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THE SUBCOMMITTEE REPORT

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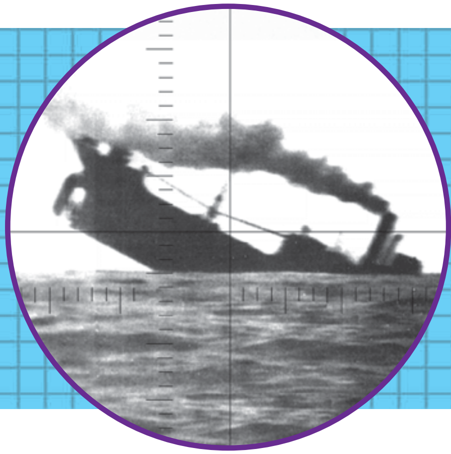
On the Cover

Tom Chalfant's lifelike 1:72 Moebius Skipjack *(depicted as* Scamp*, SSN-588)—combined with the amazing photography he's been turning in lately—makes for an irresistible front cover, don't you think? Check out Tom's article in this issue about his latest approach to shutterbugging. P.S. See that dishing in on her sail? I thought it'd been molded into the resin piece. But I checked, and the effect is actually painted on—by a certain Mr. Merriman. Wow. Utterly convincing.*

Next Issue Deadline: Oct. 15, 2021



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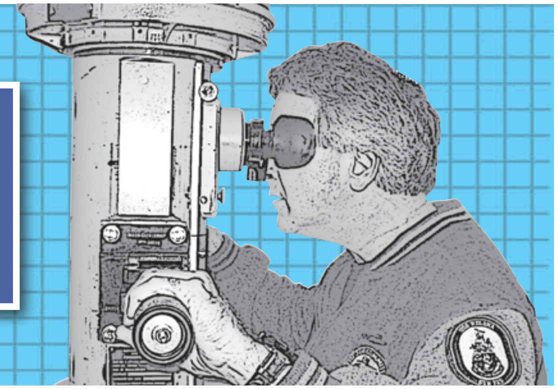


CONTRIBUTORS

Jim Christley An avid historian and former submariner, long-time *SubCommittee Report* readers will remember Jim's many articles covering different aspects of the 1:1 submarine realm. He's now returned to us and will continue his chronicling of the world of real submarines.

Paul Crozier The driving force behind the www.warfish.com website focused on the USS *Wahoo* and her daredevil command duo, Mush Morton and Dick O'Kane, Paul has assisted our magazine for many years, providing much content and production work and dutifully helming the Smoke on the Horizon column as well.

Tom Dougherty Our long-time expert on static modeling, Tom continues to provide hands-on insight about many submarine-related modeling subjects old and new. He also regularly tours museum subs and regales us with coverage of these fascinating visits.

Jeff Porteous A book review enthusiast, Jeff occasionally provides the straight scoop on various new and old submarine-related works.

Bernhard Wenzel An expert r/c modeler hailing from Germany, Bernhard has recently weighed in with multi-part coverage of his impressive scratchbuild of the *U9*. We're looking forward to more from him in the future.

Ahoy, SubCommittee faithful!

Welcome aboard another issue of *your* sub hobby magazine. Here's hoping more of you will take that message to heart and send me additional build-related or *any* other articles of submarine interest to appear in these pages. As always, the coffers are getting low here in the Yeoman's Shack, and there are more *SCR*s in convoy, hull down, just over the horizon. Contact me if you have questions about topics or submission specifics.

As for the treats coming your way *this* time, well, for starters, there's our old friend and current Treasurer, Tom "ShutterSpeed" Chalfant, showing off his camera comfort with a treatise on how waterproof photography can add more fun to our model submarining. Why not grab your own camera and join him? Also, I continue my *Harder* fixation with the next installment of Ned Beach's magazine account of her colorful history, plus Part Two of my own *Harder* conversion build from the popular Revell 1:72 *Gato* styrene kit.

As usual, you'll also find fascinating historical articles: Jim Christley covers the development of submarine control surfaces, plus there's an all-new opus on nuclear power from frequent contributor Tom Dougherty. (Better make sure your national security clearance bona fides are up to snuff; I'll be collecting cards and distributing dosimeters at the door.) Tom's regular "Static" column also brings us another of his unique looks at display model sub building.

Lastly, there's Bernhard Wenzel's final installment of his *U9* scratchbuild coverage (more to come from him in future issues), plus our regular features.

And next time? Something new: *Dueling Boats in the Key of West*—Matt Homeier and SubEd Tordahl separately put their unique spins on building an r/c version of the nuke boat our new Membership Chairman Matt himself rode earlier in his Navy career. Compare and contrast—or whistle that banjo tune right along with your own build. It's a modeling experience devoted to *L.A.*-class SSN-722 you won't want to miss.

Okay readers, step right aboard this new issue and standby for fun!

Managing Editor,
Jeff Porteous editor@subcommittee.com

Jeff

She was just about the fightingest fleetboat of them all; and her career under Commander Sam Dealey is a saga of wartime gallantry we should all remember.

Hit 'Em Harder!

by Capt. Edward L. Beach, U.S.N.
SubCommittee Member Emeritus

Sibutu Passage, in Dealey's area, provided a natural focal point for traffic to pass through. He planned to strike his first blow there, leaving calling cards in the bellies of a couple of fat targets, and then standing by for the Jap reaction. Since his initial blows were to be right on the doorstep of the Jap fleet, so to speak, he felt little doubt that there would indeed be plenty of said reaction.

On May 26th, 1944, *Harder* left Fremantle, and on the morning of June 2nd passed through the Malay Barrier. The strait she used for the transit, Alas Strait, has a

Editor's Note: For many reading this, the name of the late Edward L. "Ned" Beach is a household one...firebreather aboard famous WWII boats *Trigger* and *Tirante*; skipper of the *Piper* at war's end; later skipper of *Trigger II* and the globe-circling *Triton*; Naval Aide to President Eisenhower; right-hand man to Rickover; renowned author of *Run Silent, Run Deep* and its wonderful sequels—and more...including a beloved member of the SubCommittee! But did you also know that the good Captain actually honed his writing chops on historical sub articles for men's adventure magazines of the '50s like this one? Dive in and enjoy!

(Despite very earnest efforts, we've still been unable to reach the Beach Estate about these SCR reprints. Nevertheless, we remain convinced that as an SC member and dear old friend he would support our efforts to keep his acclaimed submarine writing before the eyes of his fans.—Jeff)

four-mile bottleneck at the northern end. Not insensitive of the desire to deny passage to enemy submarines, the Japanese had stationed there three very small yet capable patrol vessels. *Harder*'s radar picked them out of a black night however, well beyond possible visual contact, and thus easily left them far astern. Sam Dealey was after bigger game.

During the remainder of that day and the next two, sometimes diving, sometimes remaining on the surface, *Harder* held steadily on her way toward the coast of Borneo—avoiding as she did so any chance of being spotted by the many fishing boats in the area. Long acquaintance with these plentiful craft had convinced most of the submarine skippers that one might occasionally have a radio set and belong to the Jap navy.

Borneo came into sight on June 5th, and *Harder* dived for a day's submerged patrolling. Nothing was seen, and that was enough for the impatient Dealey. On June 6th, he spent all day on the surface, dodging into and out of rain squalls, working his way up to Sibutu Passage. He would attempt to pass through that very night. Surely that should bring some action!

Shortly after sunset on that day, the submarine commenced a run northward up the center of Sibutu Passage, but she was not permitted to continue her course very long.

"Radar contact!" The words never fail to spread to every man in the ship, awake or asleep. *Harder*'s ever-vigilant radar had picked up three large ships escorted by three destroyers, likewise coming through the strait but on the opposite course—the first contact worth bothering with on the patrol to date. Maybe this would provide Sam the opportunity he needed to leave those calling cards!

By this time, a radar contact and the ensuing maneuvers are old hat to Sam Dealey and his seasoned crew, but the thrill of the chase never seems to grow old. This appears, however, to be a rather easy situation as convoy attacks go, for *Harder* finds herself already on the bow of the group and has only to solve for course and speed before going in for an attack. The ships are making pretty good speed, however, and *Harder* is forced to work up to her fastest while Sam and his assistants maneuver her into the best position to start the attack. The only fly in the ointment, one might say, is that there is a brilliant full moon so visibility is excellent, even though by this time it is long after sundown. Plenty of clouds overhead, though; if luck is with them, *Harder* will attain her sought after position and submerge on the convoy's track before she can be sighted.

Not much longer to go now. The situation looks good. Sam plans to dive in such a spot that the convoy and its escorts will pass on opposite sides of him; thus he'll have a shot at tankers as well as destroyers.

But things are not to be so easy. The convoy changes course just as it clears Sibutu Passage, and *Harder* is left out in right field. Nothing to be done but dig in and try to regain what was lost—but suddenly this opportunity is also denied her! The moon, which had been cooperating beautifully, has chosen this instant to come out from behind the clouds and floodlight the entire scene. A careful scrutiny of the convoy escorts confirms the plotting party's worst suspicions: *Harder* has been detected! The nearest destroyer has now put on full speed and is headed directly for her. Great clouds of black smoke boil out of his stacks as the firerooms are called upon for maximum power; his bow lifts slightly with the force of the thrust, and a huge bow wave, frothing from before his knife-like stem, advertises he intends to have a looksee.

Nothing left to do but run for it. At "All ahead frantic" *Harder* can barely exceed nineteen knots, and it is soon evident that the blankety-blank tin can astern is clipping them off at twenty-four knots or better. Dealey will have to think of something else. The range to the enemy is inexorably reduced to ten thousand yards, then nine thousand, then eighty-five hundred.... At this point Sam pulls the plug and down his ship goes, stopping neatly at periscope depth. A lesser man might have gone right on down to deep submergence and concentrated on evasion, and there is little doubt the Jap destroyer expects exactly this maneuver. It is monstrous bad luck for him then that the sub he is after happens to be the *Harder*—for Dealey has no such defensive intentions.

All his fighting spirit has been aroused, and the skipper of the submarine now strides the narrow deck of the conning tower as an old-time frigate captain might have paced his quarterdeck. The moment the ship is fully underwater, "Left full rudder!" is called out by the skipper.

Obediently *Harder* alters course to the left and draws away from the path down which she has been running. A tricky stunt, this, fraught with danger. If the DD up there has enough sense to divine what has occurred and suspect the trap laid for him, things will be tough, and no mistake! He'll have little trouble picking up the submarine broadside-to with his sound equipment, and probably be able to do plenty of damage with an immediate attack.

But fortunately he suspects nothing, comes on furiously down the broad, telltale wake left on the surface, blunders right across *Harder*'s stern, and is greeted with two torpedoes—which strike him under his bow and under his bridge, breaking his back.

With the bow torn nearly off and gaping holes throughout his stricken hull, the Jap's stern rises vertically in the air. Clouds of smoke, spray and steam envelop him, mingled with swift tongues of red flame licking feverishly lick at his sides and decks in a hurry to consume as much as possible before the waters of the sea close over him. Depth charges, normally stowed aft where they will be ready for immediate use, fall out from the rear of their racks and crash down upon the deck slanted beneath them. Some of them, reached by the flames or perhaps merely activated upon impact, detonate in horrifying explosions effectively nullifying any chance those caught in the holocaust might have had to survive.

In the meantime, the mind of Sam Dealey has been clicking on all eight cylinders. When you're on your game in such a situation, you are capable of most anything. No sooner does he observe the success of

U.S.S. Harder (SS-257).

this attack than he utters a single rasping command: *"Surface!"*

Three blasts ring out from the diving alarm—the standard surfacing signal—and the long black hull of *Harder* slowly boils to the surface barely one thousand yards away from and less than two minutes after the eruption of her torpedoes. Water cascades from her decks and bridge structure as the conning tower hatch is opened and the skipper, followed by a few others, scrambles up to take his familiar position. He has two reasons for the haste. First, there may be a chance of saving a Jap or two, and Dealey will do his best to give even a despicable enemy a chance for life. Second, there is still a large convoy somewhere nearby which this tin can had been escorting, and there may yet be a chance of catching it.

A quick look around. The place where the destroyer had been is a mass of roiled water and oil, with a huge cloud of smoke hanging over it all. Chunks of junk still fall from the skies—mute testimony to the violence of the explosions, which after all, occurred less than three minutes before. Nothing whatsoever can be seen of the unfortunate ship, nor are any survivors evident. The lure of the convoy is calling strongly, but Sam resolves to give the Japs one more chance should there be any left around. A difficult decision to make, for the rules of war do say, "Attack first, then save life." But Dealey, for all his astute bloodthirstiness, is a humane man, and he plays his hand as he sees it.

"Answer bells on four main engines!" The order is relayed immediately by telephone to the maneuvering room, where is handled all the electrical and propulsion control of the ship. The electrician's mates on watch in the compartment (normally three, but now at battle stations, increased to five) pass the signal to the engine rooms to start engines. As soon as the "ready" signal is received from the enginemen, a complicated play on levers, switches and rheostats begins. Within seconds after the initial order from the bridge, four diesel engines are rolling over at maximum speed, muttering their readiness to answer any demand made upon them.

"All ahead one third!" This is a surprise—why four engines to only go one-third speed? The skipper has something up his sleeve, obviously. One-third speed it is, and there is hardly a change in the beat of the sixteen-cylinder V-type behemoths as they take up the easy load.

Up on the bridge, however, the Captain's object is immediately obvious as the rudder is put hard over to reverse course. Without hesitation, *Harder* heads at slow speed back toward the spot where the destroyer has gone down. Everyone on the bridge strains to see if there are any survivors floating about. Rescue gear consisting of a life ring made fast to a length of light line, two life jackets, a boat hook, and a grapnel are brought up from below, and one officer and one enlisted man prepare to go over the side to haul anyone aboard if it should prove necessary.

Slowly now, the submarine cruises the area—but nothing is seen except a heavy oil slick. Passing through it, the rudder is put over again and *Harder* reverses course once more to push into it a second time. Still no luck, and Sam Dealey now feels he has done his best, certainly more than the Japs would've done for him had the situation been reversed.

A new command is quickly called down to the maneuvering room: *"All ahead flank! Make maximum full power!"*

This is the order the electrician's mates have been waiting for. More working with rheostats, more shifting of levers. This time the even beat of the diesels increases smoothly, but oh-so swiftly, into the full-power roar which is the song of the Submarine Force. Engine revolutions go up to their maximum—and a little over—as governors are brought up hard against their stops. The timbre of the engine beat grows deeper as engine loading is also increased to the maximum. The needles on the cylinder temperature dials rise steadily under the increased engine demands, injector pressure rises, and a greatly increased volume of air is sucked into the engine rooms to feed the greedy cylinders. With engines at slow speed in low power there is a moderately strong suction, and the air currents from the main induction outlets in the compartments are fairly heavy. But when full power is called for there is a veritable gale of wind produced—it sweeps before it nearly anything not securely tied down.

In the maneuvering room, the result of all the activity in this engine rooms shows itself merely as increased volts and amperes on some of the dials displayed before the intent watchers. But that change in itself requires some adjustments—and the end result is that the two heavy propeller shafts

A weary SS-257 rests at refit.

beneath them in the motor room increase their revolutions per minute, speeding up ever faster, until they are straining at their maximum full r.p.m. On the ends of the shafts, the great four-bladed propellers have increased their swishing beat until the whole after end of the ship trembles with the unleashed power. The reduction gears' whine has now increased to a high-pitched shriek, and an atmosphere of tenseness and watchfulness has descended upon everything.

To the bridge watchers more than anyone, it is evident *Harder* has darted ahead with surprising speed. Her designers had built her for twenty knots, and with the enemy practically in sight, she is doing every bit of that and more. There is a trembling felt on the bridge which is partly the shaking of the ship's structure and partly the shaking of nerves. There is a rhythm and a cadence to it all which sets pulses pounding and hearts racing, and everyone's loins have tightened into a knot. There is also a clearness to the air and the straightness of the wake astern, a positiveness and directness to everything being done. For everyone there is a steadiness of hand belying the pits in crew stomachs, a firmness of voices belying the turmoil of souls—a fierce joy of fighting combined with a fear of dying, for all are going into combat!

The skipper continues to consider the situation. The convoy was last tracked on a course for Tarakan Island, not far from Sibutu Passage, where there would be an anchorage presumably safe from submarine attack. So now it has all developed into a race to see who can get to Tarakan first.

The radar operator watches his screen avidly, not just for information on the whereabouts of the convoy, but in case the enemy should detach a second destroyer to make sure of the submarine attacked by the first. Indeed, since he should by this time have become concerned over the lack of news, maybe he will suspect what has happened. In such a case, a second tin can will be a certainty.

"Radar contact!" Sure enough. It was entirely too good to last. Another destroyer, and not far away! From the speed with which the range diminishes, he is obvious he is heading directly for *Harder*!

"Battle stations submerged!" A few hurried minutes of tracking. No doubt about it: this fellow is a comer! Perhaps he has seen her, though it seems unlikely since, in such a case, the sub herself would have had to have lacked a proper lookout watch—unthinkable under the circumstances. Maybe he has radar information: the Japs have been suspected of this for some time. Perhaps this is the payoff? Or maybe he's just running down a most probable contact bearing based on previous information. At any rate, *Harder* had better get out of his way!

"Take her down! Dive! Dive!" There may still be a chance of going after the convoy, but this new fellow requires attention first. Again the approach. Not so easy as last time. This bird is wary, and zigzagging. He's alert, no question of it, and no doubt he is fully aware of what happened to his buddy.

On he comes, weaving first one way, then the other. It has become fairly dark. Broken clouds obscure the moon and deprive Sam Dealey of the light he sorely needs to make accurate observations. The destroyer is a dim blur in his periscope. Ranges are inaccurate and estimations of enemy course difficult to make. Finally, with the best information he can set into the TDC, Sam gives the order to fire. Get the jump on the enemy—that's the Dealey creed. Six torpedoes charge toward the oncoming destroyer.…

The sound operator listens intently for the proper functioning of the deadly fish. White-faced, he turns to his skipper: "Can't hear the first two," he gasps. "Last four seem to be running okay."

Two sinkers! But four out of six are still alright. They should do the trick, barring extraordinary luck and skill on the part of the Jap.

Up with the periscope again—simply *got* to see what's going on! The shiny steel tube hums up out of its well; the skipper's eyes glue to it, his face pressing tightly against the rubber buffer of the eyepiece. Time stands still for the fire control party—as it does now for every member of the crew. There is no way of knowing what is happening except through the eyes of the Captain. From his attitude and actions, plus what few descriptive words he might remember to say, everyone makes up his own picture of the situation topside.

This time they do not have long to wait. The Captain's figure stiffens. "He's seen them! He's turning this way! Take her down!" As the submarine noses over in obedience to the command, Dealey gets a final view of the enemy ship twisting radically back and forth to avoid the torpedoes. Almost inaudibly, Sam mutters, "Good work, you son-of-a-bitch!"

That was as far as his accolade of the enemy's maneuvers could go, since Sam now had much to do and little time to do it. *Harder* immediately becomes rigged for depth charges, and also all non-essential machinery is stopped—the condition of "silent running."

The sound man has just become the most important member of the crew. All hands hang on his words as he slowly, deliberately swivels the control wheel directing the ship's sound heads. "Target is starting a run," he announces—one might think this operator were reporting a drill instead of a life-or-death struggle.

"He's shifted to short scale!" Tension now rises all around as the enemy destroyer speeds up his efforts, shortening the interval between his pings as he closes the range. All hands unconsciously brace themselves against something—anything solid—awaiting the delivery of the first depth charges. The shock doesn't take long—*Harder* is just reaching deep submergence when the first five depth charges explode in her face! This veteran ship and crew have received many such wallops in the past, but a depth charge is something one never gets used to. The whole ship shudders convulsively as the cataclysm rains upon her, the vibration of the hull swiftly filling the air with clouds of dust particles and bits of debris from broken light bulbs and other fragile fixtures.

In the control room, a new man is on the stern planes. This is his first patrol and he is doing his best, but perhaps straining too hard in his anxiety to make everything perfect. The stern plane indicators suddenly stop moving. He instantly deduces the electrical control for the stern planes has been damaged. Quick as thought, he shifts to hand power, frantically tugging at the slow-moving change gear. Then, panting heavily and a little flustered, he rapidly spins the wheel—the wrong way! It takes less time to do than it does to tell about it. The power to the stern planes had not been lost—merely its indicating circuit—but the end result is that as *Harder* reaches maximum depth, full dive is on her stern planes instead of full rise!

In a second everyone realizes something is wrong. Instead of gradually decreasing her angle, the ship now tilts down even more, feeling as though heading into an outside loop. The deck slants at a nearly impossible angle and depth gauge needles rotate unheedingly past the three-hundred-foot mark.

"All hands aft on the double!" The diving officer's harsh command starts everyone moving except those required at their stations. In the meantime, he quickly looks the situation over, reaches beyond the struggling stern planesman's heaving shoulders to cut in the emergency angle indicator with the flip of a tiny switch—which was what should have been energized all along. It displays *"Full Dive."* Grasping the wheel, the diving officer puts his shoulder and whole body into countering the effort of the now frenzied planesman, wrests it away from him, and begins to spin the wheel counter-clockwise. He works silently with the furious speed of urgency. When he has finally corrected the planes to full rise, he turns them over again to the trembling sailor who had caused the trouble. "Watch this," he says, pointing to the emergency angle indicator—no time now for further investigation or instruction.

The angle starts to come off the ship, and she finally levels off far below her designed depth. Then she commences to rise again: the forty-odd men huddled in the after parts of the ship have created a rather large unbalanced weight, and the stern planes in hand power remain difficult to turn. So as the bow of the ship continues up, the deck now tilts in the opposite direction. The men sent aft understand what is happening and stream forward as soon as they sense the need to balance things out, but it is not until she is halfway back to the surface that she is finally brought fully under control.

In the meantime, the destroyer has reversed course and returned to the vicinity where those first five depth charges had been dropped—and the problems of the hard-working men in the control room become quickly increased by another severe hammering.

You have to hand it to this destroyer. He has taken the initiative away from the submarine and effectively protected his convoy. Sam Dealey's only thought by this time is to get away from him. It takes a few hours to do so, but *Harder* finally comes to the surface several miles away from the area of the attack. This has been an eventful four hours!

Late in the afternoon of the next day, *Harder*'s crew is still resting from the strain of the previous evening. The ship patrols submerged, and everything appears calm and peaceful—until the musical "Bong! Bong! Bong!" of the general alarm shatters the quiet of the sleeping men. They dash to their stations, hardly pausing to throw on shoes or other clothing. The word flashes almost instantly throughout the ship: Another destroyer!

This is a fast one. There has been a slight haze on the surface and the range at sighting is four thousand yards, angle on the bow port twenty. *Harder* turns and steers for the enemy, preparing all torpedo tubes as she goes. At three thousand yards, the destroyer leans over and heads directly toward her, having probably spotted her periscope in the glassy smooth sea. He then commences to weave back and forth, increasing speed rapidly as he roars in. No question now he has detected his target! Sam will have to fire right down his throat to get him. If he misses—well, he had just better not miss. If the destroyer catches *Harder* at shallow depth, things will unquestionably get very tough.

The range closes quickly. Two thousand yards. Fifteen hundred yards. Sound has been listening to the target's screws coming in, speeding up during the approach. But ut like all good sound men, he trains his gear from side to side to keep aware of all sectors. Suddenly he sings out, "Fast screws bearing oh-nine-oh, short-scale pinging!"

This can mean only one thing, but there is no time to look now. Keep calm. Keep cool. One thing at a time. This bird ahead is coming on the range. Get him first and worry about the other later.

One thousand yards! Standby forward! Standby One! Angle on the bow ten port, increasing. Wait a moment till he has come to the limit of his weave in one direction and is starting his way back. Angle on the bow port twenty, range seven hundred yards. His swinging has now stopped….

"Bearing, mark!" snaps the skipper. "Standby."

At the TDC, Sam Logan makes an instantaneous but careful check of the device and observes that the generated target bearing showing on its face is exactly the same as the periscope bearing.

"Set!" he snaps back at his skipper.

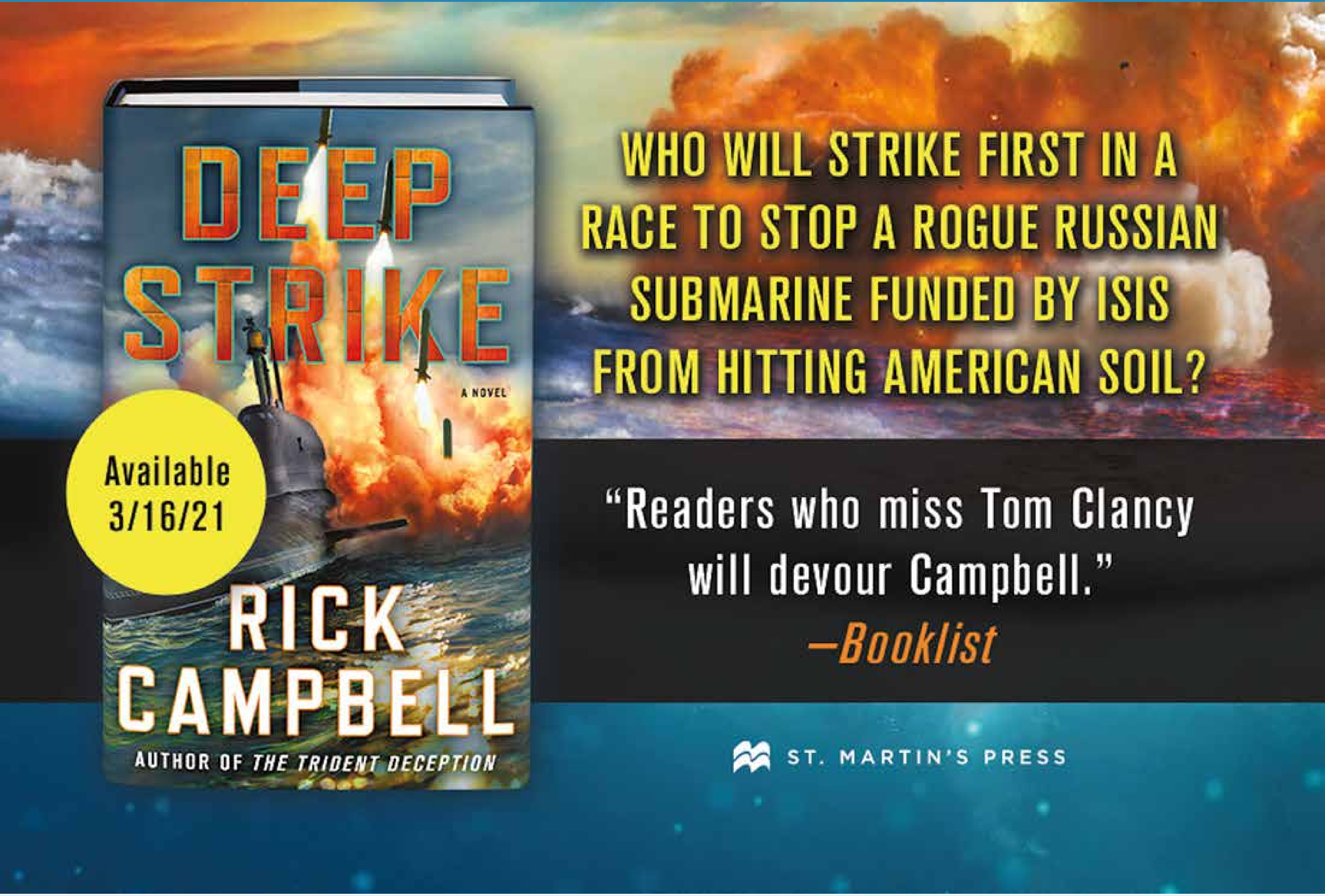
"Fire!" There is a small but perceptible jolt transmitted to *Harder*'s hull as she disgorges one of her deadly missiles. Logan takes up the count at his TDC, spacing the torpedoes deliberately to eliminate any possibility of their running into each other, and also so they will diverge slightly as they race toward the destroyer. One after another, two more torpedoes surge toward the careening vessel.

"Right full rudder, all ahead full!" Dealey hurls the orders from the periscope as he stands, eye glued to the instrument, watching for the success or failure of his daring attack.

Suddenly he shouts, "Check fire!" Almost simultaneously a heavy explosion is felt by everyone aboard. He need not pass the word to explain what this was—the crew has heard plenty of torpedo explosions before. Dealey has stayed Sam Logan's hand even as the latter was about to fire their fourth fish—precious torpedoes must not be wasted.

With rudder and speed both full on, *Harder* has already gathered way through the water and turned from her former menace. The captain continues to watch, however, and is rewarded by the spectacle of his third torpedo smashing into this poor fellow's stern. Clouds of smoke, steam and debris rise from the stricken enemy high above the tops of his masts. He is so close that although his directive force and power are both gone, momentum keeps him coming, and it behooves *Harder* to get herself clear—which she now attempts to the best of her ability.

(To be concluded in the next issue of the* SCR.*)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*click*BAIT:

by Tom Chalfant

Looking for a different way to photograph your beloved model submarines? In the following pages, I'll describe the new direction I've taken in recent months.

Shooting Your Subs Can Be as Much Fun as Running Them

"Come to Papa, Ya Little *Scamp*."

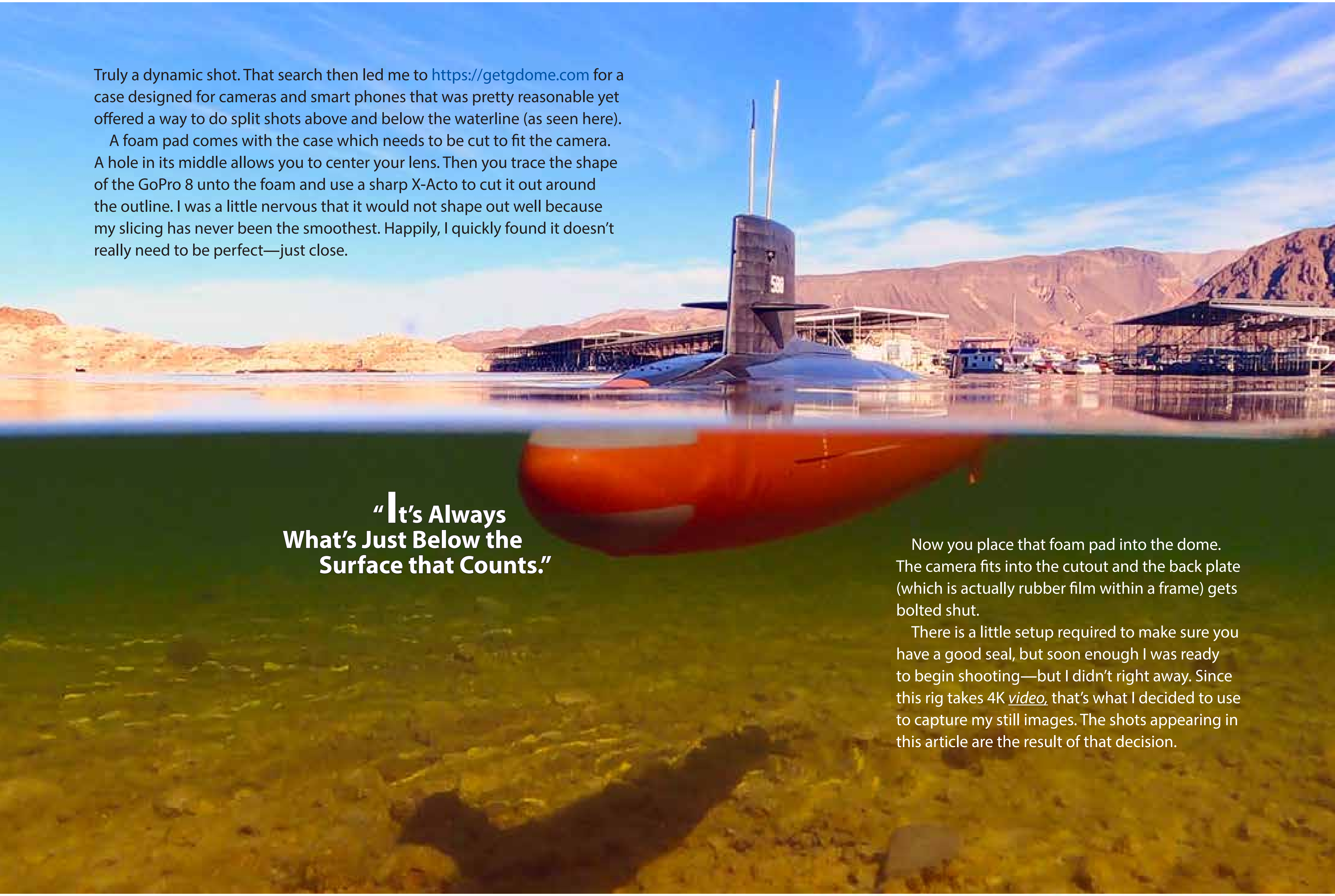
A big part of my model submarine enjoyment is recording my outings and capturing memories—and trying out new approaches to make my photos more interesting. But I had recently discovered my Sony video camera was not doing well underwater. Even though it had come with an underwater housing, the photos were turning out fuzzy.

Searching the web for a solution, I found out my Sony model actually needed a *different* housing, one featuring a flat lens. I happened to already have that particular housing on hand, so I tried it a couple of times. It leaked, unfortunately, and though the video was indeed clearer, the results still did not thrill me.

Practicing with my new camera rig. (See following pages.)

"Mirror, Mirror, on the Wall, Who's the Fairest *Scamp* of All?"

So I went and purchased a GoPro 8 Black. The Black version, as I understand it, can be submerged and can record 4K video, plus has other features, including anti-shake. I did not want to put my new camera directly into the water for fear of leaks, so I looked for a case. I ran across articles about using a dome underwater; a dome can take photos at the waterline—partly above and partly below—without a large diffractional image shift at the break line. I had seen a photo of a surfer catching a wave and the shot showed him above the waves *and* the water beneath him.



Truly a dynamic shot. That search then led me to https://getgdome.com for a case designed for cameras and smart phones that was pretty reasonable yet offered a way to do split shots above and below the waterline (as seen here).

A foam pad comes with the case which needs to be cut to fit the camera. A hole in its middle allows you to center your lens. Then you trace the shape of the GoPro 8 unto the foam and use a sharp X-Acto to cut it out around the outline. I was a little nervous that it would not shape out well because my slicing has never been the smoothest. Happily, I quickly found it doesn't really need to be perfect—just close.

"It's Always What's Just Below the Surface that Counts."

Now you place that foam pad into the dome. The camera fits into the cutout and the back plate (which is actually rubber film within a frame) gets bolted shut.

There is a little setup required to make sure you have a good seal, but soon enough I was ready to begin shooting—but I didn't right away. Since this rig takes 4K *video,* that's what I decided to use to capture my still images. The shots appearing in this article are the result of that decision.

"I am the *Walrus*, Goo goo g'joob."

The dome for the lens (above) and the sealing rubber backing (below).

