ADVANCED DIVER MAGAZINE

ISSUE 12

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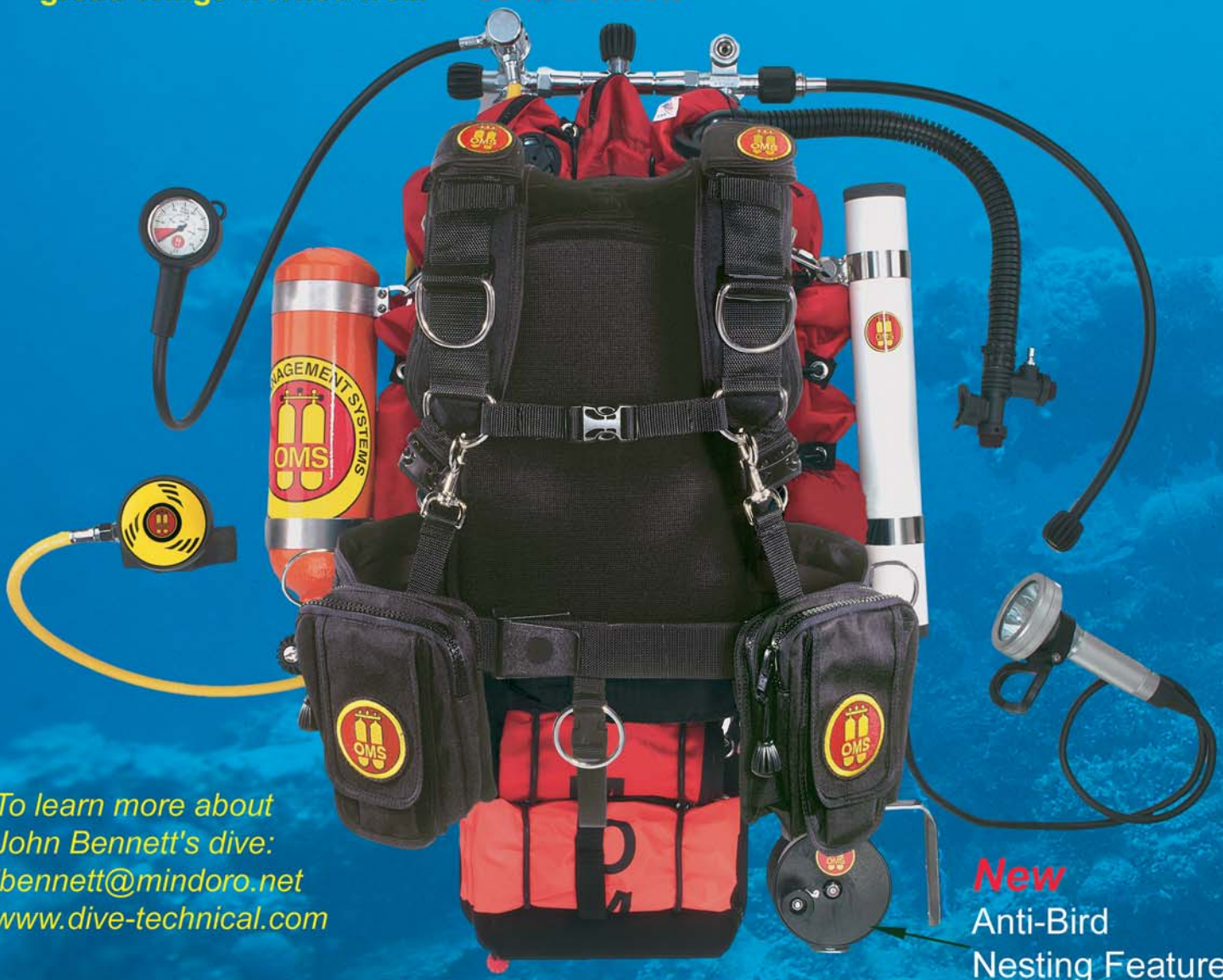

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Pictured Above -- Sidemount Lizard: This shy, nocturnal lizard, which was once thought to be frightened of water, was observed by Photographer Tom Isgar to become very proficient underwater once given a sidemount cave rig. (A very small one, of course.)

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WARNING

Diving is a potentially dangerous activity. Neither Advanced Diver Magazine, its contributors nor its staff accept liability for diving injuries by our readers. All materials within Advanced Diver Magazine are for informational purposes only and not a substitute for dive training.

Publishers Notes

Why climb a mountain? Because it's there -- calling to us, beckoning us to take up the challenge. It is for the same reason that we dare to explore the world of the underwater. It's there. We can't help but feel its voice, its pull, its lure.

Man was given the unconditional urge to explore, to spread out, to see new sights, to go, as the theme from Star Trek proclaims, "where no man has gone before." Were this not true humankind would still be hiding in caves, afraid to venture past their entrances.

Some of us were given more than our share of the desire to explore. And, sometimes it has been to the point of paying the ultimate, personal sacrifice of life itself, just to see what's around the next bend, under the next ledge or over the next mountain. I am not a mountain climber, and being from the ungodly, flat state of Florida, I never even considered the sport. That is, until recently.

Steve Cantu, a Fire Department buddy of mine, pulled my ear one day about the thought of going up instead of going down. The thought entertained me, and I soon found myself on the foothills of Mt. Saint Helens in the Pacific Northwest. As I prodded slowly upwards through the snow and ice, I pondered thoughts of exploration and life itself. No, I was not granted visions of the future by some ancient Indian god, just thoughts of wonder and amazement of mother nature's beauty and frightening power.

Crouching on a rocky ridge, the wind brushed cold, brisk air across my face as the last of the day's sun rays created a magical kaleidoscope of colors and shadows behind the mountain's summit. Darkness fell, my climbing buddies were snuggled up in their tents, and I was left alone with my thoughts and a curious, hungry chipmunk. More stars than I had ever seen before filled the sky, illuminating the blanket of clouds that stretched out 1,000 feet below.

Solitude set in and I found myself envisioning giant mountain ranges -- much larger than the peak I was crouched upon -- hidden below the ocean's surface. How is it possible for man to explore such vast places in such harsh conditions? I could explore for a thousand life times and never even put a dent in what's awaiting discovery.

After reaching the summit the next afternoon, my newly-found climbing buddies and I made our way back down to civilization. But the exploration was not yet over.

ADM Northwest staff writer John Rawlings had many more adventures awaiting for me. Diving from southern Puget Sound to just below the Canadian border and the northern San Juan Islands brought many new personal discoveries and renewed excitement.

One day, while diving on a 600-foot vertical wall in 25 feet of visibility and 45 degree water, I found myself separated from my dive buddy and alone at 140 feet. Looking down the wall that dropped straight into total darkness, my thoughts returned to my time on the mountain ridge and I wondered if anyone would ever see the creatures that awaited discovery just beyond the reach of my light.

The ocean's deep waters are truly the newest frontier for exploration and amazing discoveries. Even so, the question still echoes in the recesses of my mind: How do we reach them? Perhaps we never will. Hopefully, our discoveries of today will empower the children of tomorrow to go where we have not been able to go before.

Curt Bowen
Publisher ADM

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FEATURES

Cover Photo: Forest Rawlings inspects a patch of white and orange plumose anemones in Puget Sound, Washington. Photo: John Rawlings.

FOSSIL DIVING

by: Curt Bowen

COOPER RIVER, SOUTH CAROLINA

Catfish, This is what it must feel like to be a Catfish was running through my head as I lay on the bottom of the Cooper River in 6 to 17 inches of visibility in search of my pray. No, I was not looking for night crawlers, stink bait, a fisherman lures or any other foul thing Catfish love to eat. Sharks teeth was my quarry, not shinny white sharks teeth as most non-divers know of, but fossilized sharks teeth from the extinct fifty foot sea monster, Megladon Carcharodon.

South Carolina's Cooper River is a hot spot for such discoveries. Something I have learned over the years of exploration and travel is to first locate a local expert. On my search all signs pointed to veteran shark tooth hunter and boat Captain Tom McMillan. Captain Tom has been searching these rivers for over 25 years and knows them better then the back of his own hand.

Of course my luck, or lack of it followed me to South Carolina with a cold front with almost record low temperatures, strong winds and never ending rain. But what else should I expect in February.

Joining myself on the search was a group of experienced divers from North Carolina, John Brown noted for his rabbit skin hat *(see photo below)* also voted the most ugly hat in America, Ron Johnson and Max Bowermeister, owner of Neptunes Locker Dive Center in Monroe, North Carolina. Also joining the group of frozen divers was Shark tooth hunter extraordinar Jim Lesto of Charleston, South Carolina.

Not really knowing what to expect when I got there, I loaded for bear. I had enough equipment to outfit three openwater divers, their kids and a dog or two. I soon learned an openwater BCD, two single 80's, a regulator, the best light you can dig up, and because of the weather a heavy duty dry suit, woollies, gloves and a 24 pound weight belt was just enough. Of course because of the down pour I put my dry suit on inside my truck in the parking lot of the boat dock, I may be unlucky but I'm not stupid.

On this Rainy Saturday morning we loaded Capt. Tom's 20 foot aluminum hauled river boat with our equipment and pushed away from the dock. The Cooper River in this area is a winding water way through low swamp flatlands. It is strongly tidal affected by the nearby Atlantic Ocean and dives should be planed around the changing tides to decrease the amount of current that can be encountered. As we made our way down river visions of giant sharks teeth danced in my head. Was my luck underwater better than above?

Capt. Tom McMillan

www.CooperRiver.com

Reaching our first location, Capt. Tom briefed us on what was below and hints on locating our treasure. With my goodie bag clipped to my chest I back rolled off the boat and into the dark murky water. Purging my dry suit I dropped into the blackness below, even my Sartek 10 watt HID light barely made a glow as I descended. Landing on what felt like a rocky bottom I illuminated my dive computer just inches away from my mask, 43 feet is what it read. Visibility was pretty bad here, not more than 3 to 5 inches and most of the time zero as I grubbed around feeling each stone with my fingers. Time passed and my luck was not changing, no sharks teeth, not a one. Seventy minutes passed and I returned to the surface with just a few sharks tooth shaped rocks.

Disappointed, I climbed back into the boat. Captain Tom and Jim Lesto consoled my dropping hopes of discovery by saying visibility was extra bad there, maybe because of the bad weather and outgoing tides but the next place always had good visibility and always produced ample sharks teeth. "Even little girls with pig tails can get teeth from this spot" Jim said, So I figured I might have a chance yet.

With high hopes we waited out the changing tide for an hour or so by munching on cold Kentucky fried chicken and listening to Jim and Tom talk about giant sharks teeth they have pulled out of the river in years past. As my ears got colder and colder from the rain and wind John's ugly rabbit hat was looking some how appealing.

Rolling off the boat the visibility seemed better as I descended. Sure enough when I landed hands first onto the sandy river bottom I could see a whole 12 to 18 inches. The current was picking up a little, moving the silt away I created by wallowing around on the bottom like a pig in soft mud. Searching around I located a rock covered bottom and began scouring it for toothy treasures. One, two, three, like a kid on an Easter egg hunt I darted slowly across the river bottom tossing sharks teeth into my basket.

In the swift current and low visibility one can discover other interesting features on the river bottom, such as drifting plant life, river Flounder and large Catfish. More than once I found myself engoulfed in hay bail size clumps of river weed and small flounder escaping from under my palms. One time I even got smacked in the head by a large catfish, but I think it scared him a little more then myself because his eyes seemed the size of golf balls or was that just the fact he was only 2 inches from my mask before I could figured out what wacked me.

All sharks teeth photos on these pages are actual size.

Returning back to the surface after 80 minutes, the rest of the divers where already comparing their discoveries as I made my way over the transom. Returning back to the boat dock, the Captain and I conned the others to stay for another day of diving. John's rabbit hat was stolen by Ron Johnson who was huddling into a corner of the boat trying to stay warm.

The weather the next morning had cleared a little, temperature were still cold but the rain had stopped and at least the sun was thinking about coming out. Captain Tom drove us to a new spot he called the mud balls. At first his stories seemed to far fetched to believe. Tom said the current in this spot can get so strong on both outgoing and incoming tides it makes giant balls of mud weighing several hundred pounds that role around on the river bottom like marbles on a hard wood floor.

Visibility exceeded 20 inches today as I landed on a giant mound of mud and clay. The current was ripping around these large car sized mud clumps and I had to duck behind them to stay out if it. But these giant mud clumps also created washed out eddies where sharks teeth love to hide. Darting between these mud walls I combed the eddies for treasures left behind by the strong current, when I placed my left hand right on top of a giant sharks tooth. Dolphins would have been proud of the high pitched noise emitted from my regulator as I picked up the tooth for closer inspection. Continuing my search I made my way towards the center of the river where it flattened out and the current was very strong. Holding myself in one location with a large screwdriver stabbed into the river bottom I noticed that the mud block in front of me was moving closer, sliding over to the left side I couldn't believe my eyes as this 3 foot in diameter mud ball rolled right past me. It's true, there is such a thing as river mud balls.

One more dive of the day rounded up my trip to the Cooper River. My luck had changed, I found over one hundred sharks teeth of all different sizes and shapes in just a few hours on the bottom. Captain Tom says the water temperature gets up to the mid to high 70s in the summer months and the weather is much more pleasant. All in all I can't wait to return for more shark teeth treasures and dream about that seven inch tooth awaiting my discovery.

Capt. Tom McMillan Ph: 843•693•8485 E-Mail: CaptTom@CooperRiver.com CharlestonScuba Ph: 843•763•DIVE

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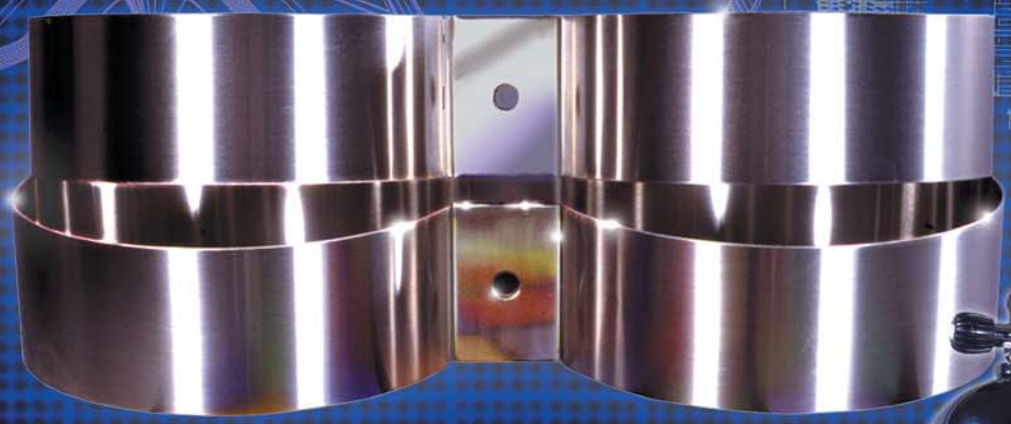

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DORNIER 24 XPEDITION

By Aldo Ferrucci

On June 1, 1949, the crew of a Dornier Do 24 seaplane lifted off from the Aspretto's aero-naval base located in Saint Mandrier, France, on route to Ajacco, which is located on the island of Corsica. Half way to Corsica Pilot Bohain informed his command that due to weather conditions and engine problems, they would have to turn back.

A couple of hours later, the pilot re-contacted command with news that he was encountering additional engine problems and was closing in on Port Cros, located on a small island to the south east of France. Suddenly, all three engines stopped and Captain Bohain was forced to attempt a sea landing in rough seas. Coming in hard the seaplane violently hit, loosing one of its two floats and flipping the hydroplane over. The crew of the Dornier escaped from the quickly sinking aircraft, but Captain Bohain was trapped and pulled under with the craft. A fishing vessel, the Anne-Marie, later picked up the remaining crew.

All traces of the Dornier Do 24 lay on the Mediterranean sea floor for the next 42 years until she was rediscovered during a French Navy sea army exercise. A torpedo was deflected from its trajectory and lost. Searching for the missing torpedo, the French found a large mass of metal that caused the weapons to malfunction. The large chunk of metal was the remains of the Dornier Do 24.

Type: Reconnaissance flying boat
Origin: Dornier-Werke GmbH, production by wesser, Aviolanda and Potez-CAMS (SNCAN); post-war, CASA, Spain.
First Flight: Do 24V3: July 3, 1937
Service Delivery: Do 24K: November 1937
Withdrawal From Service: Spain: 1967

Engine:
Model: Bramo Fafnir 323R-2
Type: Nine-cylinder radials
Number: Three Horsepower: 1,000hp

Dimensions:
Wing span: 27m (88 ft. 7 in.)
Wing Surface Area: 1,162.5 sq. ft. (108.00mÿ)
Length: 22m (72 ft. 1 in.)
Height: 5.45m (17 ft. 10 in.)

Weights:
Empty: 13,500kg (29,700 lbs.)
Loaded: 18,400kg (40,565 lbs.)

Performance:
Maximum Speed: 211 mph (340 kph) at 9,840 ft.
Cruise Speed: 183 mph (295 kph)
Range: 2,950 miles (4750km)
Service Ceiling: 19,360 ft. (5900m)

Armament:
One 7.92mm MG 15 machine gun in bow turret, one MG 15 in tail turret and one 20mm MG 151/20 or 30mm MK 103 cannon in dorsal turret behind wing.

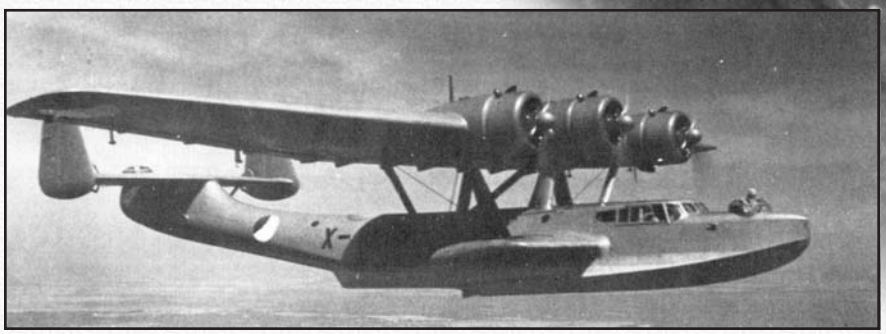
Bomb Load:
Underwing racks for twelve 110lb. (50kg) bombs or other stores.

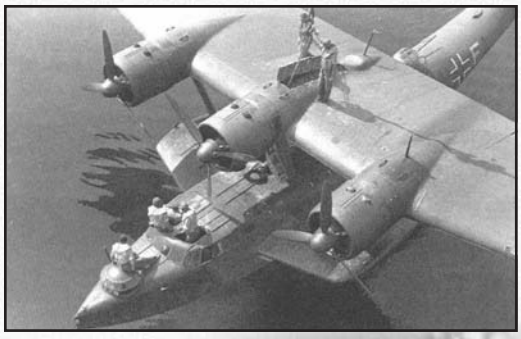
Eight years after seeing this film footage -- which had been taken from the French military exercise -- an Expedition Team attempted to locate the wreckage. With a stroke of luck, a marine officer responded to the team's questions and indicated where the Dornier was located.

The Dives...

The Dornier Do 24 was a three-engine seaplane built in Germany by Dornier-Werke for the Dutch Navy in 1934. The design was also adopted by the Luftwaffe and was proved to be one of the best seaplanes ever built, serving into the 1970s. This large and robust monoplane was built entirely of metal. It differs from other aircraft by a large central fuselage and low draft identical to the two lateral floats.

The Expedition Team was made up of five technical divers. Team leader, Aldo Ferrucci, organized expedition logistics, conducted historical research, obtained sponsors and was in charge of public relations. Ferrucci, a 43-year-old Italian, has been diving for more than 20 years on the French Riviera near Saint Tropez and specializes in technical diving and instruction, including technical nitrox, staged decompression, extended range, mixed gas blending, trimix and oxygen service technician. In addition to Ferrucci, the team consisted of underwater photographers, videographers and mixed gas instructors, who were very experienced with deep mixed gas diving.





The Dornier Do 24 lies in 99 meters / 324 ft. of water in possible strong currents conditions. After a half-hour boat ride from the dock, the search began on the flat, sandy bottom for the wreckage. In no time at all, the image of structure showed up on the team's sonar screen. Marking the location, the boat captain strategically positioned the vessel so the drop line would land on the wreckage below.

After gearing up, the team plunged overboard and followed the down line towards the wreckage. Narcosis was kept abbey by using a Trimix blend of 55 percent helium and 13 percent oxygen. The visibility was outstanding this day, allowing ample sunlight to penetrate all the way to the sea floor. Dropping below 200 feet the faint outline of the aircraft came into view -- a strange sight indeed. The whole plane could clearly be seen while the team closed in on the wreckage. Its wings were broken in the middle due to severity of the crash. A colony of spiny lobster clung to the wreckage while hundreds of mussels encircle the aircraft.

Once upon the wreckage, the fuselage showed two doors. One of them could be opened allowing the team to enter. With a lot of caution, the team explored the interior. In front sat a chair close to what appeared to be the radio. Exploring further the group discovered many artifacts, including the pilot's seat and cockpit area. Conger eels over five feet long were enticed by the new arrivals and came out to see what all the commotion was about, while an enormous spider crab sought shelter under the wreckage.

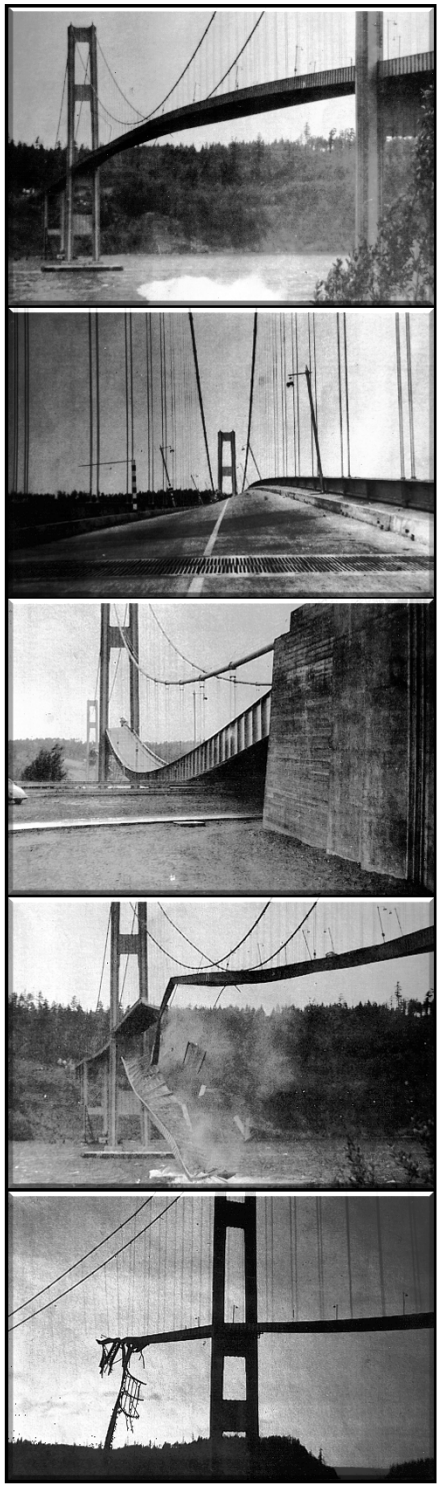
Eighteen minutes passed quickly and the time on the bottom was disappointingly over. Returning to the ascent line, the team started the required 80 minutes of decompression while using nitrox mixtures for accelerated decompression times.

Today, the team has conducted 37 dives on the Dornier, with a total of more than 700 minutes on the bottom and 3,600 minutes on decompression. The team now fully documented the wreckage with hundreds of photos and hours of film.

A Different Kind of "Wreck"

Galloping Gertie

By John Rawlings



"These days, most are aware of the location, identification and recoveries from the Titanic. The Titanic was a large ship, but in comparison it would take 5.56 Titanics end for end to occupy the space that Galloping Gertie now occupies. In raw materials the bridge contained five times that of Titanic. These figures make Galloping Gertie the largest man-made structure ever lost at sea. In addition, the current swept bottom of the Narrows has now become the largest single man-made reef supporting an abundance of marine life."

- Robert Mester, President, Underwater Atmospheric Systems

The Engineers were enthusiastic. The builders were proud. The politicians pointed to it as a wonder of modern progress and people looked upon it in awe. They said it was a marvel. They said it was a modern wonder. They said it would forever stand as a monument to human ingenuity. They said a lot of things.....

Nature had other ideas.

The History.....

South of Seattle and immediately due West of Tacoma lies "The Narrows" -- a thin corridor of salt water that connects the Southern part of Puget Sound with the rest of this virtually inland emerald sea. A study regarding the construction of a huge suspension bridge spanning the Tacoma Narrows was authorized by the Washington State legislature in 1937, and an application was submitted by the State to the Federal government for partial funding in May of 1938. Designed to connect the Washington mainland with the then thinly populated Olympic Peninsula, the bridge was seen as a vital key in terms of opening up the rich and beautiful peninsula to economic development. Construction began in early 1939 and the first vehicle crossed the bridge with much fanfare on July 1, 1940, during the opening ceremonies. A huge structure, the bridge consisted of two colossal towers soaring 425 feet above the massive stanchions from which a 2-lane concrete and metal roadway was suspended from steel cables, each of which was 17.5 inches in diameter. The overall weight supported by the cables was approximately 11,250 tons and over 20,000 miles of wire was used in the construction of the bridge. 5,939 feet long with a center span of 2,800 feet,

Photo: John Rawlings

the bridge was suspended 195 feet above the water (center span). The two stanchions on which the towers were mounted were also massive, 247 feet high on the Eastern side and 198 feet high on the West, each consisting of thousands of tons of concrete and steel. During the time that the bridge was operational, vehicles in their hundreds crossed the mighty span, greatly enhancing the economy of the South Sound area and breeding a heady optimism in both the surrounding communities and the state capitol.

From the very beginning, however, the great bridge displayed some worrisome tendencies. In even moderately strong winds it would tend to "buck" - literally dancing to and fro as the winds howled through the structure and the suspension cables. It took on a new nickname - "Galloping Gertie" - and many drivers avoided making the crossing during times of storms or high winds. Some engineers fearfully looked upon this tendency of the bridge to "gallop" and began to privately question the principles behind the basic design. The bridge would only be in operation for a few months before their fears would become reality.

The Disaster.....

The unthinkable finally occurred on November 7, 1940. A typical windstorm had arrived in the South Sound area, bringing with it winds gusting between 35 and 46 mph. As if on cue, the great bridge began its dance, swinging back and forth as the high winds whistled through the cables. Most drivers turned back when they saw the spectacle, but a few with more faith in technology than in their own eyes braved the twisting roadway. The number of these "courageous" individuals shrank as the winds grew stronger and the movements of the bridge became more violent. State highway officials grew more and more alarmed as the undulations of the bridge increased and closed the bridge at 10 a.m.. Crowds, including many photographers, gathered to watch the spectacle; many convinced that they were about to witness a historical disaster. Finally, shortly after 10:30 a.m., the first large slab of concrete fell out of the center span and hurtled down to the swirling waters below. Shortly after this, at around 11:00 a.m., with a huge roar and the thunder of snapping cables that could be heard above the howling wind, a number of the massive cables began to part. It was estimated that a 600-foot long section of the remaining roadway broke out of the span -- flipping upside down as it fell before thundering far below into Puget Sound. Only one lone driver had still been on the bridge but he had managed to leap from his vehicle and, through both running and crawling, made it to safety just prior to the final collapse, leaving his terrified dog behind in the car. The dog would prove to be the only casualty of the disaster.

As the huge pieces of roadway and bridge struck them, the turbulent waters of the Narrows splashed up into the air as though huge depth charges had suddenly exploded directly beneath the surface. It was all recorded on movie film; and for decades since, people worldwide have watched in awe as this graphic example of nature's wrath has been shown in theaters, on television and in classrooms. To this day it is difficult to imagine a more abject lesson regarding the hubris of mankind when dealing with nature, and that lesson is now continuously hammered home in schools of engineering around the world.

