting the two exhibition halls. The Pacific Northwest takes its annual boat show very seriously, and despite the recession, crowds were heavy.

During the ten-day run of the show, I made two important contacts. The first was Mr. J.V. Lamson, an executive with the Bonnyville Power Administration who visited twice, viewing the film and asking a lot of very sharp questions. It seemed they had an electrical power cable resting on the bottom between the mainland near Anacortes and the San Juan islands which had been laid in 1951 and now required inspection. Due to a maximum depth of 322 feet, poor visibility and formidable currents during tide changes, the nearly five-mile stretch of the cable across Rosario Strait had been impractical to check using conventional commercial diving gear. Mr. Lamson recognized the possibility of using

Submaray for this job and said he would be in touch later after presenting this novel solution to top aides at Bonnyville Power.

The second contact came from a fellow exhibitor, Wayne Ross, owner of Ross Electronics, a Seattle Company manufacturing radios, depth sounders and other marine electronic equipment. Wayne would leave his booth to visit occasionally and discuss my need for a communication system. He had, as a matter of fact, recently developed and tried to market such a system for SCUBA divers. It worked great, he said, but the marketing results were dismal, and he had lots of unsold units sitting on the shelf. He thought the submersible field might be an additional potential market. I enthusiastically offered to work with him for a few days after the show, installing the system in the sub and testing it. He agreed and immediately got to work modifying a pair of units, primarily to increase the range.

Right after the ten-day show, I towed Submaray to the Ross facilities and we installed the system. One omnidirectional transducer mounted in the top of the hatch both transmitted and received the ultrasonic signal. A handheld microphone connected to a small Fiberglas box containing the electronics completed the sub's system. Topside, a similar box plus meter indicating signal strength, was connected by coaxial cable to a directional transducer mounted on an arm for lowering over the side of a boat. Thus, the topside crew could tell the approximate direction of the sub from the surface boat by homing in during conversation originating from the sub.

Since I had not planned to operate Submaray on this trip, some essential equipment had been left at home to reduce the towing load on my Corvair. Most conspicuously missing was all the lead ballast. We

had to scrounge up several hundred pounds of lead before Submaray could be lowered to the surface of Lake Washington. Wayne had notified the press and local TV of our test dives and quite a delegation showed up. One spunky cameraman for a TV station asked to be my observer (and needed ballast) on the first dive. I said OK and he clambered down the conning tower with his camera and settled himself calmly atop the pile of lead in the bilge. Wayne and his son, Jim, manned the topside unit as I powered away from the dock about fifty feet and submerged into the muck. Waynes's voice came through loud and clear, and I responded, but Wayne kept repeating: "Do you read - I do not copy you". It was a replay of the San Diego fiasco. I surfaced before an array of anxious faces lining the dock. The cameraman climbed out and verified that our reception had been fine, but Wayne was bitterly disappointed, and after a photo session. the press people left.

I think it was Wayne's son who found the problem. When the cameraman entered the sub, his foot had probably caught in the mike cable and broken the connection. A quick soldering job repaired the damage, and we made several more brief dives, each one proving the excellent performance of Wayne's system. Conversation was clear both ways and the sub could be tracked quite easily from the surface. That evening Wayne treated Lisa and I to a fine dinner and to a fine dinner and to top it off the Seattle Times had a photo of me in the conning tower on its front page, along with a complimentary story which ignored the failure of Wayne's equipment.

The next day we headed home, elated that my long quest for good, reliable communications had finally succeeded, Wayne had graciously allowed me to keep the system for further testing under actual operating conditions with the only contingent being that I divulge its source to as many contacts as possible. Eventually several sales did result from my efforts on his behalf.

Back home, Doug was somewhat skeptical; being from Missouri he had to see and hear it work to believe it. First, however, Doug made up a stainless-steel arm for the topside transducer which could be conveniently hung over the side and featured a handle at the top so that the submerged transducer could be aimed in any direction with a "pan and tilt" action. Before we could get to the island for tests, an opportunity came along to work and test at the same time.