Getting back to the 4K video, there is understandably some confusion as to the exact specs of what 4K means (vendors have muddied the waters about it), but the most common is a resolution of 3,840 x 2,160 pixels. High-Definition (HD) is 1,920 x 1,080 pixels or half of 4K. So, using 4K video, the resolution is excellent for grabbing a single frame. Instead of hoping to get one shot right using a standard camera, by shooting video, I am getting 60 frames per second. Since I use an Apple laptop, I can extract frames using iMovie. In iMovie, I go to File>Share>Image.

Once your image is exported, you can then modify it (color correct or crop or whatever) to your heart's content.

"Only One Tusk on This *Walrus*, and It's Difficult to Remove; of Course, in Alabama, the Tuscaloosa."

"You Like *Gayto*, I Like *Gahto*, Let's Call the Whole Thing Off."

There are a couple of tips I can offer. One is to keep your subject as close as possible. The further away, the more the water's clarity comes into play to blur your image.

Also, keep the sun at your back or to the side. And try to make sure the camera's reflection in the water is out of your field of view. Be wary of sun flares too. Sometimes all these conditions are unavoidable; just keep them mind.

Having the sun at your back can pose its own problem: your shadow in the picture. I once captured a wonderful video clip of my *Scamp* running below the surface, but my own shadow got in the way and ruined it.

I've had this camera housing now for only a few months and a couple of runs, but I've found I've really enjoyed playing with catching my subs in unique new ways. You can too.

SUBMARINE-RELATED NEWS & EVENTS FROM LOCAL SUBCOMMITTEE CHAPTERS

Compiled by Jeff Porteous

Local SubCommittee Squadron News & Events

The SCR is always on the lookout for model sub-related local news and Squadron events. Please forward your updates, photos and other submarine news to:

Jeff Porteous
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SubComLI

We've been having a blast out on "The Island" this past spring and early summer, running practically every Sunday morning. This equates to a LOT of stick time and to the ironing out of any bugs early on. It's a joy to be part of such an active group.

On a sad note, many know I'm moving to the Dallas/Fort Worth area, which means I'm leaving behind my beloved shipmates of over thirty years. I'm sure Ray Mason, Irving Lloyd and others will continue the excellent level of fellowship we have enjoyed here. My soon-to-be new shipmates in Texas will be receiving a VERY active SC member who is looking forward to increasing fellowship and operations in that area. I may look into spawning a new local squadron should I get enough locals within a four-hour drive window. I know it's SubRon5's Op Area, but they cover a LOT of real estate and breaking it up a tad might be beneficial. After all, SCLI coexists well with SubComEast and SubRon4 nearby.

Now on to current activity! *(See photos of recent meet on next page.—ed.)* Fred Swendsen is shown with his surface-running Engel *Gato*-class boat. He purchased her "used" at the WRAM show a few years back and is currently refitting her. I don't think he's going with the piston system and may choose an entirely different diving method.

Also among those at the local party—see photos next page—is none other than World Famous Irving Lloyd with his "as generic as you can get" fleetboat, a Revell *Gato*-class surface runner. Well, at least Irving is very famous here on the Island since his was the only r/c sub we ever saw catch fire while submerged—ugly dark yellow/brown smoke bubbles and all! Happened back in the '90s, but we still laugh about it to this day. Alas, I think that particular boat has been mothballed, but Irving is quite happy with his new one.

Brian Wright showed up as well with his new "modular" SubDriver sporting a Moebius *Skipjack* skin. Photos show his second real-world sea trials, which determined his submerged trim is "stern heavy, light overall." A bit of adjustment, and a piece of foam near the stern should fix that puppy…

I brought the *Grant*, my 627-class boomer. I've been focusing on her this spring to ensure I have a smaller boat operating well. It's good to have a variety, of course, which opens up running areas. Large and deep: 1:48 *Skipjack*. Small and shallow: 1:96 *Skipjack*. You get the idea.

Had a weird inconsistency issue with the *Grant* which turned out to be air entrapment among the aft group of foam buoyancy blocks. Usually I make sure

SubComLI: Fred Swendsen's Engel Gato *surface runner.*

Fred's Gato *headed out on a So. Pacific patrol.*

Irving Lloyd shows off his *generic* Gato *fleetboat..*

Irving's boat seeking targets. Note her high freeboard.

Brian Wright's Moebius Skipjack *starts more sea trials.*

That stern foam ought to handle things, Brian.

"Sub" Ed's USS Ulysses S. Grant *(SSBN-631).*

Ed's Grant *heads smoothly downstairs…*

Ray Mason's 1:96 Skipjack. *(They're everywhere!)*

Time to go in for an allignment & lube job, Ray.

Shipmates ashore and at sea...

Skimmers would do well to remember there are four tubes aft as well.

air can get out, so this was a tough one to pin down. Took some time to figure it out! The photo (previous page) shows I'm commencing a dive waiting for those fairwater planes to dig in. To answer the long-standing question as to whether they're worth it, my fairwaters work quite well even though the boat is only 1:96. On any properly trimmed r/c sub (regardless of scale), the fairwaters WILL work. They just have a lag, like the 1:1-scale boats do.

Finally, the infamous Ray Mason showed up with his 1:96 *Skipjack* (previous page), which has an older 3" WTC. We all know Ray is fairly darn meticulous when it comes to his work, but methinks he needs to align those fairwaters better.

It was a great day as usual playing among the targets—who are now learning to exercise due caution with operational r/c subs in the water. For one moment, I was right back to the late '70s/early '80s, leaving Holy Loch with an escort to clear our baffles.

Stay safe and keep your own baffles clear...

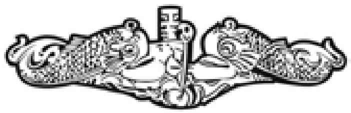
- "Sub" Ed Tordahl

SubComMI

July 3, 2021: Summer's in full swing! SubComMI has returned to our Laguna Sub Base in Elk Grove for our bi- weekly summer sub runs. We always start in the month of May and run through August, then finish off at our annual Fall Fun Run in San Francisco at the Casting Ponds in Golden Gate Park in September.

Laguna is an excellent location with clear water and plenty of biologics to play tag with our fleet of boats.

- David Marquez



SubComMI: Modified Bronco Type XXIII on patrol.

1:96 USS Sturgeon *(SSN-637) is put through her paces.*

SubTec Albacore *(AGSS-569) picks up some marine grass.*

Sacramento Model Shipwright skipper, Steve Cowdin.

SubComON

Well, there really has been nothing happening up north. We have been in lockdown for what seems like forever, and only a couple of weeks ago did things finally loosen up to the point where we could actually go to the park and float boats. But after being told the weirs were in place *(blocks of wood or concrete dropped into the river which slide into supports to act like dams, raising the water level to about four feet—per Bruce later, ed.)*, Rick and I drove for an hour only to find when we got there that we had been misinformed: no weirs—

and not enough water to float anything. So, very disappointing, to say the least. We are keeping fingers and all body parts crossed for them to open the U.S. border soon so we can get to Carmel this summer, or even run our boats with the Rochester Gang. Just trying to stay optimistic. *(Carmel's just been called off.—ed.)*

- Bruce Martin

SubRon4

Things have taken a negative turn here in Swamp Yankee-land. We basically have nowhere to run our boats. We've been squeezed out of the good bodies of water by the niche nature of our hobby, by skimmers, and by the unknowing bureaucrats who run and maintain the good waters. The RI side of Beach Pond has closed us out, since all the parking is reserved for 1:1 scale boats and trailers on the boat launch/beach side—and for hikers, shore fishermen, and canoes/kayakers on the small side, which is also too shallow and weed-choked for us. As time permits, I'm scouting for a good, relatively weed- and algae-free body of water, but the pickin's are slim! When Subase Groton made North Lake the combined ranks swimming hole and day camp, this killed our access to that location. Before the five-year hiatus caused by 9/11, we had access to North Lake for our monthly meetings. Also, Beach Pond had crystal clear water and was almost weed-free on the beach side. Then, RI closed off the beach for "environmental experimentation"—their way of keeping jerks from trashing the place! Over time, more and more available access has been closed off. My intel reveals the cretins have now even managed to spoil several potential CT State Parks, where clamping down on all users is only a matter of time. So…still looking!

Anyway, here's hoping you all get to do something related to the hobby which brings you joy!

- Bill Lambing

SubRon7

SubRon 7 has gone to the River (Colorado River—below Laughlin at the Big Bend of the Colorado River State Park) several times. I just love getting out there and running a sub, but also taking photos of the subs in operation. My last run there was with the *Walrus*.

It is getting me so interested in photography, I may get back into SCUBA diving again. Maybe even make an underwater transmitter case, like days of old. (*See Tom's article on model sub photography elsewhere in this issue.—ed.)*

The heat here has reduced my ability to go to the River for long periods, and summer projects also get in the way. I did get to join those great guys in Southern California. *(SubRonLA—ed.)* What a super time, and meeting new people is so much fun!

My *Skipjack/Scamp* did have a leak in her engine room; as of this writing, I have not investigated the source. She is still airing out and will be fixed soon.

I cannot encourage people enough to meet up with others or just get your sub working and show it to others. That is the best ambassador for our wonderful hobby. The cloud of mask requirement is now being reintroduced, but even with them, it's still a great time.

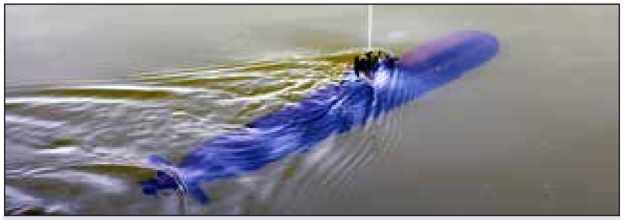
Peace,
- Tom Chalfant

SubRon7: Tom's Walrus *runs deep in the Colorado River.*

Tom's Skipjack (Scamp) *and* Walrus *opened for inspection.*

Will Oudmayer's newly revamped Type XXIII. (Editor's Note: Tom also joined SubRonLA on April 30 and July 10. This and the following photos are from April; the July run appears in the SubRonLA section.)

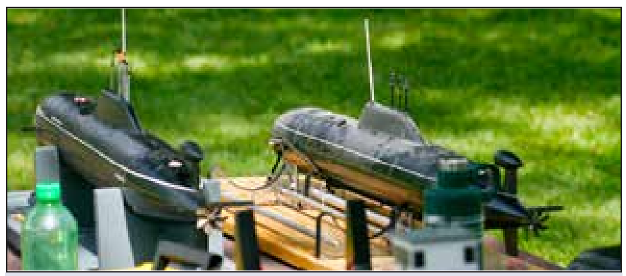
Engel 212 U-boat on the surface.



Engel 212 U-boat—pretty at PD.

SubRonLA's Jon Lim and Will Oudmayer catch up after a year off.

Farlan Clutters and MIke Dory and a tableful of boats..



Twin Engel Akulas. Looks like one's been docked awhile, comrade.

"'Sub masts off the port beam, sir! And it's not one of ours!"

SubRonLA

SubRonLA's traditional midsummer run took place at our usual spot in Yorba Regional Park in Anaheim on Saturday, July 10th. Participants included Will Oudmayer, Mike Dory, Ralph Fendley, Tom Chalfant (again, all the way from Vegas to join us—amazing!), Ben Brigham, David Moran, Jon Lim, newcomer (though he's been on the mailing list for awhile) Eric Viirre, and yours truly.

Ben brought along his long-aborning *Sir Frankie Crisp* fantasy sub—finally intent on a first real sea trial that day. Alas, sudden unexplained and severe electrical system problems frustratingly kept his boat benched —literally—on a picnic table. It had been "working on his bench at home," honest! (Boy, have we all been *there!*) His big news was not boat-related however, and was even more disappointing to the rest of us: Ben is moving to Portland within a few weeks, so will no longer be running with our SubRonLA posse. His bright perspective, optimistic personality, infectious enthusiasm, and of course his colorful, unusual boat will be missed around here by our crew, and we wish him well. I encouraged him to perhaps form a new SubRon squadron up where he's headed, while also expressing hope he would at some point drive south and join the SubComMI crew for an event. I also expect him to someday personally walk me through the 1:1 *Blueback* in Portland when I eventually get up there for a visit. Fair winds and following seas to you, my friend.

Tom of course ran his impressive *Walrus* and *Scamp* boats. *Scamp* apparently somehow sprung a leak aft, but I'm sure he'll have her satisfactorily diagnosed and repaired in short order.

Mike brought his gigantic Engel Type VII U-boat, but the weeds in the pond were too prominent to run her during this outing, so she stayed in his truck. Overall, the water was much cloudier too, a disappointment considering the usual impressive transparency on display at this venue.

John Lim ran his airboat and fanciful rowing skimmers; he told me none of his three scatchbuilt self-designed subs were functional at the moment. A shame.

First-timer Eric Virre hauled along a giant old Engel kit he had acquired pre-built—an Ebay find, I believe. This was a large, bulletproof, mostly scale version of the *Abraham Lincoln* missile boat. Impressive! It was not functional, but the guys all circled the wagons to offer plenty of specific advice on how to convert this complicated "almost there" boat into something seaworthy. It was good to bring yet another enthusastic new member aboard SubRonLA.

Will brought an ancient 32nd Parallel Type XXIII which had apparently been making the rounds before he snagged it. She's been in significant refit, involving challenging re-shaping of a seriously warped hull, and a lot of cosmetic attention. She's not yet ready to run (she'll get all-new innards), but it was easy to see why he was proud to show off his work so far. (See page 23.) He brought another of his boats or two, but I'm not sure which, if any, actually got wet.

David Moran remains sub-less for now, though we continue to lobby heavily. He did recently buy a fairly good-sized plastic Typhoon kit which looked ripe for a small-scale r/c conversion. I suggested he get in touch with "Small Sub Guy" Mark Jones up north for advice on internal components.

Ralph brought his *Skipjack* and perhaps one or two other boats. More important, he also brought his new, scratchbuilt seagoing "rescue barge," which definitely came in handy. (Keep reading.)

Me? I'm still recovering from a a recently snapped collarbone, so could only manage to haul along little *Blueback*. She was game, but her power supplies sure weren't: all three propulsion batteries I'd brought for her drained almost instantly, despite having been "fully charged" according to my charger just the day before. One of them actually gave out completely,


Our sign, so people can find us.


Tom arrives with his veteran Walrus.


Ben with his Crisp, as Tom looks on.


Crisp opened up. Amazing innards!


Tom's Scamp is obviously proud of her SCR cover shot.


Eric Virre's big Abraham Lincoln from Engel..


A last look, since she won't be around here anymore.


Yorba Regional Park in Anaheim—our wonderful running spot..

requiring a shove ashore from Ralph's new barge (designed precisely for this purpose). Also now required: a fresh lesson from Will on how to fully cycle my Nickel Metal batteries to prevent this embarrassing situation from happening again!

Our next full-squadron run will take place on September 11th. Any of you care to join us?

That's it for now. Hope you've all had your vaccinations and things are really starting to get back to normal for you —in your real lives *and* your maritime ones. Till next time…

- Jeff Porteous

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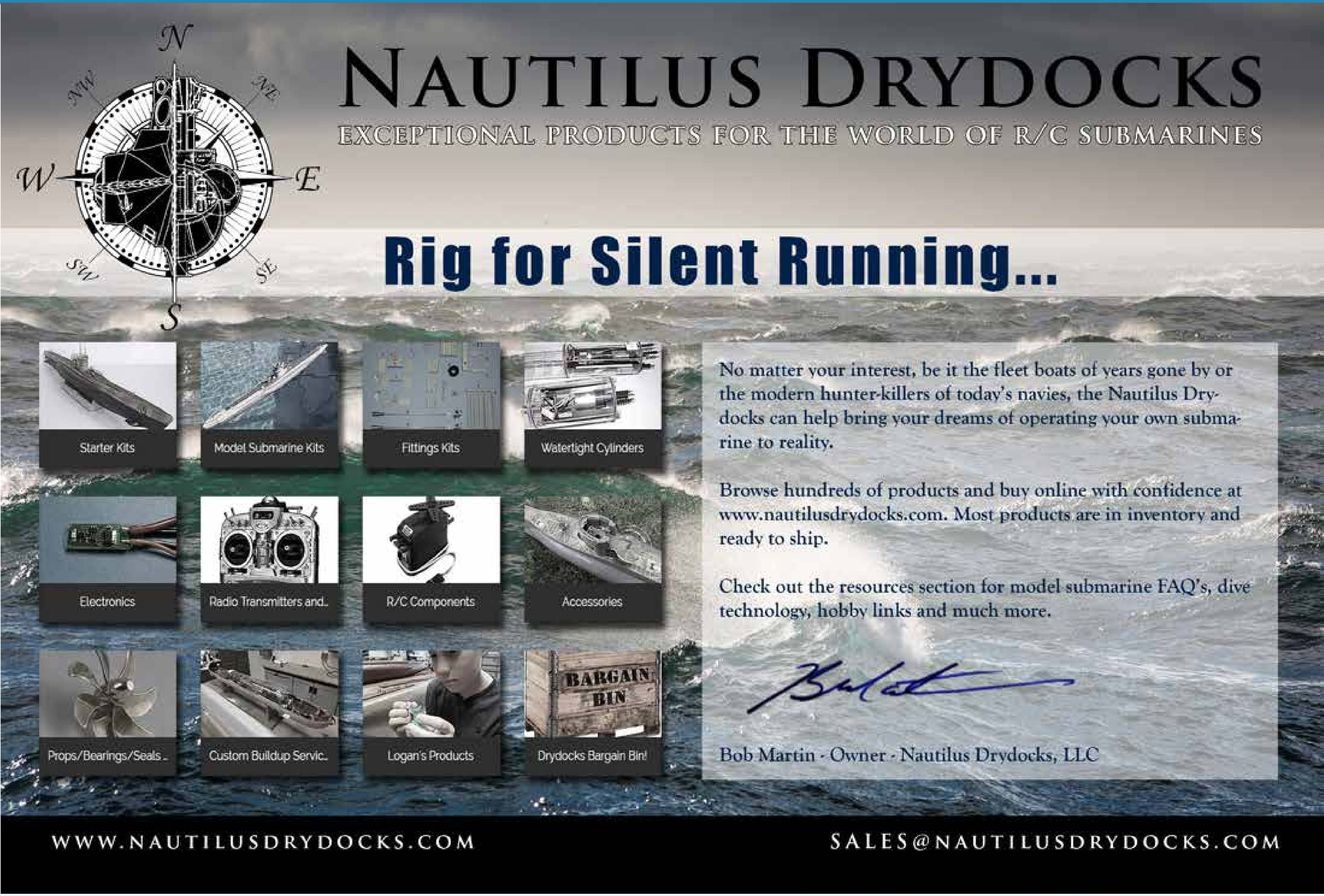
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One of our two renowned staff historians returns this issue with an in-"depth" technical look at the development of submarine control surfaces in the last century. Welcome back, Jim Christley!

Sub Control Thru the 20th Century

by Jim Christley

"How does she steer?" The question would sometimes be asked by the captain or master of a vessel under sail. It was not meant to determine the mechanism by which the ship was being maneuvered, but rather, how the ship was responding to rudder and sail forces. An answer might be, "A bit down by the head," or "Stiff on this course," or even "Sagging to leeward like a lame cow." With a powered vessel this question has little meaning and is seldom heard. The rudder is used to steer the ship. But the mechanisms by which the crew shifts the rudder angle and how these methods have changed over the past 130 years is the subject of this article.

In the waning days of the 19th Century there were two Americans who were very near to producing a viable underwater vessel usable as a naval weapon. Both were inventors, each similar in his ability to combine existing technologies with invented ones new to their designs. John Holland and Simon Lake had very different ideas on how to control their submarines underwater, however. Both designers used a combination of internal combustion engines, dynamos, and batteries installed in a steel hull, plus various ballasting methods, as their basic submersible engineering. But here the similarities ended. Each saw in his design the elementary stage of submarine development, envisioning many ideas of what needed to be improved and how to achieve it.

John Holland felt that a submarine should be very efficient when submerged; thus, his hull employed a round cross section with a small superstructure and few drag-inducing appendages. The *Holland VI* (the sixth design in the Holland sequence) was a "dynamic diver." That is, it submerged, surfaced and controlled its depth by varying its "angle of attack." We refer to this angle as the "bubble" because it is traditionally measured by the position of a bubble in an inclinometer.

The first trial of the boat went well in some respects, not so well in others. It could dive and surface consistently and seemed able to control its depth. The engine/battery/motor system further seemed to work successfully. But a big problem was revealed by the fact that the craft was very nearly unsteerable. The issue had much to do with the relative position of the ship's screw to

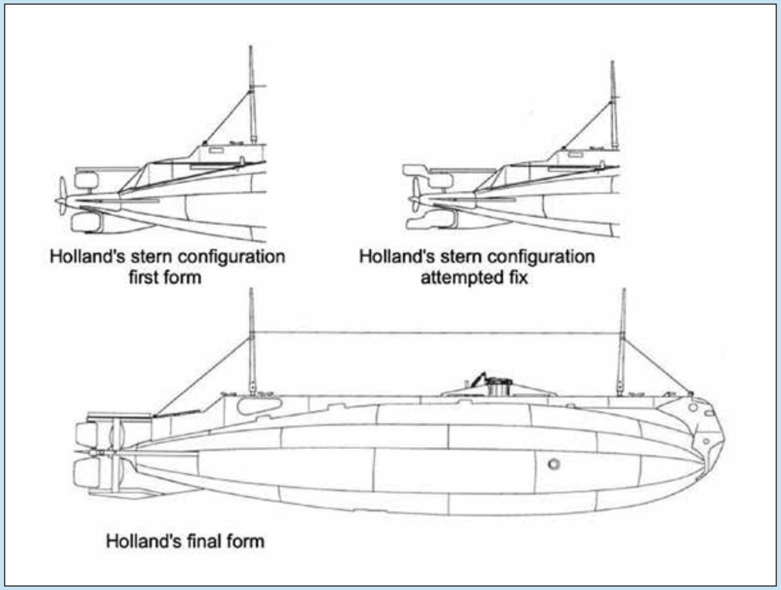

Fig. 1. Evolution of *Holland VI* stern before being accepted by the Navy.

its rudder. It was known that the most efficient approach to this question was to place the screw aft of the rudder; putting it forward instead presented a problem in that the water flow over the rudder's surface was dependent on the boat's speed through the water. Placing the rudder aft of the screw meant the flow volume, thus the force exerted by the rudder, was higher. At first Holland made a modification to the rudder's size, but his boat remained insufficiently maneuverable. The final answer came in reversing the rudder and planes' position relative to the screw. This last configuration was in place on *Holland*—and then also on Electric Boat submarines for the next forty-five years until the last of the EB S-class was decommissioned. (Figure 1: *Holland* Evolution.)

The rudder on the *Holland VI* was hand-controlled by a lever. The stern planes were controlled by a complex "automatic depth control" system invented by Holland. This setup made use of sea pressure on a set of diaphragms amplified by pressurized air operating a tiller rod going to the planes. There were no bow planes. The boat would be ballasted down to decks awash, then tilted down and "driven" underwater. The stern planes operator moved a lever on the depth control device to pivot the planes, thus varying the depth. (Figure 2: Patent Drawing of *Holland*'s Stern Planes Control One. Figure 3: Patent Drawing of *Holland*'s Stern Plane Control Two.)

Simon Lake was the other major inventor seeking to supply the Navy with submarines. His design philosophy was that the submarine was a surface

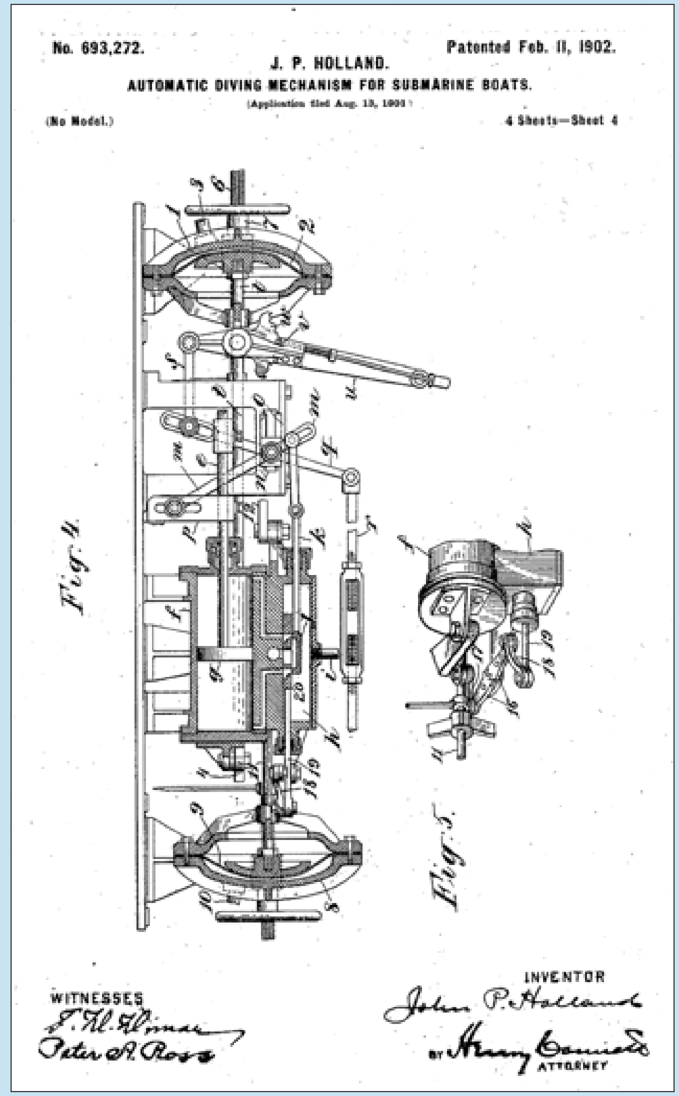

Fig. 2. A patent document drawing of the complex mechanism Holland used for stern plane control. It incorporated an early depth control concept. The device was only used on the *Holland VI*. Whether it was used throughout the lifetime of the USS *Holland* is not known.

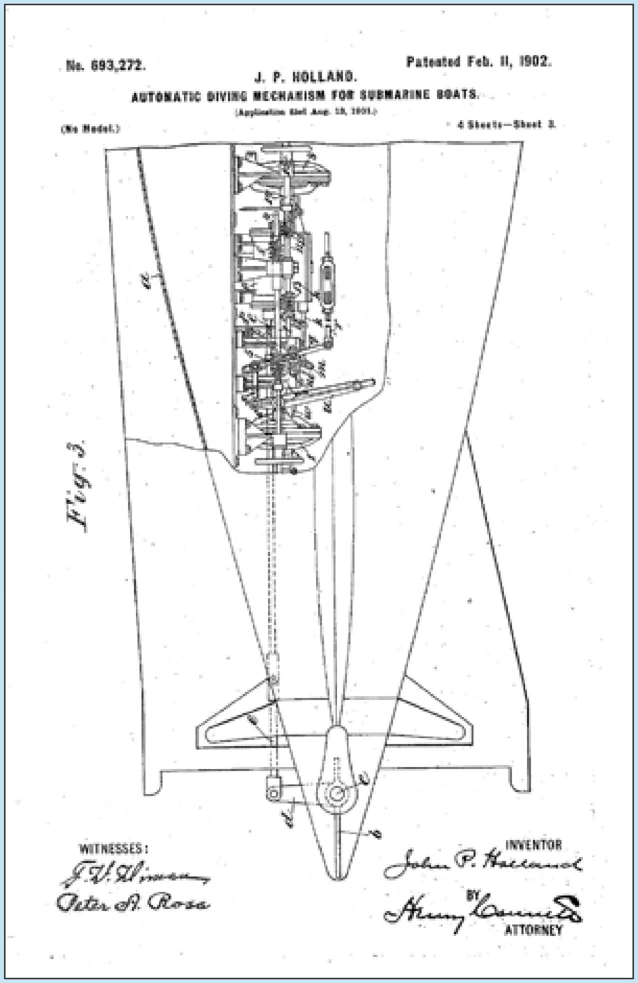

Fig. 3. A second patent document drawing of the *Holland* stern plane control showing how it was installed in the submarine.

ship which submerged to perform an assigned task such as firing torpedoes, observing enemy fleets and harbors, carrying out underwater salvage, or planting explosives. Thus, his method of control was very different from Holland's. The Lake boats dived with a zero bubble (angle) controlling their depth, employing a series of hydroplanes along the midpoint of the hull. The rudder was positioned aft of the screw and was normally of a skeg-mounted type. The operator was an electric motor moving a lead screw with linkage attached to the tiller arm. Lake's mid-mounted hydroplanes were manually operated. (Figure 4: Lake G-Class Showing Midship Planes Arrangement.)

Holland took out patents to protect his diving method and hull design. Isaac Rice, needing a customer for his batteries, invested in the Holland Torpedo Boat Company, thus holding an interest in the patents. Rice wanted to freeze a design and sell multiple copies to the U.S. Navy. This business model worked well because the research cost could be spread over several products. Then a new iteration could be introduced incorporating the next set of improvements. That this business model was successful is still seen today—it remains used in a wide range of manufactured goods

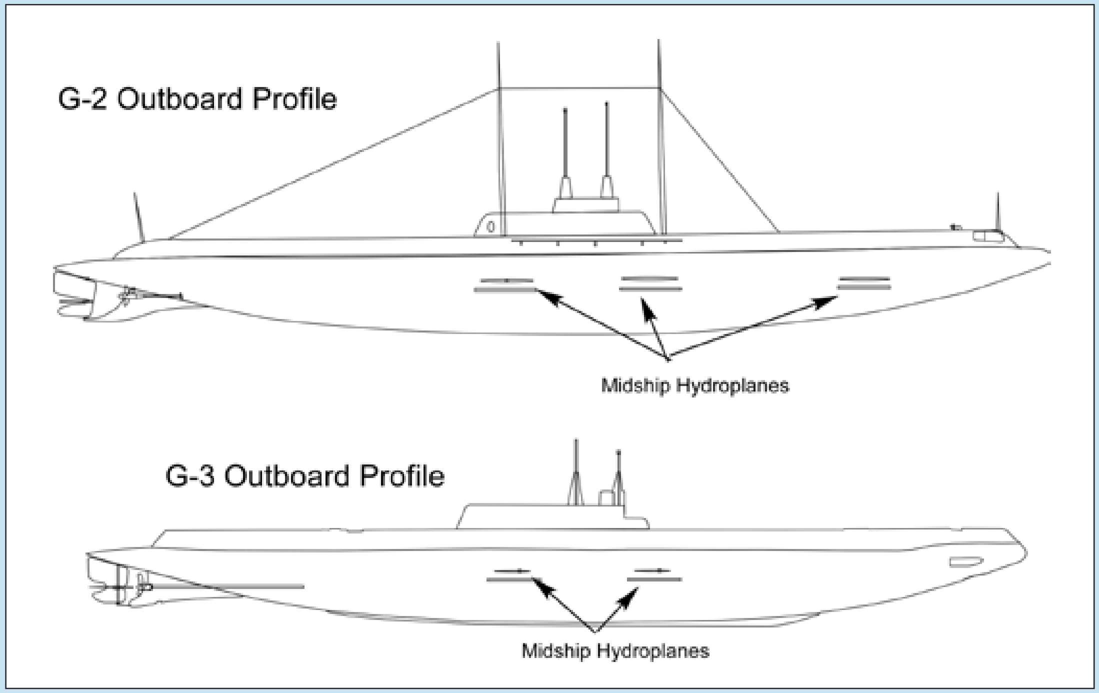

Fig. 4. Simon Lake's concept for diving called for hydroplanes situated along the midship centerline.

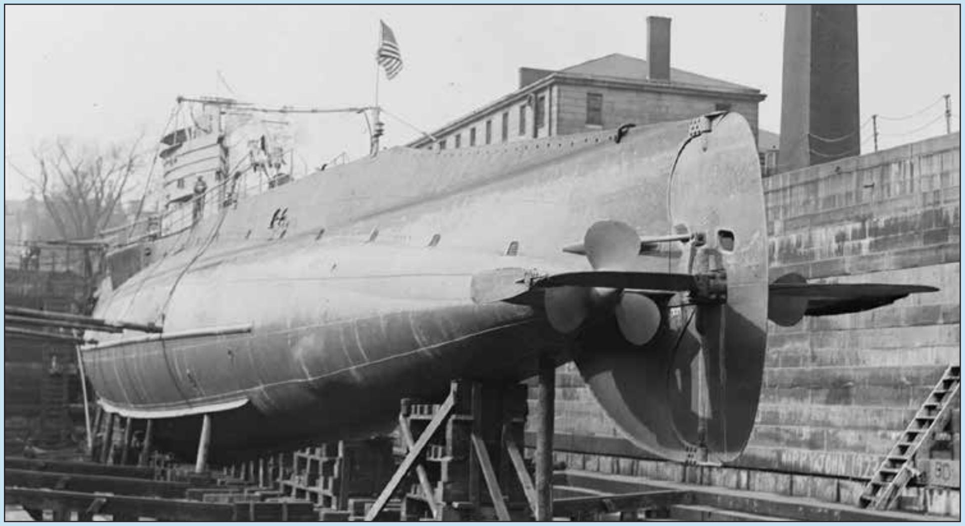

Fig. 5. EB design stern plane and rudder arrangement. This did not configure until the end of the S-class in 1945.

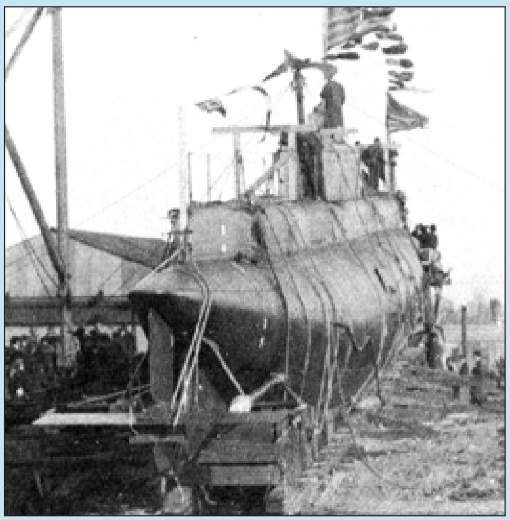

Fig. 6. Lake-design stern plane and rudder arrangement. This arrangement was adopted by the Bureau of Construction and Repair (Government) design of the *S-3* until the advent of the *Albacore*, *Skipjack* and follow-on designs.

from automobiles to electronics. Instead, John Holland wanted to improve his boats with inventions or improvements in a continuous manner; this would prove costly and delay production however. To deal with it, Rice eventually forced him out of control of the company.

Simon Lake also took out patents to protect his designs. Unlike Holland however, there was no Isaac Rice waiting in the wings with money to assist in producing boats for the Navy. Each of Lake's early submarines were unique and incorporated a series of design improvements. Thus, the boats were slow to be constructed, and because each was different, cross-hull training was nonexistent. Holland hired experienced naval constructors and engineers like L.Y. Spear for the work. Along with their building expertise, these critical personnel used their naval contacts to help sell the Holland-type boats to the Navy and overseas.