The new bridge across the Narrows stands above the wreckage of the old "Galloping Gertie".
Diver: Rusty Farst May 5th, 2002

Photo: Curt Bowen

Since then the great bridge has been replaced (using a different design) and the flow of traffic has resumed across the Narrows to the extent that a second span is even now being planned to handle the huge volume of traffic. From the shore the signs of the "Galloping Gertie" disaster can no longer be seen and the wreckage of the mighty span lies far beneath the swirling waters of the Narrows. It takes diving deep beneath the surface to find the twisted wreckage providing evidence of that terrible day long ago. Today, several charter operations conduct regular dives on the wreckage in addition to many dives from private boats. Hundreds of divers visit the remains of "Galloping Gertie" every year. The wreckage extends across the width of the Narrows and can be found in depths suitable for both sport and technical diving, as well as deep exploration. In the 1990s, thanks to the efforts of Robert Mester and his company, Underwater Atmospheric Systems, a nomination based on sonar imagery of the wreckage was submitted to have the site added to the National Registry of Historical Places. This nomination was accepted and, hopefully, this addition to the registry will help preserve the remains of "Galloping Gertie" far into the future.

The Dive.....

Just two days before we were set to dive, dense snow had been swirling throughout the Puget Sound area and we had been despairing that we would be in for a cold, miserable time on our latest planned visit to "Gertie." Within the previous 48 hours, however, "Old Man Winter" had decided to head back North where he belonged and the day dawned with a beautiful, blue sky. For the first time in what had seemed to be months, the brilliant orb of the sun shone down to glint off the sparkling green waters of Puget Sound. As our dive boat, the "Misty Fjord," motored down the Narrows toward the resting place of the old bridge, we noted, to our extreme satisfaction, that the water was like glass and all seemed to be at a standstill. The huge towers of the new bridge stretched into the sky above us as the "Misty" came to a halt alongside the massive Western stanchion. There would be no need to seek shelter in the eddy behind the stanchion today -- slack was in session and the current virtually undetectable, a rare situation for the Narrows and one for which we had planned. Staggering to the stern platform beneath the weight of my doubles and stage bottles, I glanced over the side down into the rich green water - the visibility looked amazingly good! With a grunt and a splash, Randy Williams, my partner on this dive, hit the water and quickly headed toward the side of the stanchion. Within seconds I, too, strode off the stern of the Misty and then turned for her Captain, Jeff Rogers, to hand me my camera. With a couple of short kicks, I found myself beside Randy and together we watched the Misty motor a short distance away to await our return.

Following a brief equipment check the two of us began our descent down the huge face of the concrete stanchion to the deep water below. When the new bridge was built it was constructed on the stanchions originally used for the old one, and thus they are literally covered with decades of marine growth that enshrouds every square inch of surface. As we plummeted toward the bottom and the thousands of barnacles and anemones whisked by I felt every bit like a skydiver falling next to a giant cliff splashed in color. This feeling was enhanced by the "free-fall" positions we assumed - face down with arms and legs spread-eagle. I found myself shouting "Woo-Hoo!" into my regulator as adrenaline rushed through me, and I could swear that I heard similar sounds bursting out of Randy as well. As we sank deeper, a green vista opened up before us and we realized that today we would have visibility approaching 40 feet, which was amazing for this stretch of water. As we reached the bottom of the stanchion in approximately 120 FSW, we could see wreckage stretching out from its base in all directions. The ambient light was superb and the green glow of the sun could be seen as we looked up toward the surface.

Pausing only briefly at the base, by previous agreement we headed toward the Northeast, our lights dancing across the wreckage in an ongoing quest for anything that would catch our interest. Ling Cod, Rock Fish and Greenlings danced in and out of the beams of our lights as we scuttled around a bottom covered with wreckage to the extent that it looked like a battlefield. Numerous Red Irish Lords squatted amidst the thousands of barnacles covering the debris, often not moving until we physically touched them. With the visibility the way it was, we were seeing wreckage that we had not seen before, or quite possibly simply seeing each massive chunk with a different perspective since we could see far more of it on this occasion. The bottom slanted downward from the base of the stanchion, and we kept to our dive plan limiting our depth to 150 FSW. Purple, orange, pink and tan Sea Stars littered the bottom and huge barnacles clawed into the water every few seconds, seeking a meal in the nutrients drifting by. It was bizarre to see a huge chunk of perfectly flat wreckage and suddenly realize that you're looking at what was once a well-traveled roadway long ago. Occasionally, I would pause at a particular spot and signal Randy to approach and pose for a photograph next to some particularly intriguing piece of wreckage. Being the ham that he is, he was always glad to oblige!

As we approached the mid-point of our planned bottom time, Randy spotted a unique pile of metal wreckage that can only be described as resembling the entrance to a cave and was approximately five feet across and two or three feet high. Immediately inside this "cave" entrance was large numbers of broken giant barnacle and crab shells -- the usual sign that a Giant Pacific Octopus was probably in residence. Randy slowly eased himself inside the entrance while I waited just outside, his light darting to and fro in search of the hoped for occupant. He was able to go in approximately up to his ankles and then slowly backed out, signaling me that, indeed, Mr. Octo Q. Pus was in fact at home. Both light and camera extended, I slowly slithered into the hole for a look-see, hoping to get a good shot. The Octopus was clearly visible in the beam of my light and was positioned at the far end of the chamber. However, the available space tapered off the farther in that I went (being 6'4" and wearing doubles is a distinct handicap when it comes to squeezing into small spaces!), and I realized that he was out of range for my strobe. The suckers appeared to have been quite large and I would estimate this one to have been approximately 10 to 12 feet, tip to tip.

Immediately after the escapade with the Octopus, we turned back toward the stanchion, following a compass heading back through the piles of wreckage. We have missed the stanchion before, and ended up conducting our decompression suspended from lift-bags while the boat followed us wherever the current took us. Going up the stanchion is definitely the way to go if a choice is to be had. After a few minutes on our compass heading, the huge vertical wall loomed largely in the green darkness and we made our way to its base. After a short pause to look around as a final farewell, we began our slow ascent to the surface, following the huge vertical shaft upward. We made our first stop for one minute at 90 FSW -- it was to be the first of many such deco stops, but boring they would NOT be! Descending the wall had been like a sky dive next to a tall building -- ascending would be far slower but with so much more to see. Various species of Sea Perch and Rockfish hovered near the stanchion, some obviously interested in us as we made our ascent. At each stop various types and sizes of Hermit, Kelp, Lyre, Decorator and Sharpnose Crabs entertained us. At one point Randy "captured" a beautiful example of a Heart Crab, which entertained me greatly by scrambling all over his shoulders, face and head while he tried to figure out where it was. Sculpins in particular were extremely well represented, with several different members of that genus being spotted during the deco stops darting in and out of the massive layer of barnacles and anemones. I found myself wishing that I had brought a second

camera set up for macro work -- there was so much going on that I could have taken an entire roll of film without moving 10 feet in any direction.


John Rawlings

Finally, 40 minutes after leaving the bottom we broke through the surface into the sunshine. Jeff grinned at us from less than 10 feet way. He had been monitoring our progress up the stanchion and had slowly brought the "Misty" right where it needed to be for a nice easy collection of two (perfect examples of fine, fit?) middle-aged divers who are always only too happy to take things easy whenever they can! Minutes later, as Jeff turned the wheel of the "Misty" toward home and Randy and I began the slow process of stowing our gear we began to discuss what we had seen and experienced on this dive. Both of us are talkers, yet from each of us one word seemed to come up again and again -- "magical". It had truly been a dive to both savor and remember.

Let the Diver Beware.....

As was mentioned above, the wreckage of "Galloping Gertie" lies in waters shallow enough for the recreational diver, yet deep enough for those with a taste for deep exploration. Some of the old anchoring blocks can be found as shallow as 50 FSW on the East side and rubble from the road bed at 60 FSW on the West. The deepest bridge structure is at approximately 235 FSW on the West side. No matter what your skill level or experience, "Galloping Gertie" is a dive that should never be taken lightly. It is a dive that requires adequate training, dedicated planning, boat support, personal skill and the right equipment. Currents in the Narrows can often be fierce and divers must understand the methods of dealing with them as well as planning for the very real possibility that their treasured dive plan will go awry. The wreckage itself covers a huge area and much of it will look the same, leading to problems with landmark recognition. In other words, a firm knowledge of underwater navigation and practice with lift-bag operations are both very important.

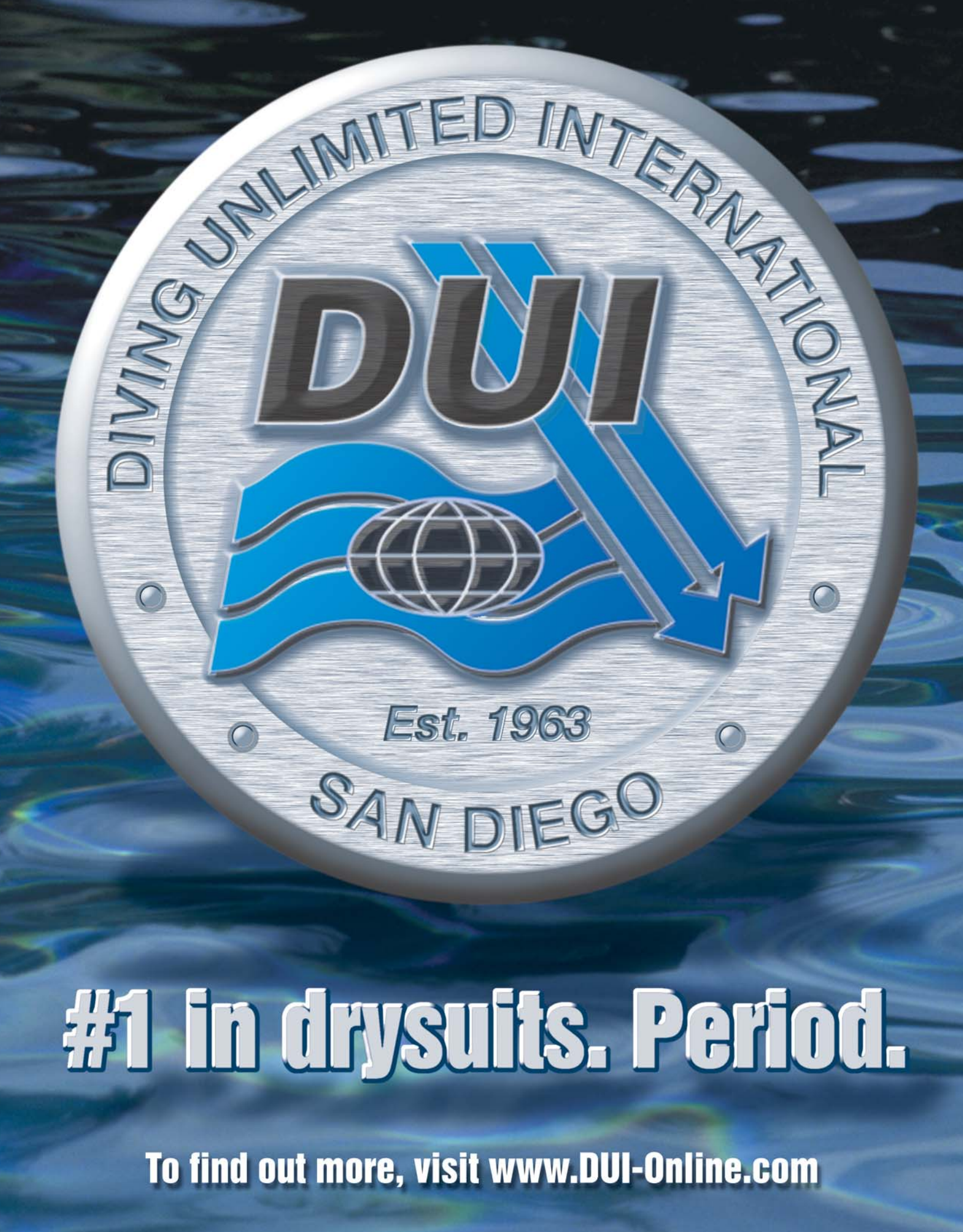
The author would like to extend special thanks to Robert Mester of Underwater Atmospheric Systems for his gracious assistance in research for this article as well as for allowing the inclusion of his sonar map of the wreckage. www.nwrain.com/~newtsuit/frames4.htm

Special thanks also to Jeff and Dayna Rogers of Soundwave Scuba Charters for their constant help in this and many other adventures. Friends are never forgotten!

Contact Information: The following professional dive charter operations offer trips to "Galloping Gertie" and other fine dive sites in the Narrows and the South Sound area.

Soundwave Scuba
(206) 463-6152
www.soundwavescuba.com

Bandito Charters
(253) 973-6152
www.banditocharters.com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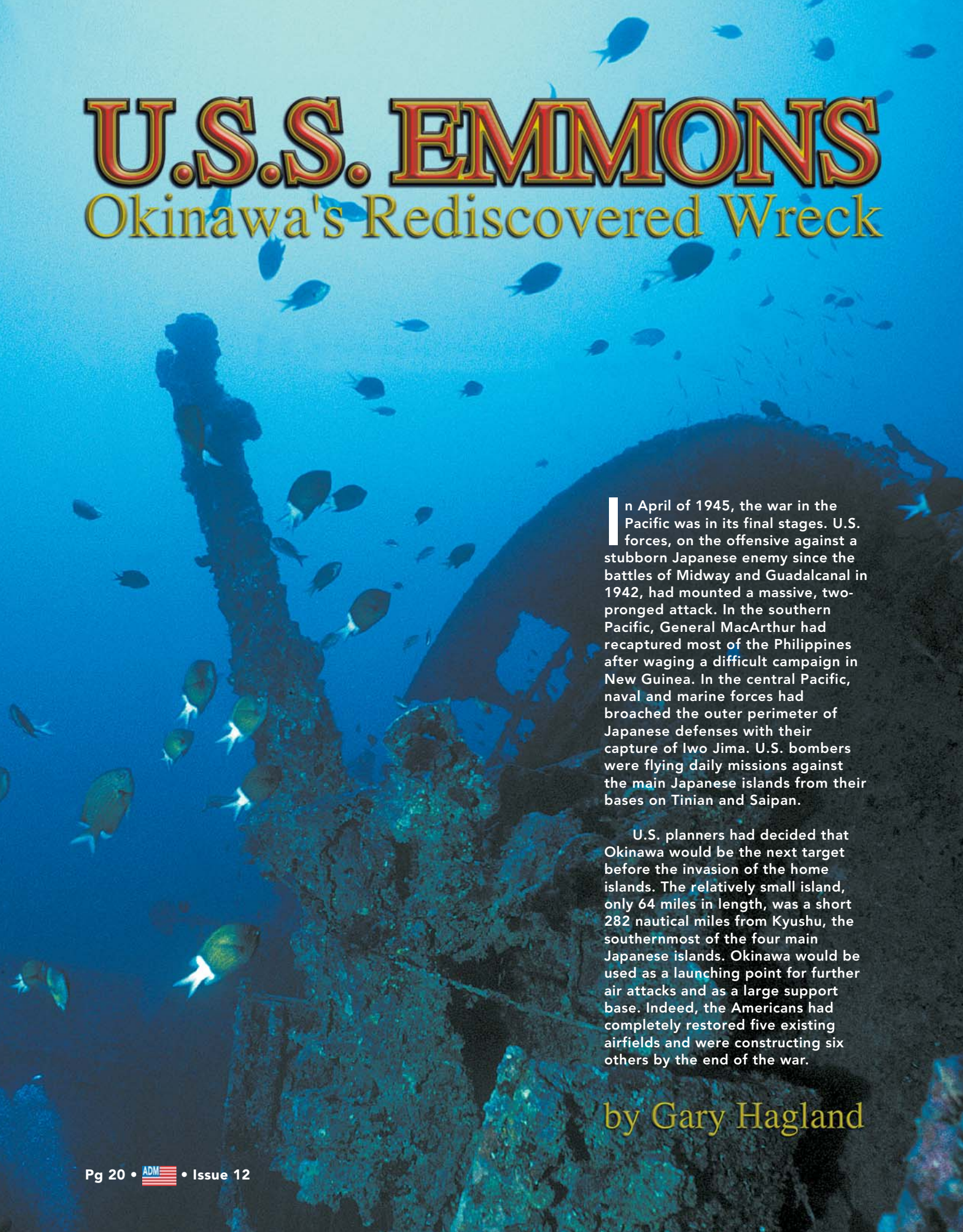
U.S.S. EMMONS

Okinawa's Rediscovered Wreck



In April of 1945, the war in the Pacific was in its final stages. U.S. forces, on the offensive against a stubborn Japanese enemy since the battles of Midway and Guadalcanal in 1942, had mounted a massive, two-pronged attack. In the southern Pacific, General MacArthur had recaptured most of the Philippines after waging a difficult campaign in New Guinea. In the central Pacific, naval and marine forces had broached the outer perimeter of Japanese defenses with their capture of Iwo Jima. U.S. bombers were flying daily missions against the main Japanese islands from their bases on Tinian and Saipan.

U.S. planners had decided that Okinawa would be the next target before the invasion of the home islands. The relatively small island, only 64 miles in length, was a short 282 nautical miles from Kyushu, the southernmost of the four main Japanese islands. Okinawa would be used as a launching point for further air attacks and as a large support base. Indeed, the Americans had completely restored five existing airfields and were constructing six others by the end of the war.

by Gary Hagland

In the face of the ever increasing onslaught, the Japanese had adopted a defensive strategy that was designed to make the attackers pay more and more in blood and material with each step they took towards their homeland. They intended to make military operations so costly that the U.S. and its allies would agree to a negotiated peace rather than continue the fighting. In that way, their system of government, emperor worship, and possibly some of their far-flung East Asian empire could be salvaged. As U.S. forces drew closer and closer, their fanatical resistance stiffened. The capture of Guam and Saipan proved unusually difficult. On Iwo Jima, U.S. Marines often measured daily progress in feet and inches. However, the allies had no intention of succumbing to any peace initiatives. Only total Japanese capitulation was acceptable.

Early on Easter Morning, April 1, 1945, an armada of 1300 ships, the likes of which had not been seen since the invasion of Normandy, surrounded Okinawa. Most were off the island's western coast where fire from 10 battleships, 12 cruisers, 23 destroyers and 177 gunboats pounded the invasion beaches and inland areas of the central part of the island. Hundreds of carrier aircraft bombed the beaches. It was the heaviest concentration of firepower to ever support a landing of troops. Okinawans called it, "The Typhoon of Steel."

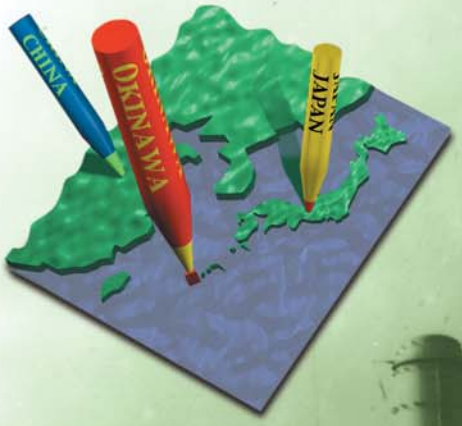
At 4:06 a.m., Admiral Kelly Turner, as he had done in numerous island campaigns before, signaled the order "to land the landing force." The main thrust of Operation ICEBERG, the military's code name for the Okinawa Campaign, had begun. By 8:30 the first of the landing craft reached the beaches. Surprisingly, the invaders found little resistance and had swept across the narrow part of the island by the next day. For several days, no real opposition was met, but that would soon change and the bloodiest battle of the Pacific campaign would ensue. The Americans were unable to claim victory until June 21. The final casualty toll included 12,000 Americans and more than 90,000 Japanese. Many estimates of Okinawan civilian deaths equal the number of Japanese military killed.

SPECIFICATIONS

USS EMMONS
DD457/DMS-22

Gleaves Class (as built)
Launched: August 23, 1941
Builder: Bath Iron Works, Maine
Converted to High Speed Minesweeper: Nov 15, 1944
Length: 347'10"
Beam: 36'
Displacement: 1630 tons
Speed: 37 kts
Crew: 276
Propulsion: 2 Westinghouse Geared Turbines
4 - boilers
2 - screws
Armament: 4 Single 5"/38 Guns
2 - 40mm Bofors AA
4 - 20mm Oerlikon AA
5 - 21" Torpedo Tubes

Note: USS Emmons lost one of her four original 5" guns and her torpedo lauchers during modification as a destroyer/minesweeper in 1944.



DD 457
STBD. BOW VIEW
NORFOLK NAVY YARD
PHOTO SERIAL 6499(43) NOV. 1, 1943

On April 6, the Japanese struck back with the largest air attack they had ever mounted. Among the 400 plus aircraft that were fielded from bases in Kyushu and Formosa (Taiwan), were at least 223 planes of the Special Attack Force, known as the "Tokko-tai" to the Japanese. Americans knew them by another name, "Kamikaze."

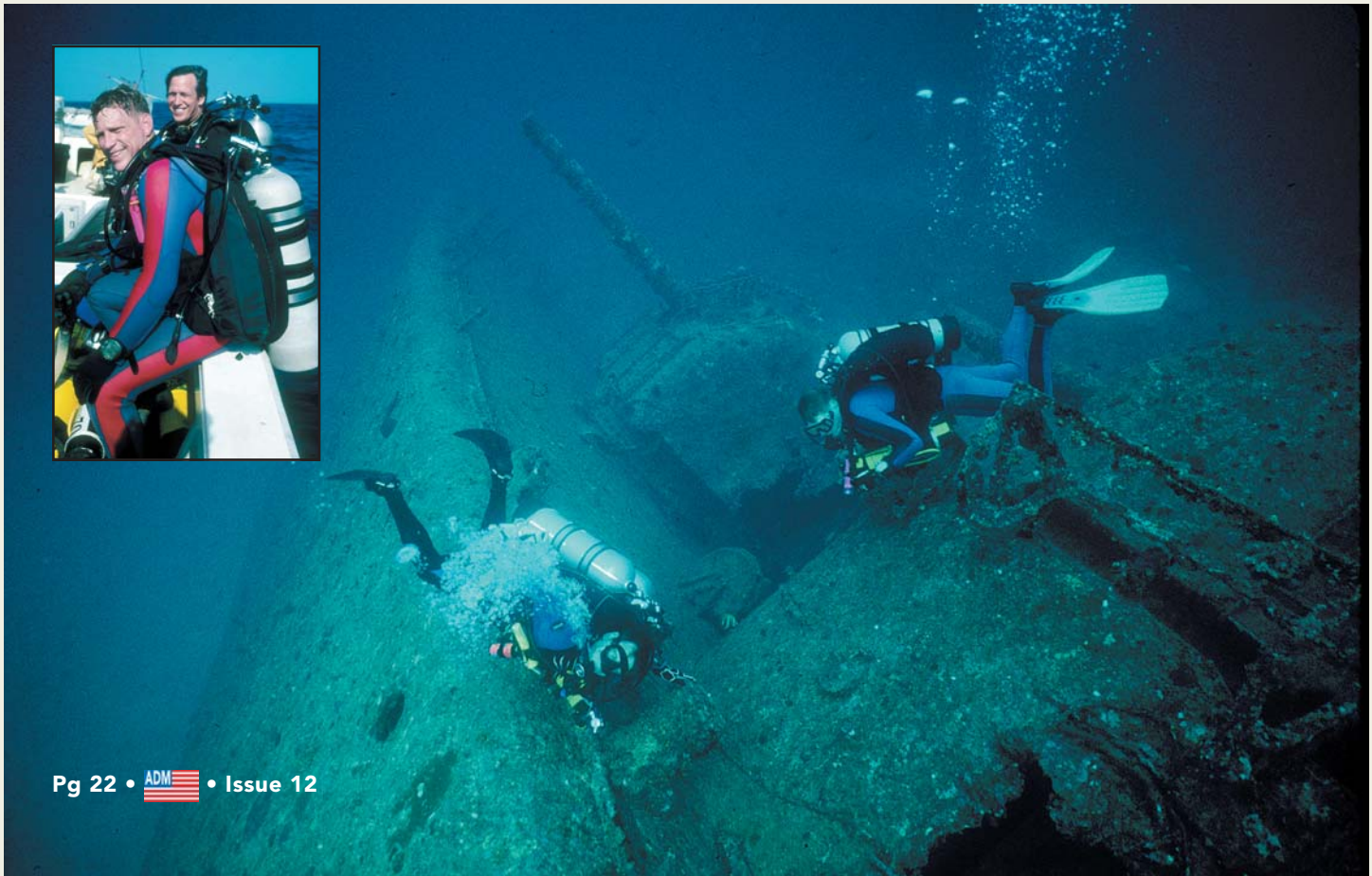
The kamikaze suicide raiders were born of Japanese desperation. They were a last ditch effort to stop the American juggernaut. Used initially in the Philippines, Japanese leadership was perfectly willing to sacrifice the nation's best and brightest young men to a certain death. Kamikaze means "divine wind," which has both romantic and historic significance for the Japanese people who understand the term in reference to the two typhoons which saved Japan from invasions by Kublai Khan in 1274 and 1281.

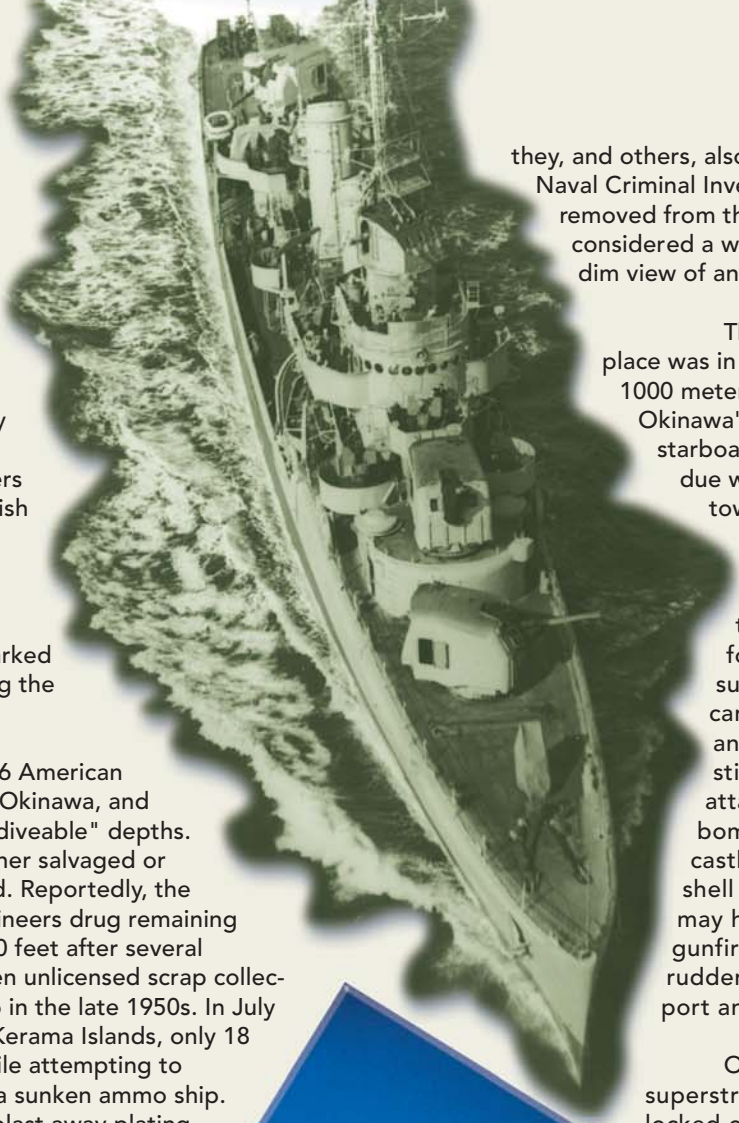
April 6 was overcast. The USS Emmons, in company with her sister ship, the Rodman, was patrolling the waters off northern Okinawa. They were covering minesweeping operations in the Iheya Strait being conducted by six smaller ships. The Emmons and the Rodman had been together in North Africa and on the highly dangerous Murmansk run in the North Atlantic. The Emmons also provided fire support for the landing on Omaha Beach during the Normandy invasion. Both had been reconfigured to support minesweeping operations, which required the loss of one of four of their 5-inch guns.

Just after 3 p.m., around 20 to 30 enemy aircraft were spotted on the horizon heading for the two ships. Thanks to accurate anti-aircraft fire by its gun crews and the assistance of carrier aircraft, the Emmons weathered the initial encounter unscathed. However, a suicide bomber hit the Rodman's forecastle.