It was my first job in the Santa Barbara area, early in April 1964. Richfield Oil had a pipeline off Goleta running out to a submerged well about two miles offshore at a depth of 210 feet. Actually, it was a bundle of three aluminum pipes, each about 3" in diameter, strapped together. Alcoa had provided the special high-pressure lines and the idea of using aluminum was relatively new, hence the need for periodic inspection. Most of my negotiations were with Don Smith, a company engineer. Mr. Smith wanted photos of the entire pipeline. I expressed doubt about the photo coverage but assured him that we could at least visually inspect the pipes over that distance.

Don Smith had chartered a 65’ boat, the Emerald, located in Santa Barbara and skippered by a most colorful character by the name of Glen Miller, (no relation to the band leader). Once again we loaded our gear in Doug's Ranchero, hitched up Submaray, and headed North on a sunny weekday afternoon. We wished to start out first thing in the 1orning, so, on arrival I checked in at the Harbor Master’s office and received permission to launch with the small boat hoist on the stub pier nearby. Whi1e getting the gear together a TV cameraman and still photog showed up, probably tipped off by the Harbor Master’s office. After answering a few questions, the sub was 1owered into the water and I powered it over to the slip where Emerald was tied up.

With everything ready for the morning tow, Doug and I checked into a seedy little hotel by the RR tracks in 'downtown ' Santa Barbara. While enjoying a drink in the lobby and watching the evening TV news we were both startled and delighted to see ourselves on the screen, performing our launching chores a few hours earlier. For a minute or so the announcer spoke about our pipeline task and how the occupants of this mini sub could operate "without fear of shark attack." (I still hope to outlive the compulsion of the news media and the entertainment industry to inject the subject of sharks into every underwater endeavor, when, in fact, the real danger, by a relative factor of several thousand to one, is, quite simply, death by drowning.)

The next morning there were representatives of both Richfield and Alcoa aboard as we towed Submaray up the coast in a glass smooth sea under sunny skies. As we entered the 'oil patch' area, natural seeps of crude oil broke the surface, and the pungent odor of escaping gas assaulted our nostrils. A marker on the beach indicated the shoreside location of the pipes, Glen, the skipper, hove to just outside the kelp line opposite the marker. I made the first dive with Don Smith, anxious to try the communication system. Sinking to the bottom at 60 feet it became obvious the water visibility was not as good as it looked from above, but the 'radios' worked great as Doug and I chattered away, a little awed with our new toy. Zigzagging back and forth, we finally located the pipe bundle (much to Mr. Smith's relief). After advising those topside, we started following the pipes out to sea with Smith intently scrutinizing it for problems such as corrosion, leaks, (they were under high internal pressure), separation of the bundle and unsupported sections spanning areas of uneven bottom.

I could faintly see and follow by looking ahead and downward, but

it was marginal visibility. However, the water cleared up as we got deeper and out of the surge inshore, which tended to stir up the bottom. Keeping in touch with those on the surface provided an immense added feeling of security. Our talk would go something like this: "Sub to surface - how do you copy?" (Doug) "I read you OK -what is your depth?" "We are at 110 and Moving right along the pipes" (Doug) "You are a little garbled - give me a ten count so I can home in" "One, two, three --- - - - now at 118 feet" (Doug) "Read you fine now, understand your depth 118 - standing by." We soon realized there was another advantage to frequent voice contact. Since the pipelines were plotted on a chart aboard Emerald which also had a depth finder, they could follow the sub, staying somewhat inshore and thereby be near when we surfaced, but not directly overhead. Previously, whenever the sub surfaced there was the possibility of coming up under the tender vessel. Now that danger could be avoided by careful use of the directional transducer topside. Indeed, we soon learned that navigation was an important side benefit to voice communication between sub and surface. Since the directional transducer handled best off the fantail, a pair of handheld CB units were used to re1ay maneuvering instructions to Capt. Glen Mi1ler in the forward wheelhouse.

The directional transducer in use

Everything went smoothly as we slowly powered deeper toward the wellhead offshore. Smith snapped some photos and used the tape recorder to provide a permanent record of broken pipe straps, corrosion, and a couple of stretches where gullies in the sandy bottom left the pipe bundle unsupported for 15 or 20 feet. We eventually arrived at the wellhead, a cluttered area of debris, loose cables and the well itself consisting of an array of pipes and valves, known as a "Christmas Tree."