An issue holding Lake back in his production of submarines for the Navy was that his shipyard in Bridgeport, CT was not large enough nor well-enough equipped to mass produce large vessels. This served to delay the delivery of contracted units. Class designs

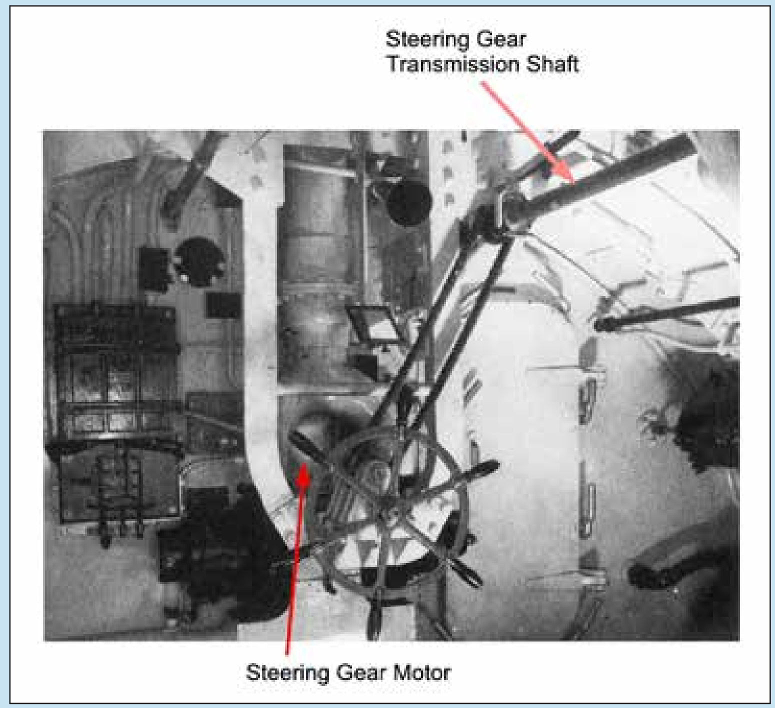

Fig. 7. D-class helm stand. The helm wheel was for "hand" operation. The motor drove the rudder shafting and was operated by a control switch.

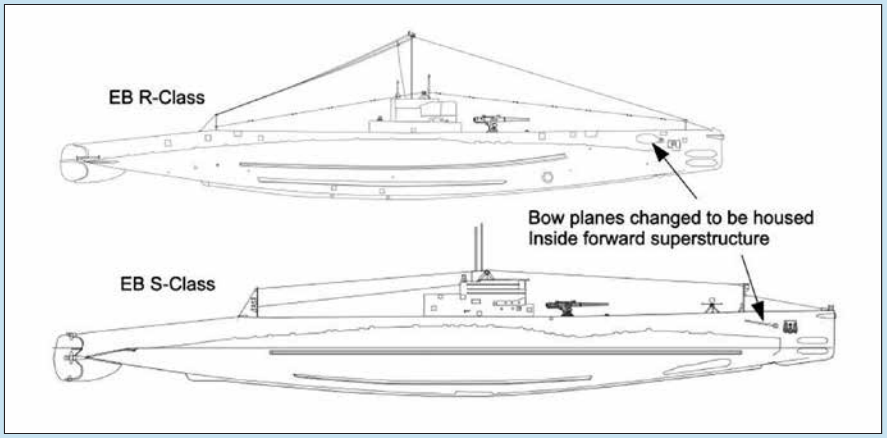

Fig. 8. EB R-class compared to the EB S-class. The bow planes' housed position was changed to further prevent damage to the planes while submarine was surfaced in a seaway.

would become split between Lake and Electric Boat Company; the Navy wanted to maintain more than one submarine designer and builder, so indeed undertook building Lake-designed boats at its own Portsmouth Navy Yard in Kittery, Maine. The first boat constructed there was *L-8*. By the late 1920s, most of the Lake-designed boats were put out of commission or laid-up in reserve. (Figure 5: EB Design S-Class Stern. Figure 6: Lake Design Stern Plane and Rudder Configuration.)

Inevitably, advancements in the Holland-type boat design meant these submarines were getting larger; soon three major changes were made in the control of their planes and rudders.

First was the addition of electric motors to drive the planes in a manner similar to that of the rudder—a lead screw linked to the planes' tiller arm.

Second, it was soon acknowledged the D-class boats were becoming too long to be adequately controlled with stern planes only. (Figure 7: D-Class Helm Stand.) Bow planes were therefore added to the E-class, creating the next major change. A noted problem with these planes as designed for the E- and follow-on classes turned out to be the tremendous impact force of "wave slap." (Figure 8: EB R-Class to S-Class Comparison.) This tended to bend or even break the bow plane linkages. The stern planes were better supported and usually submerged even with the boat on the surface however, so didn't suffer from this shortcoming. A design engineer, Gustav Lagergren, working for the Electric Boat Company (again, successor to the Holland Torpedo Boat Company), patented a folding mechanism for the bow planes in 1914. This system retracted the planes up alongside the superstructure. Once the motor for the bow planes was started, the planes folded down and the linkage was shifted to pivot them normally. When surfacing, the planes were reset at zero angle, the linkage shifted, and the motor then folded the planes back up along the hull.

The third major change was the centralization of control into the middle compartment of the boat. (Figure 9: Patent Drawing of Bow Plane Retracting Mechanism One. Figure 10: Patent

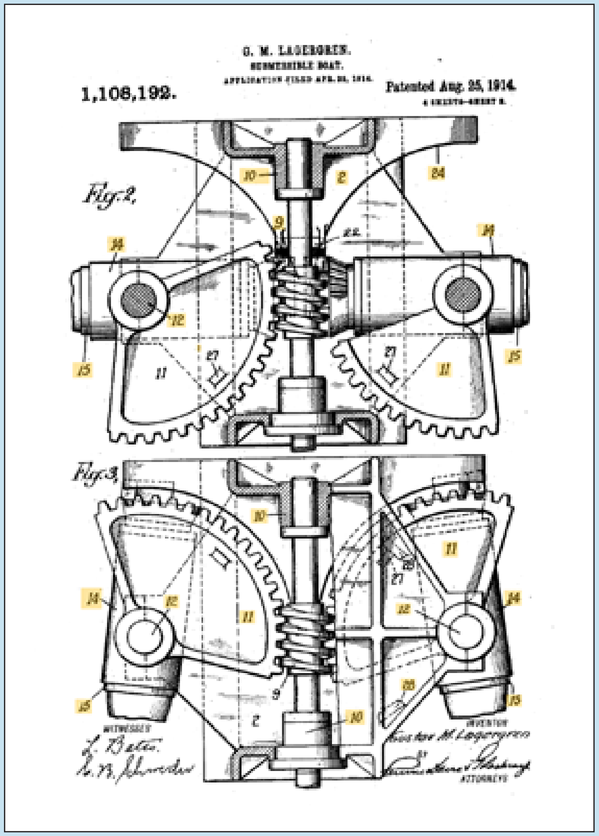

Fig. 9. Patent drawing of the mechanism for bow plane retraction. This was used on EB-designed boats. The basic concept was used until the advent of the *Albacore*, *Skipjack* and follow-on designs.

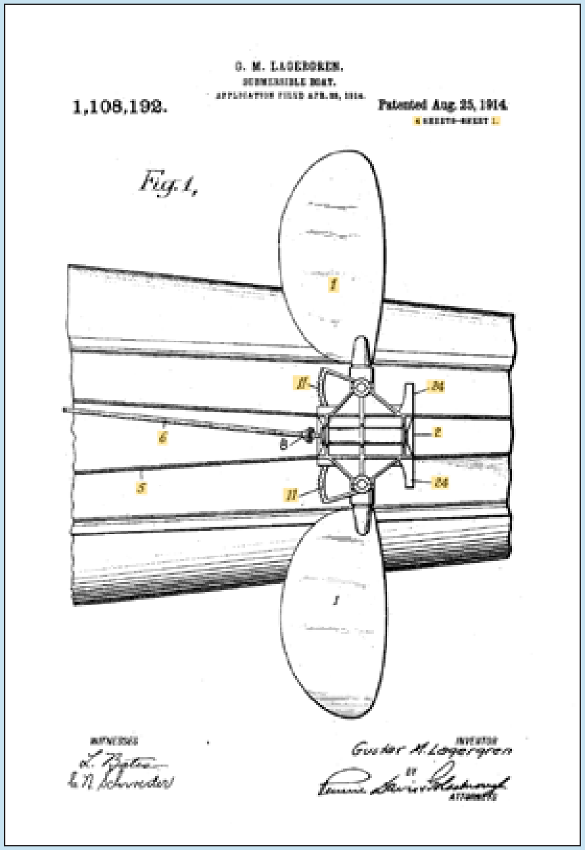

Fig. 10. A second part of the patent drawing for bow plane retraction.

Drawing of Bow Plane Retracting Mechanism Two.) Dive planes were operated from a station on the port side, with the rudder operated from the forward bulkhead of the compartment. The motors for planes control were on the deck at the planes control station. The later Lake and the government S-class bow planes were located low, down below and aft of the forward torpedo tubes. Thus they remained submerged and did not suffer wave slap when the boat was on the surface. (Figure 11: Bureau of Construction and Repair [Government] S-Class Design.)

Rotating shaft linkage connected the motor to the planes' and rudder's lead screws. These resided in the stern compartment; the bow plane linkage stretched forward to the Torpedo Room. A big issue with this system became the spinning shaft leading from the Control Room forward to the Torpedo Room and aft to the Motor Room (or in some designs, the Tiller Room). It was a hazard to the crew in each compartment. A solution was to move the actuator motors from Control Room to the other end of the shaft. Thus, the motors and their controllers were shifted to the Torpedo Room forward, and to the aftermost compartment, in order to be closer to the actual lead screws for the bow planes, stern planes and rudder. The operating switches and the manual handwheels stayed in the Control Room however. (Figure 12: O-Class Diving Stand. Figure 13: D-Class Engine Room Aft.)

Actual control of the ship's angle and depth remained as envisioned by Holland and Lake. The amidships hydroplanes on the Lake designs were viewed as superfluous by many, creating control issues by being difficult to motorize. The heavy watertight superstructure of the Lake design made his boats slow to dive. During WWI, with many of the Lake boats laid up, the only U.S. submarines to see service overseas were the Holland-type. Royal Navy observers on the U.S.

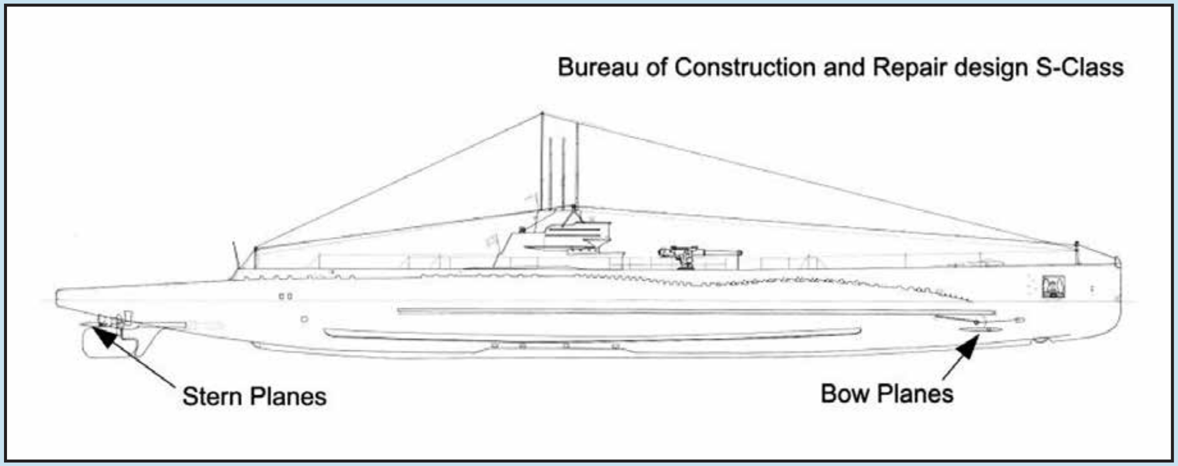

Fig. 11. Bureau of Construction and Repair design called for locating the bow planes low in the bow structure.

submarines commented on how the workload of depth control and ship's angle was shared by the diving officer and planesmen. They recommended a change so the stern planesman controlled angle and the bow planesman controlled depth. This worked on British boats and was easier than the complex U.S. arrangement where both planesmen had to work in concert to control angle and depth. American boats soon tried the British method and adopted it. It was so successful that when this author qualified on a diesel-electric boat some forty-five years later, the method was still in force. Today, the concept of having the stern planes control angle and major depth

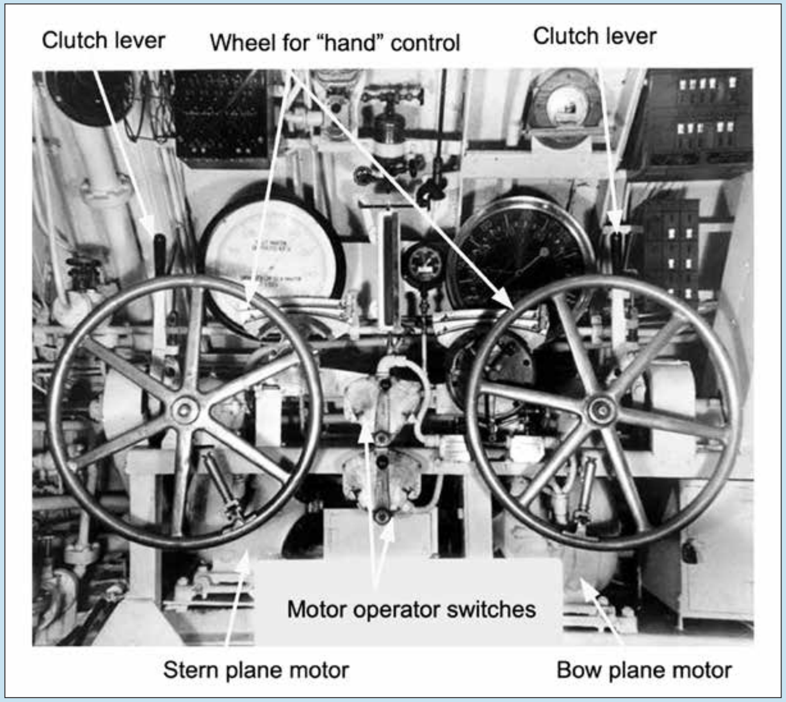

Fig. 12. O-class diving stand. The actual electrical plane control was via these switches. Every time the plane position was changed, the motor started and moved the plane by rotating the shaft the length of the boat to the rudder lead screw all the way aft. The wheel was used only for "hand" control.

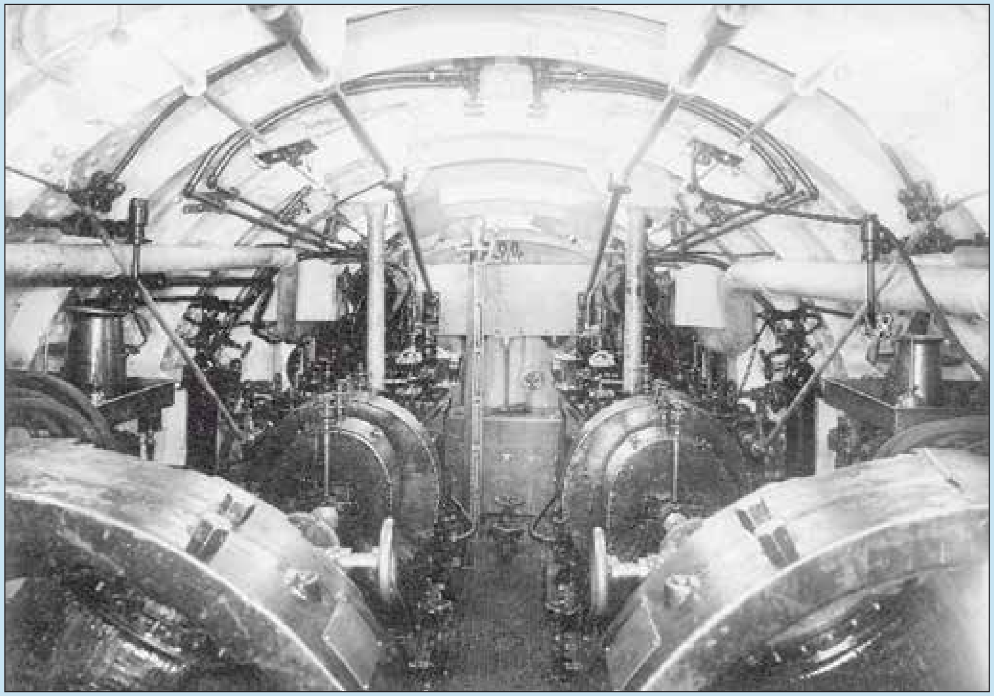

Fig. 13. D-class Engine Room looking aft. Note the long rod structure at the top right and left of the photo. These were the stern plane and rudder operating shafts. Every time the rudder and/or stern planes were operated, these shafts turned. Not something to use as a "hand hold railing," nor a place to hang your laundry.

changes, with the fairwater or bow planes maintaining depth and assisting in major depth changes, remains the general philosophy used.

This electro-mechanical system of planes and rudder control was the standard in submarine design until around the middle of the *Gato* class in 1943. (Figure 14: Bureau Design S-Class Stern Plane Shafting. Figure 15: *Grunion* Planes Schematic.) A flaw in this design was still the shaft traveling from the Control Room to the lead screws. It had to penetrate several bulkheads through packing glands, glands which needed to remain loose enough to also allow for hand operation of the planes and rudder. But with this intentional slackness came leakage under pressure in one compartment or another.

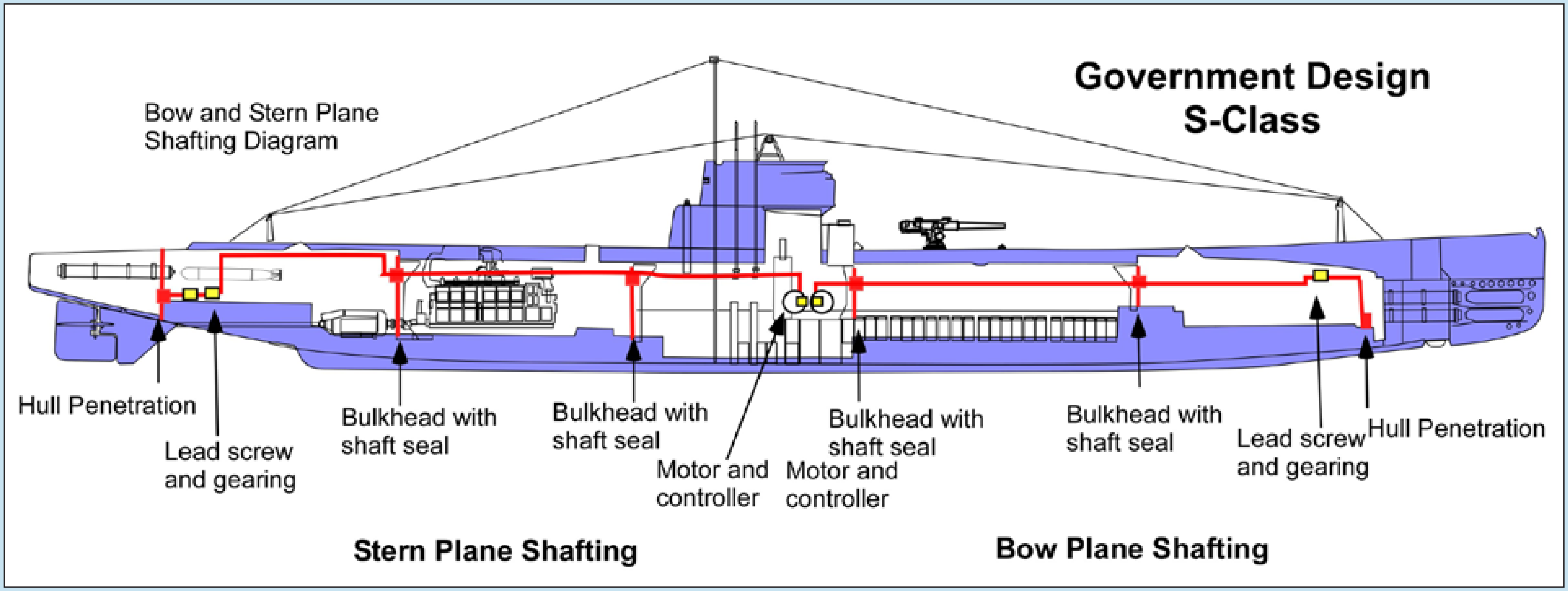

Fig. 14. Bureau design S-class stern plane shafting.

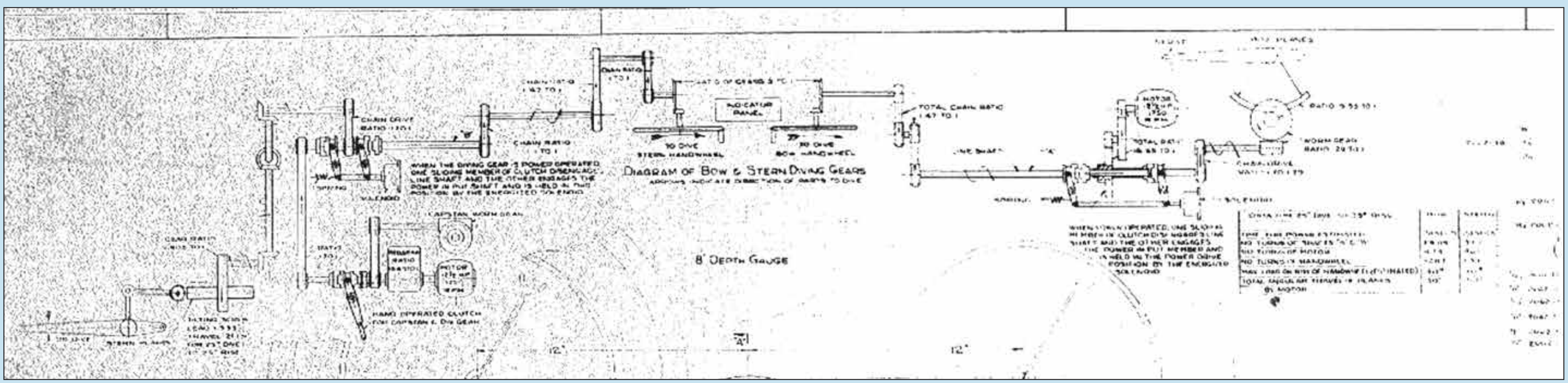

Fig. 15. USS *Grunion* dive planes' mechanical schematic.

A possible solution to eliminate shafting was to replace them with hydraulic rams to operate the tillers. The trouble with this method, however, was that existing hydraulic designs did not permit rams of sufficient length to move the rudder and planes with enough force; the pumps and accumulators then available were simply not up to the task. Then in 1933, Arthur Ellis and Daniel Francis of the Waterbury Tool Company patented a device called the "Axial Piston Normal Displacement Pump." Generically called the "Waterbury Speed Pump," it allowed control of sufficient amounts of oil at high pressure to shift a hydraulic ram with enough throw to move the tiller arms through the required distances. Installing this type of hydraulic system eliminated troublesome long shafting, replacing it instead with pipes to make the control of the planes and rudder an all-hydraulic system. A full description of this hydraulic system can be found in the Historic Naval Ship Association's online presentation of the "Fleet Submarine Series": https://www.hnsa.org/manuals-documents.

The first boat to be outfitted during construction with hydraulics which would become the standard for the next fifteen years (through the remainder of the *Gato* and all of the *Balao* and *Tench* classes) was the USS *Croaker* (SS-246). Other boats were backfitted with the system during major overhauls through the rest of WWII. (Figure 16: Early *Gato* Electro-Mechanical and Later Electro-Hydraulic Stern Plane Systems.)

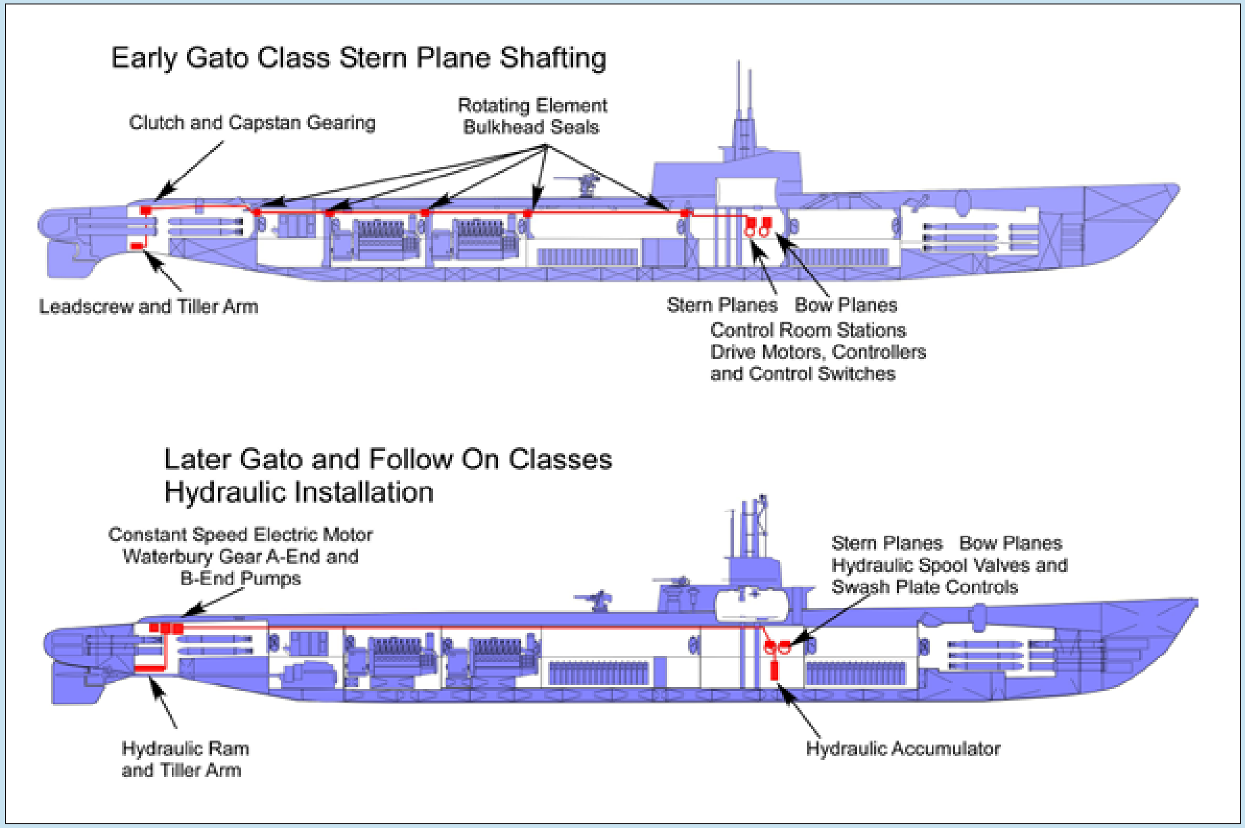

Fig. 16. Early *Gato*-class boats retained the electro-mechanical mechanism with its long shafting and multiple bulkhead penetration glands. The electro-mechanical system was later replaced by the electro-hydraulic system.

After WWII, beginning with the Guppy Program and the early nuclear submarines, a new issue in plane control reared its head. As submarines became faster, their planes needed to operate faster too. The speed of operation was a function of the rate that oil could be pumped. High speeds also meant a higher force on the planes, requiring the tiller rams to be bigger and more robust. The Waterbury Speed Gear system was not capable of scaling up to provide these higher pressures and pumping volumes. So the hydraulic system was completely redesigned to use a high-pressure/high-volume IMO pump set with a multiple accumulator group featuring the capacity for continuous operation of heavy plane forces. The control station design was also revised. With the advent of reliable synchro/servo electrical systems, there was no longer a need for the planes operators to actually operate the hydraulic valves which controlled the oil flow (except in the case of an emergency electrical failure). Gone were the large handwheels seen in many submarine movies. The planes and helm stands became modeled on aircraft control systems. Sitting side-by-side in the Control Room were yoke-and-wheel controls—groupings which could be electrically shifted between one another to suit the situation. Normally, the stern planes were operated from the port yoke while the bow planes (or fairwater planes) and rudder were handled by the starboard yoke.

The design of the *Albacore* (AGSS-569) brought back a problem John Holland had dealt with in 1900. A single-screw submarine with rudder and planes forward of the prop was nearly unmanageable at slow speeds. This was most evident in restricted waters and when mooring or getting underway. As a general rule, tug assistance would be needed by such a boat. But of course this placed an undue restriction on submarine operations. *Skipjack* (SSN-585) and follow-on classes offered two solutions to the issue. First was an increased rudder size and enlarged planes area. This did help, but maneuvering next to a wharf or pier could still be iffy. The second solution was small, extendable azipods sited well aft. These little motors, called Secondary Propulsion Motors, could be rotated (except on *Ohio*-class boats, which featured two to perform much like a two-screw ship) to act as a pusher screw to enhance maneuverability. (Figure 17: Secondary Propulsion Motor Extended.)

The follow-on to the *Seawolf* design (SSN-21) was the *Virginia* class (SSN-774). The "back end" concept of hydraulic ram control of the planes and rudder stayed generally the same as it had from the *Skate* class on. The front end of the control system underwent a vast change in that a massive use of computer power was placed between the human planesmen and the hydraulic actuators. Until the *Virginia* design, the Conning Officer ordered a particular depth and heading, then the Diving Officer ordered and supervised the planesmen to operate the planes in control of the depth, angle and rudder changes. Now the ship control party became only two: the Pilot and Co-Pilot. The Trim Manifold Operator and his follow-on, the Ballast Control Panel Operator, were also replaced in the functions of the new two-person ship control party. There were many advantages of this control system, one being the reduction in required ship's control party personnel—meaning an overall reduced cost of submarine operations. Centralized control of the maneuvering of the ship using senior submarine operators also reduced communication errors and therefore possible maneuvering errors. The hydraulic system of accumulators, pumps, valves and rams however, still ultimately moved the tiller to control the rudder and planes.

So the answer to "How does she steer?" remains "by way of a tiller," but what moves the tiller has certainly undergone changes as new technologies have altered the time-honored "hand on the tiller" to become 21st Century computer control of a hydraulic ram on the tiller.

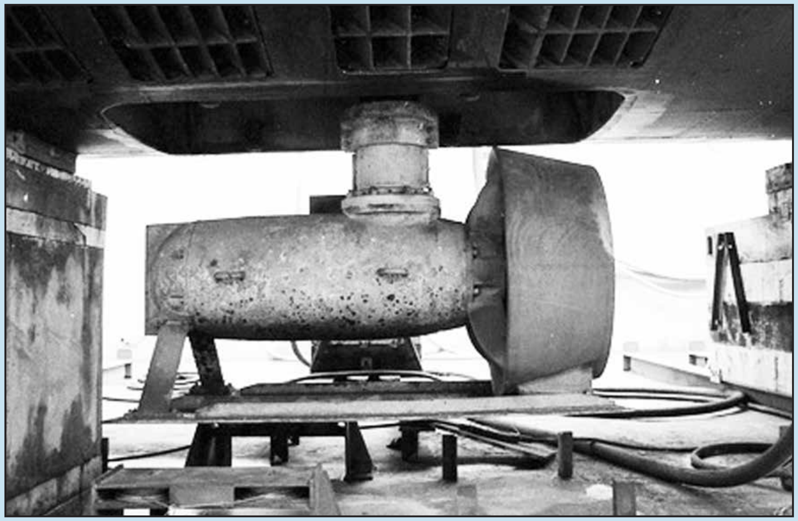

Fig. 17. A secondary propulsion motor shown in the extended position.

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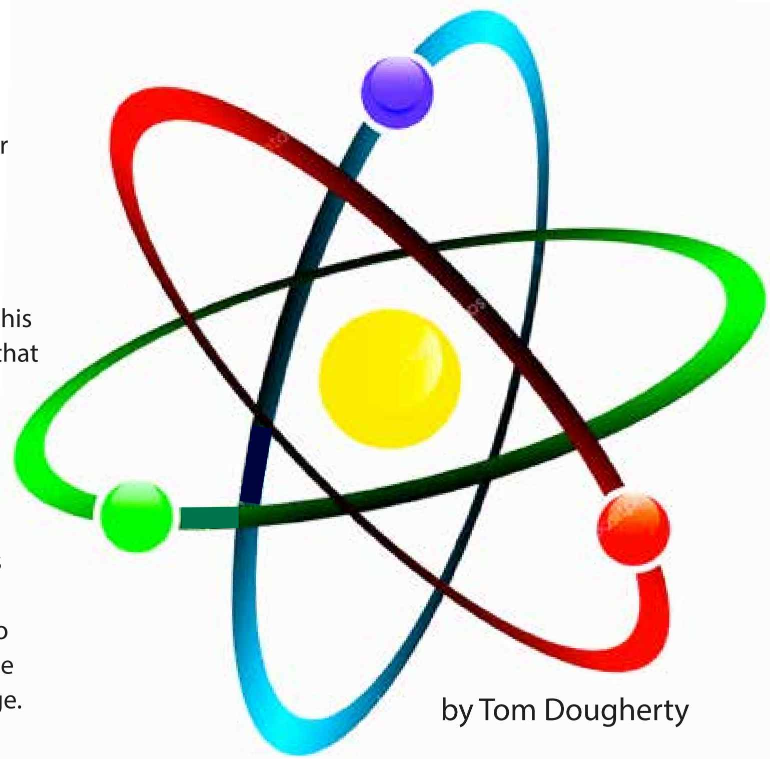
The Engineering Deck

Friend and frequent contributor Tom Dougherty rejoins us here to lift the veil of secrecy—at least somewhat—on the employment of nuclear power in submarines. Keep that dosimeter handy…

Submarine Nuclear Propulsion



by Tom Dougherty

Most people without firsthand knowledge still possess a general idea of the concept behind nuclear propulsion. Usually when you look up info. on the subject, you get a diagram such as what's seen in Fig. 1 (page 42). If that's good enough for you, read no further. But if you'd appreciate more detail, that's the direction this article will take. I should state at the outset that everything discussed herein is in the public domain. But trying to find it, assemble it, and put it together in a coherent fashion required no little effort. If you do have an interest though, I believe you'll enjoy this deeper look into the more technical aspects of the subject. Figs. 1 and 12 will serve as a good guide to the individual components to be discussed. Details of individual submarine reactors are listed in Table 1 on the next page.