At 4:30, a second wave of attacks began. Once again, the Emmons' gun crews leapt into action. However, their ammunition was running low and this time the attackers were more persistent and focused. The Emmons was circling the Rodman providing fire support to the stricken ship when, in rapid succession, five suicide aircraft struck her. One impacted the port side on the forward of the bridge. Two crashed into the fantail -- one knocking out 5-inch Gun Number 3 and the other causing significant damage including the loss of the rudder assembly. A fourth struck the Emmons on the port side where the Combat Information Center was located. The final Kamikaze impacted into the wreckage of the superstructure after strafing the ship.

With many of its sailors wounded and with some in the water after being blown over board by the horrific explosions, and with at least 60 of its men lying dead within its burning hulk, the Emmons was in danger of drifting towards enemy controlled territory. The decision was made to sink her. The proud ship, which had fought and provided vital support to operations in North Africa, Normandy, and Southern France, and had survived the extremely dangerous Murmansk Run without a scratch, was dispatched the next day by gunfire from the 5-inch guns of another destroyer/minesweeper, the USS Ellyson.





The Emmons lay silently on the ocean's bottom for 55 years. In September of 2000, Japanese Coast Guard divers rediscovered her after responding to a report of a persistent oil slick from a local fisherman. After a grainy photo of a five-inch gun taken by one of the divers appeared in a local English language publication, American divers on the island began their own quest to find the wreck. The Japanese hadn't marked it and weren't publicizing the coordinates.

During the battle, 36 American ships were sunk around Okinawa, and many of them were at "diveable" depths. However, most were either salvaged or were somehow disposed. Reportedly, the U.S. Army Corps of Engineers drug remaining wrecks to a depth of 600 feet after several disastrous incidents when unlicensed scrap collectors blew themselves up in the late 1950s. In July of 1957, 32 died in the Kerama Islands, only 18 miles from Okinawa, while attempting to obtain scrap steel from a sunken ammo ship. When the TNT used to blast away plating from the vessel's side touched off the 3,000-ton cargo, it rained fish over the tiny island of Aka, and a small tidal wave was created. In April 1958, 40 died when the sunken ammo ship, Canada Victory exploded off Yomitan in the central part of Okinawa. The action by the Corps of Engineers stopped the carnage, but left divers years later with no wrecks to explore until the Emmons was rediscovered.

Several American divers were able to locate the sunken ship in February 2001 and unabashedly promoted their accomplishment in the local English language press. However, they, and others, also earned the interest of the Naval Criminal Investigative Service for items removed from the wreck. The Emmons is considered a war grave and the Navy took a dim view of anyone disturbing the site.

The USS Emmons final resting place was in 147 feet of water exactly 1000 meters north-northeast of Okinawa's Kouri Island. It lays on its starboard side and the bow points due west. As divers descend toward the wreckage, the ship usually comes into view by 50 feet. One's attention is immediately directed to the two 5-inch guns that sit forward of what is left of the superstructure. They are canted upward at a 45-degree angle and look as if they are still ready to respond to attacking Japanese suicide bombers. The bow and forecastle are clean except for one shell hole on the port side, which may have been the result of U.S. gunfire to sink the ship after its rudder assembly had been lost. The port anchor is secured.

Only the bottom level of the superstructure remains. A hatch is locked open on the port side. A 20mm gun with the shield gone, but with its protective skirt mostly intact is located just above.

While swimming aft, divers will notice a Bofors twin 40-mm anti-aircraft machine gun. This gun was considered by the Navy to be its most effective surface weapon against the kamikazes. Some of the panels that skirted the gun are missing and the guns' characteristic barrels with their recoil springs are heavily encrusted.

Empty lifeboat davits still stand at attention on the port side, although one points inward and the other outward. Its lifeboat was launched after many sailors were already in the water. It helped pick them up and carry them to a rescue ship.

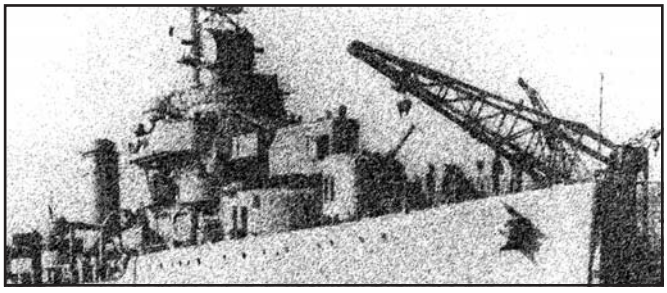
Paravanes or "pigs," as the sailors called them, looking somewhat like WWI aerial bombs, are still lashed to their bulkhead in the stern. These devices made up part of the apparatus the ship employed while conducting minesweeping operations.

On the bottom is a large debris field, much of which is below the remnants of the superstructure. Pieces and panels torn from the ship by the violent explosions are located in this location in a jumbled mess. The wheelhouse itself can be seen lying on its side within the pile of debris. Some distance away, a large paravane -- still attached to one of its mounts -- lies on the bottom at the edge of a field of sea fans, which indicates the presence of strong currents. Beyond that, less than 100 feet off the mangled fantail is the Emmons rudder assembly. Its loss left the ship helpless and sealed its doom.

Approaching what's left of the fantail, the damage becomes more pronounced. There are huge areas where the ship's internal framework is visible. Everything looks black and burnt. Peering inside, through a massive hole just below deck, metal bunk bed frames are apparent. This was the crew's aft berthing compartment.

Another 20mm gun is located in this area. Its barrel points straight up. It is positioned on a tripod-type base rather than on the usual pedestal. Its shield and skirt are completely gone. Still mounted to what remains of the deck is the aft 5-inch gun. It bore the force of a kamikaze crashing into it. The turret housing has a large jagged hole ripped in its side. The gun barrel hangs down dejectedly. It's a sad sight.

Rising slowly in the surface, divers can stare down at the lifeless hulk and imagine her as she looked when she was afloat during those final desperate hours. Decompression is a good time to reflect; and the excitement of the dive can be somewhat tempered with the memory of the vessel's last violent moments and reverence for her heroic crew. Reportedly, the ship's crew accounted for six of their attackers before succumbing to the Kamikaze onslaught. They didn't stop fighting until all means of defense were exhausted or destroyed. Sixty sailors died. The surviving crew assisted their wounded comrades into the water and to the safety of other vessels. The Emmons was absent from the huge flotilla of ships assembled in Tokyo Bay five months later when the ceremony of surrender was conducted on the deck of the USS Missouri. However, her crew had done their part to make that event possible.



CAVE DIVING
A BRIEF HISTORY

Water is an essential agent in the formation of most limestone caves, and many caves are still in a stage of development at which some parts remain permanently submerged. The desire to explore such underwater sections of cave passage is almost as old as recreational caving itself. A significant number of conventional cavers regard those who wish to dive into these dark, flooded tunnels as the lunatic fringe. However, determined individuals who make the financial and time commitments to learn how to operate safely in this so-called merciless environment will enable themselves to experience one of the greatest opportunities for original exploration on Earth. The evolution of cave diving techniques has closely followed the development of diving equipment in general. Indeed, cave divers have contributed to the latter many times. This article briefly reviews over 200 years of underwater achievements by many generations of cave explorers. It is inevitably only a summary of various milestone events from around the world.

Perhaps the first documented attempt to pass a section of underwater passage took place in 1773 at Peak Cavern in the UK. A Mr. Day tried to pass the Buxton Water Sump by holding his breath. He soon got into difficulty and was pulled from the water on the verge of drowning by one of the surface party who managed to catch hold of his arm. Mr. Day was (we are told) speechless for some time. It has thus been observed that this might also be considered to be the first cave diving rescue! (Note that the earliest documented rescue attempt in a cave by an equipped diver probably took place in Austrias Lurlochhohle in 1894.) A far more celebrated (and happily successful) free diving attempt occurred in 1922 when the French explorer Norbert Casteret passed a short sump in the Grotte Du Montespan (French Pyrenees). He discovered a dry cave system beyond, which contained important archaeological remains; the scientific potential of cave diving was thus recognized some 80 years ago.

Very few explorers had access to the early brass-helmeted Standard Diving Equipment, but some notable explorations did take place. The deep Fontaine De Vaucluse (France), the type example of a vauclusian resurgence was explored to 75ft/23m depth by Nello Ottonelli in 1878 (Cousteau, 1954). Two years after this Alexander Lambert (of Seibe Gorman Ltd) made some outstanding dives in the (artificial) flooded Severn Tunnel (UK). Although not strictly cave diving, his 300m penetration certainly revealed the possibilities of the standard equipment and early Fleuss oxygen rebreather used. Another notable early use of standard equipment took place at Orbe in Switzerland where a 95m sump was successfully passed.

Traditionally in the UK cave divers were ordinary cavers who learned to dive in order to pass flooded sections to discover further dry cave passages. (Note that this is in marked contrast with other parts of the world such as in Florida, where most practitioners are divers first then extend their activities to underwater cave visits.) In 1934 Jack Sheppard used a home made respirator in Swildon's Hole, possibly the first successful use of self contained underwater breathing apparatus (SCUBA) to pass a sump (Balcombe et al, 1990.) This early SCUBA apparatus was not very reliable and early exploratory work shortly afterwards (Balcombe, 1935) at Wookey Hole (UK) still used Standard Equipment to bottom walk along the submerged course of the River Axe. On one notable dive Graham Balcombe made the first ever live TV broadcast from inside his brass helmet at Wookey in 1935. Those involved in these early UK explorations formed the Cave Diving Group in 1946, one of the first organizations of its kind and possibly the first non-military diving organization in the world.

Upper Left: Sheck Exley prepares for a deep dive into Manta Cave, Mexico.
Lower Left: Olivier Isler and his self designed triple rebreather. Used for the solo 2.64-mile push.

Of great significance to underwater exploration globally was the invention of the aqualung in 1943 by Emile Gagnan and Jacques Cousteau. This was the first reliable SCUBA, and for many cave dives it still remains the most appropriate equipment even today. Cousteau's Undersea Research Group was also largely responsible for the widespread acceptance of free swimming with fins (as opposed to the bottom walking traditionally associated with the Standard Equipment). In 1946 they exploited their new equipment in a well planned attempt to pass the Vaucluse sump. Unfortunately the only way on was downwards; they reached a depth of over 196ft/60m but almost died in the attempt due to carbon monoxide poisoning caused by a compressor fault (Cousteau, 1954). Significant explorations were also made soon afterwards in France at Font D Estramar and the Fontaine De Chartreuse; Among those involved were Guy De Lavaur, plus Undersea Research Group members Farges and Morandiere. Elsewhere in France Jean Alinat of the same team successfully passed a 492ft/150m long flooded section in the Gouffre De Vitarelles.

The aqualung helped many other countries develop their cave diving skills in the years following, one good example being the series of deep dives in the early 1950s at Florida's Wakulla Springs (USA). A few years later the use of the Aqualung had spread to Australia where underwater caves in the Mount Gambier and Jenolan regions were being explored. In the UK post war developments took a different direction as cave divers initially exploited the relatively easily available frogman equipment (rebreathers and drysuits) rather than the aqualung at various sites. Of particular note were Bob Davies' dives in Buxton Water Sump (Peak Cavern). Many observations of water levels in a torricellian airbell here prompted the publication of perhaps the first serious scientific paper documenting work where scientific research (as opposed to cave exploration) was the main motive for cave diving (Davies, 1950).

From these early foundations, the list of increasingly audacious and successful cave diving explorations around the world in the '60s '70s and '80s grew exponentially. Many major advances were made particularly in the USA and in Europe, including the UK. The psychological barrier of being a long way from the nearest entrance was overcome, as witnessed by explorations at the Trou Madame, Ressel, Doux De Coly, and St.George resurgences (France), The Blautopf (Germany), Keld Head (UK) and Manatee Springs, Cathedral Canyon and Wakulla 1987 project (US) for example. The great underwater systems of Australia's Nullarbor Plain and the submerged lava tube of Lanzarote's Atlantida Tunnel were pushed for impressive distances.

Significant dives began to be performed in the Soviet Union, where potential for huge cave systems is recognized internationally. In the Bahamian Blue Holes the early work of pioneers such as George Benjamin was followed up by various teams coordinated by Rob Palmer, who carried out much underwater scientific work

(Palmer, 1989). The lightweight Aqualung was also ideal for transport to remote underground sites, such as the downstream sumps of the Gouffre Berger in France, where Ken Pearce's UK team made notable progress on their major expedition of 1963. The above are but a few examples taken almost at random from the extensive record of a superb era of exploration (Farr, 2000).

The other barrier that was gradually overcome during the above period was that of depth. Many French and Swiss systems explored were both deep and long, but certain explorations took deep diving to the absolute limits. The descents of Claude Touloumdjian and Jochen Hasenmayer (469ft/143 m and 672ft/205 m respectively) at Vaucluse were outstanding, as was the Nacimiento Del Rio Mante dive to 905ft/267m in 1989 (Exley, 1994). In the UK Martyn Farr was the first person to take deep cave diving seriously; his 196ft/60m exploration (1982) at Wookey Hole was significant (given the cold water and low visibility of British sumps) as was Rob Parker's 1985 push to 223ft/68m here. Many of the above sites could not have been explored to such limits without the adoption of various synthetic breathing mixtures, in particular those based on the physiologically inert gas helium

The 1990s have seen further advances at many of the sites mentioned above and elsewhere. Cave divers have made full use of multiple underwater scooters, the latest mixed gas rebreathers, underwater habitats (artificial gas filled chambers for dry decompression stops) and submersible dive computers etc. Some recent ultra long dives include the Woodville Karst Plain Project (WKPP) team's 14,100ft/4298m penetration at Chip's Hole (US) in 1996 and Olivier Isler's 14,278ft/4352m Doux De Coly (France) exploration of 1998. Both of these are major achievements, particularly in view of the significant depth of much of the passages. However, The WKPP's 18,064ft/5506m dive into Wakulla Springs (US) in 1998, at an average depth of 285ft/87m, represents a phenomenal technological advance.

Of particular note was a small British team's extension of the French Ressel underwater system. The first sump (of 6545ft/1995m and 262ft/80m depth) had only been passed as recently as 1990 by Olivier Isler. However, in the second half of the '90s Rick Stanton and Jason Mallinson, in collaboration with Germany's Reinhard Buchaly, achieved a total penetration (in Sump 5) of over 9,800ft/3000m. Unlike most of the expeditions referred to above, which had massive budgets, the most recent Ressel explorations were done quietly by a group of enthusiasts without major financial backing, in what has been described as a triumph of adventure over technology. Conversely, most UK divers, whilst never achieving record lengths or depths on a world scale, have continued to develop specialized techniques for use at home. In the UK the '90s was the decade when underwater civil engineering skills were perfected, perhaps best exemplified by the extensive submerged excavations at Malham Cove Rising.

Throughout the last decade the worldwide quest for ultimate depth has continued. In 1997 Pascale Bernabe reached 787ft/240m in the Fontaine De Vaucluse (France) while Jim Bowden and Sheck Exley's deep explorations of 1993 and 1994 at Zacaton cenote in Mexico attained 905ft/276m. Sadly Exley, who was

Jim Bowden, April 6th 1994
925ft./282m dive into Systema Zacaton, Mexico.

arguably the greatest cave diver ever, was killed on this dive. The deepest recorded dive, however, took place in South Africa, where Nuno Gomes (following on from an earlier deep dive by Exley) reached the bottom of Bushmansgat in 1996, at an astounding 925ft/282m depth.

Increasingly throughout the 1990s, many long underwater caves have been explored in Mexico's Yucatan Peninsula. Here, the water is clear and relatively warm, the passages are often beautifully adorned with speleothems and more significantly the depths are usually minimal. All these factors have led to intense activity here in recent years. Many of these cenotes have been linked such that the longest underwater cave systems by far in the world are currently to be found here, e.g. Nohoch Nah Chih / Cenote del Manatee system (200,130ft/61km), Dos Ojos (180,000ft/55km) and the Ox Bel Ha system at well over 200,000ft/60 km total length (at the time of writing). The prospect of joining even these supersystems to create a single network over 330,000ft/100km in total length reveals that cave diving has certainly come of age.

So what is to come in the future? International cooperation on cave diving projects and interchange of ideas will continue to flourish. In recent years an obvious trend has been the increasing reliance on electronic devices. This will continue in future, although sadly it will also eliminate from the cutting edge all but those with substantial financial resources. The three-dimensional, high-speed ultrasonic mapping of Wakulla Springs in 1999 is perhaps a pointer to the widespread use of the technology that can be expected. There will be an increased utilization of remotely operated electronic devices, which will collect data about the underwater cave automatically. The French have already made excellent use of such vehicles at Vaucluse, to explore beyond the limitations of the human diver. One day most underwater cave exploration will perhaps be done by such devices and there will no longer be any need for man to get in the water. In the meantime, the most promising developments seem to lie with current experiments in the use of saturation diving techniques specifically for cave diving and with the development of the artificial gill, both of which will effectively allow man to stay underwater almost indefinitely.

B.R. Wienke Deep Stops

NAUI Technical Diving Operations

Deep stops — what are they?

Actually, just what the name suggests. Deep stops are decompression stops made at deeper depths than those traditionally dictated by classical (Haldane) dive tables or algorithms. They are fairly recent (last 15 years) protocols, suggested by modern decompression theory, but backed up by extensive diver practicum with success in the mixed gas and decompression arenas — so called technical diving. Tech diving encompasses scientific, military, commercial, and exploration underwater activities. The impact of deep stops has been a revolution in diving circles. So have slower ascent rates across recreational and technical diving. In quantifiable terms, slower ascent rates are very much akin to deep stops, though not as pronounced as decompression stops. Deep stops plus slow ascent rates work together. And they work together safely and efficiently.

Many regard deep stops as the most significant development in modern diving. Here's why.

Deep stops usually reduce overall decompression time (hang time) too. And when coupled to the use of helium in the breathing mixture (trimix) to reduce narcotic effects of nitrogen, technical divers report feeling much better physically today when they leave the water. The reduction in hang time ranges from 10% to as high as 50%, depending on diver, mix, depth, and exposure time. Feeling better while decompressing for shorter periods of time is certainly a win-win situation that would have been thought an impossibility not too long ago. The basic tenets of Haldane decompression theory (and neo-classical dissolved gas theory) postulate that deeper exposures (deep stop plus bottom time) incur greater offgassing penalties in the shallow zone. Just look at those deco tables based upon Haldane methodolgy. You know, the ones you used before you bought a dive computer. Even the bulk of dive computers still stage divers using Haldane approaches. But that is changing too. New computers invoking the dual science of dissolved gases and bubbles are emerging. And deep stops are a natural result of their operation.

The depth at which the first deep stops are made can be dramatically deeper than those required by conventional tables. For instance, a dive to 300 fsw on trimix for 30 minutes, with switches to progressively higher enrichments of nitrox at 120, 70, and 20 fsw, calls for the first deep stops in the 250 fsw range. Conventional tables require the first stops in the 100 fsw range. If trimix is substituted for nitrox on the way up, total deco time can be further reduced, and divers today leave the water feeling "better" than they would on nitrox.

For most early technical divers, obtaining deep and mixed gas decompression tables constituted one of many road-blocks to safe deep and exploration diving. Existing tables ranged from ultra-conservative as an insulation against harm to a hodgepodge of protocols based on total misunderstanding. From this background, and driven by a need to optimize decompression schedules, deep stops steadily advanced as a safe and efficient change to diver staging. And this even though formal tests were usually not conducted in controlled environments, like hyperbaric chambers.

The History

Haldane originally found that deep stops were sometimes necessary in his decompression formats and tests, but either abandoned them, or could not incorporate them naturally into his (just) dissolved gas, critical tension (M-value) model on first principles. Too bad, he might have saved generations of divers much deco scheduling trouble. And all he had to do was couple his dissolved gas model to bubble dynamics. Deep stops do not emerge naturally in just dissolved gas models.

Though deep stops are regarded as a major development in diving, the first real experiments were more trial-and-error than scientific in nature. Just like so many other important developments in the real world. Underlying science with mechanistics would follow in the late 80s and 90s, albeit with considerable flack from the experts of the time. And so with helium breathing mixtures, the voodoo gas that "does not decompress".

Maybe experiments is too strict a description. Individuals, particularly in the cave diving community, toyed with decompression regimens in hopes of mimimizing their decompression time. The cave exploration Woodville Karst Plain Project (WKPP), mapping subsurface topographies in Florida, pioneered deep stop technology, establishing many rule-of-thumb protocols to be imposed on conventional tables. Irvine and

Jablonski stand at the forefront here, successfully conducting 6 hour dives at 280 feet in the Wakulla cave complex with deep stop decompression times of 8.5 hours versus traditional Haldane hang times of 20 hours. Also, the horizontal penetrations of 19,000 ft are world records (Guinness).

WKPP initially found that common decompression assumptions subjected divers to extremely long decompression obligations, and ones that, regardless of their length, were inefficient. Divers also felt badly upon surfacing from extended deco dives. Operationally (many dives over many years), WKPP divers found that the insertion of deep stops permitted shortening of shallower stops with an overall reduction in total decompression time. The decompression schedule was more effective, with effectiveness represented by subjective diver health and sense of well being. In so doing, WKPP also dispelled the "voodoo helium" myth as switches away from nitrox to trimix deco schedules finalized. In parallel mode, like strategies developed in commercial, military, and security sectors.

But even before these deep stop protocols emerged, utilitarian diving practices among diving fisherman and pearl gatherers suggested traditional staging was in need of rethinking. And early deco models, such as the so called thermodynamic model of Hills, suggested why and how. Deep stops likely evolved from cognizance of both by tech divers.

Pearling fleets, operating in the deep tidal waters off northern Australia, employed Okinawan divers who regularly journeyed to depths of 300 fsw for as long as one hour, two times a day, six days per week, and ten months out of the year. Driven by economics, and not science, these divers developed optimized decompression schedules empirically. As reported by Le Messurier and Hills, deeper decompression stops, but shorter decompression times than required by Haldane theory, were characteristics of their profiles. Such protocols are entirely consistent with minimizing bubble growth and the excitation of nuclei through the application of increased pressure, as are shallow safety stops and slow ascent rates. With higher incidence of surface decompression sickness, as expected, the Australians devised a simple, but very effective, in-water recompression procedure. The stricken diver is taken back down to 30 fsw on oxygen for roughly 30 minutes in mild cases, or 60 minutes in severe cases. Increased pressures help to constrict bubbles, while breathing pure oxygen maximizes inert gas washout (elimination). Recompression time scales are consistent with bubble dissolution experiments.

Similar schedules and procedures have evolved in Hawaii, among diving fishermen, according to Farm and Hayashi. Harvesting the oceans for food and profit, Hawaiian divers make beween 8 and 12 dives a day to depths beyond 350 fsw. Profit incentives induce divers to take risks relative to bottom time in conventional tables. Repetitive dives are usually necessary to net a school of fish. Deep stops and shorter decompression times are characteristics of their profiles. In step with bubble and nucleation theory, these divers make their deep dive first, followed by shallower excursions. A typical series might start with a dive to 220 ft, followed by 2 dives to 120 fsw, and culminate in 3 or 4 more excursions to less than 60 fsw. Often, little or no surface intervals are clocked between dives. Such types of profiles literally clobber conventional tables, but, with proper reckoning of bubble and phase mechanics, acquire some credibility. With ascending profiles and suitable application of pressure, gas seed excitation and bubble growth are likely constrained within the body's capacity to eliminate free and dissolved gas phases. In a broad sense, the final shallow dives have been tagged as prolonged safety stops, and the effectiveness of these procedures has been substantiated in vivo (dogs) by Kunkle and Beckman. In-water recompression procedures, similar to the Australian regimens, complement Hawaiian diving practices for all the same reasons.

So deep stops work and are established. But why?

The Science

The science is fairly simply. It's just a matter of how dissolved gases and bubbles behave under pressure changes. We use to think that controlling dissolved gas buildup and elimination in tissue and blood was the basis for staging divers and astronauts. And that bubbles didn't form unless dissolved gas trigger points were exceeded. At least that was the presumption that went into conventional (Haldane) tables. Chemists, physicists, and engineers never bought off on that. Never will. When silent bubbles were tracked in divers not experiencing any decompression problems, of course, this changed. And since bubbles need be controlled in divers, focus changed and switched from just-dissolved-gases to both-bubbles-and-dissolved-

gases. Within such framework, deep stops emerge as a natural consequence. So do dual phase (bubbles plus dissolved gas) models.

Here's how.

To eliminate dissolved gases, the driving outgassing gradient is maximized by reducing ambient pressure as much as possible. That means bringing the diver as close to the surface as possible. But, to eliminate bubbles (the gases inside them), the outgassing gradient is maximized by increasing ambient pressure as much as possible. That means holding the diver at depth when bubbles form. Deep stops accomplish the latter.

But the staging paradigm has a few more wrinkles. Clearly, from all of the above, dominant modes for staging diver ascents depend upon the preponderance of free (bubbles) or dissolved phases in the tissues and blood, their coupling, and their relative time scales for elimination. This is now (will always be) a central consideration in staging hyperbaric or hypobaric excursions to lower ambient pressure environments. To eliminate dissolved gases (central tenet of Haldane decompression theory), the diver is brought as close as possible to the surface. To eliminate free phases (coupled tenet of bubble decompression theory), the diver is maintained at depth to both crush bubbles and squeeze gas out by diffusion across the bubble film surface. Since both phases must be eliminated, the problem is a playoff in staging. In mathematical terms, staging is a minimax problem, and one that requires full blown dual phase models, exposure data, and some concensus of what is an acceptable level of DCI incidence.

Enter dual phase models which generate deep stops consistently within free and dissolved gas phase constraints.

The Models And Diving Algorithms

Extreme WKPP divers make their first decompression stop at roughly 80% of actual dive depth for ANY dive. They dive helium exclusively and the deep stop schedules they generate (many years of WKPP diver testing) are not remotely possible with air. WKPP schedules also agree with reduced gradient bubble model (below) calculations of the staging regimen, in both deco profile shape and duration.

Other prescriptions for deep stops were imbedded in conventional tables. The following prescription has been floating around tech diving circles for years:

1. Calculate your decompression schedule from tables, meters, or software;

2. Half the distance to the first deco stop and stay there a minute or two; as way time (software), or bottom time (tables);

3. Recompute your decompression schedule with time at the deep stop included as way time (software), or bottom time (tables);

4. Repeat procdeure until within some 10-30 fsw of the first deco stop;

5. and then go for it.

Within conventional tables, such procedure was somewhat arbitrary, and usually always ended up with a lot of hang time in the shallow zone. Such is to be expected within dissolved gas deco frameworks. So, deep stop pioneers started shaving shallow deco time off their schedules. And jumped back into the water, picking up the trial and error testing where it left off.

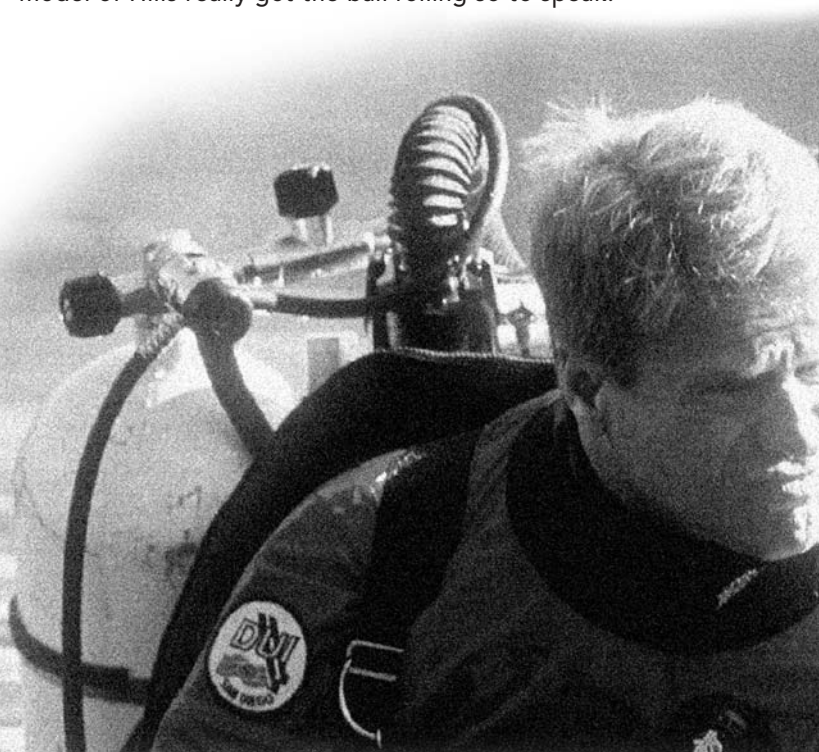
Seasoned tech divers all had their own recipes for this process. And sure, what works works in the diving world.