I gingerly maneuvered in a circle, as close as safety allowed, to give Smith a good look and to shoot more photos. He was pleased at the dive's success, (and no doubt relieved that we could surface to the sunny world above) The Emerald pulled alongside, and thanks to a dead calm sea, we easily clambered aboard

We made seven dives total during the day in order to give all the Alcoa and Richfiel engineers a good look at the pipes. According to my log, three of the dives terminated at the wellhead at a depth of 220 feet. Back on the surface, there was one scary moment as we were rigging the towing bridle to Submaray when Capt. Miller misunderstood one of our CB calls and backed down almost sucking the sub under Emerald's stern. With it's big prop churning, not only would Submaray have suffered severe damage, but a broken or bent prop would have disabled Emerald, and we were miles from the harbor. Fortunately, our yells alerted Glen in time and the tow back to Santa Barbara was uneventful. Doug and I drove home elated that all had gone well; in addition there had been hints by Don Smith that Richfield might have more work for Submaray in the near future.

Job prospects picked up nicely right after the Santa Barbara pipeline inspection. One in particular had been brewing since early in the year when we had given Frank Bestor, of the US Bureau of Commercial Fisheries, and a couple of other marine biologists, demo dives at Catalina as mentioned previously. Since then, a scientific project using Submaray had been proposed and approved by the Bureau. Back in April a flurry of correspondence between Fank and I resulted in a verbal agreement. I towed Submaray to the fisheries facilities in San Diego so that Frank could install special instrumentation both inside and outside the sub. [] to do this the mechanical arm was removed and [] installed in its place. External [] sonar gear placed inside.

Two days later [] for both Maray and Submaray in a [] the Isthmus. Doug flew over [] after Frank and his crew of three []. Having spent the previous night in [] were a smelly bunch of Marine Biologists [] getting the project under way [] a study of how background light [] distance through water [] suspended in their path. [] the pilot's position while Doug [] providing the 'pilot' with verbal operating instructions []

During one of the dives we spotted the wreck of a plane at a depth of about 180 feet. Later investigation indicated it was a twin-engine Beech deliberately ditched during the making of a movie years earlier. By a strange coincidence, the stunt pilot had been Cliff Winters who I saw killed at an

Air Show at Chino Calif. The tragic accident occurred as the pilot tried to do a slow roll in an old biplane right after takeoff and stalled out due to loss of power. Since the wreck was just a short run from our mooring, I took each one of the group down to see the ghostly skeleton of the plane, which was pretty much intact on the rocky bottom.

We worked at a steady pace for five memorable days with perfect weather and fairly clear water. Late each afternoon Frank and his crew would board the whaler and roar away down the coast to Avalon and the comfort of hotel rooms and fine restaurants. Doug and I would head in the dinghy for dinner ashore, repeated at breakfast time before the [] crew arrived, usually around the civilized hour of [].

This job was memorable for [] it allowed me to turn the corner financially. In addition to the five working days for both Maray and Submaray, I was paid for the layover in San Diego plus transit time to and from Catalina. I am most grateful to Frank Bestor for his efforts in making this job happen.

In mid-July I received a call from [] of Catalina Channel Airlines, a small outfit flying out of [] Avalon. One of these planes, headed back [] after takeoff at an altitude of [] made a hard straight-ahead landing. But the [] fortunately those aboard had time to exit the plane [] boats before the plane sank. Mr. Healey [] variable pitch props had recently been overhauled and he was under [] to locate and recover both the plane and if possible, the prop blade which had separated from the hub. The extreme vibration caused by the loss of one prop blade had caused the engine to shake loose and drop free, therefore presenting two

large targets plus the single blade for which to search. Phil Jackson and his small salvage tug vessel were based in Avalon and Phil had already combed the area using a sensitive depth sounder without getting a firm target on the recording instrument. Of course, Phil was aware of my sub, and he suggested its use to Bob Hanley. When given the OK to proceed, I decided to first do another drop test because the search zone extended out at least 300-foot depth. Also, several modifications had been done since the first drop test, therefore making another test appropriate. Once again Doug and I towed the sub to Long Point loaded with extra ballast aboard and lowered Submaray to the end of the line on the reel. This time the retrieval was [] less dramatic, but not without some work. However, an inspection [] a small amount of water, probably through the prop []