The Critical Role of Water

With one notable exception, all U.S. Navy nuclear reactors have employed pressurized water to operate. Water serves two roles in the reactor: first, it functions as the working fluid (often termed the "primary coolant") to transfer the heat from the nuclear reaction in the reactor to the steam generator system downstream. Second, water acts as a moderator of the reaction. In this function, the high-energy neutrons initially given off by the nuclear reaction of uranium are inefficient at sustaining the nuclear chain reaction. These would escape the reactor core and not contribute to sustaining the ongoing fission reaction. But multiple collisions of high-energy neutrons with H (as in H_2O) causes them to lose energy and slow down

U.S. Submarine Nuclear Reactors

Reactor	Estimated Reactor Power (MWt)	Estimated Propulsion Power (shp)	Initial Ops	Application
S1W, S2W, S2Wa	70	13,400	1953	• S1W prototype, NFR Idaho. • S2W on USS *Nautilus* (SSN-571) and S2Wa USS *Seawolf* (SSN-575) replacement power plant.
S3W	38	7,300	1957	• USS *Halibut* (SSGN-587). • 2 of 4 *Skate* class: USS *Skate* (SSGN-578) and USS *Sargo* (SSN-583).
S4W	38	7,300	1957	• S3W core in an S4W plant with an alternate arrangement of some equipment. • 2 of 4 *Skate* class: USS *Swordfish* (SSN-579) and USS *Seadragon* (SSN-584).
S5W	78	15,000	1958	• Used on 98 U.S. nuclear subs in 8 classes and on the first UK nuclear sub, HMS *Dreadnought*, making S5W the most used Navy reactor plant design to date. • Most S5W plants were refueled with S3G core 3.
S6W	220	45,000	1994	• Core tested in the S8G prototype. • Used on all SSN-21 *Seawolf*-class subs. Life-of-the-boat core. *Seawolf* SSN service life is 30 years.
S1C, S2C	13	2,500	1959	• S1C prototype, Windsor, CT. • S2C on USS *Tullibee* (SSN-597).
S1G S2G	78	15,000	1955	• S1G prototype, West Milton, NY (later became the D1G) prototype. • USS *Seawolf* (SSN-575) original sodium-cooled reactor plant, which was removed and replaced by an S2Wa PWR.
S3G S4G	78	15,000	1958	• S3G prototype, West Milton, NY. • USS *Triton* (SSRN-586), which had 2 x S4G reactors. • An S3G core 3 installed in an S5W reactor plant was original equipment in many later *Sturgeon*-class SSNs, which required one mid-life refueling. This core was also used to refuel many S5W plants.
S5G	90	17,300	1965	• S5G natural circulation prototype, NRF Idaho. • USS *Narwahl* (SSN-671).
S6G with D1G-2 core	150	30,000	1976	*Los Angeles*-class Flight I boats. One mid-life refueling was required for the original 30-year service life of the boat (extended to 33 years). Some Flight I boats were not refueled and were decommissioned early.
S6G with D2W core	165	33,500	1985	Original equipment in all *Los Angeles*-class Flight II and 688i boats. Designed as a life-of-the-boat core for an original 30-year service life (extended to 33 years). Also installed on *Los Angeles*-class Flight I boats that had a mid-life refueling.
S8G	185	35,500	1980	• S8G prototype, West Milton, NY. • All *Ohio*-class SSBNs and SSGNs. One mid-life refueling was required. Original design life of the boats was 30 years; then increased to 42 years. S8G reactor core life is at least 20 years.
S9G	210	40,000	2004	All *Virginia*-class SSNs. Naval Reactors describes S9G as "the first core specifically designed to operate without refueling for the service life of the ship." (NR FY 2004 Congressional Budget.) *Virginia* SSNs have a 33-year service life.

Table 1. A list of U.S. submarine nuclear reactors, along with their estimated reactor and propulsion power (shaft horsepower-shp) and the submarines in which they were or are deployed.

Adapted from: *Marine Nuclear Power. Part 2A: United States Submarines*. Peter Lobner. Presentation to The Lyncean Group of San Diego.

in a process called "thermalization." These neutrons can now productively collide with the highly enriched fuel, uranium (U235), sustaining the nuclear fission chain reaction in the reactor in a continuous manner. By its ability to both thermalize the neutrons and remove the heat energy generated by the uranium reaction, water has become the selected basis of all U.S. naval reactor design.

Liquid metals such as sodium in the original *Seawolf* (SSN-575) S2G plant and lead bismuth in the Russian OK550 reactor were tested, but these metals act largely only as coolants and not as neutron moderators. Additional neutron moderation methods (e.g. beryllium reflectors) are necessary with this design. Liquid metal reactors can operate at much higher, more efficient temperatures, have higher metal boiling points, and thus be kept at lower pressures, producing efficient, superheated steam. But several significant operational disadvantages of liquid metals make water a more desirable alternative. As we will see, the advantages of water as moderator are substantial as far as reactor control is concerned.

Reactor Design

Let's start with reactor basics. The U.S. Navy employs Pressurized Nuclear Reactors (abbreviated PWR) to propel all nuclear-powered naval vessels. These reactors are pressurized so that the water can be heated well above the atmospheric boiling point of 212° F (100° C). If you attempt to heat water in an open container at atmospheric pressure (14.7 PSI) above 212° F, all you'll do is increase the rate at which steam is given off into the surrounding air; you will not raise the water temperature. In order to operate the PWR system at a much higher temperature and efficiency, the system is both closed and pressurized to 1750 psi, allowing water operating

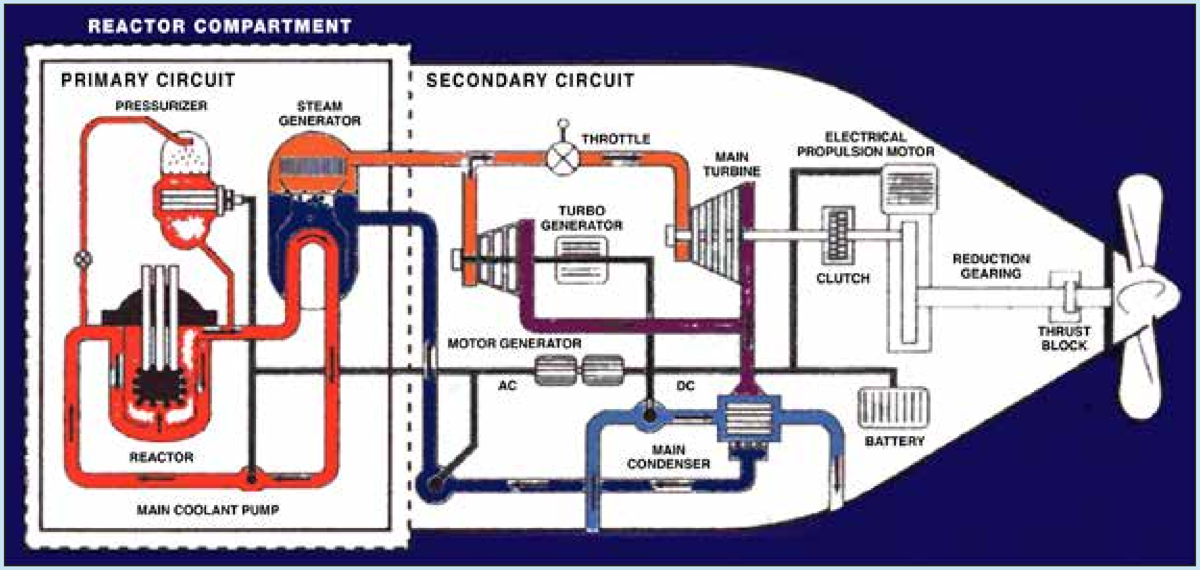


Fig. 1. Block diagram of the main components involved in U.S. submarine nuclear propulsion. The reactor, steam generator, and primary steam loop are on the left, behind the shielding. At right is the secondary steam loop and the propulsion train.

temperatures of around 500° F. So, what's required to carry this out?

The nuclear reactor itself is essentially a large steel cylinder of six-inch-thick magnesium-molybdenum alloy steel. The bottom is hemispheric, penetrated by four large pipes: two inlets and two outlets. The top of the reactor features a "lid" bolted onto the reactor body, and it contains openings for the control rods. The entire reactor interior is coated with zirconium, which forms an oxide that retards corrosion of the steel alloy from the extremely hot water inside. Over time, the constant bombardment of the reactor metal with neutrons causes it to degrade. Another source of degradation is the slow reaction between water and zirconium at high temperatures. This generates hydrogen, also causing the reactor vessel metal to become brittle. Both of these factors act to limit the lifespan of the reactor.

Uranium 235 Fuel

As mentioned above, naval nuclear reactors employ enriched U235. This isotope makes up only about 0.7% of natural uranium, which is mostly the non-fissile U238 isotope type. Using several enrichment techniques, the U235 level is brought up to 93% for U.S. submarine reactors. In contrast, most commercial power reactors are at around 7% enriched. The Navy's higher enrichment permits more compact reactor core designs and longer operation compared to commercial power reactors. The reactor holds multiple fuel bundles or assemblies. These are arranged in a regular pattern consisting of zirconium metal fuel rods and zirconium plates featuring tiny ceramic-coated spheres or capsules of enriched U235. The zirconium holder, called cladding, contains multiple openings to allow for free passage of water through and

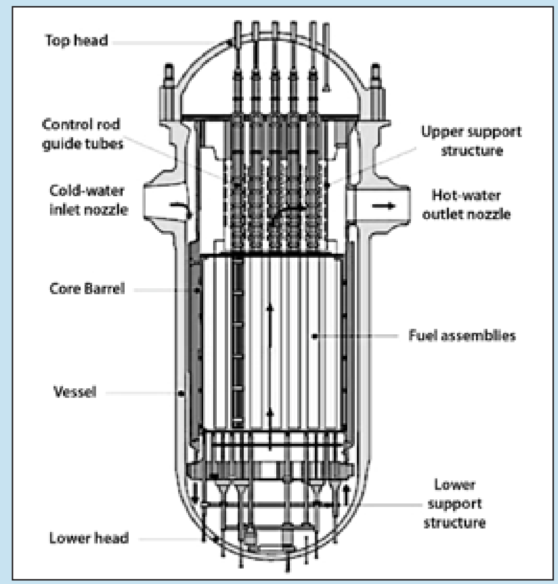


Fig. 2. The reactor vessel with inlet, fuel assemblies, control rods and the outlet. Note that "cold" and "hot" water are relative terms, as described in the text.

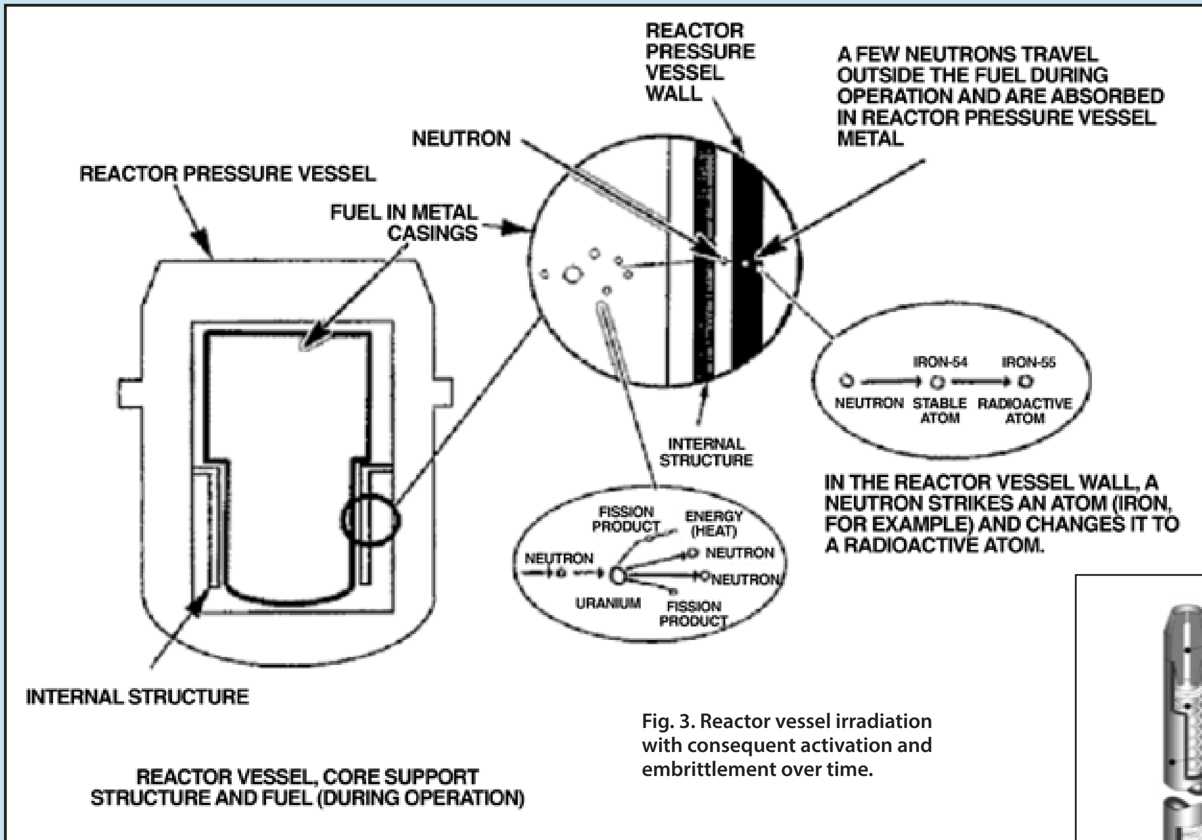


Fig. 3. Reactor vessel irradiation with consequent activation and embrittlement over time.

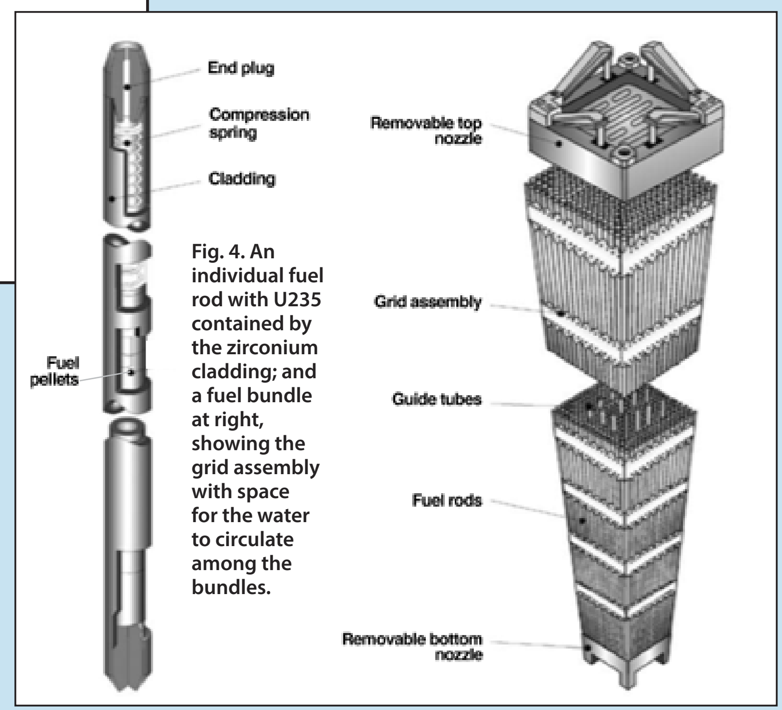


Fig. 4. An individual fuel rod with U235 contained by the zirconium cladding; and a fuel bundle at right, showing the grid assembly with space for the water to circulate among the bundles.

around the U235 reactor fuel spheres. Pure zirconium is both transparent to neutrons (important in sustaining the chain reaction) and relatively resistant itself to hot water corrosion over a long term. Coolant water enters through the inlet pipes, flows in a channel down the vessel sides to the bottom of the reactor, then sluices through a zirconium plenum (a plate with multiple small passages to distribute the water evenly) into the reactor core. There it rises up through and around the fuel assemblies, picking up heat from the fissioning uranium. This water with increased thermal energy now enters a plenum to exit the outlet pipes atop the reactor. The reactor core itself is surprisingly compact; in fact, an illustration I've seen depicts it as about the size of a curbside garbage can. Another interesting fact is that the temperature difference between the "cold" water entering from the steam generators (460°F) and the heated water exiting the reactor (500°F) is only around 40°F! But the water is pumped around the primary loop to the steam generators very quickly, passing through the reactor in less than a second. So, an enormous volume of water continuously cycles through the reactor, and in that short time quickly picks up that 40°F heat from the fission reaction. It's both the huge amount of water and the temperature difference which generates so much power.

The life of the reactor core's load of enriched uranium, U235, is measured in Effective Full Power Hours (EFPH), with the U.S. Navy employing this fuel at highly enriched 93% levels, as we've noted. For nearly all of its operational life, the typical nuclear-powered submarine cruises at modest velocities while its reactor is run at a fraction (25-30%) of available maximum power; only when sprinting is more power really needed. In an average year, then, a submarine might use around 500-700 EFPH. Based on the starting EFPH value (1200 in the older S5W reactors, much more with the new *Virginia*-class cores), the older S5W-equipped submarine could go for years between refuelings. The new, high-density cores in the *Virginia* class are intended for "life of the boat" usage however.

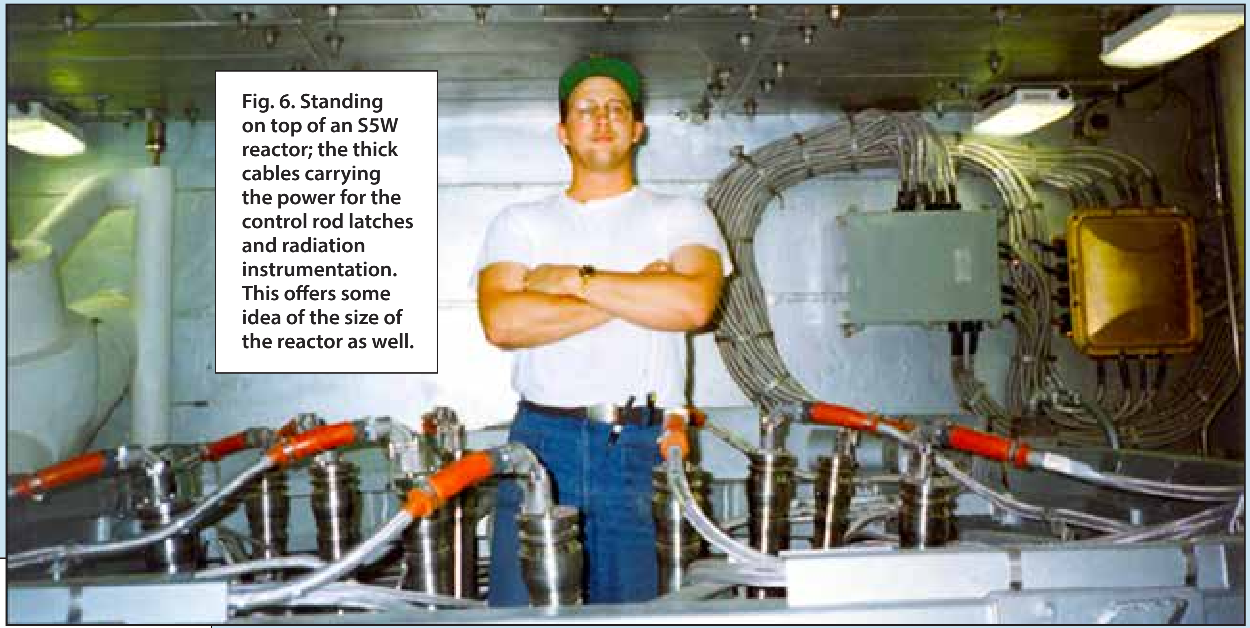


Fig. 6. Standing on top of an S5W reactor; the thick cables carrying the power for the control rod latches and radiation instrumentation. This offers some idea of the size of the reactor as well.

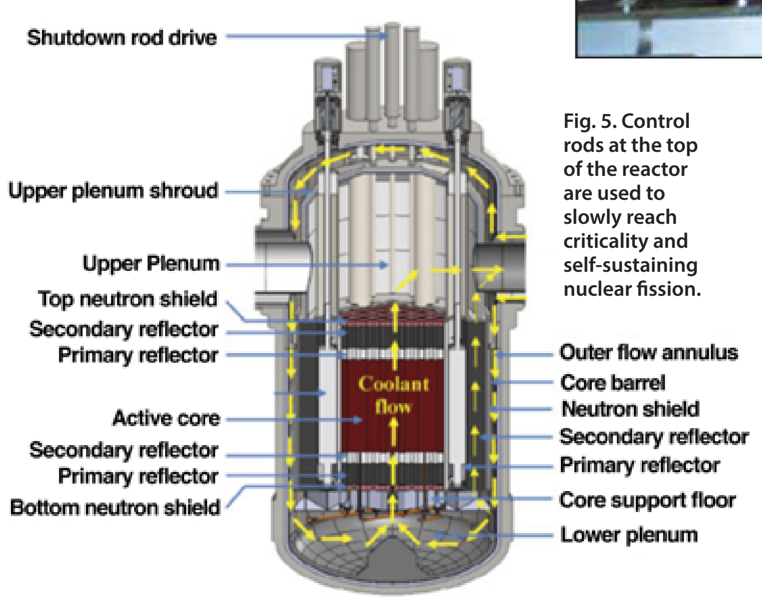


Fig. 5. Control rods at the top of the reactor are used to slowly reach criticality and self-sustaining nuclear fission.

Control Rods

Interspersed with the fuel bundles in the reactor's core are slots for the control rods. The U.S. Navy uses the transition metal element hafnium for these critical elements. When zirconium metal was first proposed for the fuel bundles, a serious problem was believed to be that in its natural state zirconium was not "transparent" to neutrons. It was soon discovered that it was actually the hafnium contaminant *within* the zirconium which was absorbing neutrons, and so the hafnium was purified away from the zirconium. During this process, it was found that hafnium was also highly resistant to hot water corrosion and an excellent neutron absorber. So, the zirconium "contaminant" became the source of U.S. naval control rod material. Control rods have a "X" cross-section, and slide in channels between the uranium fuel bundles of the reactor.

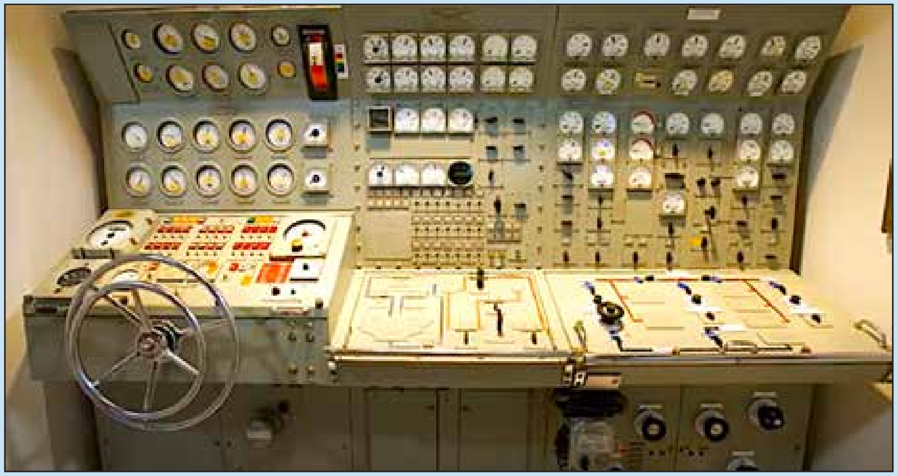


Fig. 7. Power control panel in the Maneuvering Room of an S5W submarine. Panel is divided into three primary control sections. The large wheel at left controls ahead speed; the smaller wheel inside the larger wheel is astern speed.

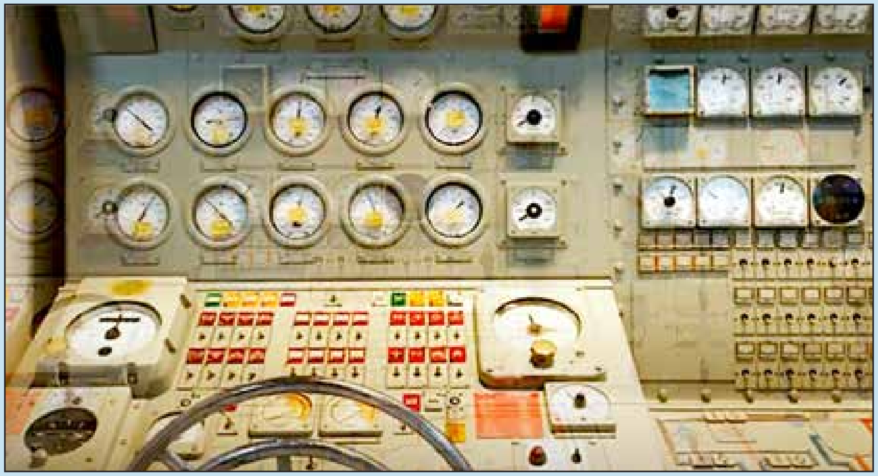


Fig. 8. On the left is the propulsion power control. The top of the steam control wheel is just visible. The gauges indicate various parameters within the engine room and twin propulsion turbines. At the far left is the engine telegraph, and above it, the RPM indicator.

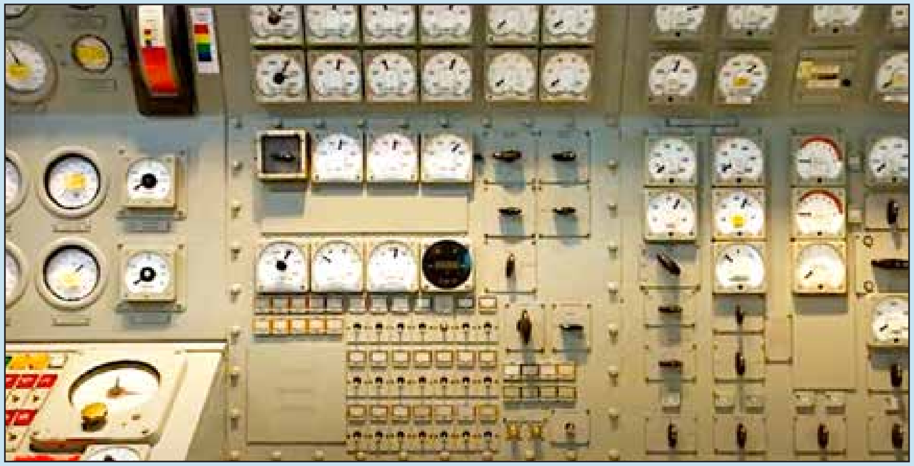


Fig. 9. The center panel contains the reactor control panel gauges.

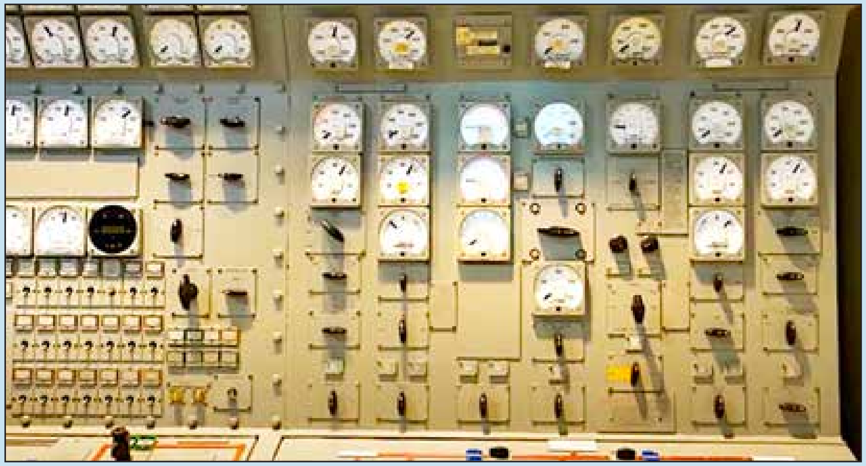


Fig. 10. The right-most panel controls the SSTGs and electrical distribution to the different busses which distribute electrical power. Both AC and DC current are provided. In older submarines, a motor/generator set was employed for AC/DC and DC/AC conversions; newer submarines use solid-state rectifiers.

To start the reactor after a shutdown, subsets (groups) of control rods are pulled up from the core in small increments. The rods are divided into linked "groups," with the center Group 1 being the "control" group in the middle. Groups 2 and 3 are positioned around the core; Group 2 in a ring around the center with 3 as the outermost ring. Groups 2 and 3 control the reactivity of their areas in order to spread out the use of the U235 (reactivity loss is called "burning") evenly over the life of the core. As the core ages and fuel is "burned," Group 3 is pulled up, leaving Group 2 in the core and Group 1 controlling the core temperature. Later in core's life, Groups 2 and 3 will swap, with Group 3 staying on the core bottom and Group 2 being pulled up. This evens out the rate of U235 use (or "burn"). Also helping are compounds in the fuel bundles along with the U235. These are called "burnable poisons." Initially these generate neutron absorbers such as xenon-135. Xenon-135 is also produced by the fission reaction itself, having a significant effect on reactor operation. Fortunately, xenon-135 absorbs neutrons from the fission process and reduces to a non-absorbing decay product. Thus, xenon-135 production and decay reach a steady state during reactor operation. As the core ages and loses a percentage of reactivity due to U235 depletion, the poisons are slowly "used up" and neutralized by the neutrons, converted to non-absorbers, and thus neutron absorption declines. The entire point of burnable poisons is to "smooth out" the reactivity of the core over longer periods yet retain sufficient reactivity near the end of the core's life to overcome the xenon-135 when the reactor needs to rapidly restart.

The amount that the control rod must be removed from the core is calculated before startup. This is termed the "Estimated Critical Position," or ECP. It's calculated based on the amount of power used in the past, and the length of the shutdown. As the core ages, the rods must be withdrawn to a higher level to achieve criticality. During startup, with the pumps running, the Group 1 rods are incrementally withdrawn over time until the power level reaches the self-sustaining point (critical) and no longer drops after each incremental "pull." The distance withdrawn should closely match the calculated ECP. The reactor is then slowly heated up by withdrawing the rods in further increments to achieve actual operating temperature. This slow rise in heat is to prevent fracturing the reactor vessel from temperature differences too large or too sudden. During the process, the rate of temperature increase is about 5°F per minute. The entire procedure is monitored from the reactor control panel in the maneuvering room. Instruments measure the quantity of neutrons, temperature changes, startup rate, and other parameters of the reactor as it increases power.

The design of the rod system is truly ingenious in its "failsafe" feature. The rods themselves are held in the core by both their weight and strong coil springs. In order to be withdrawn to start the reaction, the rods are "latched up" in their Groups. The tops of the rods are gripped by "alligator clamp"-like assemblies, which are closed by powerful electromagnets; they are literally grabbed and lifted. If power is lost, the electromagnetic clamps are deenergized; they open, and the springs drive the rods back into the reactor, causing a "scram"—a sudden reactor shutdown. Big "T"-handles on the reactor control panel in the maneuvering room direct the rod latching process, as well as the amount of distance they are lifted out of the core.

Generating the Power (Steam)

During operation, once the primary loop water exits the reactor, it goes to one of two identical vertical steam generators. These also occupy space within the reactor compartment. In the steam generator, water from the reactor at 500°F, designated the primary circuit or loop, is pumped into an inlet to a plenum which channels the primary water through a series of about 1800 inverted, U shaped tubes. Surrounding the outside of these tubes is the secondary loop water. The secondary loop is the water which will be heated by the primary loop into steam which exits the reactor compartment to drive the turbines. By this arrangement, it never comes into physical contact with the radioactive primary loop water. Further details of the secondary loop will be discussed later. In the process of generating steam, the secondary water cools down the primary loop water—which is then collected after passing through the U-tubes at an exit plenum and pumped back into the primary circuit, back to the reactor. By this arrangement, only steam generated in the reactor compartment exits, having never come into direct contact with the radioactive primary loop water passing through the reactor. The primary loop water is treated with chemicals to reduce corrosion in the steam generator loop.

Again, it's been mentioned that the water is pumped through the primary loop quite rapidly. Each of the two primary loop circuits has three pumps (six total) to circulate it. These are self-contained, sealed units roughly the size of a couple of refrigerators. They use a significant portion of the electrical power generated to move this primary water through the reactor and steam generators. They are unfortunately also noisy when operating, putting out distinct tonals which can be detected on sonar. Depending on power needs, pumps can be run at different speeds, and usually only two of the three pumps are run with the third kept quiet as a backup.

To improve pump quieting, newer submarines (post-*Sturgeon* SSN and *Ohio* SSBN classes) can employ natural circulation at low speeds, which makes use of the physical principle of hot water rising and cooler sinking. Careful design and layout of the reactor and steam generator elements make this possible. But once running above low speed, some combination of pumps must move the primary water through the reactor to the steam generators and loop it back to the reactor.

Water as a moderator has an additional key advantage. Once the reactor is operating, a call for an increase in RPMs (speed) will result in the pumps running faster, meaning more heat energy is transferred to the secondary loop for the propulsion train. This in turn cools the primary loop water, increasing its density. An increase in water density means more neutrons are slowed and thermalized, further increasing the rate of U2365 fission and therefore heat generation too. Reducing propulsion demand creates the opposite effect: less heat is removed, water becomes less dense, and fewer neutrons are slowed—reducing the fission reaction. This ability of the reactor to respond to demand changes is known as "inherent stability." The operators do not have to make major adjustments in the control rods in response to increased steam demand; physical principles largely take care of it. While pure water loses its radioactivity quickly when the reactor is shut down, contaminants such as minute metal particles shed from the pumps can retain radioactivity for long periods. Consequently, the water is passed through a resin bed, which is periodically disposed of as radioactive waste. Quick loss of radioactivity means the reactor compartment can be entered fairly soon after a shutdown for maintenance. One of the disadvantages of the liquid sodium used in the S2G reactor variant aboard SSN-575 was that the irradiated sodium stayed "hot" for a longer period, extending the time until the reactor compartment could be entered.

Fig. 11. The Maneuvering Room while underway. The area is rather narrow, with additional panels and gauges behind the watchstanders.

Other Essential Elements…

Pressurizer

One essential piece of equipment is the pressurizer. It acts to keep uniform 1750 psi pressure in the primary circuit and in the reactor so that water remains liquid. This is critical to reactor function and safety. Steam vapor in the primary system would cause a catastrophic condition leading to damage and the melting of fuel elements. The pressurizer is a tank connected by a pipe to the main coolant system. It has heaters which keep the water in the tank

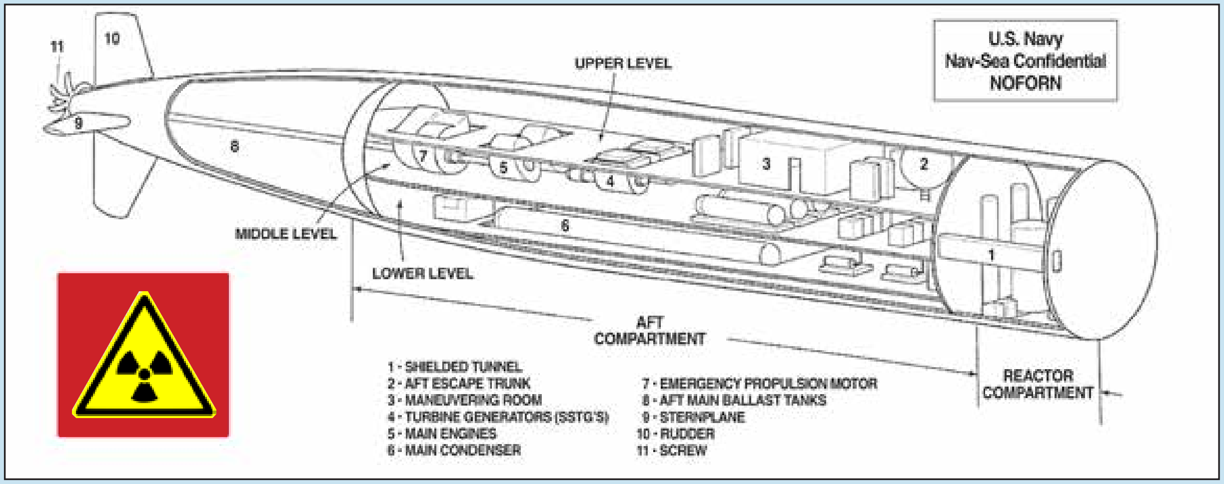


Fig. 12. A summary of the layout of the tail end of a nuclear submarine. Components are indicated in the legend in the figure. Diagram is from DeMercurio book reference.

at 617°F and 1,750 PSI, so liquid and vapor can coexist. The pressure generated is transmitted through an attached pipe, sending the water within it into the primary loop. As with the other elements of the system described above, the pressurizer is also located inside the reactor compartment.