What doesn't is usually trashed.

Concurrently, full up dual phase models, spawned by the inadequacies and shortcomings of conventional tables, emerged on the diving scene. Not only did deep stops evolve self consistently in these models, but dive and personal computers put deco scheduling with these new models in the hands of real divers. And real on the scene analysis and feedback tuned arbitrary, trial and error, and theoretical schedules to each other.

One thing about these bubble models, as they are collectively referenced, that is common to all of them is deeper stops, shorter decompression times in the shallow zone, and shorter overall deco times. And they all couple dissolved gases to bubbles, not focusing just on bubbles or dissolved gas.

Without going into gory details, a few of the more important ones can be summarized. The thermodynamic model of Hills really got the ball rolling so to speak:



1. Thermodynamic model (Hills, 1976) — assumes free phase (bubbles) separates in tissue under supersaturation gas loadings. Advocates dropout from deco schedule somewhere in the 20 ft zone.

2. Varying permeability model (Yount, 1986) — assumes preformed nuclei permeate blood and tissue, and are excited into growth by compression-decompression. Model patterned after gel bubbles studied in the laboratory

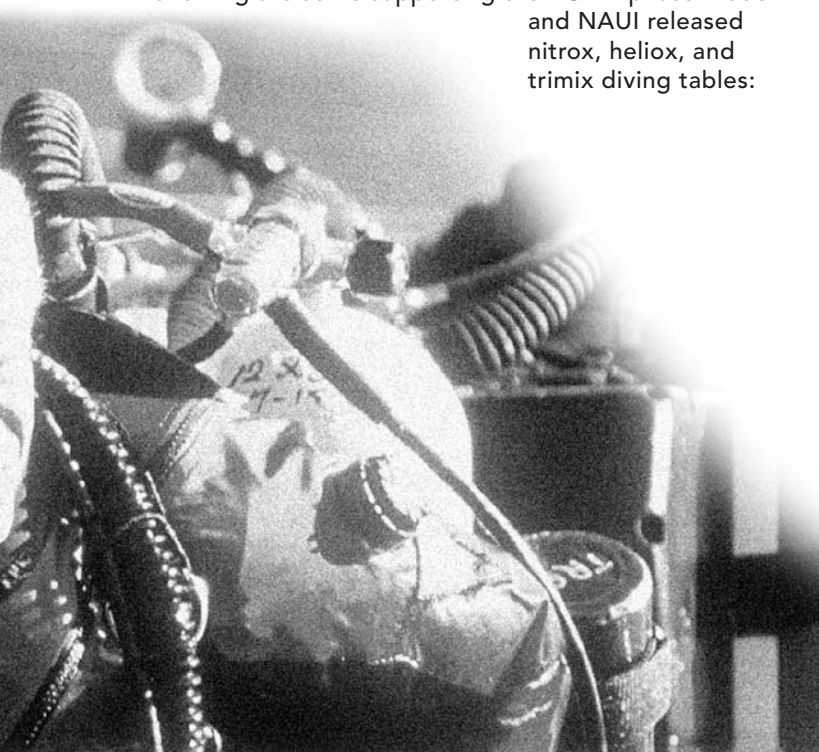
3. Reduced gradient bubble model (Wienke, 1990) — abandons gel parametrization of varying parmeability model, and extends bubble model to repetitive, altitude, and reverse profile diving. Employed in recreational and technical diving meters, and is the basis for tested new NAUI tables;

4. Tissue bubble diffusion model (Gernhardt and Vann, 1990) — assumes gas transfer across bubble interface, and correlates growth with DCI . statistics. Probably employed in the commercial diving sector.

Not all these models have seen extensive field testing, but since they are all similar, the following, addressing testing and validation of the reduced gradient bubble model (RGBM), holds in broad terms. The 1000s of tech dives on deep stops, of course, already validate deep stop technology and models to most, but the testing and validation described next spans deep stops to recreational diving in single model framework. And that is a very desired feature of any decompression theory and/or model.

The Testing And Validation

Models need validation and testing. Often, strict chamber tests are not possible, economically nor otherwise, and bubble models employ a number of benchmarks and regimens to underscore viability. The following are some supporting the RGBM phase model and NAUI released nitrox, heliox, and trimix diving tables:



1. Counterterror and countermeasures (LANL) exercises have used the RGBM (full up iterative deep stop version) for a number of years, logging some 456 dives on mixed gases (trimix, heliox, nitrox) without incidence of DCI — 35% were deco dives, and 25% were deco repets with at least 2 hour surface interval time, and in the forward direction (deepest dives first);

2. NAUI Technical Diving has been diving the deep stop version for the past 3 yrs, some estimated 700 dives, on mixed gases down to 250 fsw, without a single DCI hit. Some 15 divers, late 1999, in France used the RGBM to make 2 mixed gas dives a day, without mishap, in cold water and rough seas. Same in the warm waters of Roatan in 2000 and 2001.

3. Modified RGBM recreational algorithms (Haldane imbedded with bubble reduction factors limiting reverse profile, repetitive, and multiday diving), as coded into ABYSS software and Suunto, Plexus, and Hydrospace decometers, lower an already low DCI incidence rate of approximately 1/10,000 or less. More RGBM decompression meters, including mixed gases, are in the works.

4. A cadre of divers and instructors in mountainous New Mexico, Utah, and Colorado have been diving the modified (Haldane imbedded again) RGBM at altitude, an estimated 450 dives, without peril. Again, not surprising since the altitude RGBM is slightly more conservative than the usual Cross correction used routinely up to about 8,000 ft elevation, and with estimated DCI incidence less than 1/10,000;

5. Within decometer implementations of the RGBM, only two DCI hits have been reported in nonstop and multidiv-ing categories, beyond 40,000 dives or more, up to now;

6. Extreme chamber tests for mixed gas RGBM are in the works, and less stressful exposures will be addressed shortly — extreme here means 300 fsw and beyond;

7. Probabilistic decompression analysis of some selected RGBM profiles, calibrated against similar calculations of the same profiles by Duke, help validate the RGBM on computational bases, suggesting the RGBM has no more theoretical risk than other bubble or dissolved gas models (Weathersby, Vann, Gerth methodology at USN and Duke).

8. All divers and instructors using RGBM decometers, tables, or NET software have been advised to report individual profiles to DAN Project Dive Exploration (Vann, Gerth, Denoble, others at Duke).

9. ABYSS is a NET sotware package that offers the modified RGBM (folded over the Buhlmann ZHL) AND the full up, deep stop version for any gas mixture, has a fairly large contingent of tech divers already using the RGBM and has not received any reports of DCI,

10 NAUI Worldwide is releasing a set of tested no-group, no-calc, no- fuss RGBM tables for recreational sea level and altitude air and nitrox diving, with simple rules linking surface intervals, repets, and flying-after-diving. It almost goes without saying that models such as these have reshaped our decompression horizons — and will continue doing so.

11. WKPP mixed gas, deep deco profiles have been matched in both shape and duration by the RGBM, actually, the WKPP profiles are a validation point for the RGBM.

One last item concerning deep stops remains. What about controlled laboratory testing?

The Experiments

Doppler and utrasound imaging are techniques for detecting moving bubbles in humans and animals following compression-decompression. While bubble scores from these devices do not always correlate with the incidence of DCI, the presence or non-presence of bubbles is an important metric in evaluating dive profiles. So let's consider some recent tests, and see how they relate to deep stops.

Analysis of more than 16,000 actual dives by Diver's Alert Network (DAN), prompted Bennett to suggest that decompression injuries are likely due to ascending too quickly. He found that the introduction of deep stops, without changing the ascent rate, reduced high bubble grades to near zero, from 30.5% without deep stops. He concluded that a deep stop at half the dive depth should reduce the critical fast gas tensions and lower the DCI incidence rate. Marroni concluded studies with DAN's European sample with much the same thought. Although he found that ascent speed itself did not reduce bubble formation, he suggested that a slowing down in the deeper phases of the dive (deep stops) should reduce bubble formation. He will be conducting further tests along those lines.

Brubakk and Wienke found that longer decompression times are not always better when it comes to bubble formation in pigs. They found more bubbling in chamber tests when pigs were exposed to longer but shallower decompression profiles, where staged shallow decompression stops produced more bubbles than slower (deeper) linear ascents. Model correlations and calculations using the reduced gradient bubble model suggest the same.

Cope studied 12 volunteer divers performing conventional (Haldane tables) dives with and without deep stops. His results are not available yet — but should be very interesting.

The Bottom Line

To most of us in the technical and recreational diving worlds, the bottom line is simple. Deep stop technology has developed successfully over the past 15 years or so. Tried and tested in the field, now some in the laboratory, deep stops are backed up by diver success, confidence, theoretical and experimental model underpinnings, and general acceptance by seasoned professionals.

Amen. And dive on.

Author Sketch: Bruce Wienke is a Program Manager in the Nuclear Weapons Technology/ Simulation And Computing Office at the Los Alamos National Laboratory (LANL), with interests in computational decompression and models, gas transport, and phase mechanics. He contributes to underwater symposia, educational publications, technical periodicals and decompression workshops, having authored seven monographs (Technical Diving In Depth, Decompression Theory, Physics, Physiology And Decompression Theory For The Technical And Commercial Diver, High Altitude Diving, Basic Diving Physics And Applications, Diving Above Sea Level, Basic Decompression Theory And Application) and over 200 technical journal articles. Diving environs include the Caribbean, South Pacific, Asia, inland and coastal United States, Hawaii, and polar Arctic and Antarctic in technical, scientific, military, and recreational activities. He also heads the LANL Nuclear Emergency Strategy Dive Team, in exercises involving Special Warfare Units (SEAL, Delta), above and below water. But best of all he writes for Advanced Diver Magazine.

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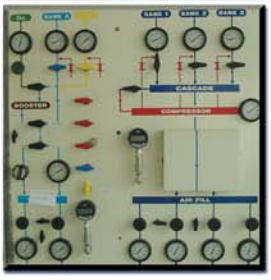

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INSIDE THE FLOODED SINKHOLE OF "POZZO DEL MERRO" (MERRO WELL) ITALY

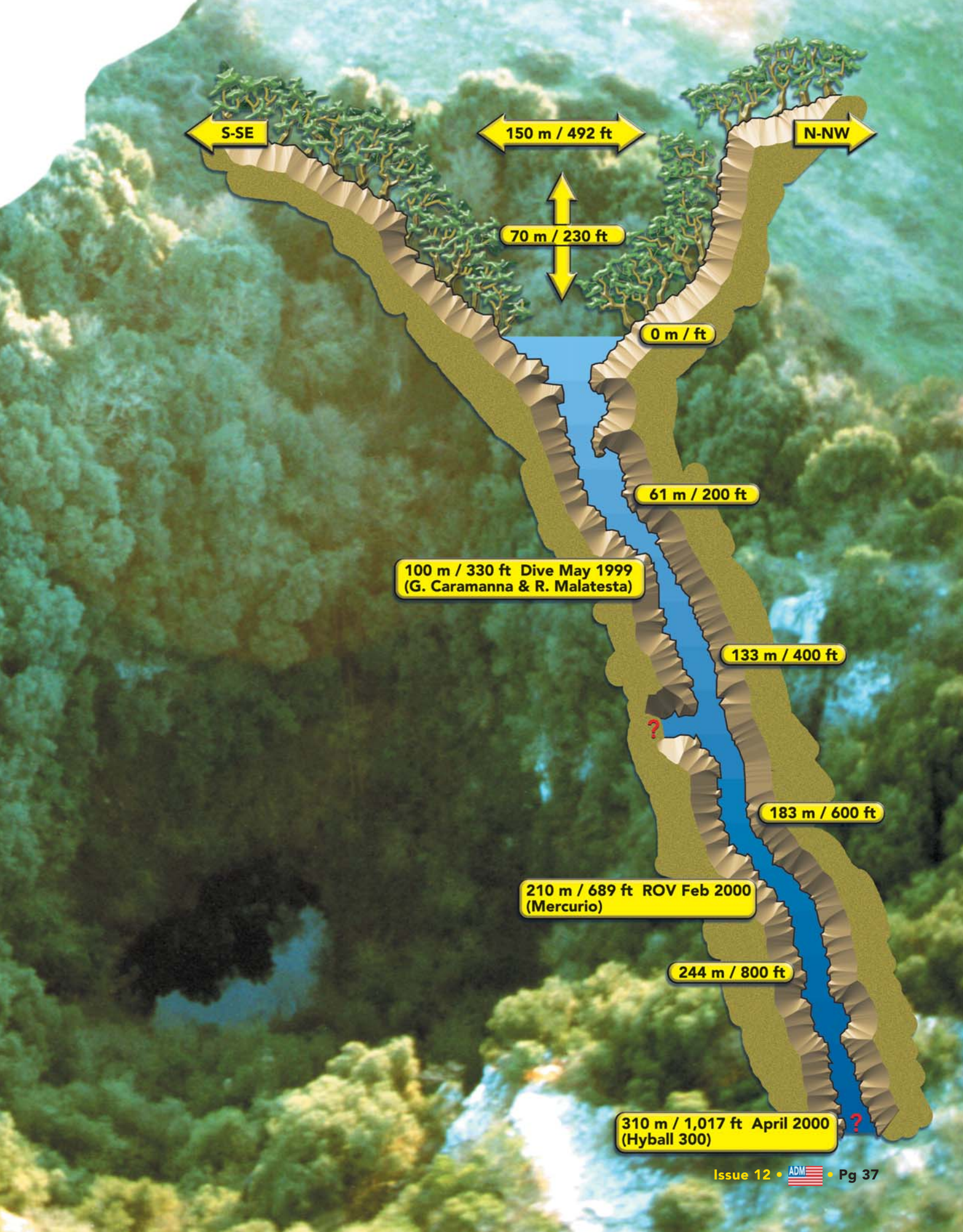
By: Dr. Giorgio Caramanna

As a geologist and cave diver, I have always been very charmed by flooded caves. These places, like secret doors in the heart of the earth, are evidence of the silent work of water erosion on the calcareous rocks during the geological ages. The exploration and study of the flooded caves and sinkholes has been the "last frontier" of this scientific research. Scuba diving is a powerful tool for geologists, archeologists and biologists, enabling them to go where "no one has gone before."

In many cases, if an individual wants to find an unexplored place, he or she has to go far away from civilized areas -- to the deserts, the jungles or along steep mountains. But this is not always necessary. Sometimes an amazing, unexplored place is waiting just few miles outside of a big city. This is the story of the discovery, exploration and study of one of the world's deepest sinkholes: the "Pozzo del Merro" (Merro Well).

Photo: Aerial view of the 230 ft. / 70 meter drop to the waters surface into the system Pozzo del Marro.

Illustration of the caves profile after being explored to a depth of 1,017 ft. / 310 meters by a remotely operated vehicle (ROV).


S-SE
150 m / 492 ft
N-NW
70 m / 230 ft
0 m / ft
61 m / 200 ft
100 m / 330 ft Dive May 1999
(G. Caramanna & R. Malatesta)
133 m / 400 ft
?
183 m / 600 ft
210 m / 689 ft ROV Feb 2000
(Mercurio)
244 m / 800 ft
310 m / 1,017 ft April 2000
(Hyball 300)
?

The "Pozzo del Merro" is a sinkhole in the Cornicolani Mountains, located a few kilometers east of Rome (Latium Region, Central Italy). It is like a big funnel in the limestone of Lias age (about 200 millions years). The name "Merro" is a Central Italian dialectical word meaning a "very deep and steep precipice." The mouth of the sinkhole has a circular boundary that is 492 feet in diameter. The dry section, with walls covered by luxurious vegetation, is about 230 feet deep. On the bottom lies a small circular lake 100 feet in diameter, hiding a dark liquid abyss more than 1,016 feet deep.

Incredibly, until my team took on the challenge, no one had ever before dove this sinkhole--and it is only 45 minutes outside of Rome! I do not know why it had never been explored. Perhaps it was because the lake in the bottom appears to be a very shallow pool filled with some water. Carrying heavy scuba gear down the lake is a hard job and few people want to do this for nothing. The only people usually willing to take the risk are geologists and explorers!

In the early part of 1999, the study of the "Merro" became the main argument for my degree thesis in Hydrogeology at the Geology Department of the University of Rome. A cave divers team was formed to explore the flooded sinkhole. The team included Simone Formica, dive instructor; Riccardo Malatesta, member of the scuba team of the Italian Fire Brigade; and me, geologist and scientific diver. We started diving to collect data, along with water and rock samples. In addition, we wanted to map the conduit and monitor the main chemical parameters.

Diving in an environment like the "Merro" requires cave diving and deep diving techniques. The first problem was to carry the scuba gear down to the lake surface. Fortunately, along the walls were some rocky steps, which were built by the Regional Water Society of Rome in 1970 for experimental purposes. However, the last 50 feet required us to use ropes and tackles to reach the water.

Entering the water was like penetrating a world that was silent, foreign and dark. A greenish glow surrounded us due to the presence of floating plants on the water's surface. Going deeper, the beams of the scuba lamps were the only lights in this water-filled abyss. During the descent the only link with the surface was the line, which was spooled out of the reel. Along the white limestone walls of the conduit were many secondary caves -- like black eyes looking at the divers. These openings were just blind alleys to nowhere. The only way to proceed in the exploration was to go down further and further in the main passage. Eventually the conduit became tight, but there was enough space for a fully equipped cave diver to swim through. Although the water was clear, the presence of silt along the walls made visibility a bit difficult. In this case, correct use of the line was the only way to exit the cave.

Our standard scuba gear included twin tanks with manifold, double regulators (first and second stage) with pressure gauge, reels, dry suits, BCDs with double air bags and helmets with two primary lights and four safety lights. The use of such redundant lights was due to the scientific probing of the cave. In this case a light failure may have caused the loss of very important data. The wide-angle lighting, thanks to the two primary lamps, was helpful for the mapping and geological survey of the environment. Naturally, this standard configuration changed with the different purposes of the dives. In my opinion, due to some years of scientific cave diving, there is not just one configuration style; however, there is the right configuration that fits one kind of dive. In a hard environment like the "Merro," one must pay attention to optimize the gear used, because a second chance may not be possible.

For the shallow dives we used air and for the deeper dives Trimix. As scientists, Trimix diving was the best solution to avoid nitrogen narcosis and to have a very clear mind. This is very important in scientific tasks where the precision is a must. We dived up to 328 feet by Trimix, taking samples of water, mapping the main conduit and exploring the sinkhole. In these technical dives we used, as usual, stage bottles for the deco gasses. For easier swimming in the tighter sections of the karst conduit, the stage bottles were clipped along a strong nylon line that was fixed on the limestone walls from 230 feet to the surface. We used the line also as reference in the mapping work.

For deeper dives our choice was the use of some automatic submergible machines: the ROVs (Remote Operated Vehicles). The ROVs are machines with electric thrusters and video cameras. They are connected with the surface by a cable that is also used for the power supply and the data transmission.

The use of ROV was possible thanks to the help of the Scuba Team of the Italian Fire Brigade, which owns and operates these devices for recovery purposes. The firemen cleared overgrown vegetation from the trails located in the dry section of the sinkhole. They then built a boogie to carry all the equipment down to the water's surface and constructed a floating device to hold the remote control station of the ROV.

In early 2000, we used two different ROVs to explore the sinkhole. The first of these, the "Mercurio (Mercury)," dived to the depth of 689 feet (maximum operative pressure limit) without reaching the bottom. The second ROV, "Hyball 300," reached 1,016 feet without touching down either! Today, the "Pozzo del Merro" is the deepest flooded sinkhole in the world that has ever been explored by ROVs.

The spread karst erosion in the dry and submerged sections of the sinkhole showed evidence of the strong activity of chemical aggressive fluids raising up from faults. These are the same faults that favored the development of the "Merro." Chemical analyses of the water shows a mineralization higher than the usual one in fresh spring water. This is because of the presence, in the neighboring area, of an ancient volcano: "The Albani Hills." Although the last volcanic activity ended tens of thousands of years ago, the ancient fire is still burning in the depth of the ground, and the typical volcanic fluids are still rising through the crevices of the limestone around the "Merro" sinkhole.

In the future, science will enable us to go further in the exploration of the sinkhole, making it possible for us to reach the bottom with a new ROV. With the age of exploration still expanding, the underwater world remains a new frontier for scientists and explorers.

Thanks to the Italian firemen who made this study and subsequent article possible through their support, hard work and valiant efforts.

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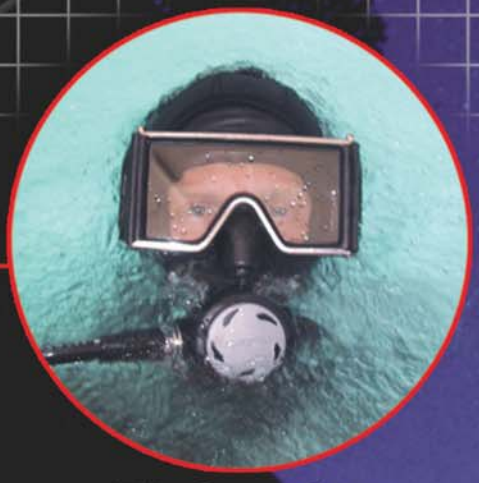

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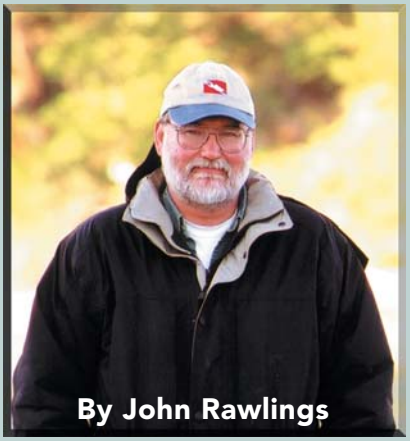


By John Rawlings

For quite a while now, I've been trying to lure Advanced Diver Magazine's publisher Curt Bowen to the Pacific Northwest to discover what our cold, rich waters have to offer. Each article I've sent in to the magazine has "set the hook" a little deeper, and with every phone call I began to hear the excitement starting to build in his voice. Finally the combination of planning combined with opportunity opened up. Curt had a trip scheduled with some Mountain Climbing buddies to fly out to climb the famous Northwest volcano Mount Saint Helens, and following the climb would have a week to spend diving. I contacted a list of friends for their help in putting together a trip to remember.

Day One

The first day began with a long road trip. Being completely ignorant of Pacific Northwest geography, ("It's somewhere up yonder by Canada, right?"), Curt had had his climbing buddies drop him off in the small southwest Washington town of Kalama, which is approximately 150 miles south of where we needed to be. I collected Curt and Bill Manning, (a diver and paramedic out of Sarasota, Florida), and we turned the nose of my truck Northward toward Puget Sound. A couple of hours later we pulled into the Des Moines Marina just South of Seattle to meet our hosts, owners Jeff and Dayna Rogers of Soundwave Scuba aboard their newest boat, the "Misty Fjord". We also linked up with ADM Videographer Rusty Farst, who had flown into Seattle and driven Southward. Introductions were exchanged all around and shortly we were motoring westward toward Vashon Island and our dive site that night, an artificial reef known as the "KVI Tower," due to the huge radio tower located there on shore. Originally established by the Washington Department of Fish and Wildlife, this site consists of large and small piles of boulders, concrete slabs, and concrete pipes. Even though this is a fairly ordinary site, Jeff and Dayna had selected this particular spot as a prime location for introducing our Florida boys to one of the most interesting underwater residents of Puget Sound -- the Giant Pacific Octopus. Anchoring in shallow water, Jeff then led the team downward toward the reef. Somewhere during the descent, both Curt and Rusty became enamored with the huge white and orange plumose anemones and paused to film them while I continued downward with the Rogers' team. The end result of this was that we found four Giant Pacific Octopuses in their dens, one a female with her eggs, while they put together some thrilling footage of Sea Anemones (yawn.). The disappointment on their faces was palpable as we described what we had seen, and together we discussed the possibilities available for the next day's operations.

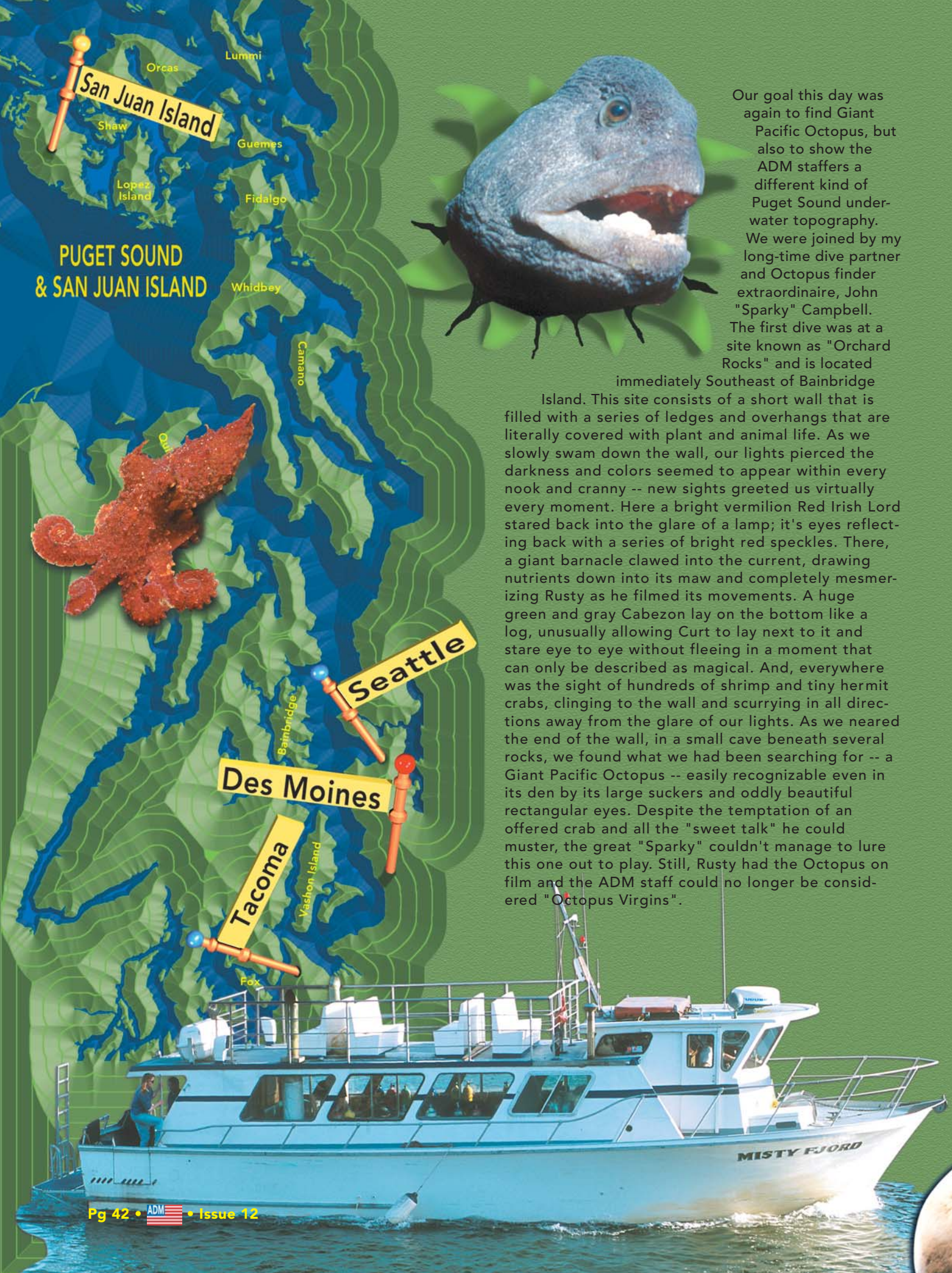
Day Two

The next morning we met Captain Ray McQuinn at the helm of Soundwave Scuba's other boat, the "Captain Hook," at the Seacrest boat launch in West Seattle.