The following morning [] transferred to our new tender vessel, Weasel [] day of charter, and because, Doug and I [] together in order to provide four eyes to [] takeoff had been in a normal direction [] submerged, and once on the bottom in about [] back and forth search pattern using the gyro to maintain [] deeper with each pass about 50 to [] visibility was about 50 feet. [] peering intently, trying to detect any target [] ahead and to either side. It was [] so we would stop to give our eyes a rest. The bottom was nearly flat sand, but once we came upon a large rock outcropping, rising suddenly out of the bottom and soaring at least 40 feet above us almost like a submerged cathedral.

The only other distractions were the occasional discarded items like old tires, rusted fuel tanks and other debris. After two dives totaling three hours and extending down the offshore slope to 280 feet, we called it a day, returning to Weasel. Phil Jackson took a couple of horizontal sexton sights on landmarks ashore to give us a position which he marked on a chart, so that we would know where we had ended up on the last dive. He also dropped a buoy line, weighted on the bottom and tied to a one-gallon plastic jug, although this would probably be picked up by a curious boater. He then took us back to Maray's mooring in Avalon where Doug and I spent the night aboard.

The next day, getting an earlier start, we managed to complete four dives totaling about five hours, searching the bottom out to a little beyond 300-foot depth, without success.
Although disappointing to us all, we had demonstrated that by carefully managing battery charging, replacing baralyme in the CO_2 scrubber and leaving the hatch open between dives, we could actually achieve a bottom time of five hours in one day. We were not absolutely certain that our search pattern [] but the general feeling was that it must be deeper and further out to [] reaching Bob Hanley by phone, he agreed that it was not worth continuing the search. During the trip back to Long Beach, Doug and I [] could be improved by having horizontal scanning sonar [] would have been prohibitively expensive and [] type of search assignment might never occur again.

There is one unanswered [] to all this, what if we had found the wreck? A single prop blade could have been simply grabbed by the mechanical arm and retrieved at the surface, but an engine or the plane itself would not have been so easy. We had all discussed this earlier of course and decided anything less than 200 feet could be reached by a SCUBA diver who would then attach a cable.

Beyond 200 feet would require a hard hat diver using mixed gas, to play it safe. However, we did discuss the possibility of grabbing a loop of cable with the sub's arm and trying to snare a prop hub in the loop. We'll never know now if that would have worked or not.

Checkinq the log as of July 1964, Submaray had accumulated a total of 242 dives since the summer of 1962. Considering the fact that both Doug and I had other work to do in order to make a living during those two years it hardly seemed possible. A great deal of credit must go to Doug, for without his participation, progress would have been far slower. It was our teamwork fueled by Doug's fervor and dogged curiosity along with my determination to create a successful new business, that made it happen. This was all the more singular, because, strictly speaking, it was not a formal dictatorship in this instance, I owned the sub outright.

During this time. Joe [] had been in touch finalizing an agreement [] would be hired to inspect a power cable, 4.6 miles [] San Juan Islands near Anacortes, Wash. [] blessing of the higher-up at Bonnyville Power drew [] to accomplish in return for a fixed [] would be the most challenging job so far.

Back in 1951 the Bonnyville Power Administration, (hereafter BPA) laid a submarine electric power cable across Rosario Strait, 4.6 miles long, from shore near Anacortes to Decatur Island, one of the San Juan group. This three-conductor, 25,000-volt, 5" diameter cable was the largest submarine cable in the world at the time. Although the cable was giving no problems, It had never been seen since the time it was laid and BPA wanted to determine its condition.