Emergency Cooling System

The Emergency Cooling System (XC) is one which moves primary water from the core to a heat exchanger, a series of tubes immersed in cold seawater to offload the heat. Cold seawater flows into the tank and exits by convection to remove this heat. Since it happens at sea pressure, the heat exchanger must be a "hard tank." Its cooled primary water flows back into the reactor in a loop.

This emergency system's seawater openings are normally isolated by valves. Using the system runs the risk of a reactor "cold water" accident, which can lead to a fuel meltdown or worse. Thus the system is used only for emergencies and must be carefully monitored in operation.

Shields

The reactor, primary loop, steam generators, pressurizer, and other elements such as the reactor emergency cooling system, are all located within the reactor compartment. When operating, the reactor gives off two kinds of radiation: gamma rays (X-rays) and neutrons. To keep this dangerous radiation away from the crew, the compartment is lined with two types of shields. Six inches of lead shields gamma rays from the tunnel used by the crew to traverse the reactor area. Protecting the same area from neutrons is an additional twelve inches of polyethylene plastic (which contains neutron-absorbing hydrogen). Lead also lines the reactor compartment, but in some areas, either water or diesel fuel is further used as neutron shielding; both have hydrogen in their molecules, offering good neutron protection. Fuel oil tanks are therefore often placed fore and aft of the reactor compartment. As fuel is used while running the diesel, water automatically flows into the bottom of the diesel tank, maintaining shield safety.

Steam for Propulsion & Electrical Power

So far, we've looked at the operation of a submarine's nuclear reactor and its components. Now we'll move outside the shielded reactor compartment to pick up the story of the secondary loop's steam after it passes from the steam generator. Recall that this generated steam is never in physical contact with the primary loop water circulating through the reactor, hence only heat energy is exchanged to the secondary loop.

During startup, no steam is actually generated. Once the reactor achieves operating temperature and is capable of generating steam, two large isolation valves—one from each steam generator—must be opened to admit steam into the secondary loop system in the spaces powering the propulsion and electrical generation systems. These are called the Main Steam valves, with MS-1 on the starboard side and MS-2 on the port. They can be rapidly closed in the event of a steam leak. This 455°F steam flows through the large header pipes overhead, all of which are coated with thick insulation (lagging). Because of the thermal expansion of the pipes with increased heat, the steam header pipes make a "racetrack"-like loop before entering the Main Engines and the Ship's Service Turbine Generator (SSTG). Much of the pipe expansion is designed to occur in the "racetrack," which doubles back on itself.

Propulsion: Main Engines

Steam is delivered to the two main engines via two lines located port and starboard. These are heavily insulated steam turbine engines—surprisingly small in size for their power. The steam enters and initially goes through an impulse stage. Sets of rotor blades are arranged on a shaft, interspersed with stationary stators mounted in the casing. In this impulse stage, the steam enters and spins the turbine blades; as the steam moves along, the rotor passage expands and the velocity of steam increases (as the pressure decreases), transferring further energy to the rotor blades. The steam then gradually gives up its heat and pressure energy to the turbine. At entry, the steam is 455°F and at 440 PSI. As it exits the main engine turbine it is around 160°F and 5 PSI. The main engines power the drive train, described a bit later.

Electrical Power: SSTG

Steam is also delivered to the two electrical turbine generators. The SSTG has a manual throttle and a speed governor at the steam's entry point. The SSTGs are large, insulated boxlike structures. Enclosed within them are turning rotor blades interspersed with stationary stator blades. As with the main engines, multiple stages (impulse and reaction) take place inside the turbine. The pressure and heat of the steam spin this turbine at a regulated and steady 3600 RPM. Its shaft is attached to a large electrical generator, which uses the rotational energy to generate AC electrical current via copper windings spinning within a magnetic field. This power is then distributed by two "buses," one "vital" (reactor cooling pumps, lighting, main seawater pumps), the other "nonvital" (condensate pumps and hydraulic pumps).

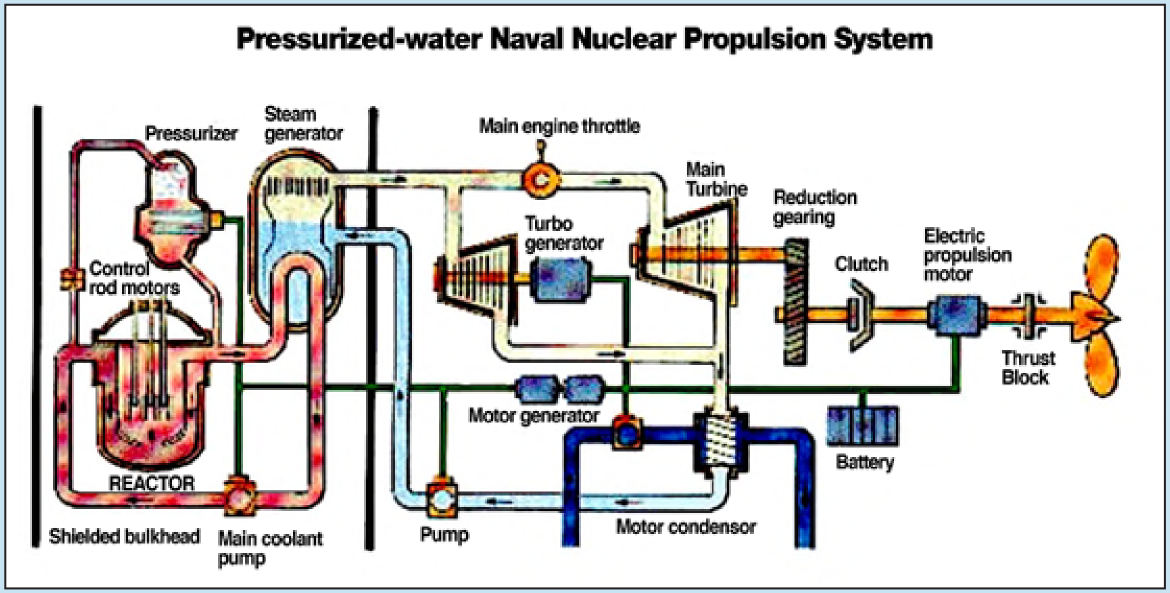


Fig. 13. Another diagram of submarine nuclear power, with the primary and secondary loops. Useful in following along with the text.

Completing the Secondary Loop

The steam exiting the Main Engines and the SSTGs has now given up the majority of its energy. To recover the water making up the steam and return it to the steam generator, the Main Condensers are used. There are two—port and starboard—below the turbines. Each condenser is a large horizontal cylindrical vessel containing a series of internal tubes. Cold seawater is continuously pumped by the main seawater pump through this cluster of tubes, and the steam flows around them, cooling and condensing back into water in the process. The condensation lowers the vessels' pressure, creating a "vacuum" relative to the incoming steam: colder seawater temperatures creates lower relative pressures. Seawater enters the system through eighteen-inch diameter pipes penetrating the hull. Since the pipes are at ambient outside sea pressure, large valves are fitted to them which can be slammed shut in case of a leak. Once steam cools and condenses back into water, it's collected in the bottom of the Main Condenser. A condensate pump then moves the water back to the Main Feed System. Here an elaborate twelve-stage axial pump raises the water pressure to 450 PSI and pipes it back through the shield into the reactor compartment, feeding it into the two steam generators to repeat the secondary loop cycle. The water in the loops is periodically tested, and its pH and ions adjusted with chemicals to minimize any corrosive effects on the piping or other components.

The Drive Train

Picking up on the flow of energy into the drive train mentioned above, the first thing to know is that the Main Engine propulsion shafts turn much too fast to provide useful speeds for the propeller. To reduce this speed to a practical level, the two Main Engine shafts combine to drive a fifteen-foot diameter "bull" gear inside a large Reduction Gear assembly. Input speed from the Main Engines is about 10,000 RPM at flank bell, which is reduced to 200 RPM for the actual propeller. Between the propeller shaft and the Reduction Gear is a hydraulic clutch; the heavy propulsion gears and turbines can be detached from the propeller shaft so when necessary it can be run by the electric emergency propulsion motor instead. There is also a Thrust Bearing assembly. The screw moving through the water generates a powerful force to push the submarine forward. This thrust is transmitted to the 12-inch diameter propeller shaft, which in turn pushes against the Thrust Bearing, firmly anchored to the submarine hull. This is how the propulsive force of the propeller is transmitted to the submarine itself. The propeller shaft passes through the hull at the stern, and an elaborate shaft seal keeps water from entering by pressurizing the seal above the exterior water pressure.

This brings us to the conclusion of our look at submarine nuclear propulsion. Obviously, there's a lot of additional complexity which couldn't be addressed here. Naval nuclear power training is a full-year intensive course of study and reactor operation. Submarines also carry massive manuals covering exact procedures for any operation and virtually every possible contingency or reactor casualty. Nevertheless, I believe you can get an appreciation for the general principles and myriad complex details involved from our basic exploration above.

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UNTERSEE overseas

A new column from the German perspective by **Bernhard Wenzel**

U9: The Triumph (Part 3)

The sea was still choppy, lashed by the wind of the previous days, but it had already dropped to Strength 3 by this time. The first rays of sun streaked the surface of the water. The air was clear, the horizon sharply in focus. The lookout kept a keen eye for the enemy—British blockade ships—which were supposed to prevent their own supply ships from providing the homeland with trade goods and raw materials essential to the war effort. The boat had fought against storms and heavy seas for two days and everyone's clothes were damp, but the crew was

Bernhard Wenzel is an old hand at r/c subs, and we're thrilled to have him contributing to the SCR. With this installment, he buttons up his three-part WWI U9 article by detailing the history of the boat's crowning achievement. Bernard comes to us by way of SONAR (an international r/c sub periodical out of Germany, which we try to massage into SCR copy after running it through Google Translate). Next time he will cover his British C-class build.—ed.

Bernhard Wenzel comes to us from SONAR magazine, a German submarine hobby publication, and the *SCR* is so pleased to have him with us!

wide awake in the early morning despite the restless night. Otto Weddigen had left Helgoland on September 19 in his boat, *U9,* with the aim of crossing the Dover-Calais Canal and operating in the Celtic Sea. Now, in the early morning of September 22 at 5:45 am, the lookout aboard *U9*, 50 km north of Hoek van Holland, sees smoke plumes on the horizon. Since the wind is driving their own boat's petroleum exhaust in front of them, obstructing their view, the officer on watch orders zigzagging in order to get a better look at the horizon. Then it quickly becomes clear: the distant smoke columns and mast tips belong to three heavy units. Without a destroyer escort, and in a reasonably calm sea, these three enemy armored cruisers run directly toward the *U9*.

"Prepare the boat for diving!"

David versus Goliath—that's what this duel might colorfully be called—taking place in the North Sea in the early morning of September 22, 1914… almost seven weeks after the outbreak of World War I. Actually, the fight was even more unequal than that description: it was really one David versus *three* Goliaths—SM *U9* up against the British armored cruisers HMS *Aboukir*, *Cressy* and *Hogue*.

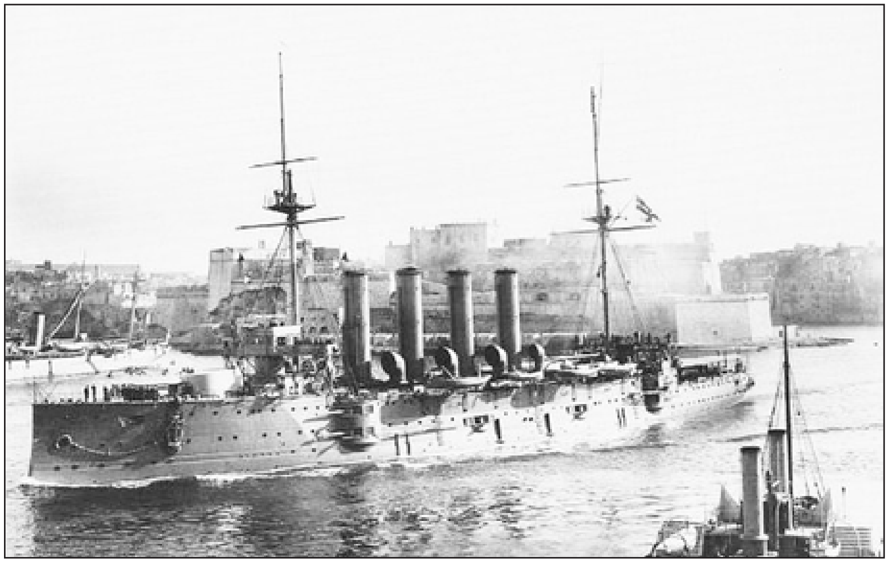
German Captain Otto Weddingen in WWI.

At about 600 tons, 57.4 m in length and carrying a 29-man crew, the *U9* was a respectable boat for its time, but basically already out of date at the beginning of the war. Although she had only had her keel laid down at the Imperial Shipyard in Danzig in 1910, her 1000 hp-over-water engine system was not exactly generously dimensioned. In addition, these were petroleum engines because the more powerful diesels were not yet available at the time—the first German boat to feature such diesel propulsion would be the *U19*.

The three identical British battlecruisers were a bit more aged, between eleven and thirteen years old apiece, but were still impressive and formidable: each was 144 meters long, displaced 12,000 tons, had 23.3 centimeter guns, and carried a crew of 760. They represented a deadly danger for a small submarine. Thus, the stage was set, the protagonist and antagonists determined. But what circumstances would help David prevail on this particular September 22?

The Allies needed troop reinforcements to counter the advancing German army, which is why an expeditionary corps was to be transferred to the Belgian and French ports. Cruiser Group C of the Royal Navy's Southern Force had been commissioned to patrol the English Channel roughly at The Hague—to protect the troop transports and as part of the naval blockade which Great Britain had imposed on Germany immediately after the start of the First World War. To do this, the cruisers planned to first run north-northeast at a distance of one-and-a-half nautical miles on parallel courses, then turn around and return south-southwest. A standard maneuver, trained countless times.

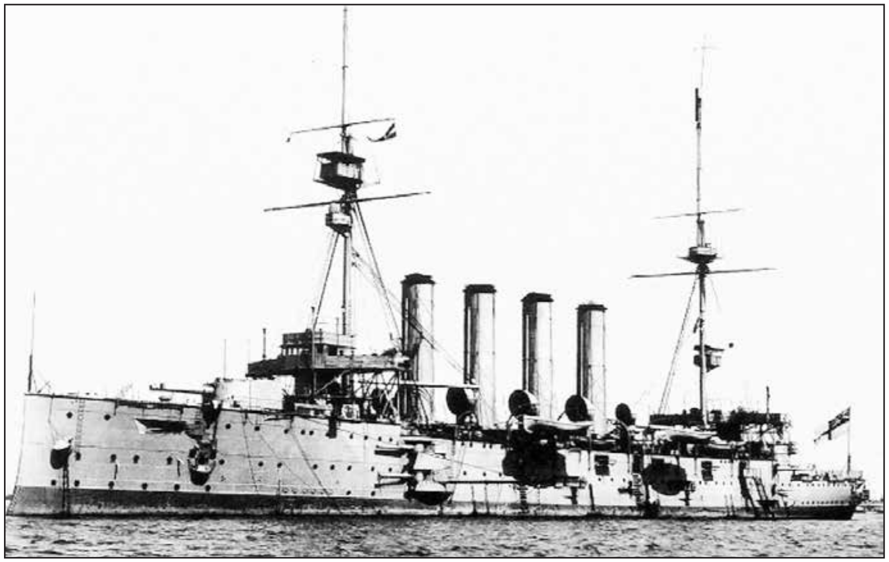
Bad weather forced the accompanying escorts to turn away—they simply couldn't keep up with the big armored cruisers in rough seas. Then the flagship of the group, the HMS *Euryalus*, had to turn off because her coal supply was running low. There remained the *Aboukir*, the *Cressy* and the *Hogue*, now commanded by Captain John Drummond as the longest-serving of the three ship commanders.


HMS *Aboukir.*

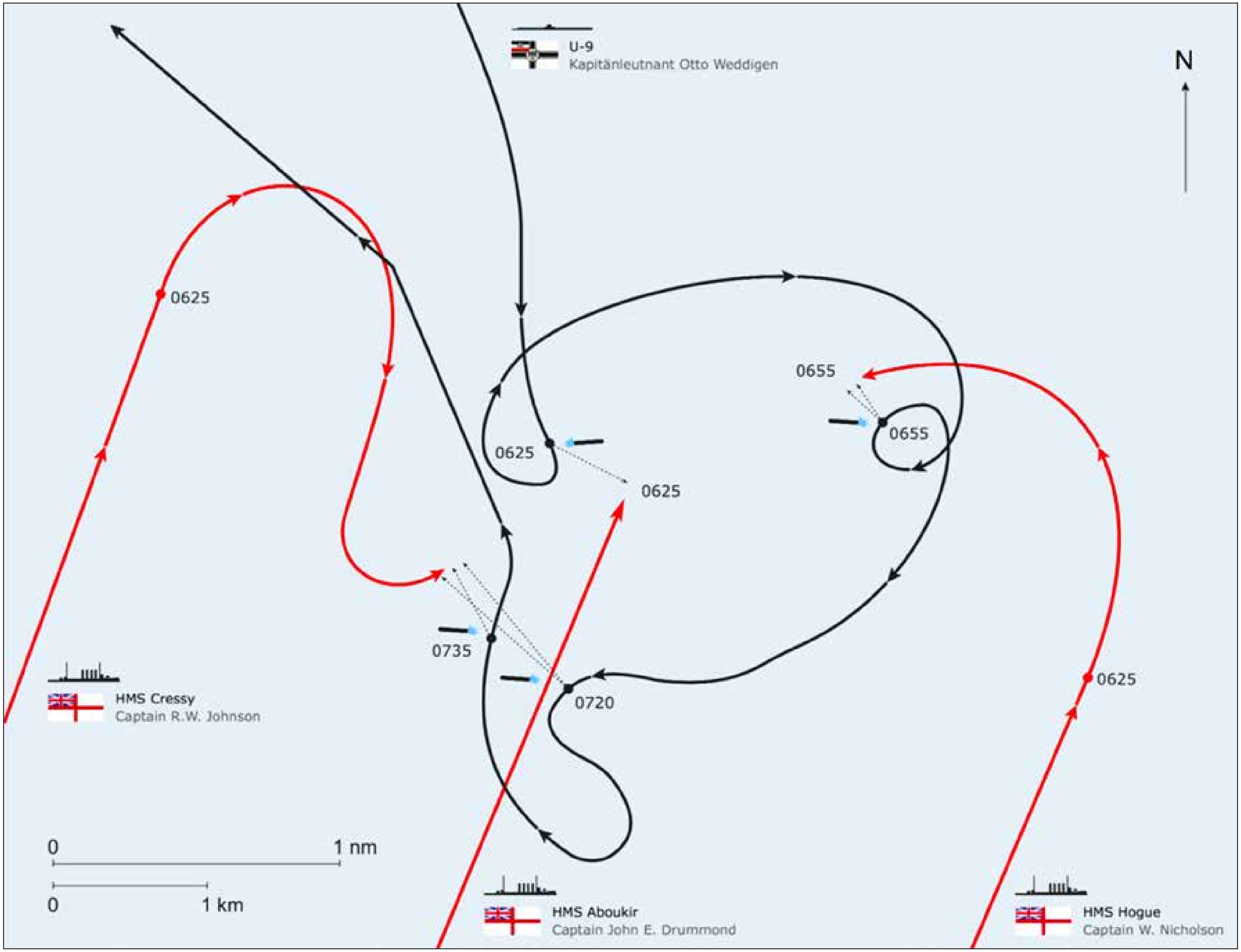
The British Admiralty and its commanders did not rate the fighting ability of German submarines particularly highly, so the the Goliaths probably felt fairly safe in these waters. When the weather cleared up on September 21, 1914, Drummond did not recall his destroyers—not the wisest of decisions.

Actually, a lively breeze was still blowing and the destroyer group preferred stay comfortable, not wanting to go to sea. Submarines? Today? No way! How could they have gotten into the area when their own larger destroyers had had to withdraw due to the weather? In addition, Drummond refrained from zigzagging his ships—next to destroyer escorts, the safest protection against submarine attacks—and another very poor decision, it turned out.

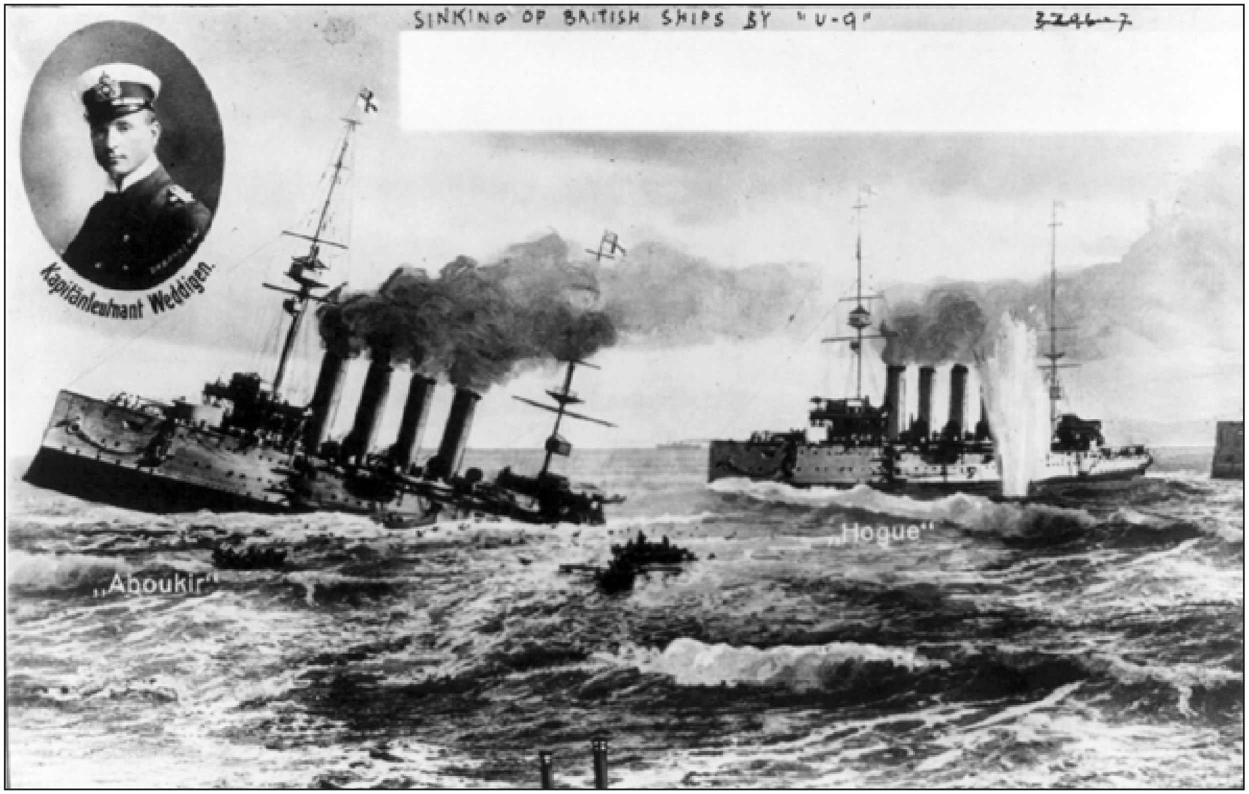
Drummond never noticed *U9* maneuvering into a favorable firing position. At 6:25 a.m., her first torpedo connected with HMS *Aboukir*'s port side, triggering a huge explosion. The other two cruisers immediately set course for their sinking sister. Their commanders believed Drummond had simply struck a mine.


HMS *Cressy.*


HMS *Hogue.*



Action of 22 September, 1914. (Wikimedia Commons image.)



Popular SM *U9* postcard.

To be on the safe side, Captain Robert W. Johnson of the HMS *Hogue* indeed had his lookout watching for periscopes, but only on her starboard side. A previous observation had apparently mistaken the *U9's* periscope for a chunk of driftwood. But Weddigen in *U9* maneuvered skillfully and brought himself to the other side of his opponent within two turns. He attacked again on the port side with a 90° angle shot.

Two accurate torpedo hits sank the *Hogue* in a mere ten minutes. The HMS *Cressy,* commanded by Captain Wilmot Nicholson, then set course for his stricken sister ships. At 7:20 a.m., after reloading, *U9* was ready to fire again and launched two more torpedoes, one missing, the other causing only slight damage.

Now Weddigen had only a single torpedo remaining. He turned his boat to fire one last time with an angular shot from the aft tube—a direct hit. Now *U9* retired from the area without ever being seen. A total of 1,459 British sailors drowned from her efforts that morning; only 837 from the total complement of the three ships could be saved through the assistance of a British fishing boat and the Dutch passenger steamers *Flora* and *Titan*. All this carnage had resulted from a battle which lasted just seventy minutes.

The joy at home from the news was enormous, and Weddigen and his little crew were enthusiastically cheered and celebrated when they arrived back at their home port of Wilhelmshafen just a few days later. Postcards were issued featuring photo-montages of various submarine images identified as the *U9* (some were not her), and they became immediate bestsellers. Kaiser Wilhelm II soon awarded Iron Crosses to the *U9* commander and his crew.

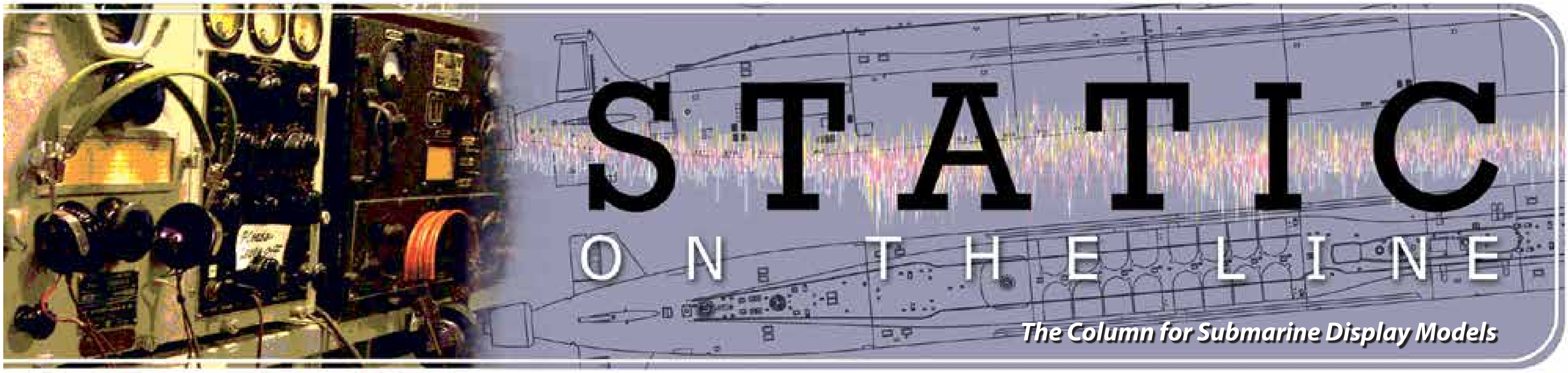
German naval command authorities then changed their Navy's operational priority—away from capital ships and toward the smaller, cheaper submarine, which could be better and more efficiently used as an offensive weapon. This approach remained in effect right on through the string of consequences which came about as a result: the sinking of the *Lusitania*, the enactment of unrestricted submarine warfare, the United States' entry into war—and ultimately, Germany's defeat.

Weddigen himself never witnessed these far-ranging effects. Almost three weeks later he sank the

British cruiser HMS *Hawke* off Aberdeen and received the Pour le Mérite for this success. At the beginning of 1915, he was given command of the *U29*, and on his first patrol into the Irish Sea sank four cargo ships. On March 18, 1915, while returning from his operational area near Scotland, *U29* met the Grand Fleet, which was on its way home to Scapa Flow. After a missed shot on the battleship HMS *Neptune*, *U29*'s periscope was sighted by the HMS *Dreadnought*, who took up the hunt and ultimately rammed the U-boat when she found she could not get deep quite fast enough. Her foredeck came to the surface for a short time, allowing her boat number to be positively identified. The *U29* then slipped forever beneath the waves.

Bernhard makes an adjustment to his beautiful WWI U-boat.

A broadside shot of Bernhard Wenzel's scale recreation of the SM *U9*—smoking stack and all!



New GUPPY Becuna *and SSN-637* Sturgeon *Kits*

by Tom Dougherty

This time, we'll be looking at a 1:350-scale resin model of a Guppy submarine I just completed. We also preview a new, large 1:144-scale *Sturgeon* (SSN-637) kit that was just issued by MicroMir.

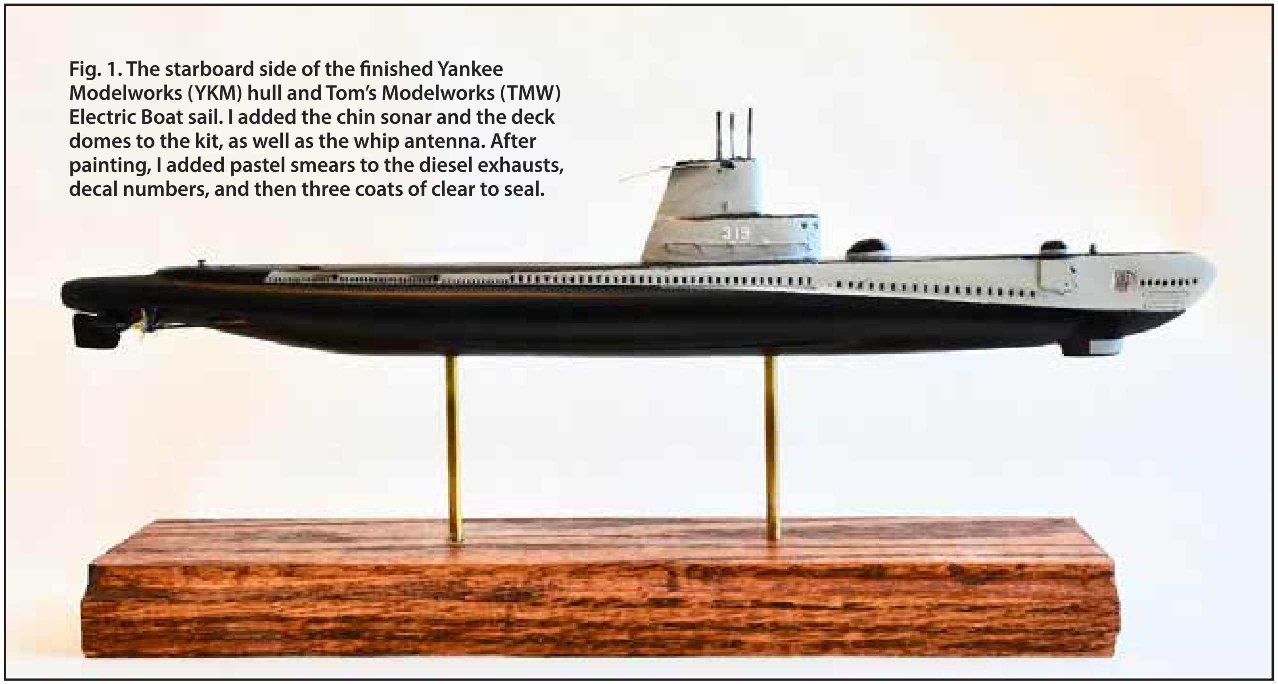


Fig. 1. The starboard side of the finished Yankee Modelworks (YKM) hull and Tom's Modelworks (TMW) Electric Boat sail. I added the chin sonar and the deck domes to the kit, as well as the whip antenna. After painting, I added pastel smears to the diesel exhausts, decal numbers, and then three coats of clear to seal.

Guppy IA *Becuna*

Way back in the late 1950s/early '60s, nuclear submarines were new and exotic. The initial designs changed from *Nautilus* to *Seawolf* to *Skate* to *Skipjack*, with *Triton* and *Tullibee* thrown in the mix as well. They were also relatively rare. When I once visited the nearby Philadelphia Navy Base with the Scouts, the submarines stationed there were either a few unmodified fleet submarines or conversions to the Guppy program. The Guppy submarines

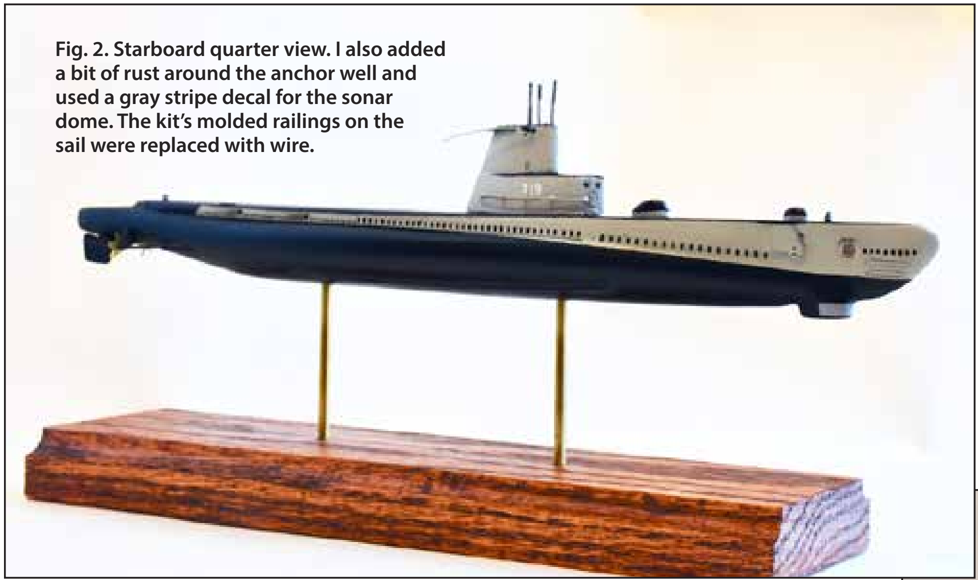


Fig. 2. Starboard quarter view. I also added a bit of rust around the anchor well and used a gray stripe decal for the sonar dome. The kit's molded railings on the sail were replaced with wire.

stood out with their rounded bows and sleek-looking sails. Most had "step sails" with two levels. One of my school buddies, Mike, had a submariner for a father, and his father gave me a photo of his Guppy sub taken from above. Of course, back then I was seven or eight years old, and the design differences between "atomic submarines," as they were known then, and diesel-powered submarines were not clear. After all, *Seawolf* had a step sail! His diesel sub had a step sail, but I can't recall if it was an Electric Boat or Portsmouth sail.