Photo: An Orca breaches in the waters off Washington's San Juan Islands. Megan Gardner

Photography by:
Curt Bowen
Megan Gardner
John Rawlings
Terry Whalen

Our goal this day was again to find Giant Pacific Octopus, but also to show the ADM staffers a different kind of Puget Sound underwater topography. We were joined by my long-time dive partner and Octopus finder extraordinaire, John "Sparky" Campbell. The first dive was at a site known as "Orchard Rocks" and is located immediately Southeast of Bainbridge Island. This site consists of a short wall that is filled with a series of ledges and overhangs that are literally covered with plant and animal life. As we slowly swam down the wall, our lights pierced the darkness and colors seemed to appear within every nook and cranny -- new sights greeted us virtually every moment. Here a bright vermilion Red Irish Lord stared back into the glare of a lamp; it's eyes reflecting back with a series of bright red speckles. There, a giant barnacle clawed into the current, drawing nutrients down into its maw and completely mesmerizing Rusty as he filmed its movements. A huge green and gray Cabezon lay on the bottom like a log, unusually allowing Curt to lay next to it and stare eye to eye without fleeing in a moment that can only be described as magical. And, everywhere was the sight of hundreds of shrimp and tiny hermit crabs, clinging to the wall and scurrying in all directions away from the glare of our lights. As we neared the end of the wall, in a small cave beneath several rocks, we found what we had been searching for -- a Giant Pacific Octopus -- easily recognizable even in its den by its large suckers and oddly beautiful rectangular eyes. Despite the temptation of an offered crab and all the "sweet talk" he could muster, the great "Sparky" couldn't manage to lure this one out to play. Still, Rusty had the Octopus on film and the ADM staff could no longer be considered "Octopus Virgins".

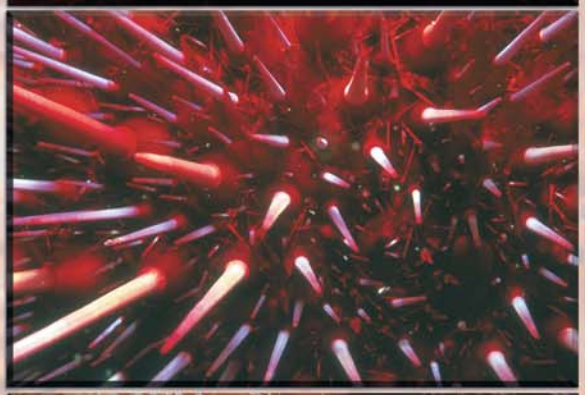


The second dive was just slightly Northwest of the first. "Blakely Rock" is a rocky pinnacle that protrudes out of the water and whose slopes extend gently downward in all directions covered with boulders and ridges. Broadleaf Kelp covers the shallower portions and provides cover and concealment for a huge variety of smaller creatures, making this site a popular one with macro photographers. Huge Sunflower Stars crawl over the rocky reef, constantly in search of prey, while giant red and orange Sea Cucumbers litter the bottom. Here again, the ever-present White-Plumed Anemone abounds, gently swaying as nutrients are gathered from the current.

Day Three

Our third day began at the Point Defiance Boat Launch in Tacoma, where we again met the "Captain Hook," this time with still another Captain at her helm, Tammy Scrichfield. She took us to one of the prime sites in South Puget Sound, "Sunrise Wall," which is located at the Southeast end of Colvos Passage between Vashon Island and the Olympic Peninsula. This site consists of a volcanic rock wall that eventually gives way to a sandy bottom. The wall is covered with a beautiful pink algae and a huge variety of small creatures make it their home, along with a seemingly endless number and variety of multi-colored starfish. The colors alone would attract divers and underwater photographers to this site, but the main draws of Sunrise can be summed up as follows: Octopus and Wolf Eels. The volcanic rock provides a series of natural caves and crevices that are perfect denning sites and since this is an Underwater Park with an abundance of food items, both species have thrived here. Over the years divers have taken to hand feeding both Wolf Eels and Octopus at sunrise, and some of the Wolf Eels especially have become quite "tame," (although they are still wild animals and are capable of removing a finger or two if a diver isn't careful!). My partner on this dive was Jerome Ryan, a noted Puget Sound Technical Instructor. Together, he and I descended to the Southern tip of the wall to begin our dive while "Sparky" dropped down with Curt and Rusty to a deeper portion of the wall.

Almost immediately, Jerome and I came across a small (5 - 6 foot span) Giant Pacific Octopus completely out in the open, resting on the face of the wall. It had assumed the darker color of the rocky face it was attached to and the texture of its skin had also taken on the roughness of the volcanic surface. It was only due to slight movements of its arms that we had noticed it at all. Taken with this great opportunity, I happily clicked away with my camera, burning up half my film in a few moments while Jerome slowly eased in for a close look as well as to give some size perspective in my shots. We moved Northward up the wall seeking an encounter with a Wolf Eel. While we had been



spending time with the Octopus, the other team had in fact found a lone diver engaged in feeding herring to a large Wolf Eel that was quite willing to emerge completely from its den in search of a free meal. Swirling about the divers arms, chest and face, the huge "Eel" (actually, technically a Wolf fish) plucked the proffered herring from his hands much like a family dog would accept scraps from the hand of his master.

Still another type of marine environment was on the agenda for the second dive of the morning as we traveled further South into the Tacoma Narrows. We dived a location known unofficially as "Mile Marker 8" from the fact that there is a small sign to that effect marking the railroad tracks at that point on the shore. This was a typical Narrows dive site, consisting of a steadily dropping slope covered with huge boulders and rock piles. Here, the ADM staff was treated to what can only be described as "Ling Cod City". Ling Cod are voracious predatory fish and are the largest member of the Greenling family. They are also an extremely popular food fish for both anglers and spearfishermen on the West Coast. They can reach five feet in length and can usually be found lying on the bottom or on rocky ledges.

Following our arrival back at the Point Defiance boat launch, we bid farewell to our friends with Soundwave Scuba and turned our noses Northward toward the San Juan Islands. Following a two-hour drive we caught a ferry at the town of Anacortes and stood in awe as our eyes savored the sights of hundreds of large and small tree-covered islands slipping past in our wake. My friend, Ron Kenny, co-owner of Island Dive and Water Sports, had arranged for us to stay at the Roche Harbor Resort on San Juan Island, which is the largest in the island group. We arrived at the port of Friday Harbor just before dusk and at the resort just in time to savor the incredible sunset over the marina.

Day Four

Ron and his co-owner, Mark Gardner, picked us up from the Roche Harbor marina at 9 a.m., and he turned his 38 foot boat, the "San Juan Diver" Northward toward Stuart Island, a small island immediately Northwest of San Juan. Our first dive this day was to be at "Turn Point". The underwater wall here is massive and drops down approximately 900 feet, according to the chart. Ron backed us in close to the wall and we strode into the water like a team of skydivers exiting a plane, one immediately after the other. As we plunged downward the green watery vista opened up like a huge book, and we had a panorama view of the absolute massiveness of the wall. The wall literally drips with white Plumose Anemones, looking for the world like a colossally-vertical wad of giant cotton balls. Between them can be found clusters of red, orange and green anemones of various species, orange cup corals, and huge bright urchins of all sizes and colors.

Next to a beautiful Crimson Anemone, ADM Publisher Curt Bowen examines a huge Puget Sound King Crab.

Sponges of all kinds and colors are present here also -- we spotted some unusual ones such as the Giant Puffball Sponge and the Cloud Sponge on this dive along with many far more common. Brown columns of Kelp dance at the upper edge of the wall, extending toward the surface and giving a brownish tone to the light shining through them from the surface. The absolute beauty of this wall dive rivals anything found on earth, and it was with deep regret that we approached the surface at the end of our bottom time and swam over to the stern of the "San Juan Diver" for pick up.

From the Northwest tip of Stuart Island we turned and motored Southeast toward our next dive site. While enroute we encountered a fairly large group (15 - 20) of Dall's Porpoise, and they stayed with us for quite a while, dancing and leaping in our bow wake and alongside. These unique, blunt-nosed, black and white porpoises are cold-water animals living exclusively in the North Pacific.

Our second dive of the day was off Henry Island, immediately off a land feature known as Kellett Bluff. This, too, was a deep wall dive with colors and beauty rivaling that of Turn Point. Again, a lush Kelp bed graced the water just under the surface and a covering of white anemones enshrouded the great wall below. Near the beginning of the dive, we encountered a huge Puget Sound King Crab, which Rusty documented on video while I took still photos. These huge (up to 12 inches across the carapace) fluorescent orange and sapphire blue crabs are normally in extremely deep water (down to 450 FSW) but will come up into relatively shallow water in the late winter and early spring to breed. As we were filming, Curt swam over to see what the fuss was about -- the shocked look on his face when he initially saw the huge crab was the subject of much entertainment for both Rusty and I. We continued our plunge along the wall, again being treated to a myriad of colors and unusual shapes as planktonic larvae and Moon jellies slipped by us in the water column, carried along in the gentle current.

Returning to the boat, we were thinking that the next thing would be a swift return to shore -- how wrong we were! Ron had been monitoring the radio and had heard that Orcas (a.k.a. Killer Whales) had been sighted due South of our location. Once all of the divers were aboard, he immediately turned the boat in that direction and before long we were treated to the sight of a pod of Orcas moving as a family group while feeding on Salmon. The pod consisted of multiple females, many with young babies, some of what can loosely be called "teenagers," and one huge bull with a dorsal fin approximately 6 feet high. Often

the younger whales would play near the surface, slapping their tails on the surface of the water as if for our entertainment. Their scientific name, Orcinus orca, means "Demon from Hell," but as we watched this peaceful family group feeding and playing together, that name did not seem to fit at all. As we motored back to Roche Harbor, our discussion centered on how many species we had seen that day that the non-Northwesterners among us had never seen before. The discussion continued in the bar that night!

Day Five

Ron met us at his shop in Friday Harbor the next morning at 9 a.m. and the departure aboard the "San Juan Diver" was almost immediate. Our first dive was less than 10 minutes out of the harbor at the Northern tip of Turn Island. This also was a wall dive, although not plunging to the depths of the walls we had dived the day before. Rock Fish of various species and Kelp Greenlings darted in and out of the clusters of anemones and large clusters of blood red and deep purple Sea Urchins littered the wall and rocks like huge overstuffed pin cushions. The pink algae that is so common to diving in the Northwest is absolutely prolific here and the walls appear to be almost like an artist's drop cloth.

Traveling due South, the "San Juan Diver" roared to a location known as "Whale Rocks" on the charts. There, we saw something that Curt had wanted to photograph all week -- Sea Lions in their element. Those in this particular group were Steller Sea Lions, not the California Sea Lions most commonly seen further South in Puget Sound. A cluster of huge (up to 2,200 pounds) golden brown bulls stared at us from the shore as Ron took the boat in as close as he dared due to shallow rocks. The much smaller females formed a small ring around the big males, while those with babies lounged around on the outer rocks in the sun. The camera shutters fairly flew and the video camera whirred -- it wasn't long before we heard a sheepish comment from Curt, "I'm out of film!" Within minutes we were motoring back toward Friday Harbor for our last dive of the day. It would have to be a fast one because we had a ferry to catch to take us back to reality! Ron made a good choice -- "Sir Walter's Wall" again, a site immediately outside the harbor. As we strode off the stern of the boat, I happened to look upward at the shore -- there, perched at the top of one of the tress, a beautiful Bald Eagle looked down at us like an omen for a beautiful dive. I had decided to shoot macro on this particular dive so that I could record some of the tiny creatures to be found in the San Juan Islands. I thus happily busied myself within a small portion of the rocky wall while Curt and Rusty continued with their video safari. Almost immediately, I found a beautiful little Grunt Sculpin who insisted on playing hide and seek with me amongst the nooks and crannies. To my deep regret, I was never able to get it within range of my lens and I turned my attention to other tiny critters. All too soon, the agreed upon bottom time had been reached and we found ourselves climbing aboard for a sprint to the harbor. Taking care of his "brood" until the very end, Ron and his store manager, Terry Whalen, helped us pack and load our gear, getting us to the ferry line on time.

As the ferry churned Eastward back toward Anacortes we all stood at the railing and watched as the islands slipped by, the smell of salt in the air and gulls calling into the wind. Rusty was kind of staring off into space with a bizarre grin on his face, and we discussed what that was all about. "No mystery about that," I said. "He's just falling in love with this place!"

"No problem there," Curt replied. "We'll come back!"

Special thanks to the following:

Jeff and Dayna Rogers
Soundwave Scuba
(206) 463-6152
www.soundwavescuba.com

Ron Kenny and Mike Gardner
Island Dive & Water Sports
1 (800) 303-8386
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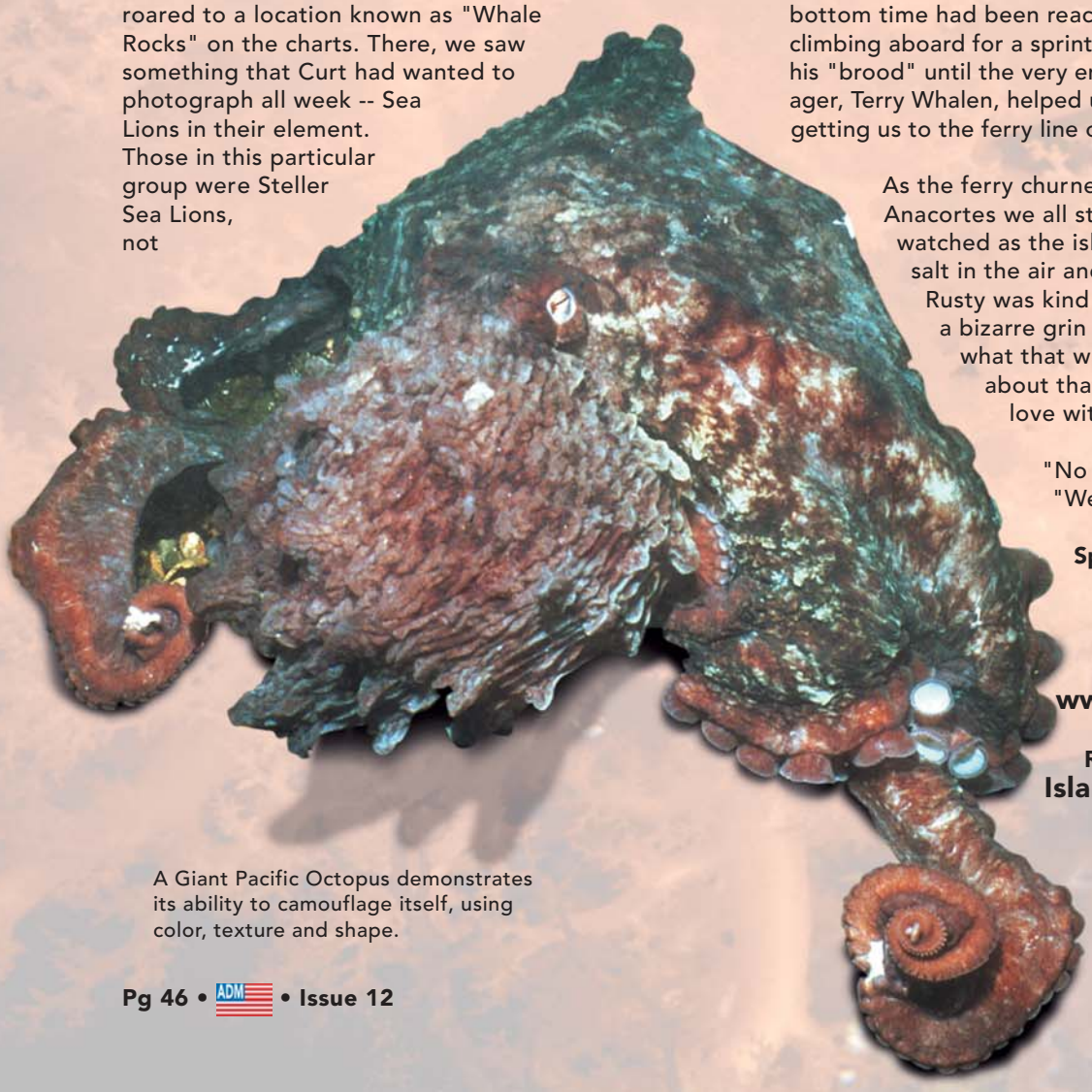


A Giant Pacific Octopus demonstrates its ability to camouflage itself, using color, texture and shape.

Wreck of the Eber Ward
Straits of Mackinac

By Robert and Jan Underhill

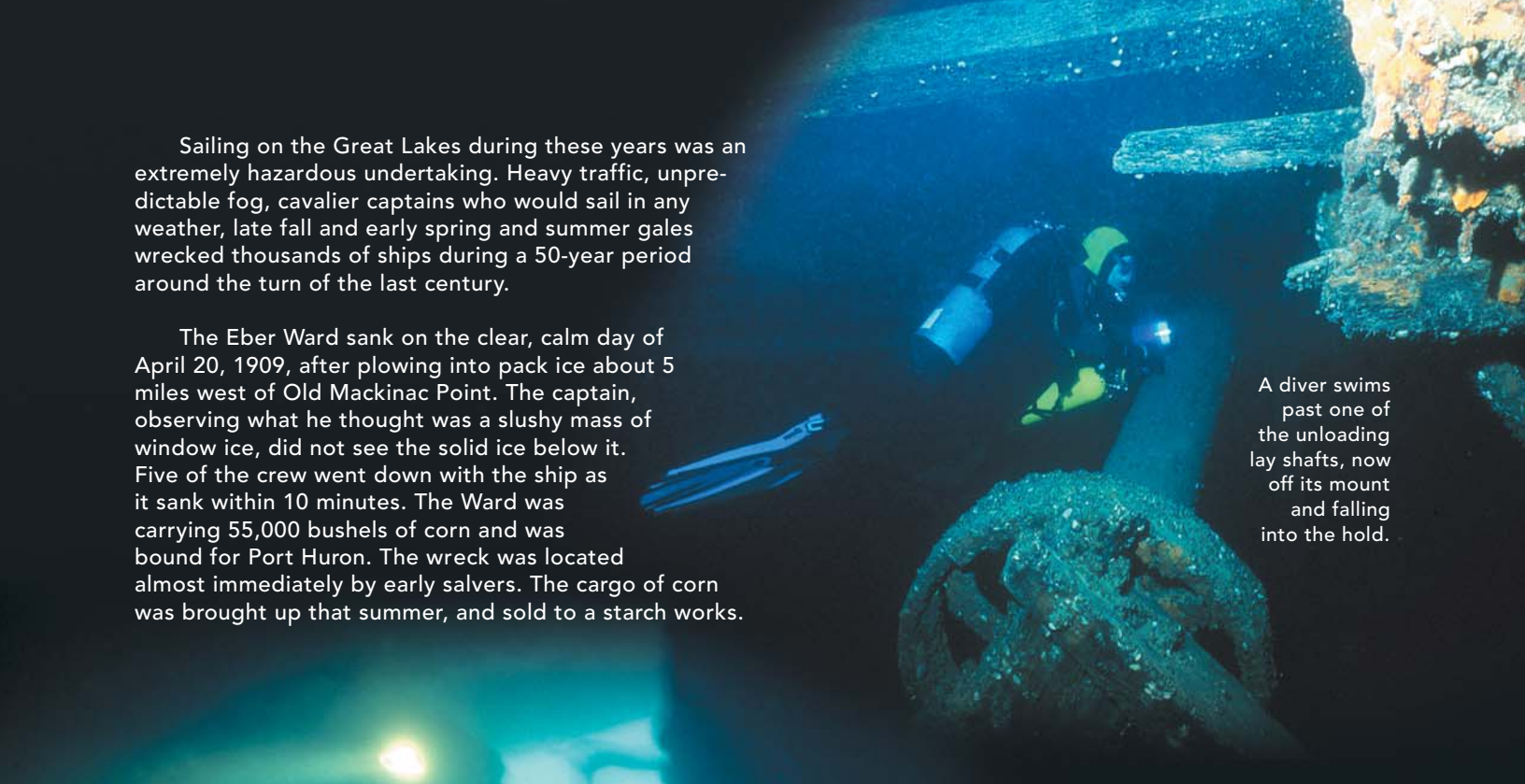
One of the best dives in the Great Lakes is on the Eber Ward in the Straits of Mackinac. The main hull of the Ward is upright and intact in 140 feet of water. Discovered in the era of aluminum 80's and Benjamin valves, the Ward is still a popular destination for technical and advanced sport divers today.

The years just before and just after 1900 were a very busy time for shipping in the Great Lakes. The inland waterway of the five Great Lakes provided transportation for a growing Midwest, as schooners and steamers plied the route between Buffalo, Chicago and Duluth. Before the railroads stretched west into these regions, much of the steamer traffic was passenger and trade goods. Bulk cargos of grain and coal were shipped on Lake Schooners. As people moved to rail in later years, steamers were evolved to carry bulk cargos of grain, coal, and iron ore. Schooners were cut down to a small emergency sail plan and used as barges towed behind the steamers.

A Burbot hovers above the shank and stock of the port anchor at the Eber Ward's bow.
Photo Robert Underhill

Sailing on the Great Lakes during these years was an extremely hazardous undertaking. Heavy traffic, unpredictable fog, cavalier captains who would sail in any weather, late fall and early spring and summer gales wrecked thousands of ships during a 50-year period around the turn of the last century.

The Eber Ward sank on the clear, calm day of April 20, 1909, after plowing into pack ice about 5 miles west of Old Mackinac Point. The captain, observing what he thought was a slushy mass of window ice, did not see the solid ice below it. Five of the crew went down with the ship as it sank within 10 minutes. The Ward was carrying 55,000 bushels of corn and was bound for Port Huron. The wreck was located almost immediately by early salvers. The cargo of corn was brought up that summer, and sold to a starch works.



A diver swims past one of the unloading lay shafts, now off its mount and falling into the hold.

The ship rests on a hard bottom. The entire propeller and most of the rudder can be seen at the stern.

In 1980 the Ward was rediscovered by Chuck Feltner and has become one of the more popular dives in the Straits of Mackinac Bottomland Preserve. A dive on the Ward usually begins at the harbors of Mackinac City or St. Ignace. From either location it is less than a 10-mile boat ride under the Mackinac Bridge and to the wreck site. All wrecks in the preserve are buoyed, and the Ward often has a buoy on both the bow and the stern. Diving in this area can be tricky due to currents, low visibility and storms funneling up from Lake Michigan and Lake Huron. Having said that, when conditions are right, it can be a pretty friendly dive. Visibility in recent years has approached 70 feet during the right day.

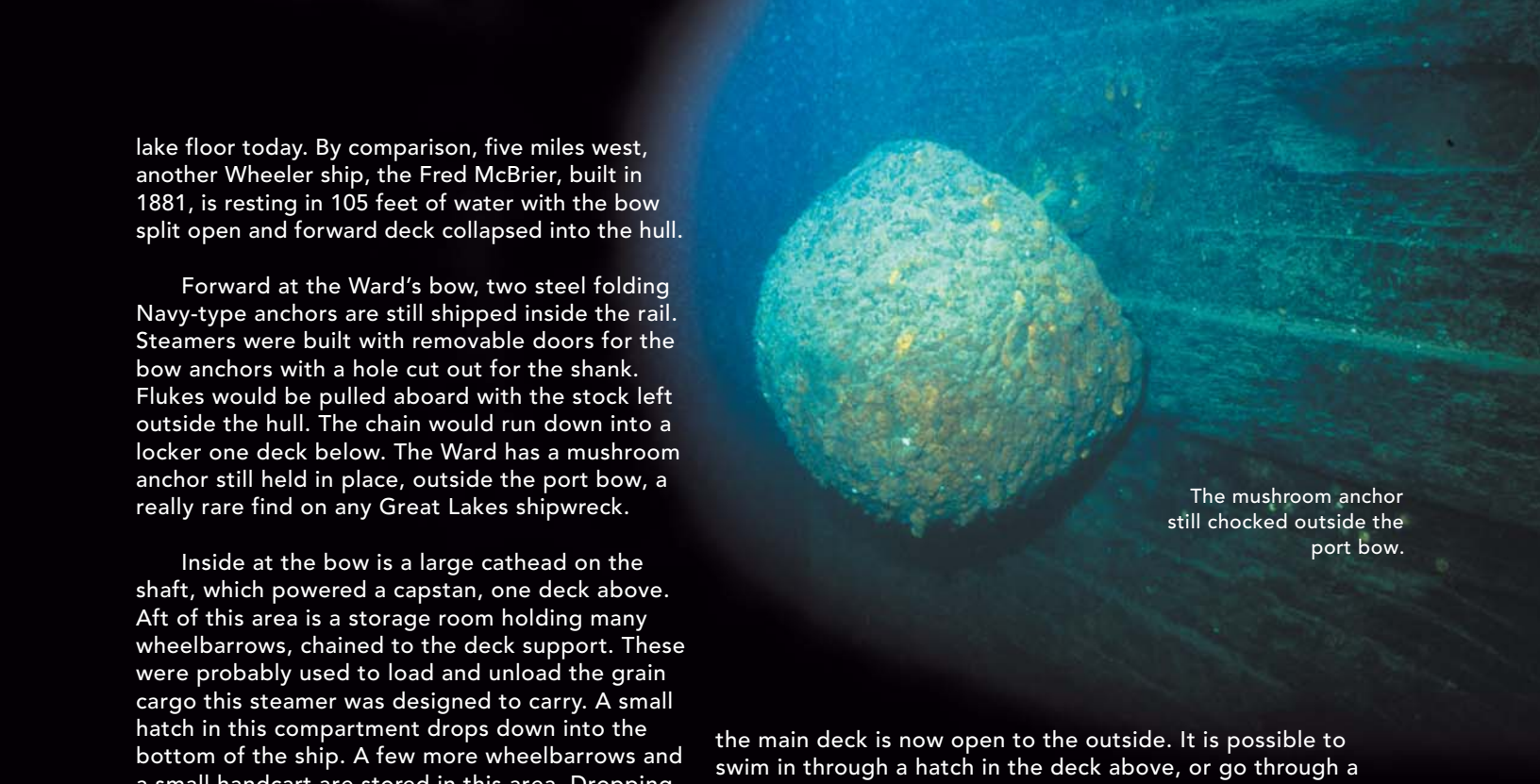
The Eber Ward was built in 1888 by the F. W. Wheeler yard in Bay City, Michigan. Wheeler was noted for many innovative designs, building in wood at a time when many shipbuilders were switching to steel. The ship has a rather interesting hatch system. Unlike most bulk carriers, which have large, center-mounted hatches, the Ward's hatches are smaller and split port and starboard. A power shaft runs just under the center of the top deck from the engine room aft forward to anchor handling equipment in the bow. This power shaft is connected to lay shafts in each of the hatches, which were used to raise and lower cargo into the hold. Hooks attached to the side of the hull just under the main deck held ropes used to hoist bins of grain to the deck level.

Wheeler was aware that the future of shipbuilding was steel. Unable to afford the cost of converting to steel fabrication, he experimented with composite construction, using steel to strengthen traditional wood construction. An examination of the inside hull structure of the Ward today reveals the steel banding bolted inside between the planking and the frames. This construction may be the reason the hull is intact on the

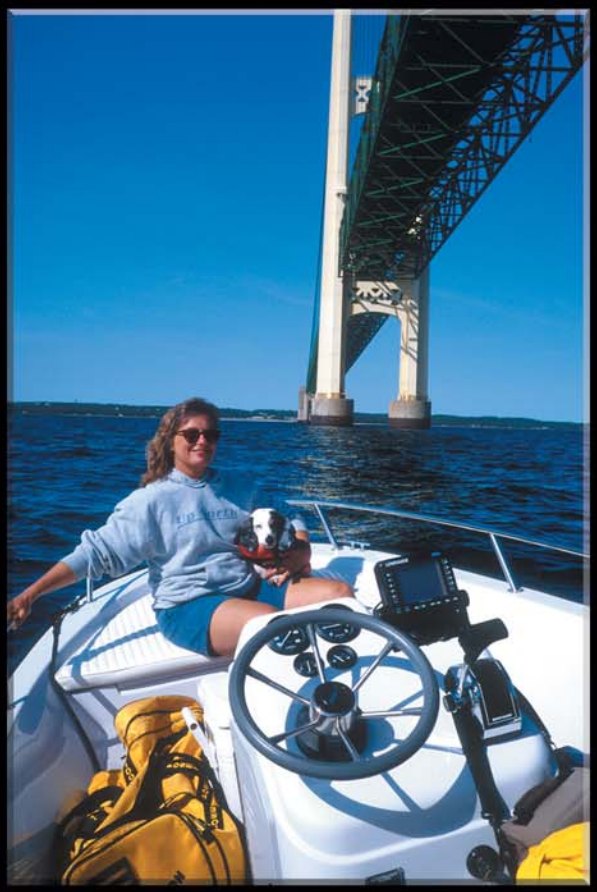
lake floor today. By comparison, five miles west, another Wheeler ship, the Fred McBrier, built in 1881, is resting in 105 feet of water with the bow split open and forward deck collapsed into the hull.