For a job of this magnitude, I realized that my crew would have to be the 'A' team. Dick Anderson, with his commercial diving experience and overall knowledge of things nautical, agreed to act as 'Safety Diver' and topside communications man. We were well briefed on conditions in Rosario Strait by BPW and it was obvious this would not be a 'strol1in the park'. Doug Privitt was absolutely essential on this one. I know of no one, then or now, who would have cheerfully assumed the risks of squeezing into the sub's tiny observers' space for hour after hour of harrowing progress, bumping along, unable to see more than about three feet ahead of the bow light. In some places broken and detached strands of the 1/4" diameter wire, originally spiral wound to provide armor protection for the three power cables, protruded upward in our path. There was always the chance that one of these jagged strands would wedge itself into some small opening along the keel. Also, we had been warned that this had at one time been a practice bombing range and some bombs failed to explode on impact, therefore presenting a hazard of live ammo, or in military terms, UXB! Then too, there were rocks, some bigger than the sub!

With Doug's trusty old Ranchero loaded with gear and sub in tow, we picked up Dick at a local airport near Anacortes and launched Submaray at a small marina equipped with a boat hoist BPA did not want to assume

any liability connected with the sub operation, so I had previously chartered a 32 foot boat, the Vision, out of Seattle, to serve as our surface tender.

There were no buoys marking its location, so the problem of locating the cable was a bit tricky, but carefully planned by BPA. First there were tidal currents sometimes exceeding three knots, so it was necessary to work out a time schedule indicating each period of slack tide. We had two daylight periods of about two hours each when current velocities would be less than one knot. This would allow a total of seven divas during the four days of operation. For precision positioning, SPA stationed two transit teams on nearby land positions, equipped with UHF radios, to direct us above the known location of the cable as shown on charts. Before submerging, I would set the gyro to line up with the general direction of the cable. Once on the bottom in total darkness below 170', if the cable was not seen, we would determine the drift by watching the bottom and turn 90 degrees into the current and begin our search. When Doug spotted it, he would yell out 'MARK' and I would immediately turn to our original heading, with Doug constantly giving me a left or right rudder order, so I could steer Submaray, keeping the cable centered under the bottom view port. I could see nothing from the conning tower except a glow of light forward.

Now, with the sub lined up with the cable, I could reset the gyro to zero and try to hold it there, aided by occasional 'left' or 'right' orders from Doug. I should add that, early on, we had decided to install the 'drag snake', six feet long, for several reasons; first, It would cushion our impact with the bottom during descent, secondly, it kept the sub a couple of feet above the bottom, a distance controlled by adjusting the buoyancy trim tank, and lastly, it slowed our speed down to a pace that allowed a more careful inspection and even permitted coming to a full stop, if desired. Doug kept up, a running commentary on the conditions such as rocky or sandy

bottom, any unsupported section, signs of wear or damage, etc. while I would call out our depth and the time occasionally. The audio tape recorder played continuously. Later, a BPA clerk would type out a transcript of everything on the tape, including voice transmissions to and from Vision.

All-natural light faded out at about 170 feet, and once, at a depth of over 200 feet, I switched off all our lights just to see what it was like. It was awesome! The total blackness was so pervasive I could not help uttering an expletive. Divers have a name for the feeling of depression and fear they sometimes get at extreme depths: it's called 'The Uglies' and that sure describes what I felt at that moment. With the lights back on, a sense of safety and security returned. After that the lights stayed on.

By the end of the second day, we had covered the deepest sections of the cable and the rest of the inspection was completed without incident. We had pinpointed a few areas of exposed cable where the armor sheathing had unwound, but otherwise the BPA engineers felt that the cable was in generally good condition, and they were satisfied with our efforts. Needless to say, I was greatly relieved to have completed the job, as was Dick Anderson. Who admitted he had not relished the possibility of having to rescue the sub if it got hung up in deep water.

Before heading back to Anacortes on the last day, we all had a sort of 'wrap up' discussion on the overall job and Doug was able to elaborate on conditions he felt required a more detailed description. Then Vision towed Submaray back to the marina and the three of us said our cordial goodbyes to the BPA crew. Especially gratifying was the super performance of the UW communications system. During the work, Wayne Ross had cruised by in his boat and we spoke to him via radio, thanking him for providing this vital piece of equipment. Several months later he visited S. Calif. and enlisted Dick and I, along with Maray, to test out a diver to diver version of the same system.