It was only when rekindling my interest in submarines during the 1990s that I learned the details of the Guppy program, initially by reading Jim Christley's excellent columns in the *SCR*. I subsequently obtained Friedman's *U.S. Submarines Since 1945*, John Alden's fine book, *The Fleet Submarine in the U.S. Navy: A Design and Construction History*, and several other references to these submarines. I should also mention that a wonderful Jim Christley article on the development and history of Guppy submarines appears in fairly recent *SCR*s #114 and #115. Over time, I came to understand the different Guppy modifications and variants, and how they changed as these boats held the underwater line in the Cold War well into the 1960s. Most recently, I visited the last of the conversions, the extensively modified Guppy III *Clamagore* (see *SCR* #116, page 34). Earlier, I had also made the trip back to Philadelphia to tour the Guppy IA boat, *Becuna*.

A few years ago, for a very brief period, the old Yankee Modelworks company made 1:350 resin kits of both early Guppy subs and a Guppy III, the *Clamagore*. These featured all the deck modifications found on Guppy postwar subs. And the Guppy III *Clamagore* kit featured a slightly longer hull, since the 1960s' Guppy IIIs received a fifteen-foot hull "plug" to accommodate a modern sonar suite at the time. Tom's Modelworks also made resin kits of Guppy submarines.

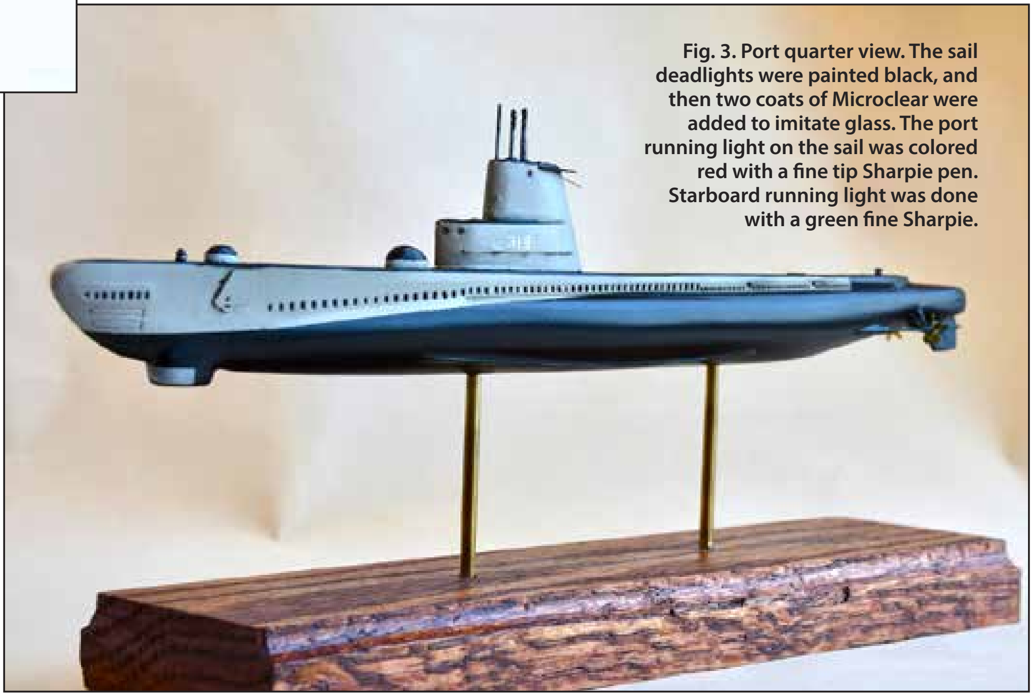


Fig. 3. Port quarter view. The sail deadlights were painted black, and then two coats of Microclear were added to imitate glass. The port running light on the sail was colored red with a fine tip Sharpie pen. Starboard running light was done with a green fine Sharpie.

Fig. 4. Aft starboard quarter view. Propeller shafts are thin brass rod. Limber holes were filled in with a fine tip black Sharpie.

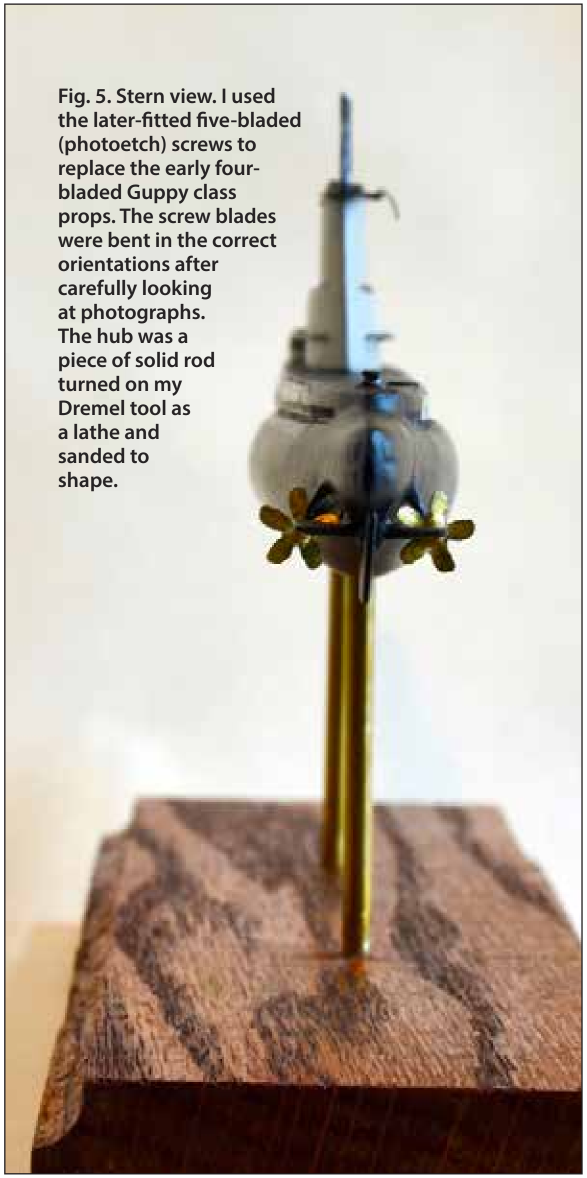


Fig. 5. Stern view. I used the later-fitted five-bladed (photoetch) screws to replace the early four-bladed Guppy class props. The screw blades were bent in the correct orientations after carefully looking at photographs. The hub was a piece of solid rod turned on my Dremel tool as a lathe and sanded to shape.

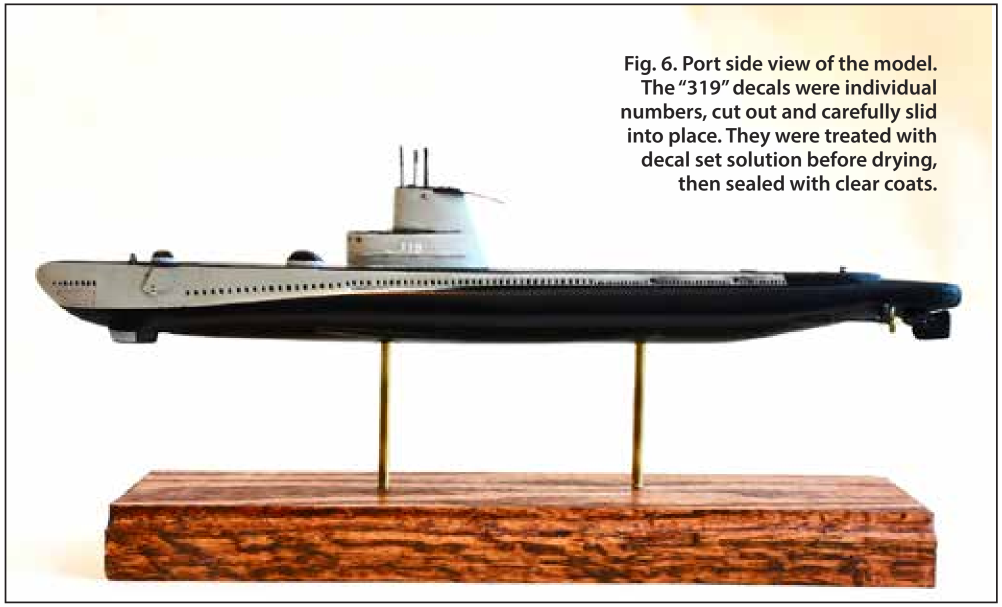


Fig. 6. Port side view of the model. The "319" decals were individual numbers, cut out and carefully slid into place. They were treated with decal set solution before drying, then sealed with clear coats.

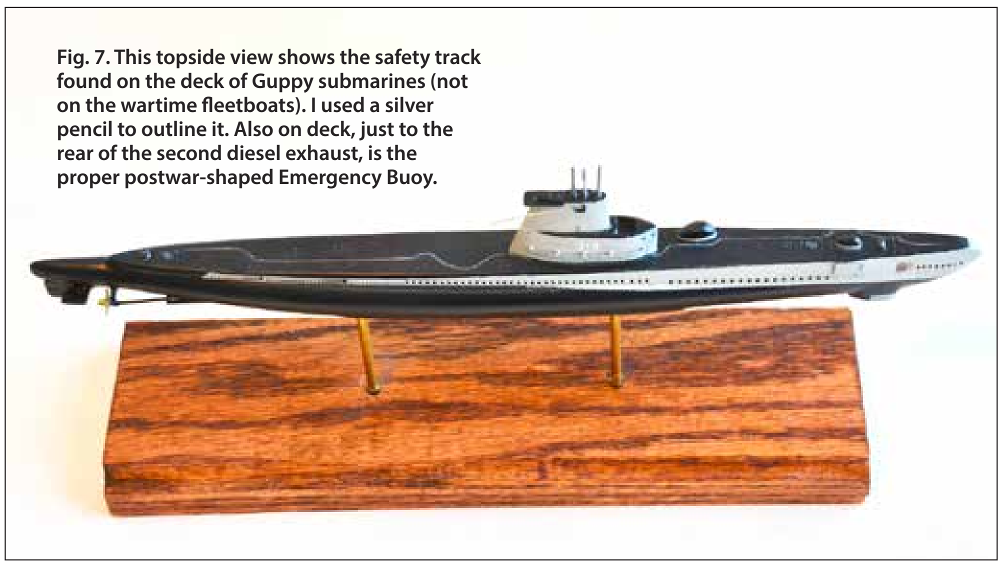


Fig. 7. This topside view shows the safety track found on the deck of Guppy submarines (not on the wartime fleetboats). I used a silver pencil to outline it. Also on deck, just to the rear of the second diesel exhaust, is the proper postwar-shaped Emergency Buoy.

These featured accurate Guppy sails for the Electric Boat step sail, the Portsmouth step sail and the Atlantic GRP sail. But these kits came only with a standard WWII fleet submarine hull. You were given s template to round off the bow by sanding, and the deck layout was definitely an unmodified WWII-era *Balao* boat. While the Yankee Modelworks Guppy sails seemed a bit "soft"—with details such as the EB sail windows in an incorrect shape—the Tom's Modelworks sails were significantly better. So, I set out to build two Guppy submarines using the superb Yankee Modelworks hulls combined with the

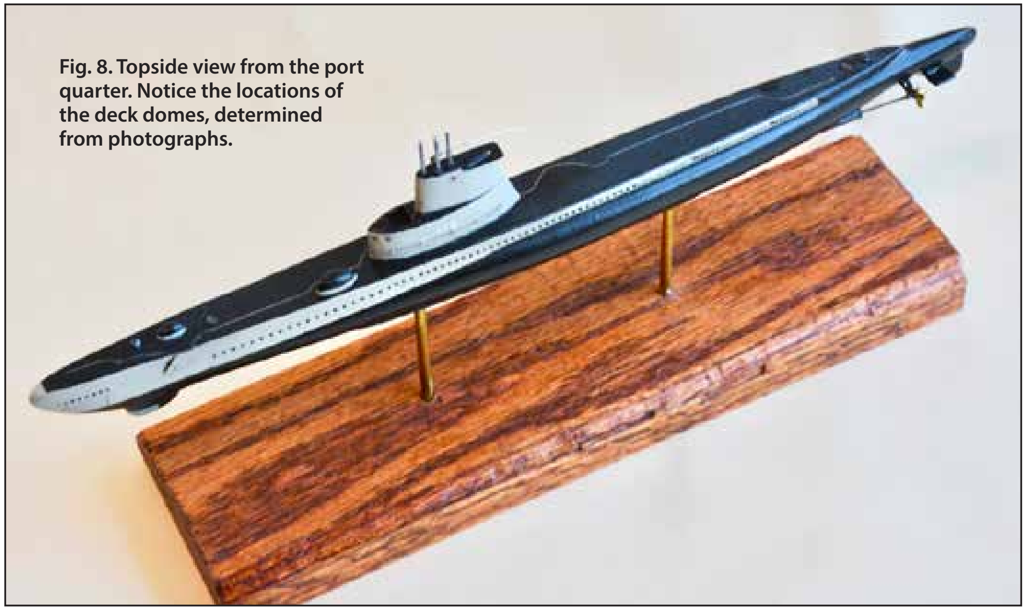


Fig. 8. Topside view from the port quarter. Notice the locations of the deck domes, determined from photographs.

superior Tom's sails. I include photos of the sails from the two sources in this article.

At this point, I have completed the initial Guppy IA build, which I did as the SS-319, *Becuna*. *Becuna* is a Independence Seaport Museum ship in the Delaware River in Philadelphia. I did exercise a bit of modeler's license in two areas. Although the Guppy III *Clamagore* kit comes with a chin sonar, the earlier Guppy version did not have this feature. I knew that a chin sonar was added to some earlier Guppy conversions though, so using two-part Milliput putty, I sculpted a rough outline using the underside of the bow as a template to get the correct curve. After it hardened, I then sanded to final shape and carefully glued it to the bow with cyanoacrylate. Bondo glazing putty sealed the small gap and blended it into the hull. I did the same for the two domes on the deck, which represent the topside of *Becuna* at various points in her career. These domes housed sonar and other equipment. I also used the Yankee Modelworks' five-bladed late-Guppy screws, fitted in the late

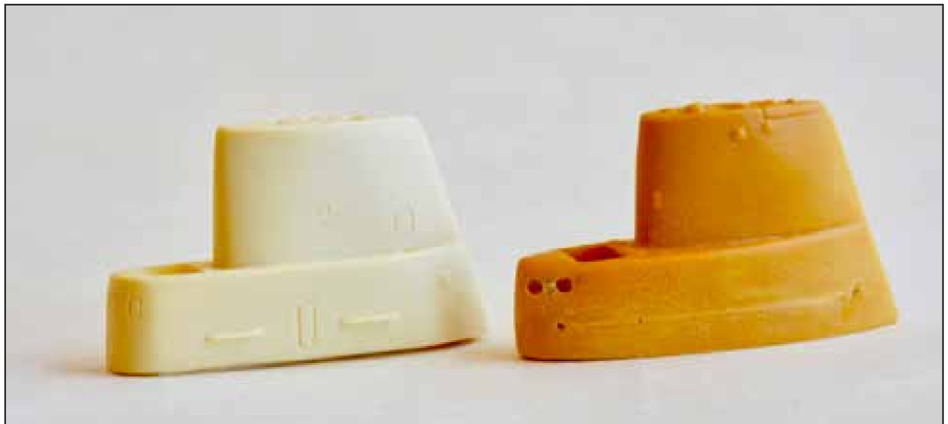


Fig. 9. On the left is the YKM Electric Boat Guppy sail which came with the kit. The deadlights are scribed in the wrong shape. On the right is the Tom's EB Guppy sail I used, with the correct EB round deadlights. The oblong-shaped deadlights were on the Portsmouth Guppy sail.

Fig. 10. Here are the two Guppy step sail versions from Tom's Modelworks. The Portsmouth design is on the left; the Electric Boat design to the right.

Fig. 11. These are the two sails for the *Clamagore* Guppy III kit. On the left is the YKM version which came with the otherwise superb hull and PUFFS fins. On the right is the Tom's Modelworks version I will be using when I build *Clamagore* as a Guppy III.

'50s. As you can see from the photos, it turned out reasonably well.

Next up will be the *Clamagore* build, using the Yankee Modelworks hull—with their three provided PUFFS sonar fins—combined with the Tom's sail, which is more accurate and detailed than the one provided by Yankee. That will be the subject of a future issue.

1:144-scale *Sturgeon* (SSN-637)

MicroMir, a Russian company, has been active in producing a number of 1:350-scale model submarines, including most U.S. nuclear boats. These even include two 1:350 polystyrene versions of USS *Parche*, one in each of her Special Projects configurations. (I hope you appreciate the irony of a Russian company producing these

Fig 12. The MikroMir 1:144-scale USS *Sturgeon* (SSN-637) box. It's big!

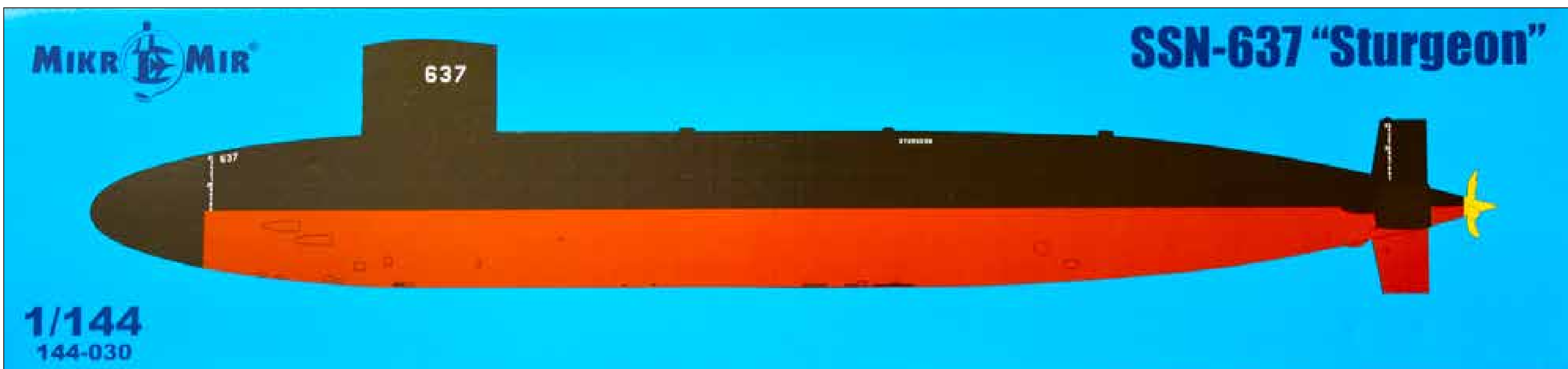


Fig. 13. The main hull next to a six-inch steel ruler. The hull itself is fairly thick GRP material and hollow inside. As mentioned, it is in "as built" configuration.

kits…!) MicroMir's latest production and marketing foray is into the much larger 1:144 scale with a new kit of the USS *Sturgeon* in her "as-built" condition. This is *Sturgeon* before towed array and other topside domes were added in her later years. I want to note that the hull cylinder, which is a single piece, is glass-reinforced fiberglass and about 1/8-inch thick. So I suppose with some work and cutting, you could make it into an r/c'd version. I've included several photos of the hull. The scribing is very fine and delicate, and both topside and ballast tank openings match the Greg Sharpe plans I'd sent them. I include a topside bow closeup here so you can discern the scribing. It's not terribly deep, so painting will have to be thin coats, with some line shading techniques possibly added later to make them stand out a bit. There is an unfortunate seam running down the side of the hull (see photo) which will have to be sanded and puttied to blend in.

Fig. 14. A closeup of the bow area to illustrate the scribed details, such as the safety track, hatch, ballast tank vents, etc. The kit's scribing is very light.

The nose dome/cone is cast in polystyrene in two pieces, which is

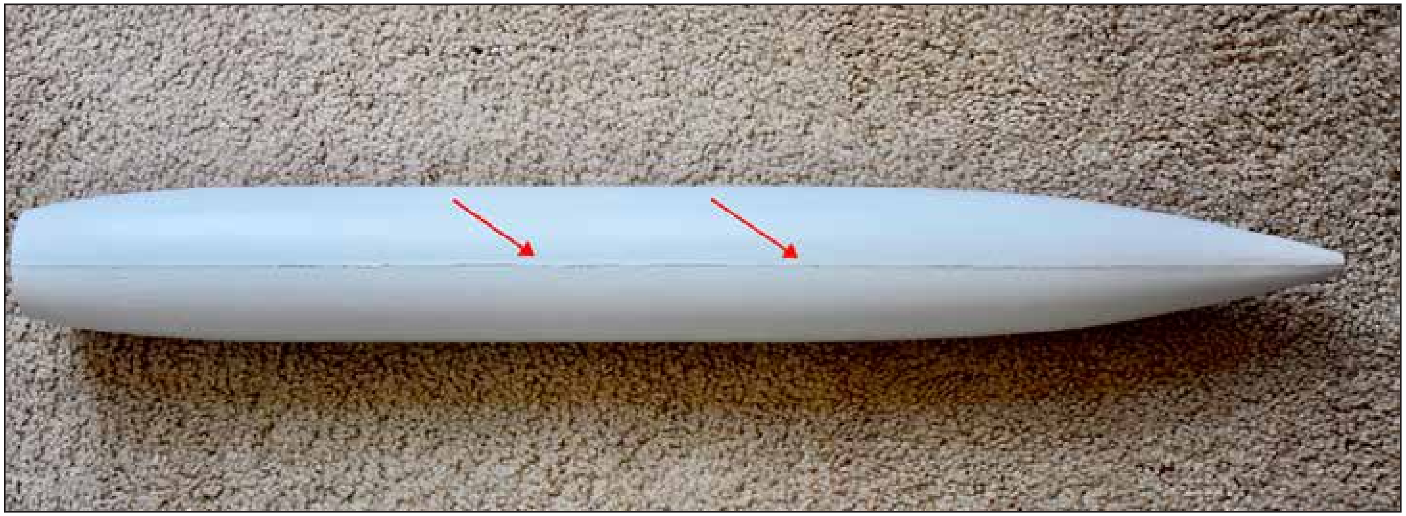


Fig. 15. The seam (red arrows) which runs along the side of the hull about where you'd divide the lower red hull from the upper black. This is going to take both sanding and putty to blend in. It's a lot of seam work to address on both sides of the hull.

Fig. 16. Underside of the hull. The ballast tank openings are scribed, again not very deep. I may put some of my photoetch screens over them. The aft openings are correctly positioned near the auxiliary machinery room, which is surrounded by the aft ballast tanks. Also, the "mushroom" anchor is at the stern.

unfortunate since there will be seam work to accomplish here as well. The sail is also two pieces, as are many of the other parts. Gluing all of the polystyrene pieces to the GRP hull (sail, nose, etc.) will require cyanoacrylate glue or two-part epoxy, since the standard "model" toluene and other formulation glues used for polystyrene all soften and partially melt the polystyrene plastic for adhesion. This won't work for adhering to GRP!

There aren't a lot of pieces to the kit, so it should be a relatively fast build. But there is ***one rather large problem***. Known for their recent habit of providing a propeller hub with separate blades and no blade attachment indicators, MicroMir's unfortunate practice continues here as well. Even worse though, they provide ***only six blades for the screw!*** Not the proper seven, but six! You'll recall I mentioned above having sent MicroMir the accurate Sharpe *Sturgeon* plans? Why couldn't they follow them with regard to this prop? Also, their prior 1:350 kits of the short- and long-hulled versions of the *Sturgeon* were released *with seven-bladed screws*, as were their two *Parche* kits! Just what happened with MicroMir's going to 1:144 scale? To me, this is truly a fundamental feature on the model—you simply can't get it wrong. Especially in this larger scale.

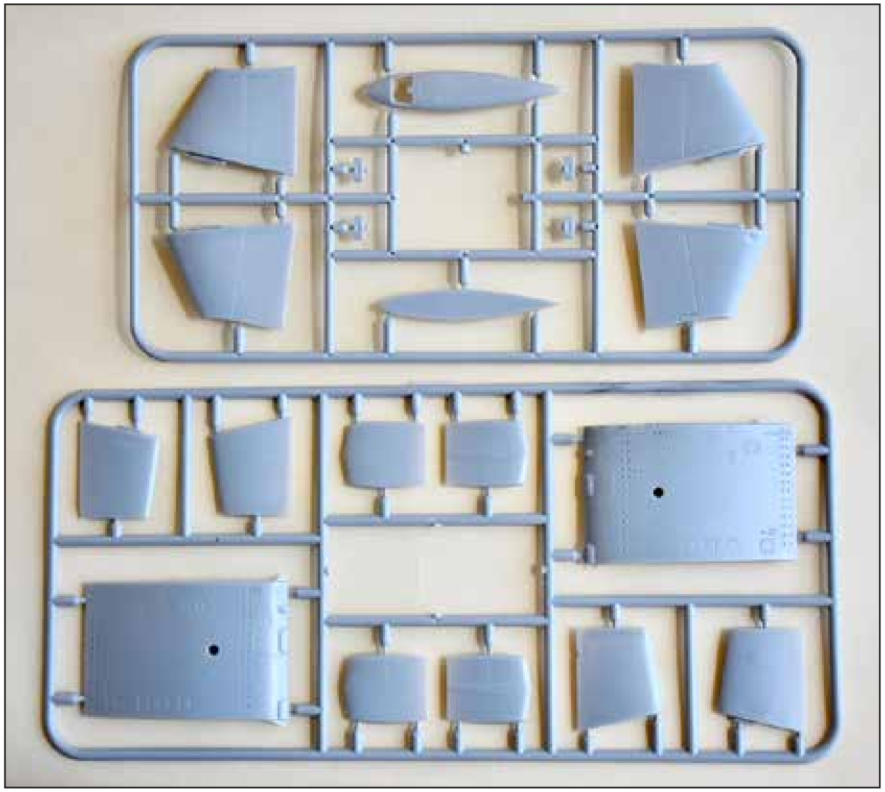


Fig. 17. The fairly simple polystyrene sail, sail top, rudders, and stern planes on a single sprue.

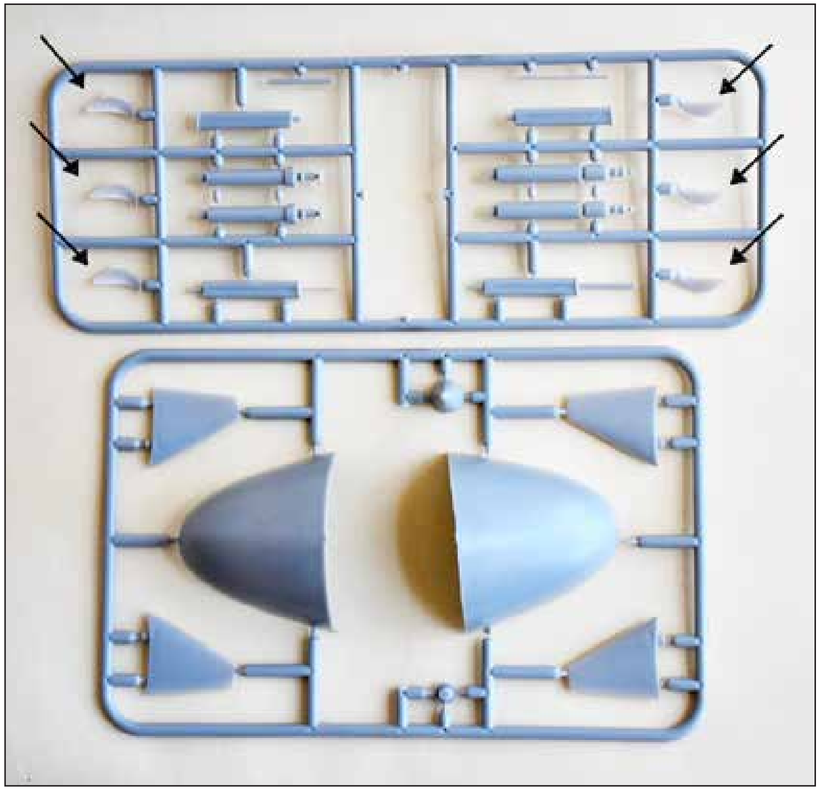


Fig. 18. Two-piece nose cone, sailplanes, masts, cone-shaped propeller hub and (black arrows, count 'em!) *SIX* blades for the screw. *What were they thinking?!* Modelers screwed by the screw… *(Love that. —ed.)*

Of course, if you are going to r/c this kit, you will purchase a separate robust propeller for it. But what about if you just want a display model? Well, I suppose you could try to use one separate blade as a template to recreate the missing one. Fortunately, however, Mike Fuller comes to our submarine modeling rescue. Selling 3-D printed propellers which I recently reviewed here, Mike goes by "Mulsanne Mike" on Ebay. And he makes a beautiful 3-D printed 1:144 seven- blade "J screw" that's a perfect solution for this kit's sad screw situation. I highly recommend his products in both 1:144 and 1:350 scale! Apparently, MikroMir is also planning a 1:144 *Los Angeles*-class submarine in the future. Yes, I sent Greg Sharpe's 688 plans (and information on the differences between all three versions of the class) to them for this release as well. Here's hoping they get it right this time.

Fig. 19. Screw solution for this kit from Mike Fuller: his 3-D printed "J screw" for the *Sturgeon* class in 1:144 scale. This can be ordered on Ebay (Mulsanne Mike) or directly from him by email (mike@mulsannescorner.com). For r/c, a metal propeller would be in order.

Honoring *Harder*

Building Revell's 1:72 *Gato* boat as SS-257

by Jeff Porteous

Harder off the beach at Woleai, 1944.

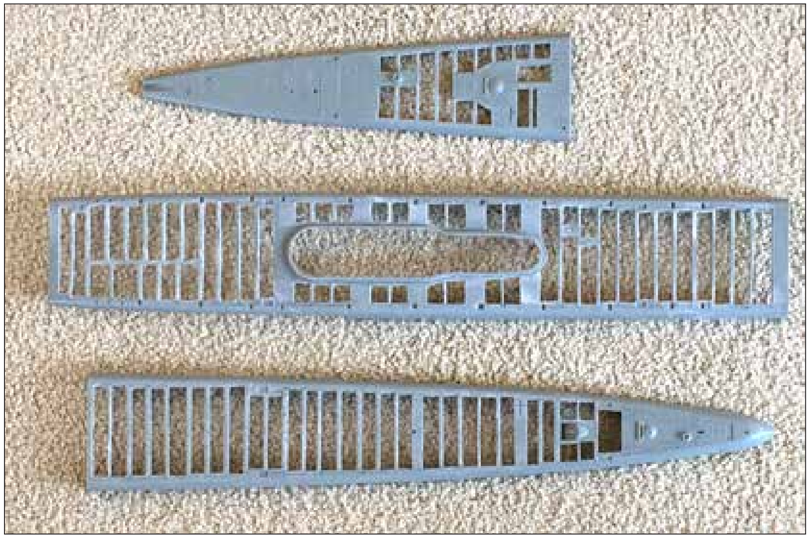
Part Two...

Welcome back to the Electric Boat shipyards, So. Calif. Division, where we're endeavoring to convert the generic 1:72 Revell *Gato* kit into a reasonable facsimile of USS *Harder* (SS-257)—so she can take her rightful place within a three-boat memorial wolfpack of similarly converted and r/c'd famous *Gato* fleet submarines. (The other two will be USS *Wahoo* [SS-238] and USS *Trigger* [SS-237]; see Part One of this series in the April *SCR* to learn how all this came about.) Last time we had just finished basic construction of her bow and stern assemblies—including rudder, props, all planes, etc. Now it's time to turn our attention to her superstructure, hull, and deck.

The first consideration when planning to make an accurate *Harder* out of a boxful of generic fleetboat parts is to recognize that she had a teak deck for her entire length—as did many of her sisters—whereas this kit features a deck depicted only as partially wooden, the rest being perforated steel. This configuration was certainly true for a lot of boats built later in the war—or those converted afterward, when teak was sometimes further removed—and there's nothing wrong with this if you want a nonspecific *Gato* in your fleet. But the kit-provided deck would never do for my *Harder* to be created anywhere near accurate.

One solution, as at last word attempted by Tom Kisler for his *Trigger*'s deck conversion, would be to add a lot of thin, scale-sized third party styrene strips over the existing deck to make it "all wood." I admire Tom greatly, but the approach wasn't for me (his answer soaring *far* beyond my available skill set and patience level). I chose instead to go with an all-new photoetched deck.

But I'm getting a little ahead of myself here. No matter which approach you select, you first have to prep the existing deck for the conversion. This involves cutting away a lot of material, essentially leaving "frames"—roughly in the size and position of the 1:1 boat's deck frames, actually—for the new deck elements to sit on and mount to. My first photo shows this; the second photo shows the amount of material actually removed. All good, since any weight deleted from above the waterline will aid in trimming the boat later on, and may even allow more air to escape from under the deck during submergence. (Note: wider areas are left around the base of the fairwater to better support it, while elsewhere, other random wide spots are also left intact where there are indentations for kit detail parts—cleats and such—to be later glued to the deck.)



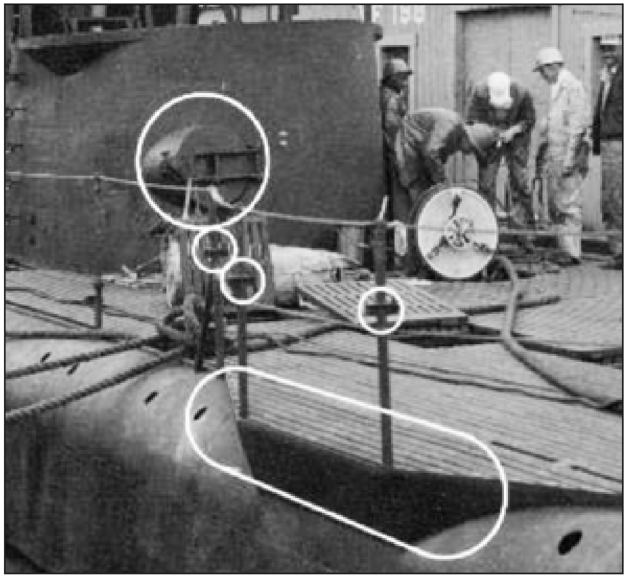
Achieving this framing—imperfect as it is—still involved a lot of time and effort with a Dremel cutting wheel and assorted files and sanding sticks.

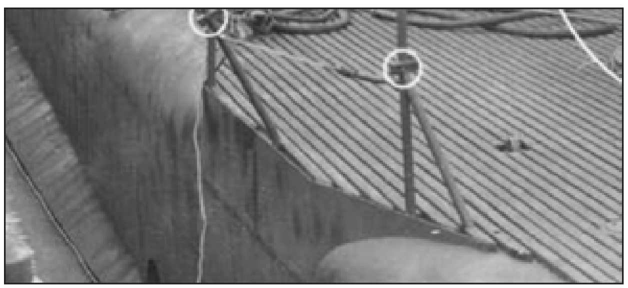
By now you're probably aware that Oto Gerza of *rcsubs.cz* supplies truly magnificent PE sets for all kinds and scales of submarine kits enjoyed by our hobby—including full-length decks. (An ad for his goods appears elsewhere in this issue by way of proof.) Not only is the inherent super-detailing of a full PE deck simply breathtaking—and obviously in this case, far more accurate than the kit deck—but PE pieces sit just slightly proud of the supporting under-deck, like the real teak strips did on the 1:1 boats. Very cool looking.