Forward at the Ward's bow, two steel folding Navy-type anchors are still shipped inside the rail. Steamers were built with removable doors for the bow anchors with a hole cut out for the shank. Flukes would be pulled aboard with the stock left outside the hull. The chain would run down into a locker one deck below. The Ward has a mushroom anchor still held in place, outside the port bow, a really rare find on any Great Lakes shipwreck.

Inside at the bow is a large cathead on the shaft, which powered a capstan, one deck above. Aft of this area is a storage room holding many wheelbarrows, chained to the deck support. These were probably used to load and unload the grain cargo this steamer was designed to carry. A small hatch in this compartment drops down into the bottom of the ship. A few more wheelbarrows and a small handcart are stored in this area. Dropping down into this compartment, it is possible to see outside through the collision holes. Aft are the double-decked cargo holds, filled with much silt. The boiler and engine areas are quite chaotic due to collapsed bulkheads, but it is possible to squeeze through. The area in the stern just under the main deck is now open to the outside. It is possible to swim in through a hatch in the deck above, or go through a cargo opening in the side of the ship.



The mushroom anchor still chocked outside the port bow.



The bottom of this part of the lake is hard sand. The ship rests with very little of its hull below the lake floor. On the bottom at the bow, it is possible to see where the collision holed the hull just behind the stem on both sides. Swimming aft, one can find a cook stove on the sand next to the large propeller and rudder. Out beyond the stove is a lifeboat, which can be seen from the area of the stove on the clearest days.

Commercial salvage diving influenced the early days of Great Lakes shipwreck diving. Borrowing techniques from professional divers, underwater explorers deployed lift drums, lift bags, pipe wrenches, pry bars, and even explosives to bring artifacts to the surface. Many of these items are still displayed at marinas, parks and harbors around the Lakes. As diving matured, a new ethic emerged. Divers came to realize that these freshwater wrecks spanning about 50 years represented a time when sail would change to steam, wood to steel, and the oil running lamp would became electrified. Shipwrecks in the Great Lakes are now protected from souvenir collecting of any kind. The many wrecks that lie in the Bottomland Preserves of the area represent time capsules from the year they were built. Very few are alike. All have a story to tell.

STATE POLICE NJ T.E.A.M.S. UNIT

By Jeff Barris

Honor. Duty. Fidelity. These are the words by which a New Jersey State trooper lives. Since their inception in 1921, New Jersey State troopers have continually upheld the law in the garden state, keeping the public safe from the menacing evils that lurk in an ever-changing society. Within the ranks of this highly diverse police organization, standards are extremely high and pride runs far below its highly polished surface. Their exemplary professional performance and striking appearance, automatically demands one's respect.

As decades passed, New Jersey emerged from its rural, no mans land of thinly scattered homesteads, surrounded by finely cultivated farm fields, into the most populated state per capita. Its near bulging interior is the product of an ideal climate, great shoreline and its close proximity to New York City, the world's financial Mecca. As a result, New Jersey's topography is now heavily populated with many modern cities of diversity, outlined in quaint, finely manicured suburbs with the farms of the past dwindling into obscurity.

It's no secret this geographical location denotes perfection for the import and export of goods by sea, allowing modern industry and business opportunities to easily thrive. Unfortunately, along with progress, comes increased crime. With this, officials from the New Jersey State police started to see a change in the kinds of criminals, along with the illegal activities they engaged in, which spread like a plague. A criminal type more devious and witty from previous years gone past was now blossoming into a royal thorn in society's backside, and an ever growing obstacle to the brave men in blue. In order to keep up with this growing scourge, the troopers needed an edge. They needed to become more sophisticated and specialized in their fields. Intelligence, surveillance and many other assorted task forces were born, creating a division of specialists, unique in their fields. Their laborious missions were to zero in on a particular criminal activity, infiltrate its nucleus and wipe it out for good. Results were impressive, leading to a major decline in crime, and a newfound arsenal of intelligent crime fighting tools. A more diverse and professional law enforcement agency, that few throughout the country could match, was the end result.

In the 1980s, yet another specialized unit was in need. This time the call was for an elite unit to be used in handling the most dangerous of assignments. A unit comprised of the" best of the best", that would deal with extremely high risk operations, placing them

in harms way 24 hours a day, seven days a week. The name given to this special group of State troopers is T.E.A.M.S. It stands for Technical, Emergency, And Missions, Specialists. Their mach speed, adrenaline-pumping duties include, but are not limited to the following: special weapons and tactics (swat), high angle rescue (high structures and buildings), confined spaces (world trade center tragedy) and scuba diving operations. The T.E.A.M.S. are comprised of three, 10 man squads, strategically placed throughout the entire state, allowing for maximum effectiveness and quick deployment.

SPECIAL WEAPONS AND TACTICS: commonly know as SWAT. This mission involves nerves of steel and specialized equipment, combined with lightning fast strikes and precision teamwork. Today's troopers are cloaked in subdued green and black dress. Their bodies are adorned from head to toe in high tech body armor, communications, along with an array of modern semi and automatic weaponry strategically strapped to their muscular frames. Collectively, you got one tough, tactical trooper. They constantly train and plan for a multitude of specialized tactical missions from executing precise building entries to heart stopping hostage recoveries. When all goes wrong, I mean really wrong, it's SWAT that is usually summoned to save the day.

HIGH ANGLE RESCUE: High atop a building, bridge or other aerial location, hundreds of feet skyward, is where this crack unit goes. Lengths of brightly colored braided rope, nylon harnesses, and hi tech mountaineering hardware secures these human arachnids as they outwit the vertical surfaces of the urban jungle. They rigorously train for this in an old blimp hangar at the Naval Air station in Lakehurst, New Jersey, the exact place where the famed Hindenburg once rested its rotund airframe.

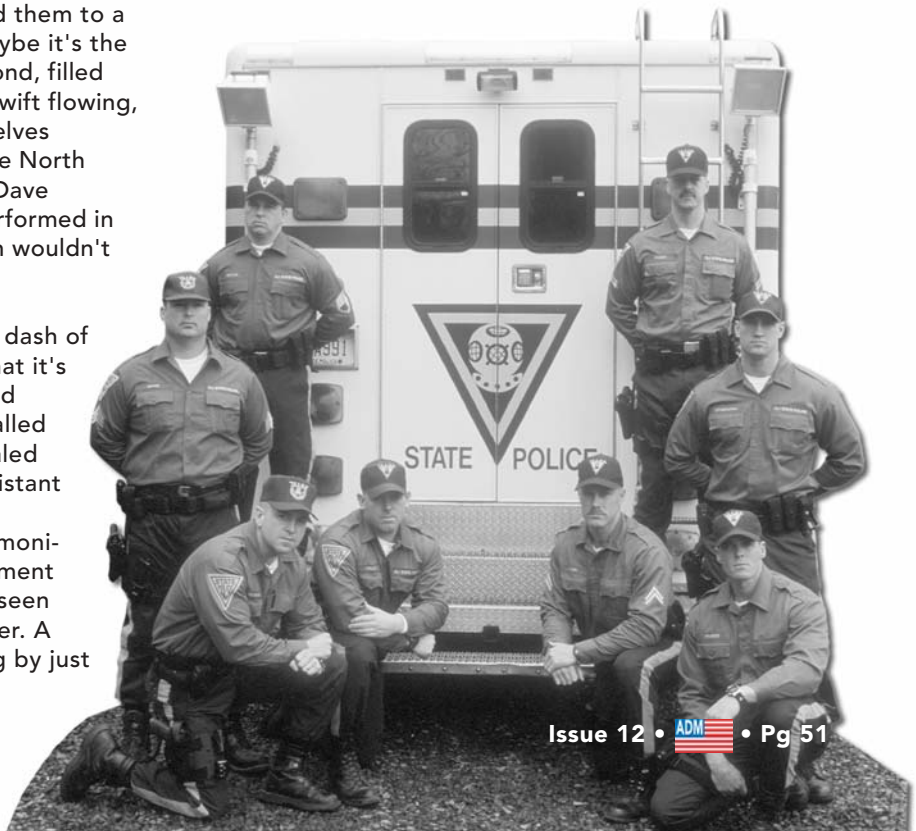
SCUBA: Their water born operations lead them to a variety of unfriendly liquid environments. Maybe it's the swampy shallow depths of a debris-choked pond, filled with dangerous obstructions or perhaps in a swift flowing, snag filled, muddy river. They also find themselves logging bottom time in the briny depths of the North Atlantic Ocean. According to T.E.A.M.S. Sgt. Dave Meyers, "Mostly all of our diving is usually performed in some god-forsaken body of water that a leech wouldn't think twice about living in."

Its blackwater diving at it's worst, with a dash of hell thrown in just for fun. Braille diving is what it's called amongst these pistol-packing pros. And these troopers are the best there is. When called upon, these men enter the hostile waters sealed from head to toe in heavy-duty, puncture-resistant drysuits with full faced masks, complete with topside communications, linked to a tender, monitoring their every breath. This modern equipment will hopefully shield their bodies from the unseen snags and toxic water they normally encounter. A safety diver is always geared up and standing by just in case of a problem. Evidence collection ranging from stolen autos, expired bodies, to weapons used at the scene of a heinous crime, along with amphibious reconnaissance, are the tasks these " navy seal" types perform when called upon. They can also be found doing helicopter deployment training with the United States Coast Guard's rescue swimmers.

These skills they possess require dedication, teamwork, nerves of steel, and the calm of a saint. Obviously, not for the faint of heart, nor is it what most of us will ever do, but it's a job that must be done. The members of this unit need to be recognized for their untiring dedication and valor. They need a pat on the back and a thank you for a job well done! Because, without a doubt, they are New Jersey's finest.

When preparing this article, I found myself diving along side of them in a frigid, murky, body of water in the middle of winter, followed by a lofty trip, high up in an old blimp hangar, to finally witnessing their tack driving SWAT operations. But most of all, it was their quiet, humble demeanors, and intense focus that amazed me the most. Dealing with a great bunch of friendly, down to earth guys, whose sole purpose is to do their job to the best of their ability, is what makes up the best of any team.

I would like to extend my thanks to the New Jersey State police and the members of the T.E.A.M.S. unit for their kindness and assistance.
Staff Sergeant Ed Cetnar • Sergeant Dave Meyers
Trooper I Ken Wilson • Trooper I Jeff Algor
Trooper I Paul Karagias • Tpooper. II Tristin Collins
Trooper II Al Ponenti • Trooper II Glen Szenzenstein
Trooper John Eustace • Trooper Robert Shaughnessy



Photography by Krista Geis
Amphibious photography by Ed Braun, and Mike Mustac

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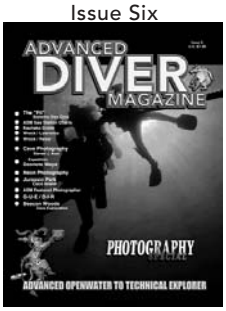

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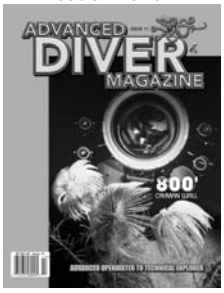

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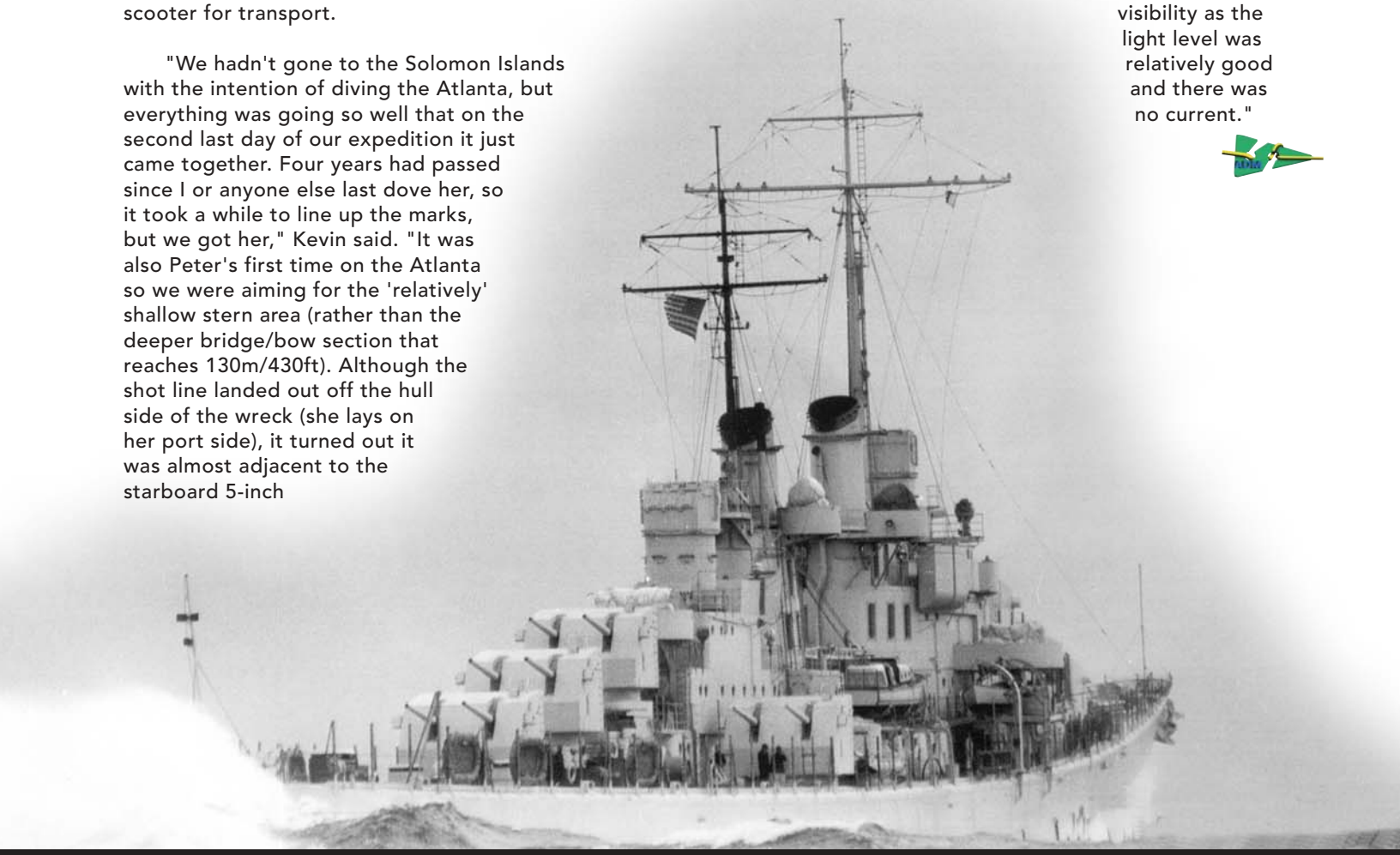
USS ATLANTA REVISITED

By Miria Denlay

For the first time in four years, the wreck that lies on the edge of Iron Bottom Sound off Guadalcanal in the Solomon Islands was revisited by divers. Not since my own dive in 1998, which at the time was the deepest wreck dive by a woman, had human hands touched or explored the USS Atlanta. On April 26, 2002, while using closed circuit re-breathers, or CCR's, Kevin Denlay and Peter Frith dove the sleeping giant. This was the first time that CCR's had been used on the Atlanta, and the expedition itself was the first devoted entirely to the use of CCR's for technical diving in the Solomon Islands. As the dive was rather an 'impromptu event' late in the expedition, they did just one dive to 115m/378ft on the shallower stern section of the wreck. Peter Frith used an Inspiration CCR, while Kevin used a Mk15.5 CCR and a Silent Submergence UV-18 scooter for transport.

"We hadn't gone to the Solomon Islands with the intention of diving the Atlanta, but everything was going so well that on the second last day of our expedition it just came together. Four years had passed since I or anyone else last dove her, so it took a while to line up the marks, but we got her," Kevin said. "It was also Peter's first time on the Atlanta so we were aiming for the 'relatively' shallow stern area (rather than the deeper bridge/bow section that reaches 130m/430ft). Although the shot line landed out off the hull side of the wreck (she lays on her port side), it turned out it was almost adjacent to the starboard 5-inch dual waist mount, with which I am very familiar. Having the scooter for transport, I rode up to the break in the stern, the shallowest point at around 100m/330ft, but the visibility was rather poor, way to poor for wide angle photography, so I didn't continue on over to the separated stern section which had been my target. After a while I "scootered" back and found Peter inspecting the decimated waist mount and then motored a little farther forward, almost to the torpedo hole in the hull, before terminating the dive as the visibility had continued to deteriorate. Returning to the general area of the shot line, it was reassuring to see the Sea Blitz strobe I had set on the down line flashing in the gloom, guiding our way home. It was a shame about the visibility as the light level was relatively good and there was no current."



CL-51 USS ATLANTA

Displacement 8,000 Tons Dimensions, L = 541 ft X W = 53 ft

Armament 16 x 5”38 DP, 16 x 1.1” AA, 8 x 20 mm, 8 x 21” tt.

Armor, 3 3/4” Belt, 1 1/4” Mount, 1 1/4” Deck, 2 1/2” Conning Tower

Machinery, 75,000 SHP; Geared Turbines, 2 Screws Speed, 32.5 Knots, 800+ Crew

"Lost in night action, Friday 13th, November, 1942."

The divers used a heliair diluent of trimix 8/62 (8 percent oxygen, 62 percent helium) in their re-breathers, which gave an equivalent narcosis depth of only 37m/123ft at 115m/378ft. Both divers also used VR3 mixed gas computers to control their closed circuit decompression schedules, and after spending 15 minutes on the bottom were out of the water a little over two hours later. They kept their bottom time intentionally short as they did not have enough open circuit bailout gas or the support divers needed for safely completing longer deco times with correspondingly higher CNS (central nervous system) oxygen loadings.

"As it was the new helium algorithm in the latest version of the VR3 (as used in Proplanner Decompression Software) shaved almost 40 minutes off the deco we would have done if we were still using the Proplanner deco schedule we used four years ago. Of course we weren't diving CCR's four years ago, so that was a bonus, but it's an interesting comparison on where decompression theory is headed," he remarked.

Kevin did 17 consecutive days of CCR mixed gas diving on this, his latest Solomons' expedition -- two dives a day some days, one on others, all with extensive deco and all using gas (helium).

"This was the first time I had used my CCR in the Sols, and I have to say that of all the expeditions I have conducted there, this was the best I had felt physically at the end of each day's diving," noted Kevin. "Neither Peter nor I bothered to change to air diluent for the shallower afternoon dives. On all our dives we stayed on gas until the 6m/20ft deco stop and then flushed the re-breathers with oxygen, so the final stops were done on almost pure oxygen. We didn't even bother with a deeper air flush. Dived correctly, helium is your friend, not nitrogen."

In those 17 consecutive days of mixed gas CCR diving, Kevin used only 1,700 litres, or approximately 60cf of helium, in his diluent -- less than what just one deep dive on open circuit would require!

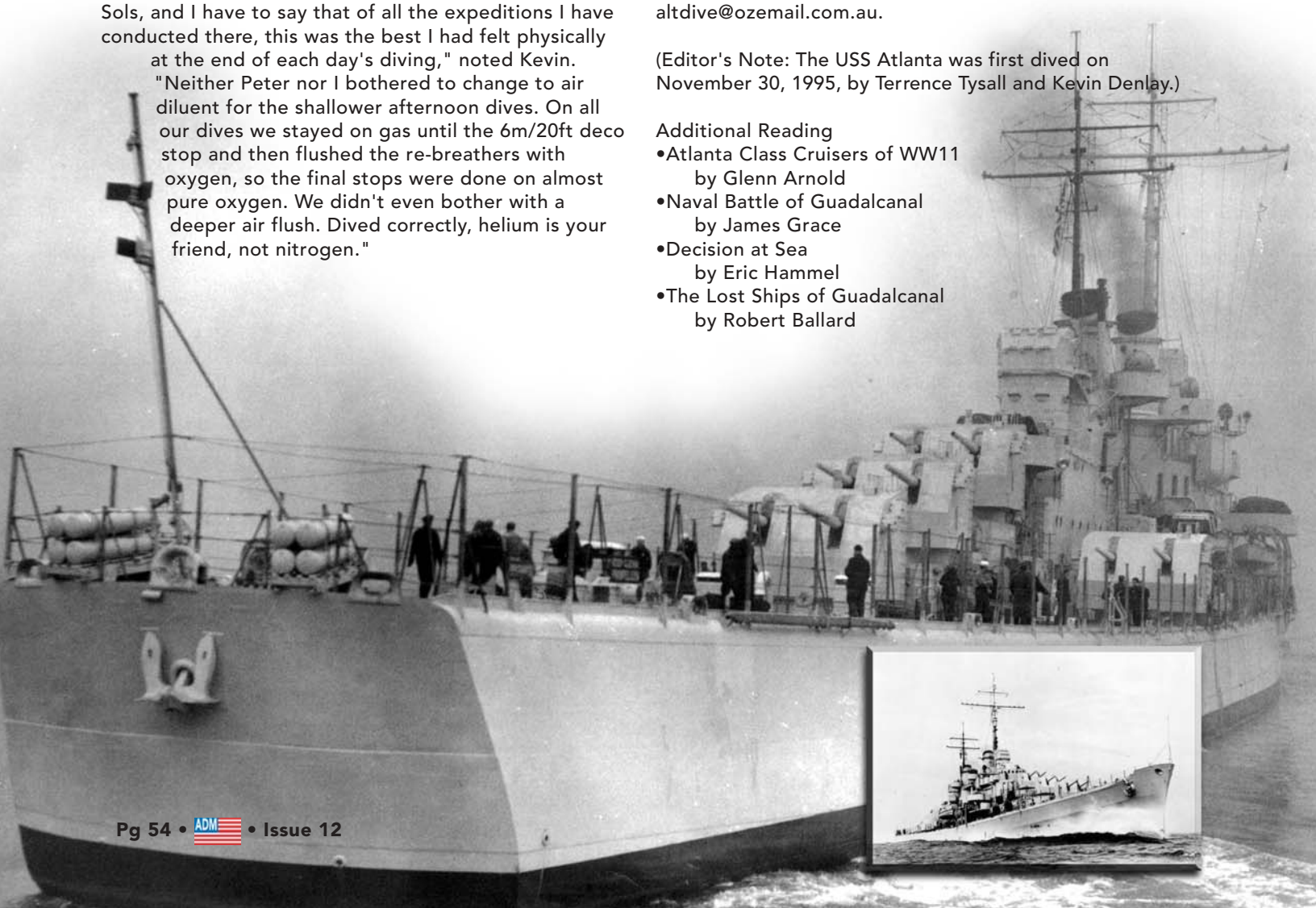
"To do the dives we did on open circuit in the Solomons' would have been rather expensive and require extensive gas mixing each evening. A CCR might seem an expensive investment up front but a few expeditions or dive trips of this nature and it pays for itself, said Kevin."

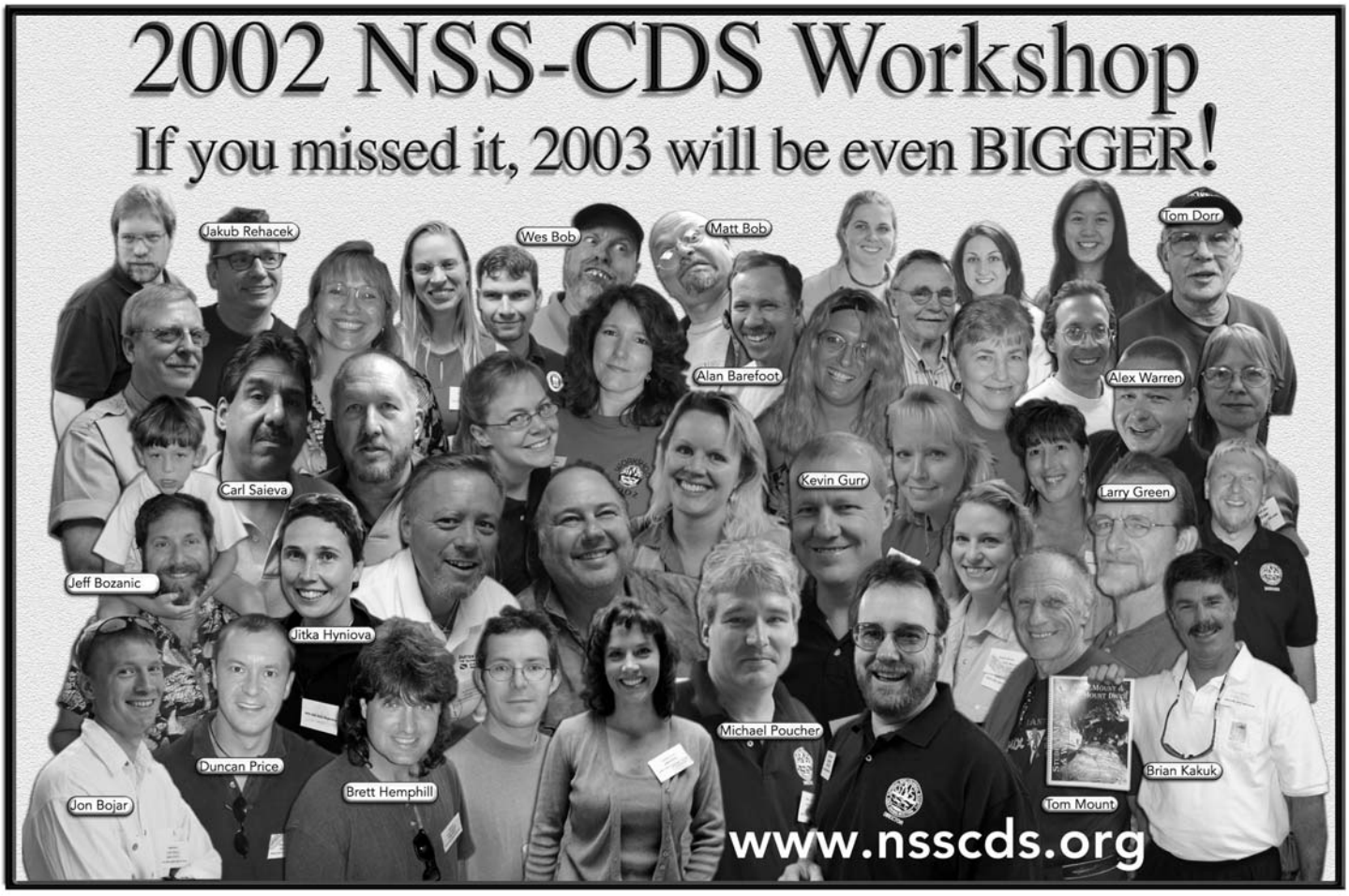
The divers stayed at the recently refurbished Vanita Lodge in Tulagi and dove with the new proprietors of Solomon Islands Diving, now based in Tulagi, across Iron Bottom Sound from Guadalcanal, and had nothing but praise for their operation. In addition to the Atlanta they dove the USS Aaron Ward (a destroyer), USS Kanawha (a fleet oiler), USS John Penn (an attack transport), HMNZ Moa (a subchaser), four individual Japanese 'Mavis' Kawanishi flying boats, the recently rediscovered 'Tama Maru' and the large Japanese transports Azumasan Maru and (the deep and rarely dived) Sasako Maru.

For more information on the fantastic diving offered in the Tulagi/Guadalcanal area, contact Neil, Matt or Kathie at Solomon Islands Diving tulagidive@solomon.com.sb or Kevin at altdive@ozemail.com.au.

(Editor's Note: The USS Atlanta was first dived on November 30, 1995, by Terrence Tysall and Kevin Denlay.)