The one weak link in this otherwise successful inspection was the lack of photography. Original discussions had stressed the desire of BPA to obtain still photos in addition to the tape-recorded data. Fortunately, I had backed away from promising a complete sequence of stills, and the agreement merely stated 'photos where and when possible'. I did manage to shoot a few stills of cable damage in fairly shallow water with ambient light. These were taken with a handheld camera through a special Plexiglas port installed in place of the mechanical arm for which we had no need and was simply in the way. But this port was on the starboard side and made It necessary to maneuver the sub into position, a time-consuming operation.

Ideally a 200 frame Canon or Nikon system with strobe flash, mounted externally in a housing, and operated by means of an internal switch, would have been great. However, I did not own that kind of equipment, and besides, Doug & I had our hands full just staying within visual range of the cable through the bottom centerline port. At that time portable video was expensive, bulky and of poor quality.

One helpful device I neglected to mention was an internal meter connected to an external senser which could detect 60 cycle current. This little gadget, provided by BPA, allowed us to anticipate the proximity of the cable within 8 or 10 feet and made each search for the cable a lot easier on the few occasions when we became 'lost'.

As we were driving to the local airport where Dick had flown in, he graciously suggested that I use his ticket to fly home to Los Angeles, and he and Doug would make the long drive home. It took me all of 3-1/2 seconds to reply in the affirmative and offer my profuse thanks. It had been a long four days and they were a good 15 years younger than I.

The major credit for convincing BPA to go along with this unprecedented method of underwater inspection goes to Joe Lamson, area engineer, and J.D. Rohlman, Maintenance Superintendent. I thank them both.

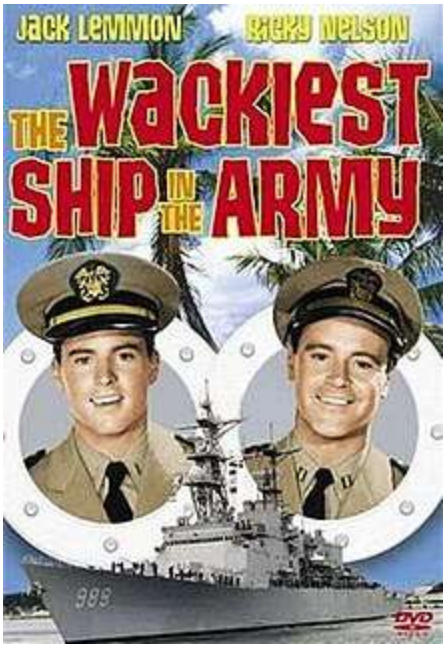
This is the end of the Mart's manuscript.

Epilog:

The manuscript by Mart Toggweiler appears to be incomplete in terms of the projects Submaray worked on. The Submaray continued to be successful for many more years.

Hollywood:
Submaray was also featured in a second Hollywood production, again as a prop, but with much more screen time.

Initially, “The Wackiest Ship in the Army” which was released, as a film in 1960, but Submaray did not have a part.



Actors:
Jack Lemmon, Lieutenant Rip Crandall
Ricky Nelson, Ensign Tommy J. Hanson
Tom Tully, Captain McClung
John Lund, Lt. Cmdr. Wilbur F. Vandewater
Chips Rafferty. Patterson (coast watcher)

The plot:
In 1943, U.S. Navy Lieutenant Rip Crandall, an expert yachtsman in civilian life, is based at Townsville, in Australia. He is surprised to be assigned command of a sailing ship, the USS Echo, a unique ship in the Pacific Fleet. The only crew member who knows how to work a ship with sails is eager young Ensign Tommy Hanson, who cost Crandall a yacht race with a mistake before the war. Lt. Rip takes command for a secret mission in waters patrolled by Japanese warships.

The USS Echo was based on the real-life USS Echo (IX-95), a 40-year-old twin-masted scow (flat-bottomed schooner) that was transferred from the New Zealand government to the United States Navy in 1942 and returned to the New Zealand government in

1944.

Later, “The Wackiest Ship in the Army” TV series pilot was released on September 19, 1965, with a total of 29 one-hour episodes. The last episode was released on April 17, 1966.