Yes, I knew I needed full-length "teak" for my *Harder*, but along with that—to match other details of the 1:1 ol' girl—the deck had to include only a single lifeboat cutout on the port side (not twin boat cutouts as on some of the early *Gatos*), plus fore and aft round marker buoy openings, and port and starboard deck extensions on either side of the deck gun—again, a detail found on many of the *Gato* boats but not included with this Revell kit. At first I attempted to scratch-build these extensions myself, until (as shown in the accompanying photos) I became aware that Oto's PE set would provide me with accurate scale versions.

Oto's amazing work brought me all the above-described precision detail and more in fact, so making the PE investment was a no-brainer. But first some ordering confusion had to be resolved: Oto's website showed the set I needed, but ordering it by its tagged number ultimately delivered me the wrong goods. It turned out the set I needed had been designed but technically never manufactured nor offered. But Oto took care of me, eventually making and shipping the exact set I needed, the one featuring the port side life-boat outline and deck extensions—

Lots of above-the-waterline dead weight removed.



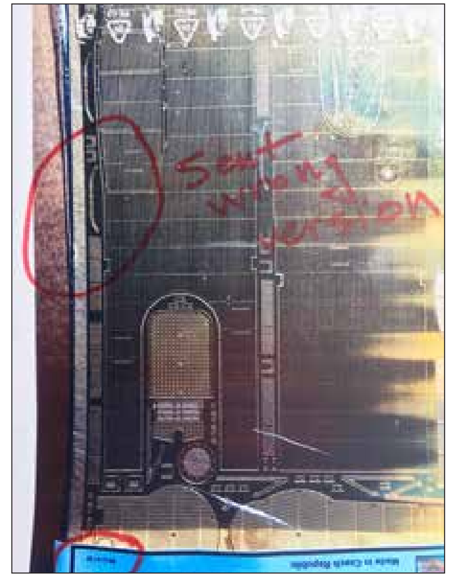


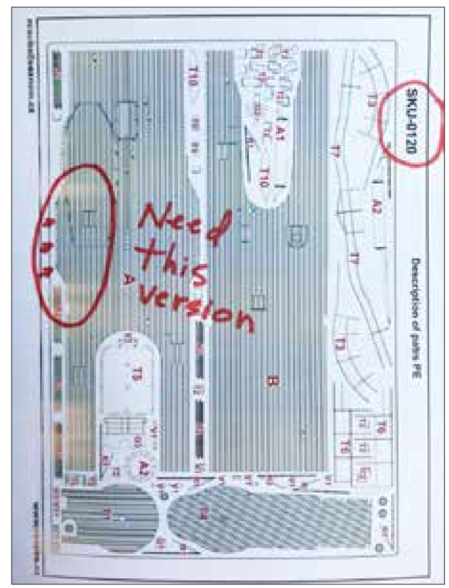
Left column: Fleetboat reference photos show just the sort of deck extensions required by my Harder *on either side of her forward gun, including the one (bottom shot) depicted on my 1:96 Fine Art model of the USS* Cod *(SS-224). This common extended design is not included on the Revell kit's deck structure.*

Above: Promo photo of one of Oto Gerza's stunning 1:72 Gato *PE sets in place; note it features the desired gun deck extension. This was how I discovered its availability in the first place.*

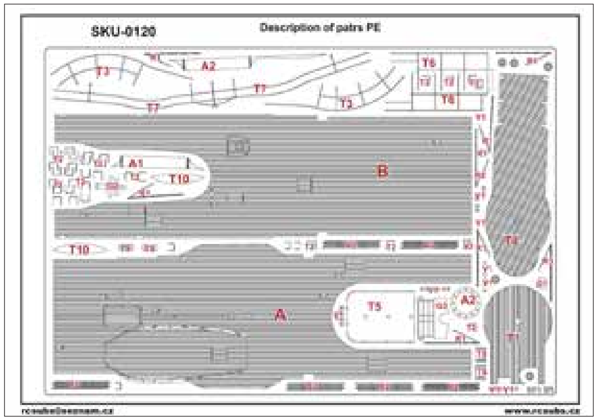
all as shown in the accompanying photos.

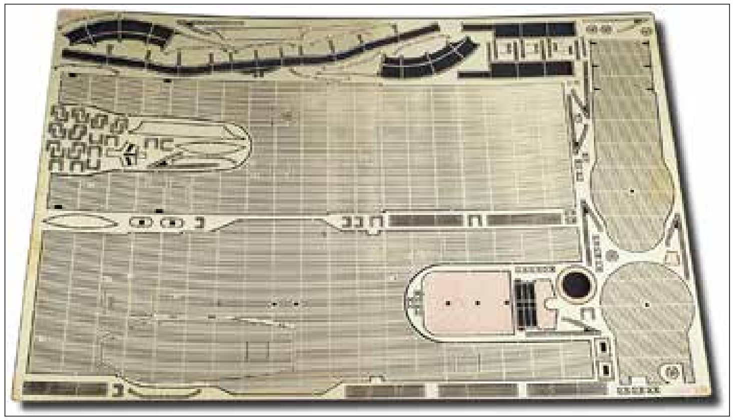
Mentioned above also were *Harder's* bow and stern buoy markers; these were likewise an issue with the Revell kit. It comes, as you may know, with only a single, large cylindrical version molded into the afterdeck. Once again, I believe this is either a late-war or postwar mod—quite visible on the USS *Cod* (SS-224) museum boat in Cleveland and on my Fine Art model of same. But since *Harder* sported circular





Clearing up an ordering snafu with Oto: The first PE set I ordered all the way from CZ—despite having the correct SKU number—turned out to be the set without the extensions, though the lifeboat cutout was correctly configured. I let him know what I'd received vs. what I know I needed and he made sure the correct version was produced and on its way to me ASAP. Thanks, Oto!

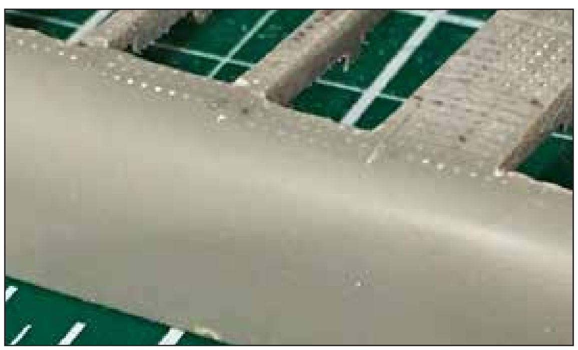




The correct PE set for Harder*—both as designed and as rendered in brass. Now watch my smoke!*

ones fore and aft (now accounted for by the scale openings in Oto's PE deck), the fairing for the elongated version in the kit's deck had to go. This was easily accomplished with some Dremel cutting and finely shaped sanding. (See photos directly at right.) Similarly, a rounded fairing had to be built up nearby to replace it, which I later achieved fairly successfully using a small circle of styrene with a piece of thin sheet styrene wrapped around it—all puttied together in a simple scratchbuilt effort. (See photos on next page.)

Experiments making deck extensions out of thin styrene from index card templates. Happily turned out I didn't need 'em. Thanks again, Oto.

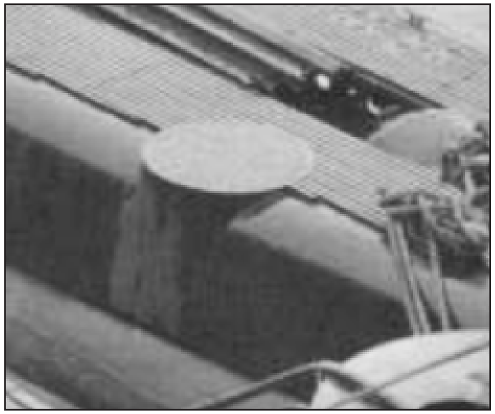


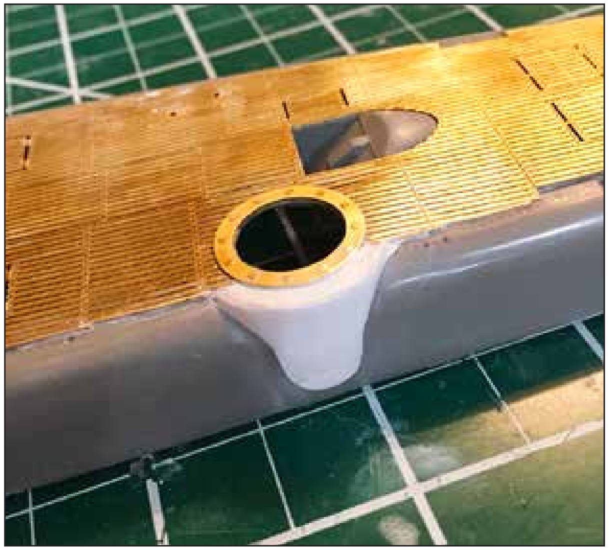
*Removing a distinctly non-*Harder *fairing from the after deck. Voilá—like it was never there!*

But something needed to go inside those round openings, right? Yup, the marker buoys themselves. Nothing remotely like them is furnished with the kit, so it was scratchbuilding time once more. Reference shots of *Harder's* and other boats' decks—plus a set of *Harder* plans from Floating Drydock—provided me with a pretty good idea of what was required. And since only the *tops* of the marker buoys are visible above the deck, that's all I needed to make. Their rounded tops were created by "manually vacuforming" some heated thin sheet styrene over the rounded end of an appropriately sized screwdriver. These were sliced out and mounted to squarish pieces of styrene cut to fit spots hogged out beneath the deck to hold them. Top-mounted grab rings were made from thin rounded brass rod attached to the buoy tops with near-microscopic cut styrene connectors. Tiny access plates were sliced from round sprue with JB Weld "bolts" (applied with a toothpick) added, plus circular bullrings mounted atop the buoys made from unused deck stanchions found in the scrap metal parts box. I've gotta admit, I'm pretty pleased with how these turned out. (Again, see photos on following pages.)

Somewhere around this point more *Harder*-specific detailing was added to the stern assembly (essentially covered in Part One) and dual matching magnets were adhered to the bow, the aft end of the superstructure, and in a series along the sides of the supstructure—all to firmly

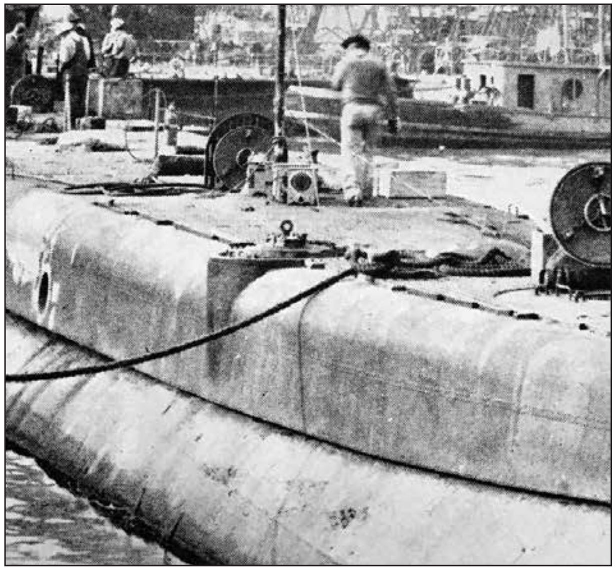
Assorted reference photos of Gato after buoy marker trunks/ fairings.

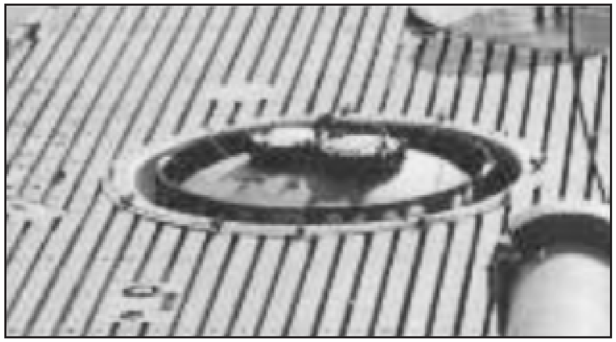




My scratched styrene fairing. Paint and sanding will help.

Note how tiny steel deck perforations have been filled where they show.

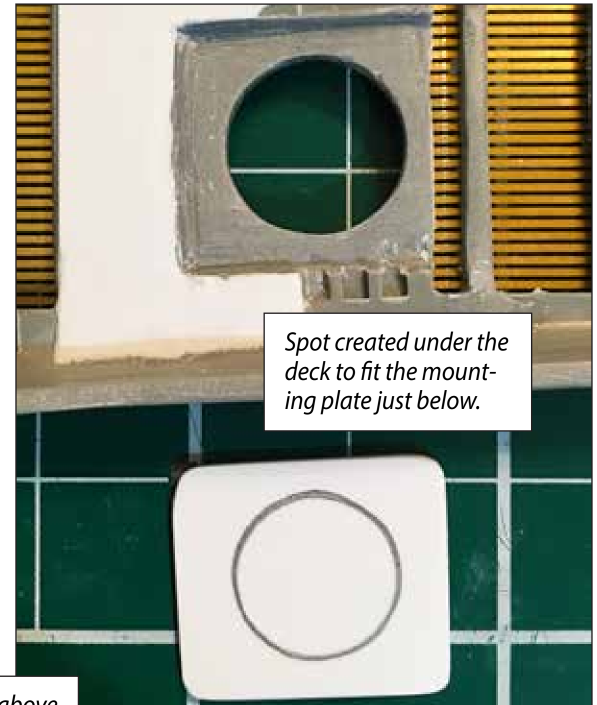




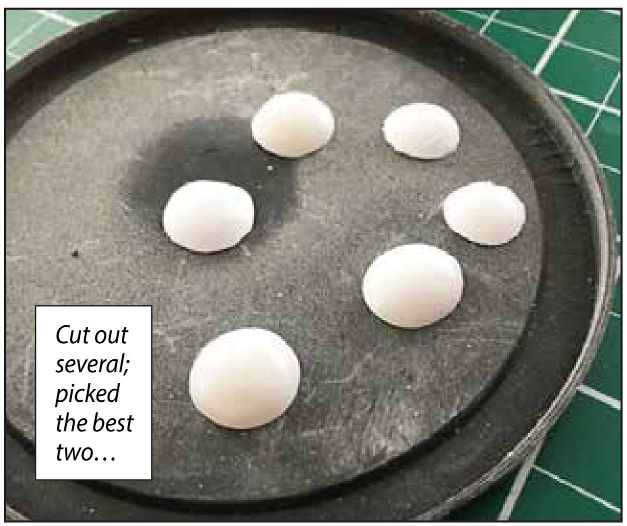
Top: Actual shot of Harder's *aft buoy marker trunk and fairing for reference.*

Immediately above: Closeup study of the top of the same type of marker buoy showing access plates (?) circular grab ring and bolts visible above the deck—this one located in a foredeck trunk. It's a simple version of this which I tried to scratch-recreate. (See photos next page.)

"Vacuforming" buoy tops with heated styrene.

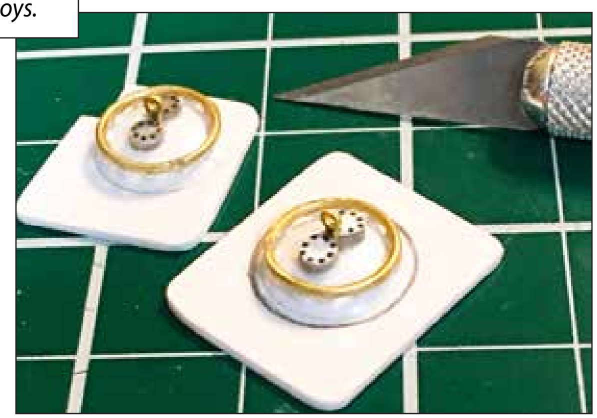


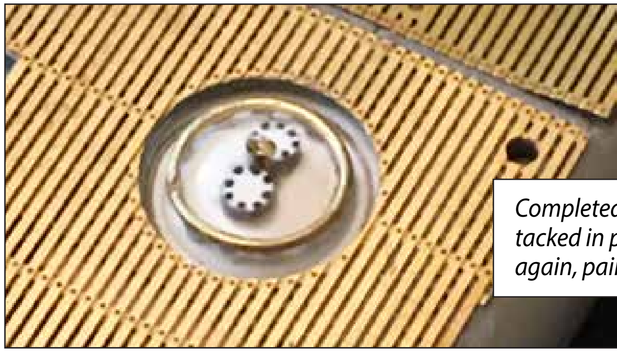
Spot created under the deck to fit the mounting plate just below.



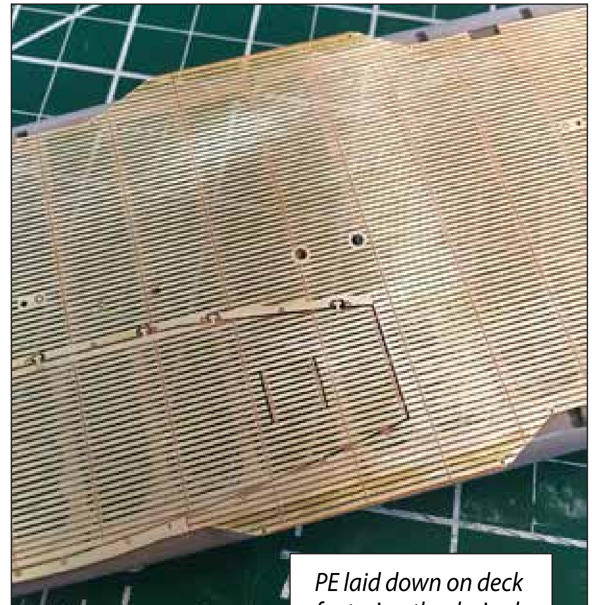
Cut out several; picked the best two…

Parts shown above come together to create the buoys.

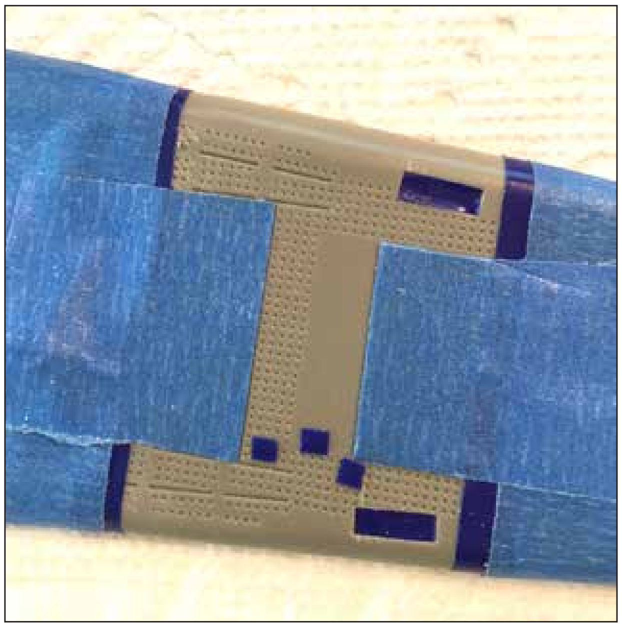


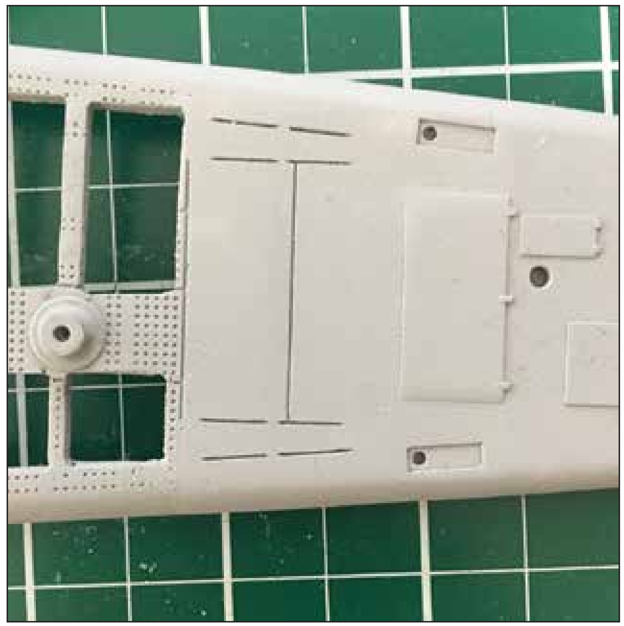


Completed buoy top tacked in place; once again, paint will help.

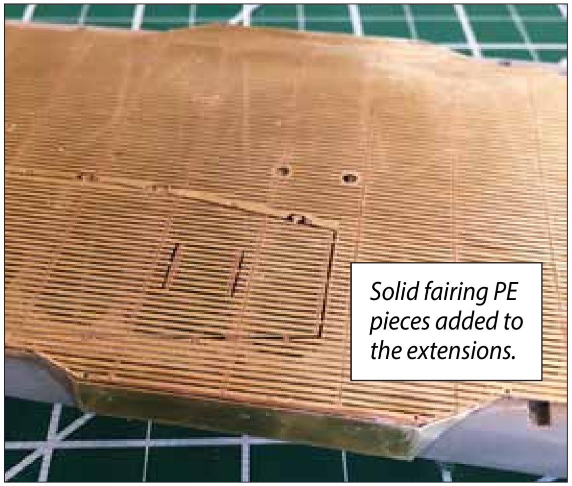


PE laid down on deck featuring the desired port/stbd. extensions.



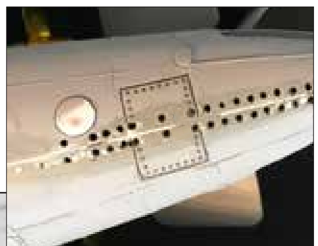


Prepping the foredeck piece of the superstructure; frames are cut for the "teak" PE overlay later and those visible tiny steel deck perforations are puttied over since Harder *didn't have them. Not certain if* Harder *had those remaining thin channels cut into the deck—no way to know—but apparently at least some of the* Gatos *did, so I left that detail in as eye candy.*

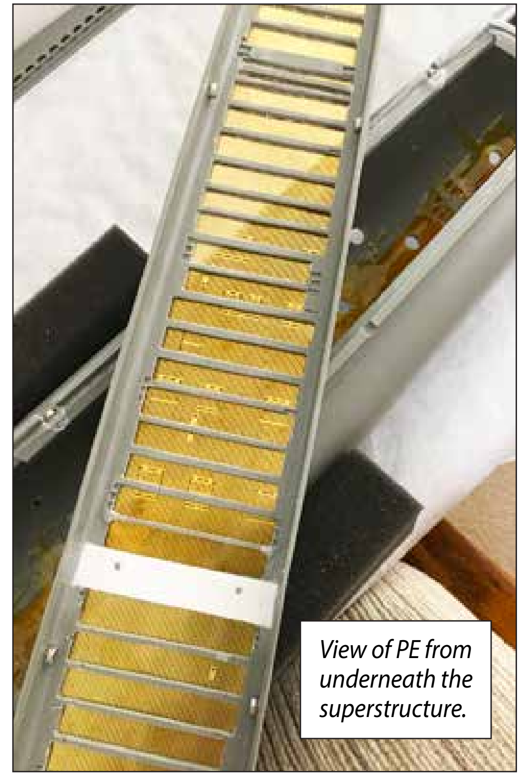


Solid fairing PE pieces added to the extensions.

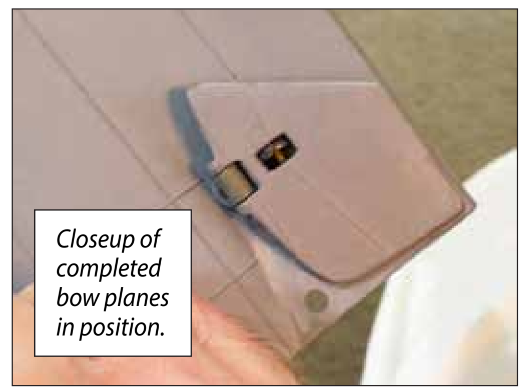
Harder *reference shot (below) shows large access plate on stern—recreated in scribing at right.*



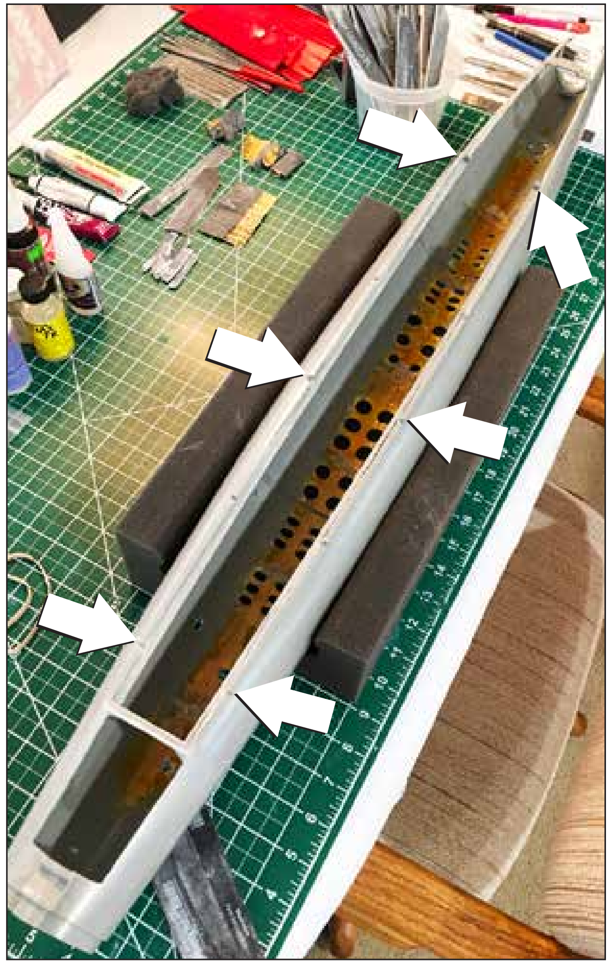
Superstructure gets full-deck PE treatment in this early test shot—before upgrade pieces arrived featuring the required extensions shown upper left. Bow and stern sub-assemblies taped on for test fit. The EB foreman was pleased!

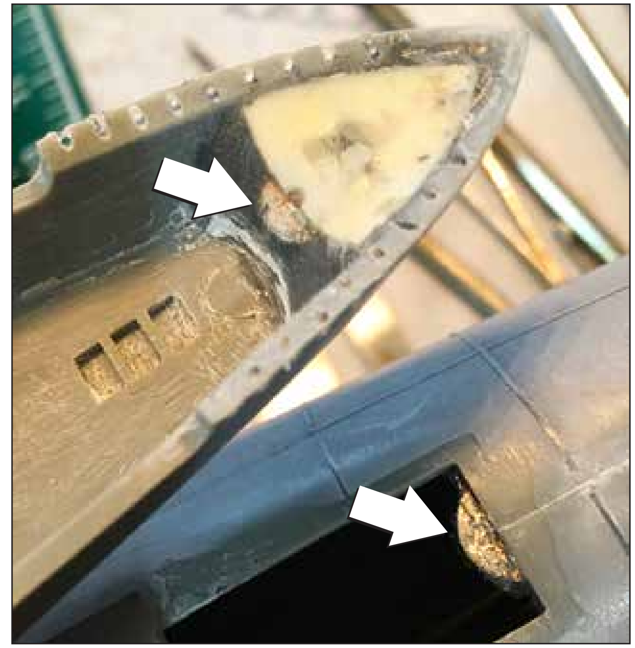


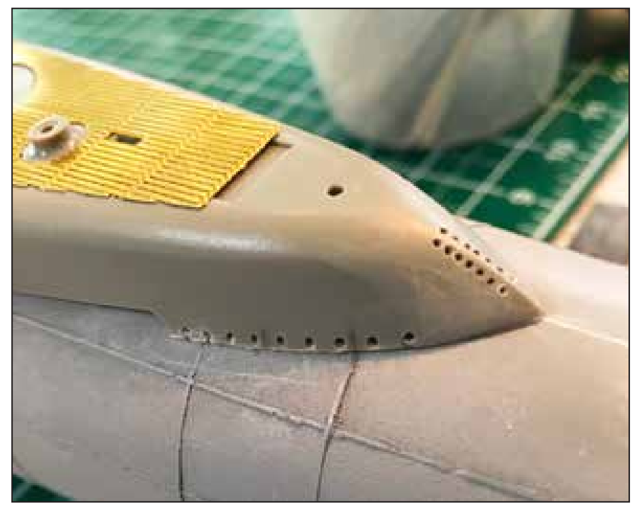
View of PE from underneath the superstructure.



Closeup of completed bow planes in position.







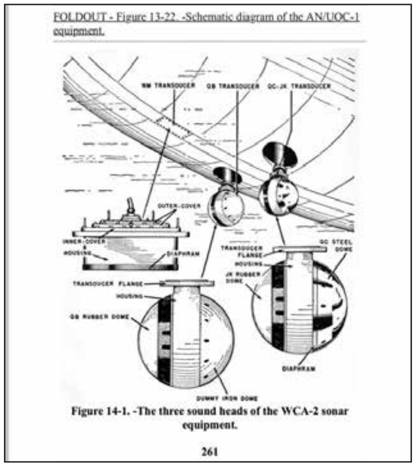
Left: Full-length view of keel with bow and stern temporarily attached. As mentioned in Part One, a lot of work went into these scale-sized and -positioned keel flood holes (essential detailing disappointingly not provided by Revell).

Middle: View of the hull's empty interior. Arrows show where magnets will go, to connect with counterparts along the deck.

Top right: Arrows show magnets installed in the deck and hull, connecting the turtleback at the aft end of the superstructure.

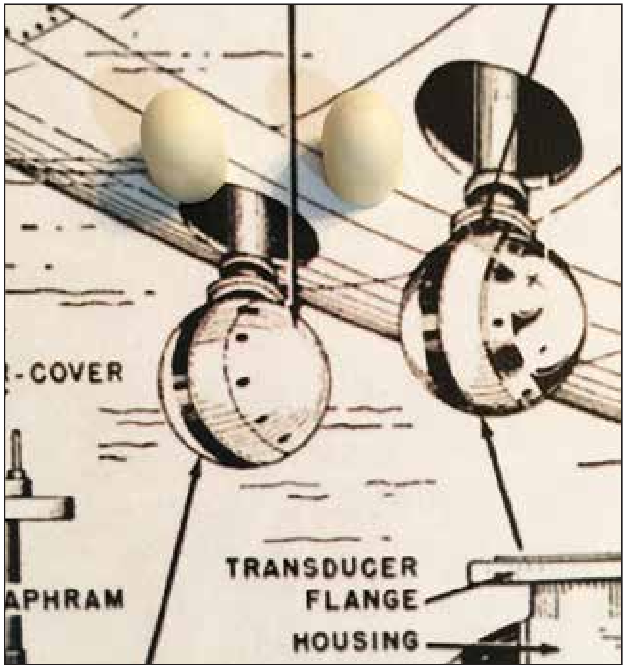
Bottom right: Turtleback held in position by magnets; still needs some cleanup along its edge. Magnets also hold on the bow.

attach it to the hull without need for either unsightly screws or the magic-trick connectors (secret capstan bolts, etc.) employed by others more capable than me on their fleetboat and U-boat decks. The whole top is indeed held on very snugly while remaining removable for the Big Dave Welch WTC slated to go into the hull later. What remains to be seen, of course, is how easy or practical it will all be to pull apart without breaking the delicate cosmetic deck details also slated to go on later. We shall see; adjustments may need to be made.

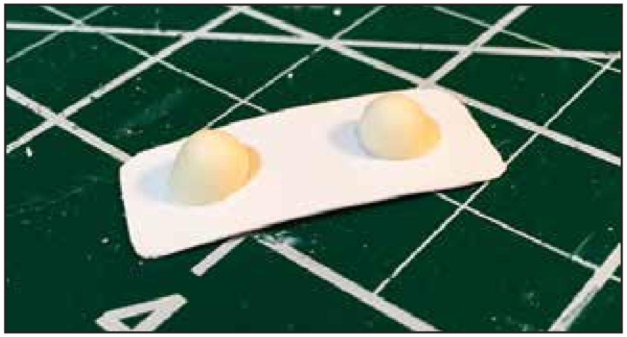


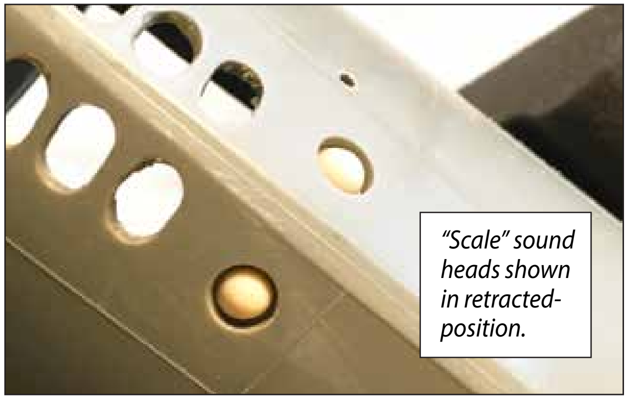
Another detail I decided to add—happily a simple one—was something to represent the dual sound heads found on the keel of every fleetboat. Reference material on relative size and positioning was readily available (illustrations shown here), and simple versions of the heads were made by rounding scraps of thick resin sprue and mounting them inside the hull on a piece of thin styrene. (See photos this page.)

Next in line as far as continuing the general construction of the kit was concerned was attaching the long side pieces representing the EB-style limber hole pattern…and here's where I have to admit I



My two scratched soundheads appear toward the top of the illustration. Below's the completed scratched part. Note they are angled such that when the base piece is bent to match the sharp curvature at the keel, the heads themselves will "straighten out" to the proper angle.





"Scale" sound heads shown in retracted-position.

really stepped in quicksand. Oh my.

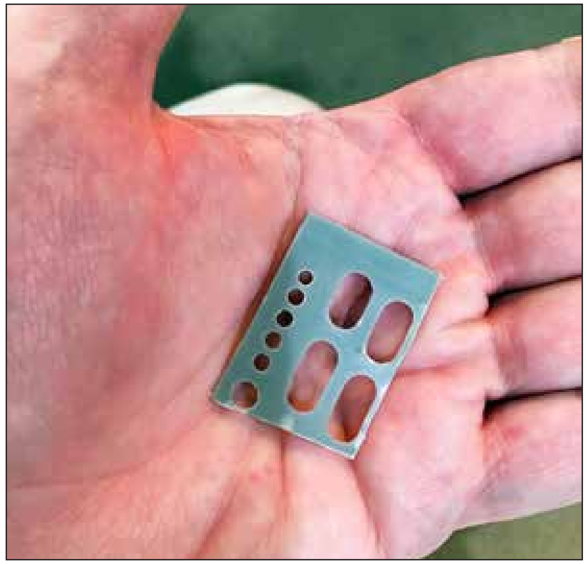
The trouble—and its resulting weeks-long forehead-slapping setback—began when I simply couldn't get those twin long limber hole side pieces to fit properly; they were just too warped. Figuring some heat should allow me to massage them into the proper shape, I very carefully (but indeed *oh-so stupidly*) went after the task with a heat gun. Extreme caution didn't matter: in the blink of an eye I had not only ruined the side pieces themselves, but also the perforated areas behind the forward dive planes and even a big part of the foredeck piece! Gadzooks—what a mess! A real disaster!