Additional Reading
- Atlanta Class Cruisers of WW11 by Glenn Arnold
- Naval Battle of Guadalcanal by James Grace
- Decision at Sea by Eric Hammel
- The Lost Ships of Guadalcanal by Robert Ballard





WINGS
Tools of the Trade

By Scott Carnahan
ProTec Advanced Training Facility
Playa del Carmen, Qroo, Mexico
www.protecdiving.com

Wings. This is a suitable term for the technical diver's flotation devices. After all, they are responsible for the "flying" effect that we all desire while diving, especially while carrying the sometimes extensive amount of equipment required for technical diving. "Wings" in fact resemble wings, mounted off the back of divers and protruding to the sides, much like the wings of a bird or plane. This flotation tool works similarly to that of the conventional open water BCD's of recreational diving, while being designed completely differently and with a very different construction. Wings are simple and are essentially three pieces. One piece, the inner bladder, is made from polyurethane and is a solid "bag" that only has the job of holding air. Added to the outside of this internal bladder is an outer "shell", or covering, that provides structural protection from punctures as well as protection from the sun (UV) and from external wear. The third piece is a low-pressure inflator that controls the inflation and deflation of the entire system.

The inner bag is the storage area for the air needed to control a diver's buoyancy. As mentioned, it is generally made of polyurethane or a urethane laminated Cordura, which are both excellent, long lasting options for non-permeable membranes. Polyurethane is exceptionally resistant to breakdown due to water, salt, chlorine, and all of our other problems found in the diving environment. This inner bladder does need to be maintained by rinsing with fresh water after use. Salt crystals that accumulate inside will eventually form a crystal size large enough to cut the material that is supposed to be holding air. The contact with the salt water and other chemicals does not affect the material itself, as it is nonporous. Sun is a serious problem for the bladders as are abrasion issues by contact with rock, reef, or any metals. Without the outer protection, the polyurethane bladder would be utterly useless for us as divers. Some of the other fine qualities of these bladders is that they are flexible, have a slight expansion quality, and can be easily fixed or patched if a tear is encountered.

The outer shell is the protection and the housing of the inner bladder. Outer shells are constructed of a number of materials in a number of colors and shapes. This protecting layer blocks the inner bladder from exposure to UV rays, takes the blows from the wrecks, reefs and cave walls we encounter while making the finished product attractive and streamlined. Today, most outer shells are constructed of high denier Cordura (1000 denier is strong), which offer supreme qualities for the job that the shell must do. Zippers are added to inspect, clean and repair the inner bladder as well for cleaning purposes. Most wings additionally have some sort of drains in the bottom of the outer shell to assist in water removal and drying. Care should be taken to rinse the outer shell as well with fresh water after dives. This material does absorb water to a certain degree and will show breakdown after time exposed to chemicals and salt.

All we are missing now is a way to fill our wings with air. As with most diving equipment on the market today, a similar low-pressure inflation system is attached. Generally located across and over the left shoulder is a corrugated hose that attaches at one end of the bladder with an elbow of some kind. At the other end is the actual low-pressure inflator. Low-pressure inflators offer a lot in a compact unit. Push button inflation and deflation is available as is a way to orally inflate the wing if needed or desired. The location of the buttons does change a bit due to manufacturers, but ultimately one button inflates the wing with air from the tanks and another opens and closes the air space. If the open shut button is pushed and raised higher than the bags you will have air leaving the bag. If the same button is pushed and has air forced into it (blowing into it with your mouth) the wing will fill with this air. The concept is simple as is the practical application. Earlier mentioned was a corrugated hose that connected the low-pressure inflator mechanism to the bladder. This hose is usually one inch to an inch-and-a-half in diameter, flexible, and can be of varying lengths depending on manufacturing. Changes can be made in this length, depending on the

desire of the diver but consulting the manufacturer is recommended before you modify your equipment. For the same, the connection of this hose to the bladder options are available. Some manufacturers have an additional air dumping system coming from this connection. This dump valve has applications in open water diving, but has limited need in many overhead environments and many cave divers, for example, choose to eliminate this and go to straight 90-degree elbow to avoid problems with a part that will not be used during diving.

Wings are manufactured in a number of different lift capacities depending on the amount of positive buoyancy needed by the diver. The amount of lift needed can be calculated depending on the material of your tanks, the number of tanks you are using, and any additional accessories of negative buoyancy the diver has with them. Wings have a range from 30 pounds of lift to more than 100 pounds of lift. Varying colors are available, as well as additional dump valves on the bottoms of the wing. These details between manufacturers need to be looked at to configure a set of equipment that is best for each diver.

The design of the wings is meant to put the divers in a horizontal position while underwater and the majorities are designed to be used with double tanks. The air in the wings lay along the sides of the double tanks providing the maximum amount of trim control to aid in underwater comfort. Wings can be attached to the tanks one or two at time depending on the needs of the diver and the dive. Some manufacturers are making wings that have inside of the outer shell two internal bladders. This "dual bladder" system has two completely independent bladders and inflation systems in one, which will provide a backup in case of a failure of your primary bladder. No additional accessories are added to make a wing work but some people do make small changes depending how the unit comes from the factory. For example people may wish to change the dump valve at the base of the LPI with a rounded elbow, cutting out one diaphragm (one potential failure point) from your system while other may remove the handles on dump valves leaving just the string to avoid a point where a hang-up could happen.

Above: Standard gear configuration for double cylinders with wings, backplate and harness. The wings help balance the cylinders by cupping air along the divers sides while the harness secures the whole system comfortably on the diver.

Commonly asked questions

• How much lift do I need?

There is not an easy answer to this question. The real question is how negatively buoyant are you? Tanks are a large factor in this; steel tanks are much more negatively buoyant than aluminum, for example. Depending on how many cylinders you are carrying will partially determine the amount lift. Exposure protection is another factor. The more neoprene you are wearing, the more lift your wetsuit is going to provide. Battery packs for dive lights are usually fairly negative, argon bottles, back plates, specialty video or camera equipment can also affect your weighting. There are some charts available when you purchase tanks that will tell you the buoyancy of the tanks alone, and that is a major factor in the amount of lift you need. However, it is also a good idea to test your buoyancy before you are in water over your head and can't float.

• Are there differences in wings between manufacturers?

There are small differences between the wings of all of the manufacturers. Ultimately, they all serve the same purpose -- to provide positive buoyancy at the surface while floating and to maintain neutral buoyancy underwater while diving. One difference between wings is the shape. Small changes in the shape of the wing will change the way the air shifts or balances in the wing, which will change the way that you sit in the water. These changes are usually slight between the manufacturers. Low pressure inflator hoses might be of different lengths. The position of the dump valves do vary, but all wings are interchangeable with most back plates and changes can be made to the wings themselves if you would like to for example change the length of the low pressure inflator hoses. Some manufacturers have designed wings that use a bungee system that act as retractors to squeeze the wing smaller when not fully inflated. This again is a matter of opinion, so a little research before making that decision. The current major manufacturers are Dive Rite, OMS, Halcyon, Abyss and Scubapro in the United States and abroad.

• Do I need to do anything to the wing after I purchase it?

Wings come from the manufacturers ready to be mounted to the tanks and used. It is recommended that you inspect the wings visually for any damage that might have incurred during shipping and inflate the wings completely to insure that they hold the pressure. Some technical divers choose to change the system used for inflation and deflation. Some options to this system include shortening the low-pressure inflator hose or changing the piece that connects the corrugated hose to the wing itself. If you have one of the pull dump systems that have a cable and a diaphragm on the wing you may choose to change that to a solid elbow piece. This change will eliminate a possible failure point in the system if the diaphragm should become stuck open, ripped, or worn. These changes should be done by trained professionals and can be accomplished at many technical diving facilities. The only other things you need to do to your wings is put them on your diving system and go diving with them.

• Do I really need two wings or a redundant bladder?

Can you swim your equipment to the surface if you didn't have your buoyancy control device? Some technical divers use a dry suit as a back up source of buoyancy control. This may be an acceptable practice in some situations, but for wetsuit divers carrying multiple tanks, a backup wing is generally recommended. The rule goes if you must use the buoyancy device to get to the surface and could not reach the surface without it, you should consider backing it up with a redundant bladder. Some divers put two single wings on top of each other before mounting the back plate while other choose to buy a wing that has two bladders in a single outer casing. This is a choice for the diver.

Ultimately the job of the wing is to provide proper buoyancy control at the right time of the dive. Look for rugged material, quality craftsmanship, and a product that you think you will be happy with. If you dive from a center that offers repairs and quality instruction, they will be able to assist you in making a decision that is good for you regarding buoyancy control. Remember that lift capacities are very important if you are using tanks that might be more negatively buoyant than others. Streamlining will become easier with the proper equipment which will not only make your diving more safe and comfortable but will reduce stress while making your dive rememberable and enjoyable.

Left: Halcyon has taken the wing concept and reduced its size so it can be used for recreational diving. Following the DIR philosophy of clean and streamline systems.

Looking for the perfect alternative to your "been there, done that" standard dive trip? Look no further then Tulamben, Bali. Consider the following - 1,400 species of fish in the bay, 400 on the wreck of the Liberty, breakfast for $1.50, Carlsberg for $.60, active volcanoes and someone else to carry your tanks. Tulamben is on the northern coast of Bali, Indonesia.

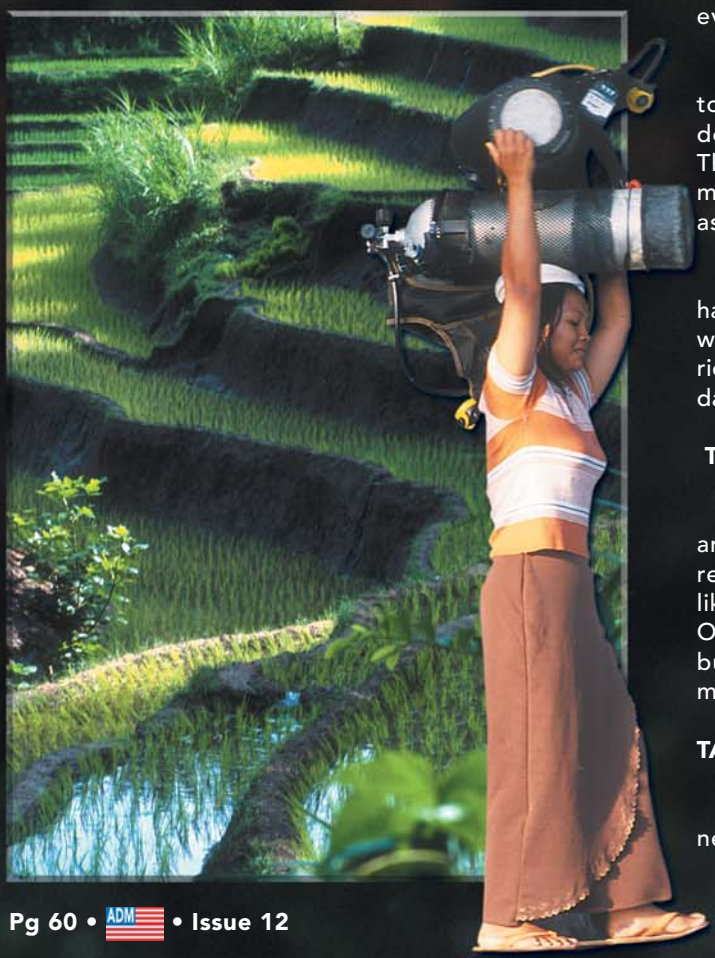
Text and Photography by Tom Isgar

ABOUT BALI

Travelers from the U.S. can get to Bali from either coast. Bali is served by China, Korean, Eva, Asiana, Cathay Pacific, Singapore, Continental, Thai and Garuda airlines from the U.S. West Coast and also by Air France and Virgin Atlantic from the U.S. East Coast. China and Korean airlines offer prices 20-25 percent cheaper than the other airlines. One of the best East or West Coast routes is with Singapore Air into Singapore and on to Bali. A great trip could be made even better by planning a stopover for a few days in Frankfurt, Singapore, Honolulu or Tokyo. It would also ease some of the jetlag.

Bali is an island of two-lane roads that carry at least three lanes of traffic -- mostly minivans and motorbikes, which are loaded to capacity. However, unlike other places where tourists take their lives into their own hands just by entering a cab or chance driving, the Bali drivers seemed to lookout for each other.

Bali is mountainous, and like other islands that have been shaped by volcanic activity, the mountains rise directly from the shore. This makes driving from the Bali airport to Tulamben very scenic and enjoyable. I was met at the airport and transported in an air-conditioned 15-passenger van. Photo opportunities existed all along the way. There were exotic statues at every major intersection and every town entrance.



As we drove, we passed through many small towns with their own special craft - furniture, carved doors, wicker, gold and silver jewelry and terracotta. There were also numerous businesses devoted to making temples for individual homes and yards, as well as brick and shingle makers. Shops also dotted the road.

Bali is a hand labor society. Doors are carved with hand tools and a hammer. Rice is farmed by human labor with the assistance of an occasional ox team. In addition to rice, coconuts and betel, vegetables are grown in abundance. There are many roosters in baskets for sale.

TULAMBEN

Tulamben is a wide spot in a two-lane road. There are four resorts, two restaurants, (not affiliated with the resorts) a half-dozen small shops which sell the basics -- like the razor I needed to replace -- and nine dive shops. Other dive shops were nearby. The dive shops weren't busy and prices were very negotiable, especially if doing more than one dive.

TAUCH TERMINAL

Tauch Terminal (German for Diving Station) is the newest resort in Tulamben and one of the nicest. It has

Tulamben, Bali

Exotic Dive Travel

nine bungalows and nine rooms in a hotel wing. There are also two suites for larger groups or special events. There is an open air dining area, pool, beach bar, diving center and covered hammock area, which doubles as the massage area.

They have two of the four instructors and four of the eight dive masters in Tulamben. Many of the Dive Masters have been at Tauch Terminal for several years. The dive guides are the masters of finding the small critters that exist in the local water - pygmy seahorses, cowries, tiny shrimp, porcelain crabs and nudibranchs, all of which were plentiful.

The resort staff is very friendly and always available to help. They all speak some English. The restaurant is very good and serves a mix of Continental and Indonesian dishes. Americans should be very satisfied with the offerings. And, food is cheap. My food bill for 10 days was $115.70, which included three meals a day, some deserts and drinks as well as a few afternoon Expressos and brownies (required for four dives a day).

I was there in early December, and there were very few Mosquitoes, No-see-ems or other biting insects. The rainy season begins in December, but I didn't find it a distraction for diving. The temperature was in the low 80's with low humidity. July is the coolest

month with temperatures in the high 70's and March is the hottest with temperatures in the low 90's. Water temperature ranges from 80 to 85 degrees. The 'beach' is covered with round stones and looks like a mountain riverbed. The stones are the result of volcanic lava being tumbled by the surf for ages.

DIVING

Even though the diving is fairly unstructured, every diver is required to have a buddy. There is a daily sign-up board where one can write in the times and places he or she wants to dive. The resort tends to offer three scheduled dives a day, which a diver can join; or a diver can design his or her own day to suit individual needs. The guides are available for every dive, but one can choose to dive with a buddy and no guide. I found the guides to be very valuable in finding things to photograph. Of course, part of the challenge for a photographer in Tulamben Bay is to decide which fish or critter to photograph from the dozens of choices.

A unique feature of diving in Tulamben are the porters. The porters carry your tank and BC from the resort to the dive site. They are mostly women, very young to elderly, who carry two tanks at a time across the rocky shore. They are aided by special gear - a towel on their head and flip flops on their feet. The first few trips I made, carrying my weight belt, fins and camera, put me completely in awe of these women, as I felt lucky to have made it without the gear.

The diving at Tulamben offers something for everyone. There are nice shallows directly in front of the resort and there are 180-foot slopes covered with coral and, of course, there is the wreck of the Liberty, a 400-foot tanker with bulkheads, which rival some of the walls in the Keys and Caribbean. (See Liberty Wreck Sidebar.)

There can be current, but what I encountered was very mild and for the most part wasn't a factor. Visibility ranged from 40-100 feet. This is probably the most understated diving I have ever done. If you called the resort and asked about diving they would say that there are three sites (The Liberty Wreck, the Drop-off and Coral Gardens) and some day trips available. If you ask me, I would say there are 12-15 different sites. Most of them are unnamed and rarely visited. However, they are all within a 10-minute ride by fishing boat.

DIVE SITES

The wreck provides at least three different dives by itself. I dove it several times including three times in one day. I found plenty to explore and photograph there,

although it would be possible to swim all the way around the wreck in one dive and enter it in your log as, "Been there, done that." However, that would be a big mistake. The dive begins at 15 feet on the stern and can go to 100 feet in the sand at the base of the bow structure. There are a number of overhangs and compartments that are all open for inspection and are the home of different critters. There is a school of Jacks that number in the thousands and a school of 14 bumphead parrotfish - the largest of the parrotfish. There are nudibranchs everywhere, as well as several species of scorpion fish, a family of gold-specs jawfish, an anemone with spinycheek clownfish and the list goes on. The wreck is also covered with a variety of soft and hard corals, which provide homes for numerous shrimp, cowries and hawkfish.

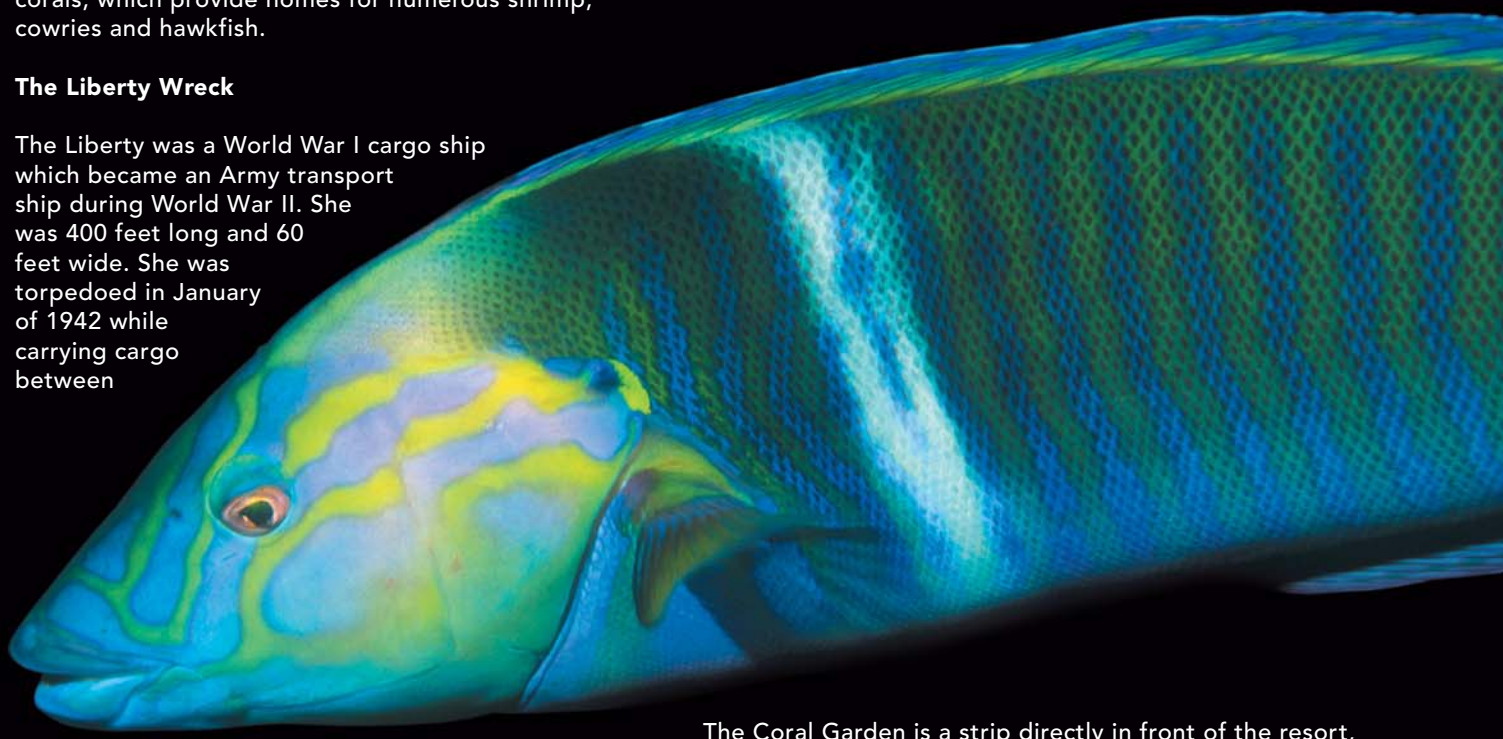
The Liberty Wreck

The Liberty was a World War I cargo ship which became an Army transport ship during World War II. She was 400 feet long and 60 feet wide. She was torpedoed in January of 1942 while carrying cargo between Australia and the Philippines. The incident occurred in the Lombok Strait, which runs between Bali's northern coast and the nearby Island of Lombok. An attempt was made to tow her to the port at Singaraja, Bali, but she was only to go as far west as Tulamben where she was beached. The Liberty remained on the beach until 1963 when Mt. Agung erupted. The streams of lava from the eruption pushed the Liberty off the beach to her current position. Mt. Agung is still active, and at 10,308 feet it towers over Tulamben.

Even though the Liberty has been underwater for less than 40 years, she is well covered by both hard and soft corals, as well as other invertebrates, including sponges, crynoids, tunicates. Rudi Kuiter, who has dove the Tulamben area extensively and published several books, estimates that there are over 400 species of fish on the wreck and that another 100 pelagic species visit. During my trip, I saw numerous large jacks, three species of sharks as well as very large groupers.

The Drop-Off

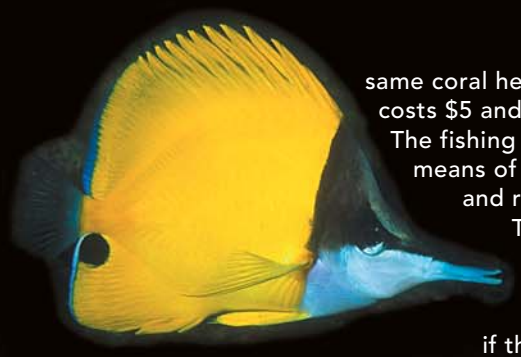
A 180-foot wall with a variety of chutes and points as you swim along. As you round the point away from the resort, there may be some current. What I encountered was very manageable. The wall is loaded with overhangs and nooks to explore. It is also one of the reliable places to find pygmy seahorses (PSH). They reside on the gorgonians, some of which are 10-12 feet across. I spent an entire dive on one sea fan shooting several PSH. The wall, like the wreck, isn't a one-trip dive. There is enough terrain to dive it several times without crossing your earlier path.



The Coral Garden is a strip directly in front of the resort, which is probably best at 25-40 feet, although there are cleaning stations at 70 feet worth the trip for the abundant, small cleaning shrimp and crabs. In the shallower depths, there are several blue ribbon eels in both the mature blue color and the juvenile black. There were also two leaf scorpionfish which were easily located. The coral garden is also filled with colorful reef fish as well as numerous other eels.

While I didn't go to Tulamben to photograph nudibranchs, when I looked at my slides I had photos of 26 different species, and 15 were new to my nudibranch photo inventory. Several of them are not in my Pacific and Australian critter books. This doesn't mean they are unidentified, only that they aren't in my references.

Beyond the drop-off and several sites, noted only by numbers (5-9) in the Diving Bali book, is an area called Batu Kelebit. A fishing boat is the only way to reach Batu Kelebit. It is huge and is good for several dives. It is a series of deep sand chutes which all return to the



same coral head. The fishing boat costs $5 and takes 10 minutes. The fishing boats provide a means of getting some shore and resort photographs. The boat can pick you up where you surface or it can follow your bubbles if there is a current.

There are other sites that offer their own sources of interest and are reached on day trips from the resort. The prices include ground transportation, lunch, two dives and the use of a boat to reach the dive site. Some of them are accompanied by a beach barbecue and offer snorkeling and exploration opportunities for non-divers. The Tauch Terminal organization also offers complete dive and tour packages that include other islands, as well as Bali. For more information go to their travel web site at www.resort-aboard.com.

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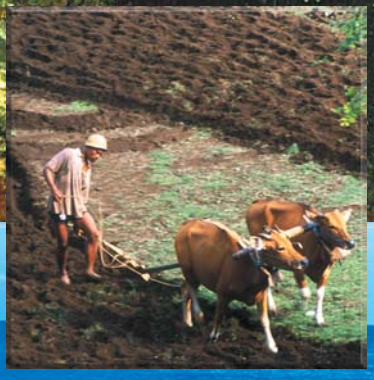
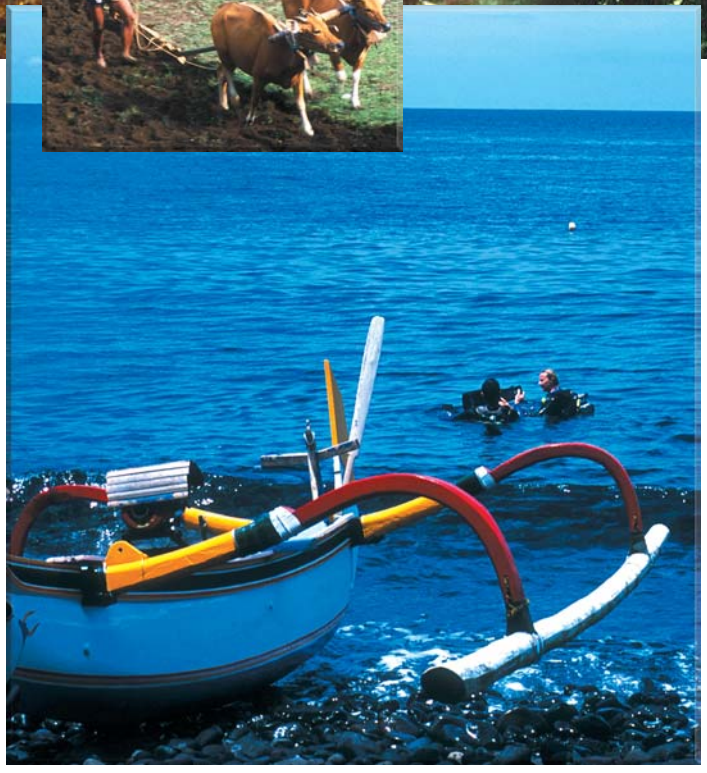
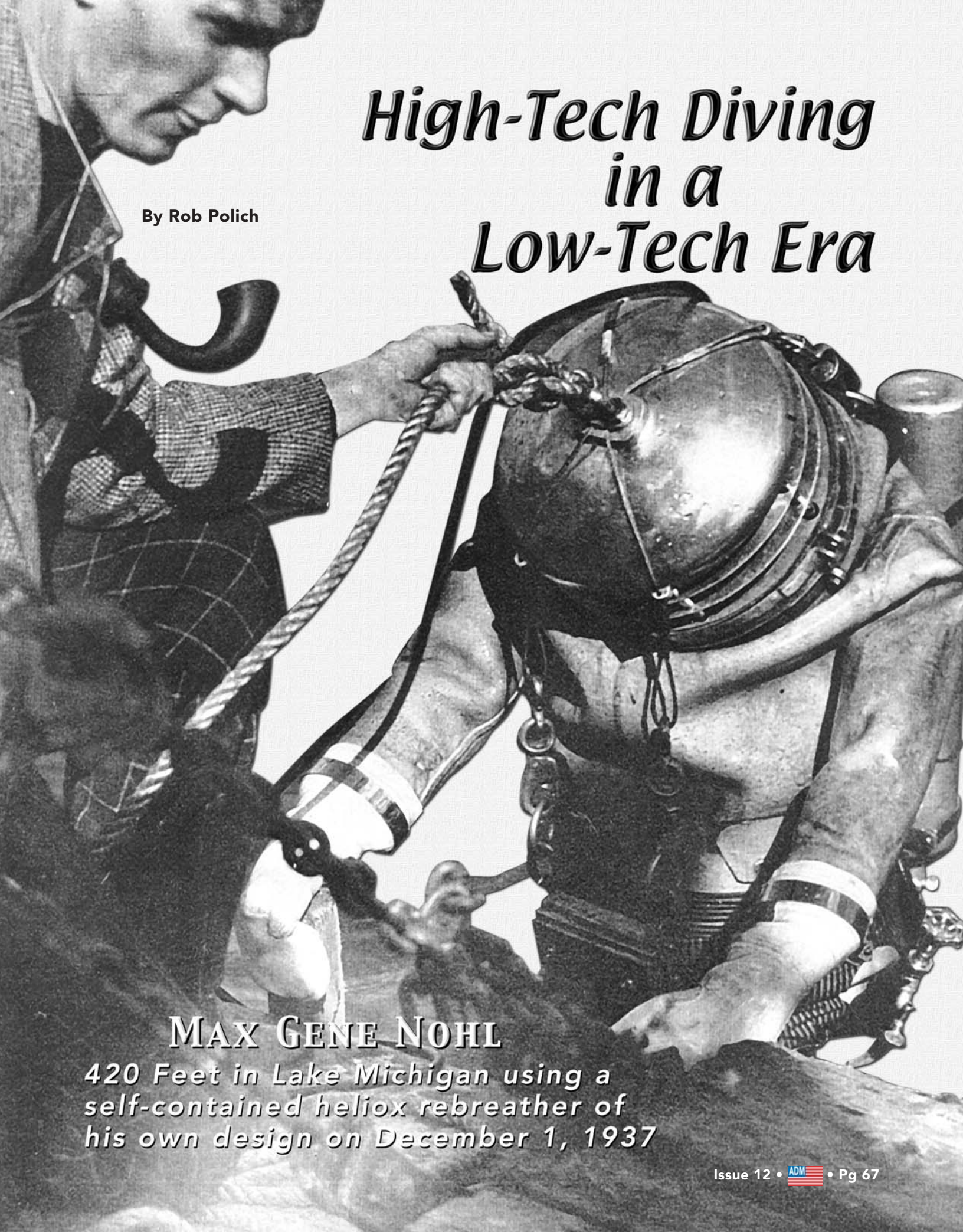




High-Tech Diving in a Low-Tech Era

By Rob Polich

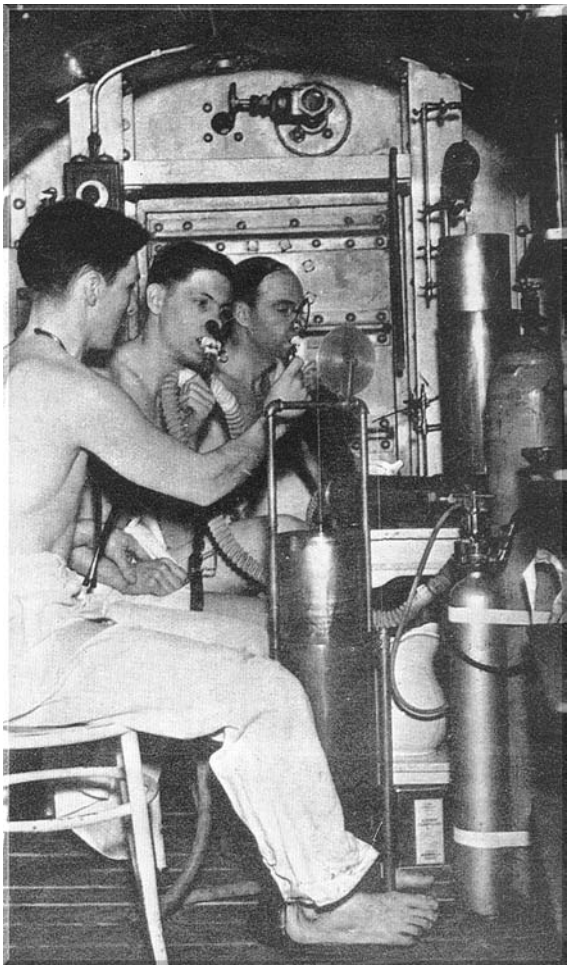


Max Gene Nohl

420 Feet in Lake Michigan using a self-contained heliox rebreather of his own design on December 1, 1937

Tech divers today can read of their peers latest accomplishments and discoveries in each issue of Advanced Diver Magazine. These articles are read with great anticipation and interest. It is within these articles that we discover the ingenuity of other divers and where they in turn earn our respect. However, you may be even more amazed looking backward toward the past at other diver's accomplishments. Without a doubt, one of those impressive stories is that of Max Gene Nohl, a Great Lakes tech diver who made a dive to 420 feet in Lake Michigan using a self-contained heliox re-breather of his own design on December 1, 1937.