Actors:
Jack Warden, U.S. Army Major Simon Butcher
Gary Collins, U.S. Navy Lt. Rip Riddle, Captain of the “Kiwi”
Mike Kellin, Chief Petty Officer Willie Miller

Guest stars:
Karen Steele, Jack Soo, and James Hong.

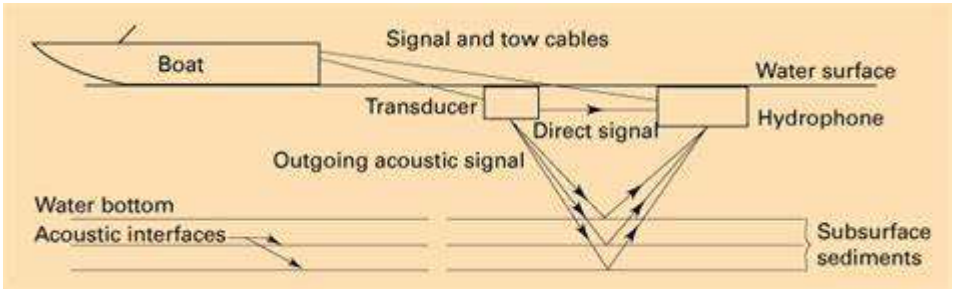
The “Wackiest Ship in the Army” in the TV Series Pilot, Season 1, Episode 1, “Shakedown”, the Kiwi is hit by a dud torpedo and captures a Japanese submarine.

The Submaray with its “wardrobe” installed, is first seen at about 27:22 into the episode.

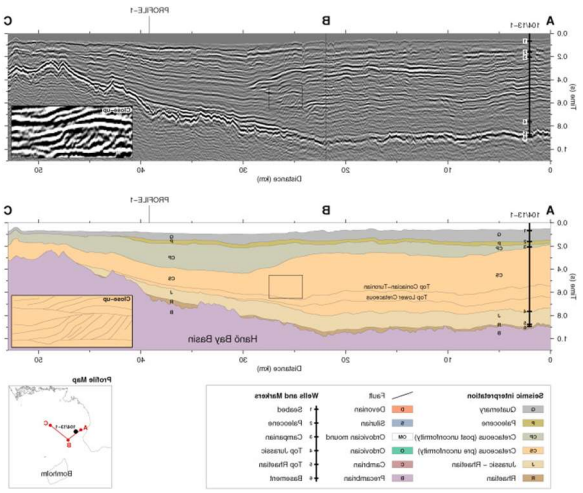
Mackinac Pipeline inspection:
Another project Submaray worked on was the Mackinac Pipeline inspection between Lake Michigan and Lake Huron.

Santa Barbara Channel Oil Exploration:
In the mid-1960s, a group of SCUBA diving geologists from southern California began providing underwater geologic exploration services out to a depth of 150 feet. This is the limit that a diver can safely go with a single tank, however it would be a very short dive due to the time limit which gets shorter the deeper you go. The oil companies began using them off Santa Barbara for taking rock samples and measuring the dip and strike of the rock strata. This was used to help create geological maps of the area in search of oil.

The geology group's company was "General Oceanographics, Inc. One of the geologists had developed a shallow penetration "sparker system" to perform Continuous Seismic Profiling (useful for harbor studies and determine the depth to consolidated rock). They have received a contract to survey Long Beach harbor and chartered the Maray as their support vessel. While they were underway to the dive site, Jim Vernon had noticed a picture of Submaray in the wheelhouse and started asking questions. He learned that it could go to 300 feet (double what they could do with SCUBA), Doug Privitt had built it (who was onboard to assist Mart) and it could carry two passengers. A seed had been planted in Jims's mind about this new capability and the business it could bring.



Example, Sparker system (the transducer sound was produced by electrically short circuited seawater, the "sparker")


Example, Seismic Profile

A few days later, Jim met with Doug to gather more information: it was 36” in diameter (cozy but big enough), it had a mechanical arm (which could be used to take samples), had a compass (to measure the direction of the strike), with an inclinometer (they could measure the dip) and, he had built a cardboard mockup of a 42” diameter hull and included a keel to house eight batteries (extending the work time to an entire day before needing a charge). He decided to contact oil companies to see if they were interested in geologic data out to 300 feet.