I admit I was thoroughly cowed by this setback… so disgusted by my reckless mistake and intimidated by the extensive repairs required that I had to put the whole build aside for weeks. Eventually I got my act together and a new kit arrived from which to cut out "patches" with which to replace the destroyed areas of the hull. This method worked wonderfully for the areas behind the dive planes. But despite my best efforts, a thick new starboard frame "welded into" the foredeck didn't work out at all; the whole kit piece was simply

Ruined area scribed to be excised and replaced.

New kit arrives for needed repair parts. Cool new box art!

too far gone from heat warp. So a brand new foredeck was worked up and installed at the bow end of the superstructure assembly. This involved once more carefully removing material to create frames for the PE and putty-filling the tiny deck perforations (which *Harder* didn't have…teak, remember?)—starting over, in other words—and then ordering PE replacement

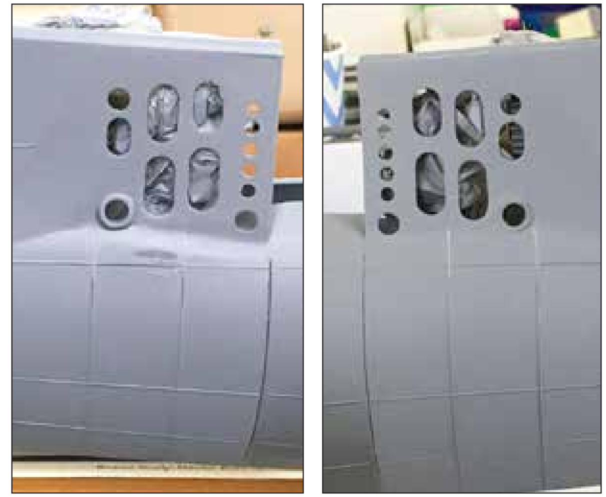


Replacement "patch" cut out from new kit part.

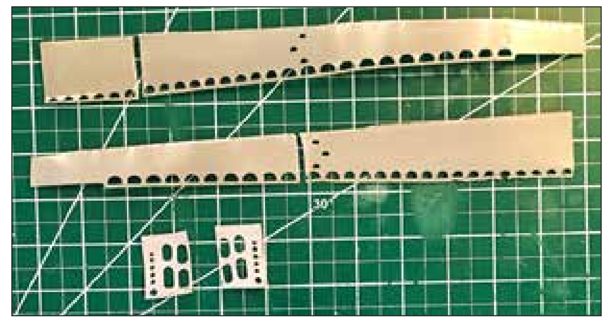
"Patch" glued into position and puttied in.

parts for the new area too. Sheesh!

Eventually I succeeded in accomplishing these needed repairs and finally got those troublesome (now replacement) limber hole side pieces attached in

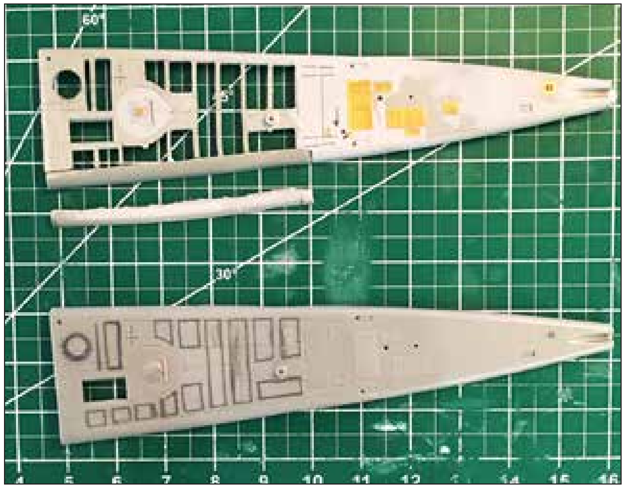


Completed port and starboard replacement patches.



The heartbreak of accidental wholesale ruin!

place—though not without a battle. In one case I had to brush solvent cement onto the unseen backside of the piece to melt it a bit, making it just maleable enough to properly bend into and remain in position. Then, just as I was puttying the forward seams and excited about finally moving forward with the build again, I suffered a broken collarbone in a fall—rendering



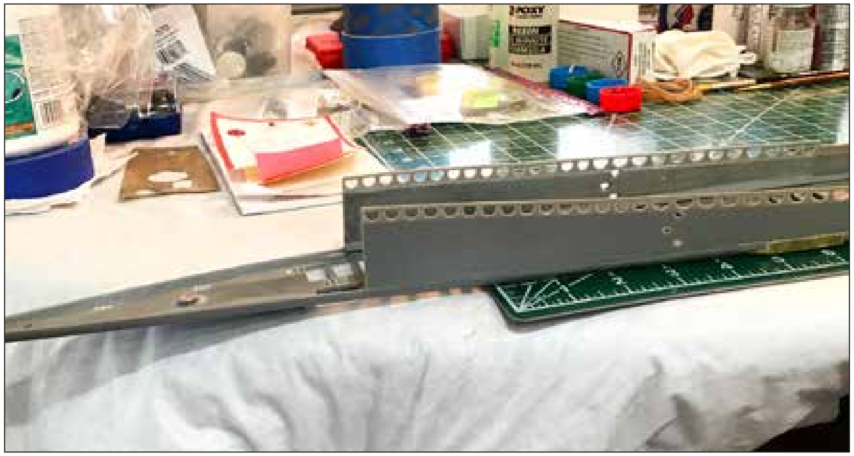
Failed foredeck repair attempt above; full replacement below.

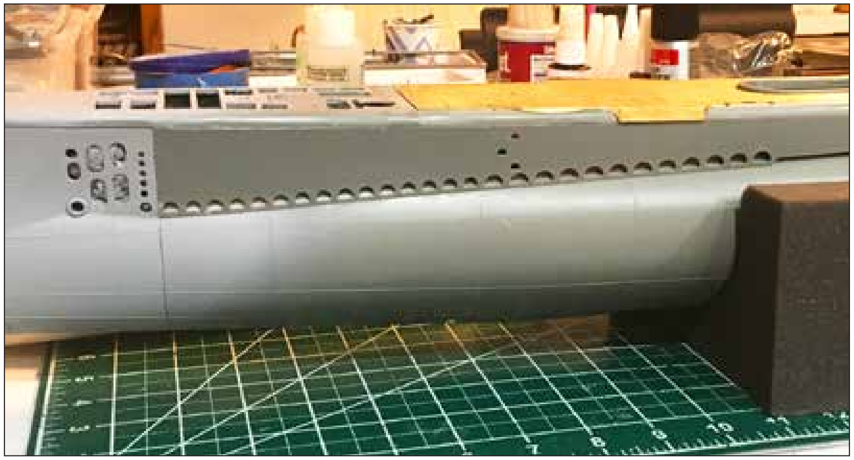
me indefinitely one-handed—and had to set the whole thing aside again for months. Honestly, did the Groton EB yardworkers go through this?

Once recovered to some extent and finally back at the boat, I realized I needed to redo unsuccessful earlier putty work and replace weld lines lost to sanding on the bow before attacking anything else. (See photos starting next page.) Then I added fresh PE to the newly reworked foredeck. Man, was it hard getting those little fiddly bits into position and aligned before the CA set. For example, I lost track of how many times I had to pry that far-forward little vent cover off, sand down the deck and re-glue it! The big foredeck "teak" replacement piece was finally put in position too.

Then I moved onto something which had been bothering me for some time. *Harder* reference photos showed much thinner frames around her fairwater's twin access doorways than how I had previously

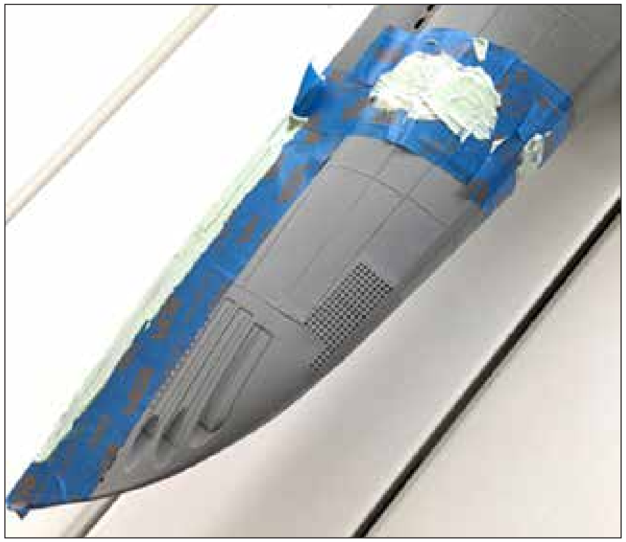
Brand new replacement foredeck prepared & installed, minus PE to come.





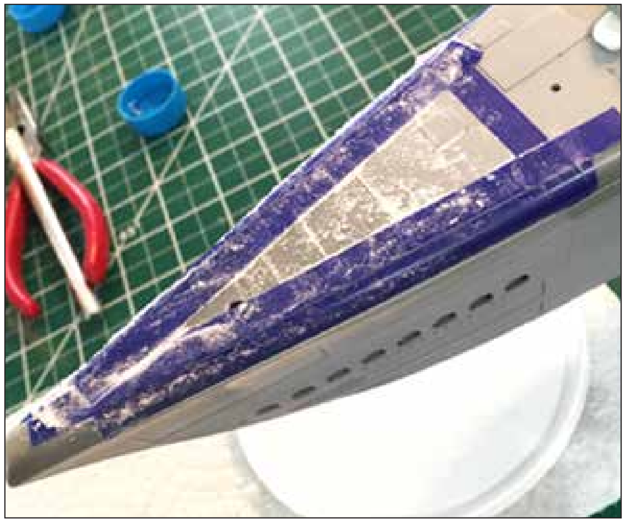
Above: Pesky EB-patterned limber hole pieces finally succumb to my will and take up their positions, awaiting putty.

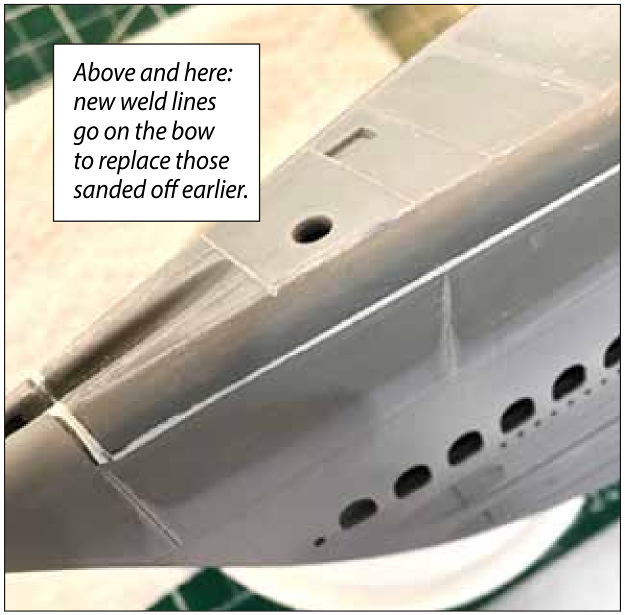
created them. So I went in again with more filing and sanding and opened them up more. I'm pleased with the results. (Again, see photo.) Also, I finally sanded off those goofy—probably postwar—raised oblong panel lines along the sides of the fairwater. These welded cutouts were evident on *Cobia*—which Revell had used



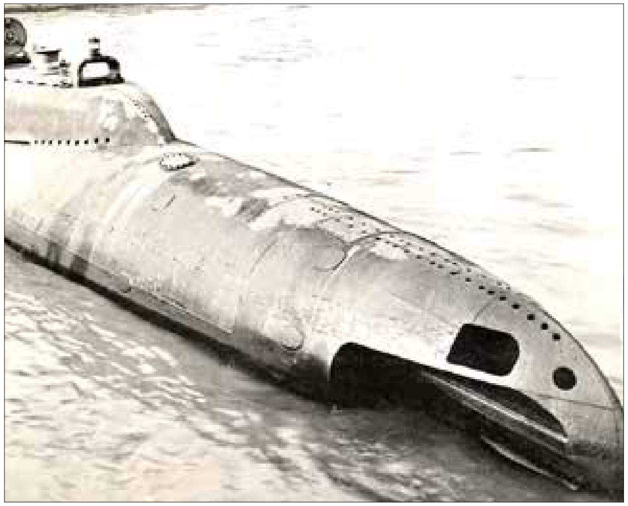
Bow seam gets masked and re-puttied after extensive foredeck and hull weld replacement work. Finished result above right.

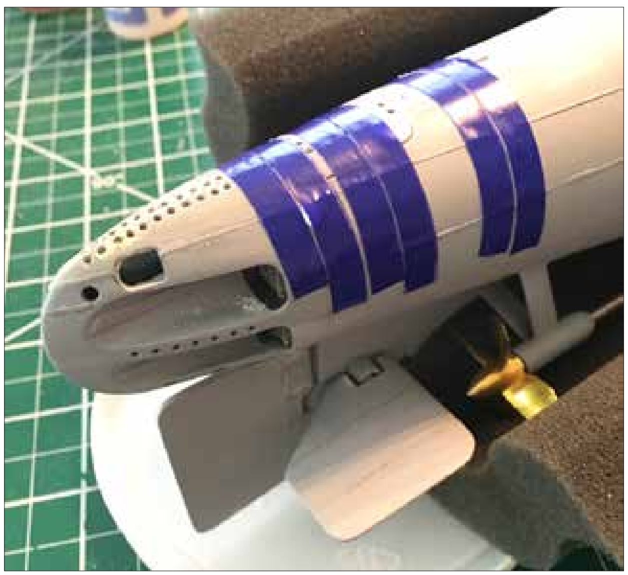
in their kit research—and were not necessarily found in that shape or pattern on other boats. So: gone. I further attempted to clean up some disappointing prior detail work on the stern, but in a typical setback, pretty much made a mess of things. More cosmetic repair and cleanup was therefore involved before moving forward again. Among other tasks, this included dealing with the unpleasant discovery that the boat's rudder was suddenly spinning *on* its shaft rather than *with* its shaft. Of course, my first correction attempt resulted in *seizing up the entire shaft* when a little thin CA got away from me—what a dope! Now I had to dismantle the whole stern section to address it. Fortunately, I'd designed the adhesion of its component parts for this very possibility, using only a few strategic blobs of CA gel to tack things together, then firmly joining the rest of the seams with RTV/aquarium sealant. This allowed me to safely "pop" the assembly apart, then when





Above and here: new weld lines go on the bow to replace those sanded off earlier.



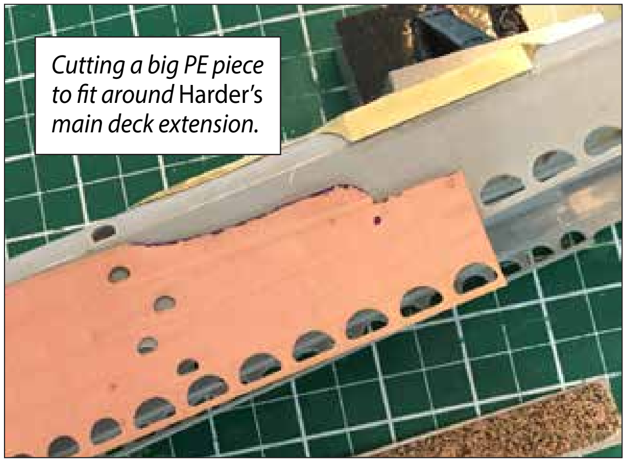


Weld line repair and replacement work now takes place on the stern to more closely match the Harder *reference photo above.*

PE parts lg. and small go back on the reworked replacement foredeck.

Fairwater access door frames now thinner, more scale-looking.

Stern assembly now fully taken apart again to address rudder shaft issues: I had accidentally frozen it with some runaway thin CA glue. Everything inside got a do-over, and I even did some weld line redressing on the stern planes while I was at it.

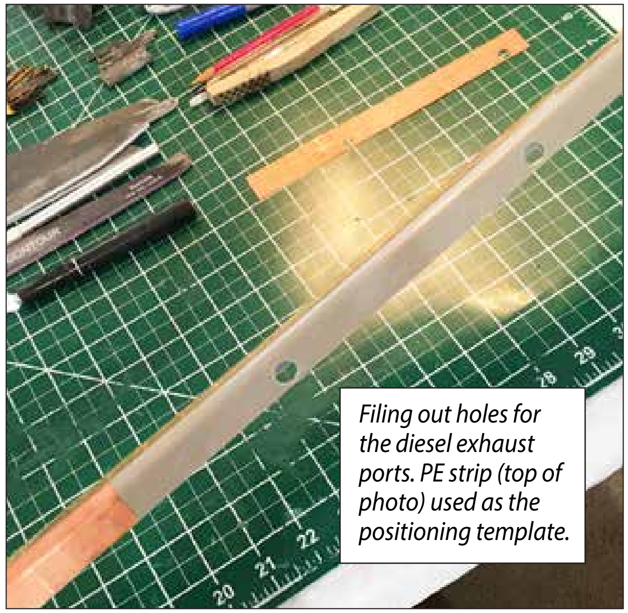


Cutting a big PE piece to fit around Harder's *main deck extension.*

Adding on Eduard's beautiful "hinge" side PE pieces—not easy!

finished put it back and reseal it the same way. I will, of course, need to be extra-vigilant about avoiding stern collisions when on patrol!

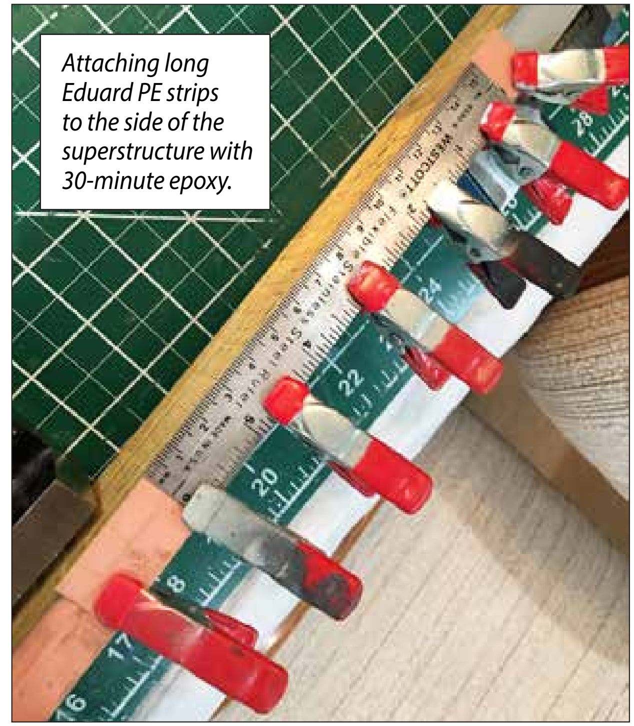
At last I could advance to applying the final large PE parts, this time from the handsome set created by



Filing out holes for the diesel exhaust ports. PE strip (top of photo) used as the positioning template.

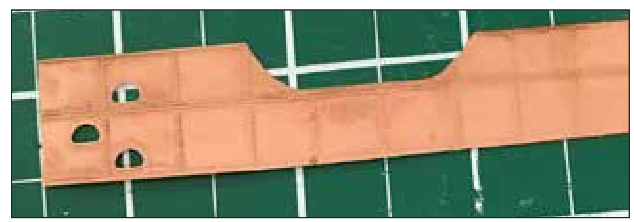
Eduard—specifically, the long "hinge" strips to go on both sides of the entire length of the superstructure. These are beautiful pieces, showing off the extensive fine rivet patterns along the upper sides of the *Gato* boats. They are pretty shallow in scale relief, however, so I've got to wonder how much they'll show up under multiple coats of primer and paint. Guess we'll find out.

The parts also include an additional needed "sea step" (footstep cutout) forward, and diesel exhaust ports aft, —none of this stuff present within the kit's plastic parts. (Again, as with the missing keel flood holes discussed in Part One, *no exhaust ports?!* WTF was Revell thinking?) Also present in these PE parts are full sea step patterns aft—very cool additional eye candy. In my case, though, disappointing: *Harder* reference photos showed she

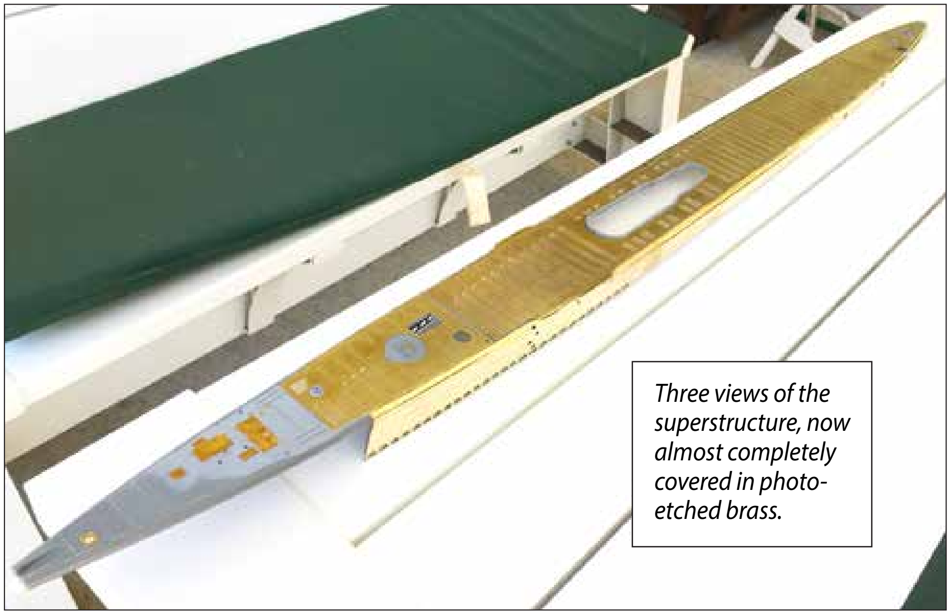


Attaching long Eduard PE strips to the side of the superstructure with 30-minute epoxy.

didn't have them. So I had to remove the steps from the PE by replacing those areas with solid alternative sections; not easy when needing to align them with neighboring rivet patterns.



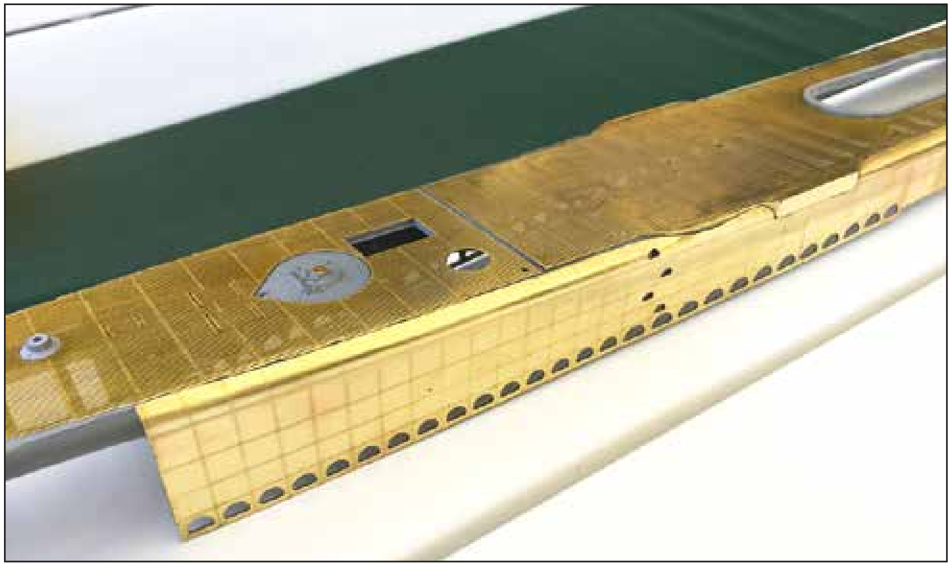
The sea steps I didn't want, and the buoy cutout I couldn't use.



Three views of the superstructure, now almost completely covered in photo-etched brass.

But I'm getting ahead of myself again. An important consideration was that I was utterly new to this kind of cosmetic work. Once diving in I found the metal to be so thin and delicate it was easy to ruin, while simultaneously so thick it was difficult to bend into the compound curves required to fit the boat. Lose/lose—at least potentially—for a neophyte like me. This was borne out by my first dismal failures, and it took me several times (fully depleting my in-house PE stock!) to get anywhere near the hang of it.

A big part of the problem was that I had to custom-cut and shape many of the superstructure pieces to fit around the aftermarket deck extensions I'd already installed—protrusions unrelated to the kit's original design. That is, Eduard's pieces were created only to conform to the kit's generic configuration. As such, even more custom trimming came into play at the aft end of the boat when dealing with the different shape and positioning of my scratchbuilt stern marker buoy. The cutout section Eduard provided accommodated only the kit's original buoy fairing (which I'd removed), so that area needed to be replaced with a solid PE section. Meanwhile, my scratched replacement fairing now had to be cut around instead. But hey, I'd gone into all this accurizing modification with my eyes open, hadn't I?



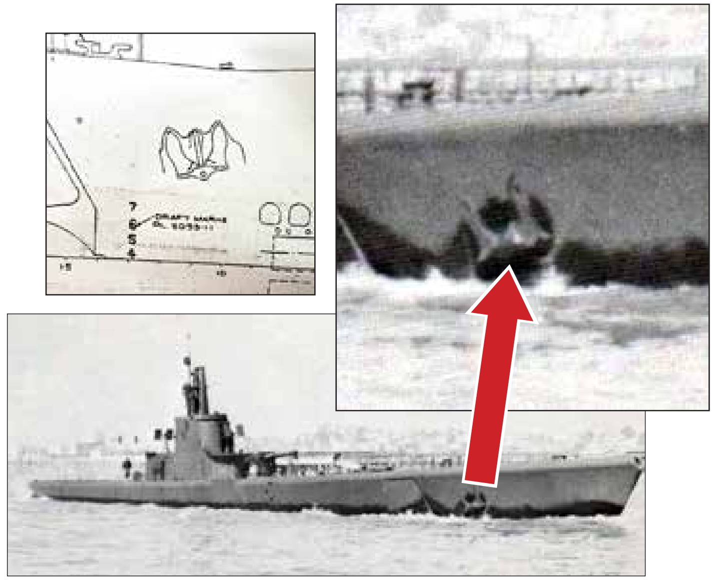

Superstructure now attached to the hull.

The rest of the trouble was decidedly of my own doing, being all fumble-fingered and inexperienced. Dealing with thirty-minute epoxy to affix the pieces, then with thin CA to conform their folded-over tops to to the curved edges of the main deck? Yikes! "Bending to my will" was just a fantasy.

Still, all this eventually bore fairly acceptable fruit, as my photos should attest here. I say this because "good enough" generally works okay when paint can later be employed to mask a multitude of sins. Also working in my favor (proven during my ongoing episodes of trial and error) was that vigorous later use of steel wool on the installed PE parts would erase their tarnish and most of the little glue globules created by my amateurish efforts. And let's not forget that the real boats always came home pretty beat up from patrols; my own looking dished in or bumpy around her edges wasn't *that* much of a stretch. ;-)

With all this particular PE work now behind me—good, bad or indifferent—it was finally time to move on. Yet another *Harder* reference photo (plus Floating Drydock's scale *Harder* plans) showed her anchor well more rounded on the right side than the kit's squared-off version. This was confirmed by photos of other fleetboat anchor wells sent to me by my pal Tom Kisler. So I took a Dremel tool to the well's right edge, filled in the kit's existing mounting hole with a small chunk of styrene, made a new hole to fit the stem of the more accurate 1:72-scale Shapeways anchor I'd obtained to replace the kit's clunky one—and *voila:* I managed to get the anchor (below) to more closely resemble the photo of *Harder*'s actual anchor.

All of which brings us to a pretty good stopping point for this installment. Next time we'll move ahead with more work on *Harder's* superstructure, deck and fairwater. See you back at EB-West then!



SUBCOMMITTEE BUSINESS

President's Comments

Wow… time is *flying* by and it doesn't seem like so long ago Jeff was hitting us up for the writeups for the previous *SubCommittee Report*.

On a personal note, I was taken out of commission by followup surgery to my prior one from two years ago. I had to fly from home in Florida to the MD Anderson facility in Houston, TX. All in all, this latest journey under the knife will have set me back a month. Fortunately, my doctor is fairly certain this should be the last time they need to go in for this particular reason, and my prognosis is excellent.

On the bright side, recuperation time on the couch has offered me the opportunity to put more work in on the new SubCommittee website. In addition to a full CRM (customer resource management) suite, the new site will also offer a more robust networking feature, more membership options, and many more features we've been itching to implement for a long time now. Once we get closer to launch, I'll post up the draft version of the site and open it up for feedback before we go live.

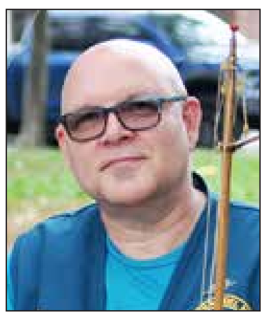
Right before I left for Texas, we had our second live SC Executive Meeting via Zoom. I will not mince words: attendance was exceptionally disappointing. This leads me to believe that either the time was very inconvenient (which I have a hard time believing), or there is just an abundance of apathy toward the organization as a whole.

We've received great ideas from a handful of people, but the vast majority of members seem perfectly content to leave things lie and let others fight to grow the organization and hobby. Please don't be those people! This is *your* organization. This is *your* hobby. It will not grow, or dare I say *survive*, without feedback and help.

We're in this together, shipmates. Let's get to work!

Bob Martin, President
(president@subcommittee.com)

Vice President's Comments



Ahoy shipmates! Welcome aboard Issue 125. While it may have not seen like much, a lot *has* been going on behind the scenes. Attend one of our live SCEC Meetings and you'll see.

I've actually stepped up and started to do what I mentioned in the last issue. First I reached out to all the SC Squadron Commodores, and got great feedback. We're going to make a transition from each one being just an informal group of folks running boats together, to solid, grassroots member groups receiving aid and having a say.

I have also reached out to SSMA and the IPMS to form a close alliance with them. I have reached out to famous, high-viewer-count YouTubers in an effort to get us exposure. I believe recruitment is a responsibility for all members! Example: If you like a YouTube Video (ie: a TX radio review), leave a comment stating who we are and a link to our YouTube Channel! It will bring people! Speaking of membership, let's all pipe aboard our newest Membership Chairman, Matt Homeier! I'll let Matt introduce himself.

I can't believe our YouTube Channel has a paltry forty members. Shame on you all! Go subscribe to it. Added numbers will drive our search success rate up! It will do what you all claim to want…increase exposure and, by default, increase membership. It's easy…and it costs *nothing!*

By reaching out to other groups and social media, we will get exposure. Then the real task ahead, once it builds up, is balance and equity for all involved.

I remember Skip Asay once telling me at the WRAM Model show that a potential customer didn't want to purchase applicable items because he thought "That stuff is for submarines." This customer simply didn't understand that most of Skip's hardware was applicable to most r/c boats, surface or submerged. After all, a submarine is just a surface craft that changes displacement.

So, we as a group learn from this lesson. In other words, we can't have everyone thinking the SubCommittee is just about r/c submarines.

It's a whole lot more.

"Sub" Ed Tordahl, Vice President
(vicepresident@subcommittee.com)

SUBCOMMITTEE BUSINESS

Membership Chair Comments

Greetings SubCommittee Membership! I am humbled to have been granted this opportunity to serve you all as the new Membership Chairman. I am a living, breathing Submarine Warfare officer! I currently serve as an Instructor at Nuclear Power School in Charleston, SC. I previously served aboard USS *Key West* (SSN-722) from March, 2017 to May, 2020. My radio control sub experience includes buildups of a 1:72-scale Moebius *Skipjack*-class USS *Sculpin* (SSN-590), and a 1:72-scale *Los Angeles*-class USS *Key West* (SSN-722). I attribute my knowledge and skill level to years of research on the SC Forums, reviewing Dave Merriman's Cabal reports, reading literature such as Norbert Brüggen's *Model Submarine Technology*, and watching Bob Martin's "RCSubGuy" on YouTube.

What does the Membership Chairman do? As per our Articles of Incorporation, he is "responsible for the handling of matters dealing with membership in The SubCommittee." In the early days, this would have consisted of maintaining paper logs and records of who the members were and where they were located. This is now covered by our website software, minimizing the need for paper tracking and allowing me to focus elsewhere.

One of our organization's biggest concerns is how to forestall our slow decline in numbers and re-spark interest in the hobby. To begin to address this, I've begun collecting data to determine the health and status of our various internet footprints. Our Facebook group is active with over 1,900 members. Our website's Forums—representing actual SC members since only they can post and access the *SCR* there—report 1,773 members, 103 of which are considered "active." Our recently revived "The SubCommittee" YouTube Channel is a *fantastic* way to get our name and presence known, especially since the typical internet surfer spends a LOT of time there. We need YOU, as a SubCommittee member, to Like, Comment, and SUBscribe! Share it on your Facebook newsfeed!

With regard to our local chapters, we're looking at having our upgraded website permit member profiles to denote local squadron affiliation—actual or desired. This should help coordinate member contact by geographic area and aid in facilitating local sub runs.

I look forward to working with you to propel our hobby back onto the Navigator's track.

Ready in All Respects,
Matt Homeier, Membership Chairman
(membership@subcommittee.com)

Treasurer's Comments

Hello once again from the Treasurer's desk. Thanks for your continued support of The SubCommittee! Since the previous *Report*, we have had the expenses and income shown below:

Beginning Checking Balance:	
22 February, 2021:	$6,387.65
Income:	
Dues:	$1,381.17
Total Income	**$1,381.17**
Expenses:	
Internet	$290.38
DropBox	$199.00
Total Expenses:	**$489.38**
Ending Checking Balance, 6 July, 2021:	$7,279.44
Beginning Savings Balance, 28 February, 2021:	$15,092.36
Interest:	$1.48
Ending Savings Balance, 30 June, 2021:	$15,093.84
Ending total bank balance:	**$22,373.28**

NOTE: We continue to have a deposit balance with Ace Party Rentals of $871.44, which is not reflected in the above total. This was the down payment for the tent for use at the Carmel Fun Run which was cancelled last year due to the COVID 19 pandemic. This balance will be available for our use in this year's event. As in the past, The SubCommittee puts up the funding for the event and is then reimbursed afterwards. This makes our actual net worth $23,244.72.

Respectfully Submitted,
Tom Chalfant, Treasurer
(treasurer@subcommittee.com)

THE SUBCOMMITTEE REPORT

Once again, Tom Chalfant's generic Revell 1:72 Gato shines on Photo Patrol. See the article inside about his latest successful photography methods. Hey, howzabout some similar cover submissions from the rest of you swabbies?