Six companies responded affirmatively, so he contracted Mart to lease Submaray and on March 3, 1967 they left Santa Barbara harbor abord the “Dawn Star”, with it’s Captain Chet Brown, for a survey trip off Santa Rosa Island. (The Dawn Star was later purchased by General Oceanographics as the support vessel for “Nekton Alpha”.)

Jim Vernon, noted “that we were undertaking the first submersible operation to ever collect geologic from the seafloor to search for oil.”


Jim Vernon, a geologist, aboard the “Submaray”

Due to bad weather on the third day of the trip, they sheltered in Cuyler’s Cove on San Miguel Island. In the calm water they checked out Jim Vernon to pilot Submaray. In part because of the delay and dead time but they also decided two geologists making observations were better than one.

The storm with 14+ foot waves

At the end of their geological mapping program, they received a call from Mobil Oil, they had lost a 2500-foot-long seismic streamer off Santa Rosa Island worth $100,000 and would take weeks to replace. With the provided coordinates they easily found the streamer hung-up on a jagged shale outcrop, snugly trapped. They successfully released the streamer, but it would drift from the current and snag again. After several more tries, they gave up. They contacted Mobil with the news and told them that it was likely it could be recovered in calmer water. They turned down the opportunity to try another recovery attempt.

The seismic streamer stuck under a shale outcrop

A few weeks later they wound up their geological mapping program off San Miguel Island in mirror-flat sea, so they decided to attempt another recovery. They successfully freed the streamer and brought it hand over hand on board. They reluctantly sold it back Mobil for $4,100 (that was their offer), since there was a small to non-existent market for a used and damaged seismic streamer. So, they accepted and moved on to other activities.

Doug and his nephew, Craig DeWeese, were currently working at C & D Tool & Mfg. which was a machine shop and a partnership. General Oceanographics offered a partnership where they provided the capital and promotion, with Doug and Craig providing the labor. They agreed and created “Nekton, Inc.”, a subsidiary of General Oceanographics, Inc. starting another legacy of submarine construction and operation.

The company name “Nekton” was chosen because it refers to the actively swimming aquatic organisms in a body of water. It was to be called Nekton because a submarine is free swimming. That would also be the name of the sub. The desired collapse depth was 1,500 to 2,000 feet, so with a 1.5x safety factor the depth was determined to be 1,000 feet.

Two additional submarines were subsequently built, so the original “Nekton” was renamed to “Nekton Alpha” and the additional two subs were called “Nekton Beta” and “Nekton Gamma”.

Current status of Submaray:
At some time Submaray was sold, the owner (we believe this was Lacy Johnson) and its location are unknown (Lacy lived in North Carolina). This is the last known picture of Submaray. The picture below shows Submaray being lowered into the water of a lake. It had a new rudder design. The water in the lake was very murky and they were likely not able to see the bottom (let alone one inch) from any of the ports.


Last known picture of Submaray

Its last known owner was Phil Nuytten and located at Nuytco Research, Ltd. Vancouver, Canada. Phil purchased it to be included as part of a submarine museum to display the history of underwater equipment. It was reported that, while welding on the hull's battery box the hull was warped and it was no longer able to dive. We suspect this could be repaired, but the current operational status is unknown.

Phil’s company developed the Exosuit designed and built in North Vancouver by Nuytco Research Ltd, this hard metal dive suit allows divers to operate safely down to a depth of 1000 feet (305m) and yet still have exceptional dexterity and flexibility to perform delicate work.

The current owner of Submaray is unknown (expected that is still Nuytco). Phil Nuytten passed away in 2023. Attempts to contact Nuytco Research, Ltd. to determine the status of Submaray, obtain a more recent picture, and its current location have been left unanswered.

The total known dives for the five submarines built by Doug:

Submaray 425
Nekton Alpha 828
Nekton Beta 842
Nekton Gamma 1442
Delta 5874

Total: 9411 Dives

There are many more, the dive logs have been lost or cannot be currently be found.

The Total is Well over 10,000 Dives!