Max Nohl a Milwaukean had been interested in diving since his teens. He was a very bright student whose grades enabled him to attend the prestigious Massachusetts Institute of Technology. Upon his graduation from MIT in 1933, he returned to Milwaukee and purchased his first set of dive gear. Nohl wanted to make an impact in the dive community by drastically improving diving equipment and techniques. In 1935, Nohl dove on the wreck of the John Dwight, a steel steamer that foundered off Cuttyhunk Light near Vineyard Sound, Massachusetts. He worked the wreck with Captain John D. Craig, an accomplished diver and Hollywood movie producer. Craig expressed his many frustrations with the surface supplied dive equipment of the day, a frustration Max Nohl shared. This became their common ground and stimulated their discussions of a new, self-contained breathing system.



Craig and the Lusitania

John Craig stood along the south coast of Ireland gazing out at the sea when he overheard an old Irish fisherman say, "The Lusitania sank right out there." This intrigued Craig. Craig was well aware of the many rumors that still circulated regarding the valuables she contained in her safes and strong holds. Could he dive and reach the wreck? Could he possibly salvage the vessel? The Lusitania, a Cunard ocean liner, was torpedoed on a Trans-Atlantic voyage during World War I. The Lusitania came to rest in approximately 300 feet of water. The deep water was beyond the reach of dive equipment of the day. If the Lusitania was to be salvaged, it would be the deepest salvage project ever undertaken (a walk on the moon in 1935). Its extreme depth wasn't the only concern -- other significant obstacles were more challenging. The water she lay in was near freezing with strong currents and rough surface conditions. Several dive salvage companies had seriously considered undertaking the challenge. All had hedged, eventually dropping the idea except for one, Tritonia Corporation.

Tritonia, an ambitious dive company based in Scotland, had recently designed an all-metal dive dress that could reach depths currently unobtainable with conventional dive equipment. Tritonia was interested in salvaging the Lusitania using their newest contraption. While on a trip to London, Craig was contacted by Tritonia and invited to Glasgow to discuss the possibility of making a film of their proposed dive operation. The possibility of being involved in a dive operation on the Lusitania was very enticing to Craig. He immediately accepted their invitation and headed for Glasgow. Craig confessed later, "The possibility of making such a film fired my imagination."

In October of 1935, Tritonia located the wreck and their diver entered the water, reaching the wreck's icy gravesite and actually walked around upon her. The current, said to be two-and-a-half knots consistently, along with the incredibly heavy suit, which weighed somewhere in the neighborhood of 1000lbs, proved to be to much for any practical salvage attempt. As it turned out, this single diver would be the Lusitania's sole visitor for many years to come. With this in mind Craig knew that any successful salvage of the Lusitania would require the development of new dive equipment and radical advances in dive physiology, an appropriate challenge for his bright and ambitious friend Max Nohl.

Craig went to Milwaukee to meet with Nohl and discuss design ideas for a new dive suit with him. With financial backing from Craig, Nohl began the development of the new "SCUBA Unit" which would be functional at depths greater than 300 feet. During this time they experimented with various systems and configurations in the local quarries of Wisconsin. By spring of

1937, a completely self-contained dive apparatus had appeared and it was dubbed the Craig-Nohl suit.

The Physiology

Nohl had enlisted the help of another Milwaukeean, Dr. Edgar End M..D., who was a researcher at the Marquette University School of Medicine. Dr. End was interested in the use of helium as a potential breathing gas for deeper dives. Few had theorized about the plausibility and effects of helium mixes, as no one had ever tested or used them on human subjects. In fact, the only experiments seemed to be those done by Sayers, Yant and Hildebrand a decade earlier involving the use of lab mice. Throughout 1937, Dr. End experimented with various heliox mixes in a recompression chamber with both Nohl and Craig at the Milwaukee County Hospital. This was possible through the courtesy of the chamber's designer, Joseph C. Fischer.

Three chamber dives were conducted each with the more helium in the mixture and less nitrogen than the previous dive. The chamber contained two compartments. Nohl and Craig equipped with a rebreather that contained a helium based mix were in first compartment. Dr. End breathed air in the second compartment observing the divers through a small window. The first dive contained a breathing mixture of 21 percent O2/ 26.5 percent HE. The second dive contained a mixture of 21percent O2/ 52.5 percent HE, and on the third dive all nitrogen was removed and a 21 percent O2/80 percent HE mix was used in its place. All dives were conducted at 90 feet for 60 minutes. These experiments proved very promising, as Nohl and Craig were decompressed without incident each time. They showed no signs of impairment other than distorted speech during any of these dives.

Nohl's Creation

Nohl's new "SCUBA unit" marked the beginning of a manufacturing company that he would establish later that year. This company initially named the "Dive Equipment and Salvage Company" would later be known as DESCO. DESCO would go on to become a world leader in commercial dive equipment and design.

Nohl's new "SCUBA Unit" seemed to overcome most of the problems associated with traditional dive gear of the period. Probably the most striking feature of the Craig Nohl suit was its helmet. Nohl's helmet contained a large glass dome resembling a lantern or lighthouse that gave the diver a fairly unobstructed 360-degree view of his surroundings. The helmet was simply held in place by two large clamps attached to the suit dress. Absent was the heavy metal breastplate that most helmets were attached to at that time. This meant that a diver using Nohl's suit would not need two tenders to dress him, nor would he have to support the weight of the heavy breastplate, helmet, lead shoes and 100lb weight belt. While the suit may have appeared cumbersome, it was extremely light for its day and was much more flexible than others. The helmet was made of aluminum, reducing weight even further as typical helmets were brass or spun copper. This proved to be a challenge to manufacture, requiring a high degree of quality machining and polishing.

Inside the helmet was a suite of instruments including a depth gauge, stopwatch, compass and pressure gauges for his cylinders. A set of headphones attached to a phone cable enabled the diver to communicate with the surface. A microphone in the headset also allowed Dr. End to hear Nohl's respiration. Nohl wore a football helmet to reduce the possibility of head injury during the dive operation. This was especially a concern when being lowered into and raised out of the water.

Nohl designed a special oral nasal mask, which attached to a scrubber bag. This mask contained valves that directed all exhaled gas through the scrubber bag, removing CO2 from each breath. The helium and residual oxygen were not removed, greatly increasing his gas supply.

Nohl wore a back mounted pair of steel cylinders with valves oriented at the bottom. The steel cylinders increased negative buoyancy and helped to reduce the amount of weight the diver needed to wear. This valve arrangement allowed the gas to enter the suit and be controlled manually by the diver himself, another tremendous innovation at that time. One cylinder contained a "respirable gas", as Dr. End called it. This was bled into the suit to counteract the increase in water pressure (suit squeeze). This cylinder was used, in part, as an inflation bottle, though it had to contain a near normoxic mix since the diver was breathing from within the suit itself. The other cylinder contained oxygen, which was bled into the suit carefully to satisfy his metabolic requirements. Nohl had changed the entire interior of the suit into a giant heliox re-breather. At that time no device was available that could have accurately measured the fraction of oxygen that was in the suit through out the dive.

As he descended, Nohl could saturate his suit with the 20 percent O2 mix, re-breathe it and thereby reduce the fraction of oxygen in the suit. He then could add small amounts of his bottom mix or oxygen at his discretion, depending on his metabolic needs. The suit was vented of gas at various times throughout the dive. This was of course essential when the diver was ascending to reduce the expansion of gas within the suit and enable him to change from lighter to heavier mixes, or as the case on this dive, pure oxygen at specific decompression stops. Nohl made progressively deeper dives throughout the year. By fall of 1937, Nohl was confident he could set a new depth record.

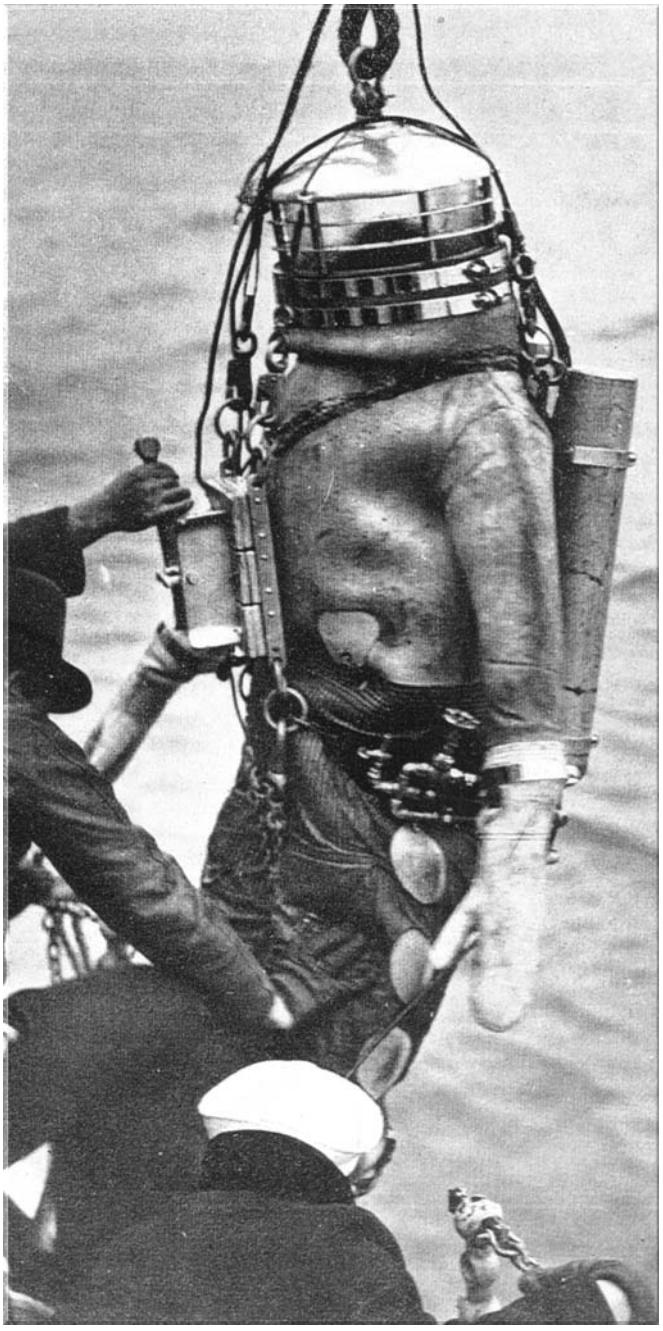
The plunge

On December 1, 1937, aboard a Coast Guard cutter some 12 miles out off Milwaukee, Max Nohl suited up for his dive into history. The event was broadcast on nationwide radio. A cable was attached to Nohl's helmet and he was lowered into the cold gray waters of Lake Michigan. In three minutes, Nohl had reached a depth of 200 feet where he paused to make adjustments to his mix and allow his ears to equalize. At that time a severe and potentially deadly problem revealed itself. A deck hand had not fed out the communication cable properly. The heavy telephone cable had played out too quickly and its excessive scope draped below Nohl. As Nohl descended deeper he past through the hoop in the line, snaring himself. Nohl tried to continue his decent, but after 26 minutes of maneuvering and an increase in depth of only 40 feet it was apparent he wasn't going to make it to the bottom. Nohl decided to abort the dive and was brought back to the surface rapidly.

A half-hour later, Nohl was again lowered into the water, his decent was uninterrupted, expect for a momentary pause at 400ft. At this time Ive Vestrem, one of Nohl's assistants, asked Nohl to call the dive and return to the surface. Nohl told Vestrem that he had better go as deep as he could. A few moments later Nohl found himself standing on the bottom of Lake Michigan at the incredible depth of 420 feet. His total decent took 9minutes. The Coast Guard cutter blew its whistle and the crew cheered; a new record was at hand.

Nohl desperately searched the bottom walking in small circles trying to find a rock or some other object to bring up as a souvenir, but the lake bottom consisted only of mud, depriving him of any such booty. He commented on the dreary bottom conditions. Visibility was an astounding 6 inches, and that the water was close to freezing.

After nine minutes on the bottom on a mixture of 20 percent O^2 80 percent HE, he started his ascent. Dr End



raised Nohl at what he considered the very slow ascent rate of 18ft per minute to a depth of 30feet. He vented his suit, and flooded it with 100 percent O^2. His decompression schedule was as follows: 30 feet for 22minutes, 20 feet for 28 minutes and 10 feet for 46 minutes.

After 118 minutes of deco time, Nohl surfaced and was back on the deck. The large helmet was removed from his head and a grinning Nohl muttered his first words, "What's that funny smell?" To which the crew replied, "fresh air."

Notes

Dr. End commented that while he did not reduce Nohl's decompression time greatly after such a deep dive, the deco time could have been shorter in duration. He claimed that approximately 30 minutes less deco would have been possible if Nohl had not had residual gases in his tissues from the first dive. In fact, this deco schedule was considered very conservative by Dr. End's standards.

The previous depth records were 344 feet in Britain and 306 feet in the United States, set by Navy diver Frank Crilley. Crilley's dive was conducted in the warm, clear waters of Hawaii.

In this author's opinion, the realities of oxygen toxicity were treated with little regard at that time. The dangers of excess oxygen exposures were not fully understood. The high ppO2 and fO2 levels of Nohl's dive were completely off the scale in comparison to modern planning. Little or no significant data seemed to be available at that time regarding the subject.

In summary

This was an incredible piece of dive history set by incredibly brilliant men. Dr. End and Max Nohl, with an inspired breath by John Craig, had literally brought helium-based diving to the world. Proving its worth as well as the benefits of a completely new self-contained dive apparatus. The chamber dive records and data were also sent to the United States Bureau of mines. The U.S. Navy reached the depth of 500 feet the very next year on a helium gas mixture. These dives would not have been possible if not for the collaboration of Max Nohl and Dr. End.

The Craig-Nohl suit functioned flawlessly. Nohl emerged from the dive completely dry. The usual leaks that plagued standard diving suits were refreshingly absent. Nohl exhibited no signs of DCS or for that matter, even significant fatigue. He also was clear-headed and comfortable on the bottom.

A three-cylinder version of the suit was designed and tested. This could enable the diver to stay down longer and add a possible third gas to his profile. With this cylinder arrangement, Nohl claimed a diver could stay down for 15 hours at a depth of 300ft. Dr. End also mentioned the possibility of more complex mixtures involving the addition of some nitrogen. Could this have been a prelude to trimix?

Jack Browne was a significant contributor to the Craig Nohl suit and a key player and co-founder of Dive Equipment Salvage Company. He would go on to test and produce more dive equipment for DESCO. James Lockwood, one of Nohl's closest friends and assistants, claimed that Browne did attempt to dive the suit himself, but rough surface conditions and an apparently more sensitive stomach caused him to throw up while inside of it. The effects were obvious. However, on April 27, 1945, using a pressurized water tank at DESCO, Jack Browne dove to the incredible depth of 550 feet on a heliox mixture, setting another significant record and placing yet another feather in Desco's hat.

Why the filming or salvaging of the Lusitania never materialized we may never know. It seems likely that Max Nohl's ambitions and preoccupations with DESCO consumed the majority of his time and effort. It is also possible that after achieving such success with the record dive, Nohl may have felt the Lusitania project lacked enough purpose. When first hearing of Nohl's attempt, many people conceived the event as no more than a stunt. Nohl spoke at dive forums all over the world about his suit design and record dive. After seeing the design and end product of Nohl's investment, they were convinced otherwise. Nohl appeared to be an unassuming man, humble yet confident and very intelligent. Little if anything in his life was done without firm purpose.

In later years at DESCO, Nohl, Jack Browne, Jim Lockwood, and others would develop and produce various commercial dive gear and re-breathers for the dive industry and the US Navy. Nohl and Lockwood worked extensively on the Tarzan series of films (shot in Silver Springs, Florida). Nohl seemed to attract many ambitious and brilliant people. This is evident in the impressive accomplishments of his closest friends and associates. DESCO was, and still is, a major player in the commercial dive industry. Max Nohl and his wife were tragically killed in an automobile accident in 1960. They had no children.

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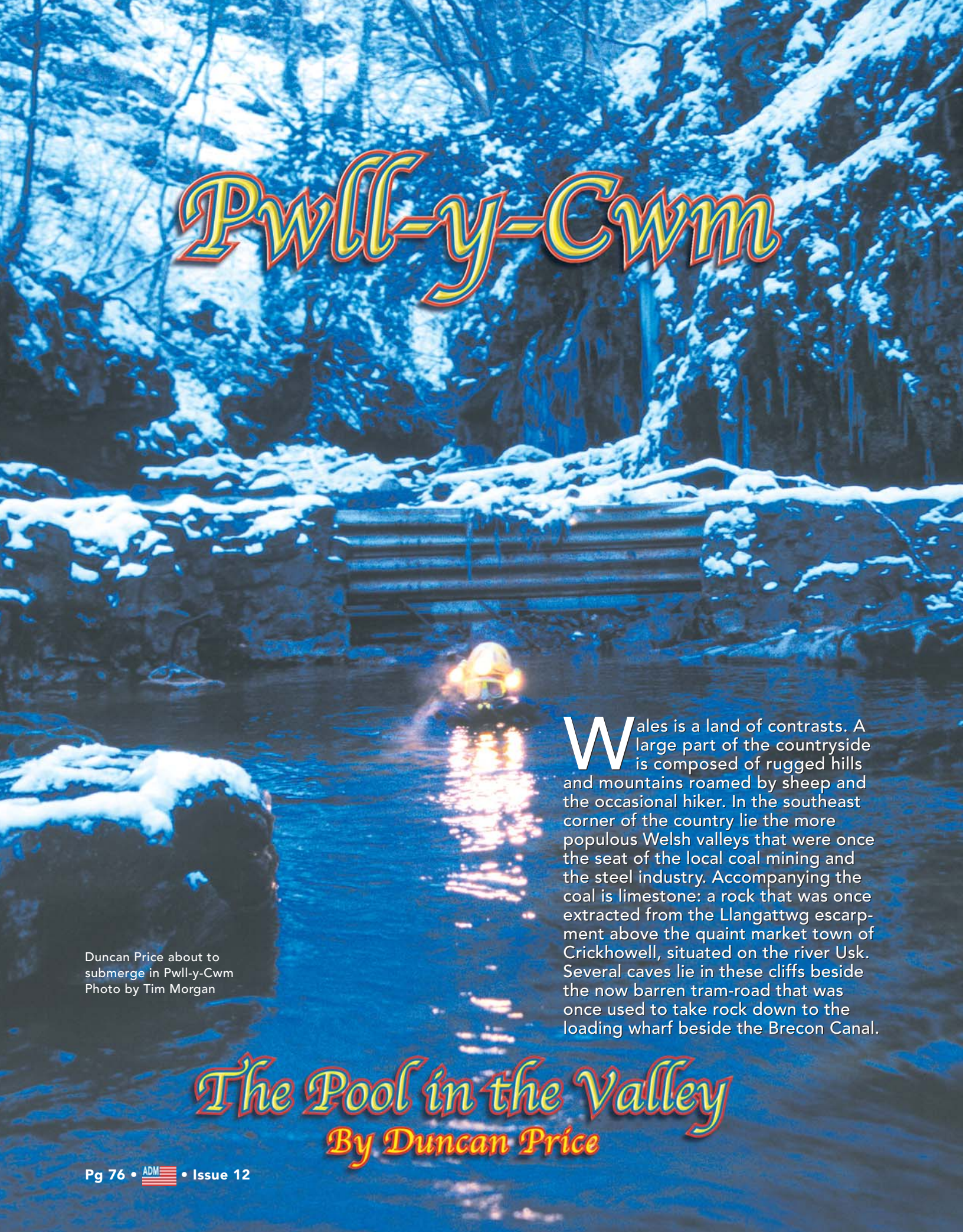
Pwll-y-Cwm



Duncan Price about to submerge in Pwll-y-Cwm
Photo by Tim Morgan

Wales is a land of contrasts. A large part of the countryside is composed of rugged hills and mountains roamed by sheep and the occasional hiker. In the southeast corner of the country lie the more populous Welsh valleys that were once the seat of the local coal mining and the steel industry. Accompanying the coal is limestone: a rock that was once extracted from the Llangattwg escarpment above the quaint market town of Crickhowell, situated on the river Usk. Several caves lie in these cliffs beside the now barren tram-road that was once used to take rock down to the loading wharf beside the Brecon Canal.

The Pool in the Valley

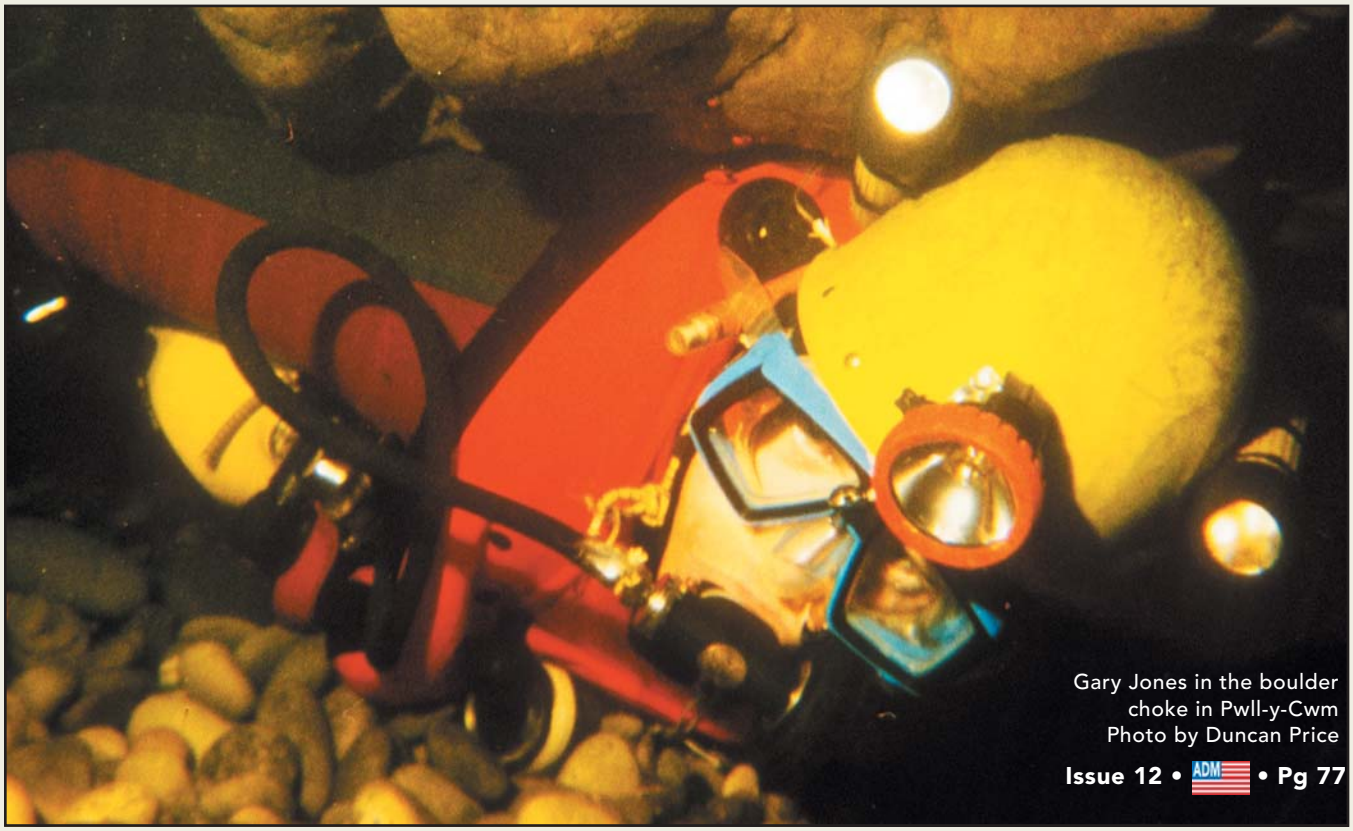
By Duncan Price

The most westerly cave entrance is that of Agen Allwedd (Keyhole Rift). Discovered in 1948, this is one of Britain's major winter bat roosts and its small entrance is gated so as to allow access only to bona fide cavers. The cave is famous for its 20 miles of large dry passages and the active river cave. At the base of a cliff in an obsolete quarry and behind the headquarters of the Chelsea Speleological Society is the inconspicuous entrance to Daren Cilau (Place of Shelter). Hardly deserving of the name, the entrance is a low, wet crawlway that continues in the same fashion for the next 1,500 feet with hardly any room to stand up or turn around. Experienced, fit, unlanden cavers might pass this obstacle in an hour or so. The effort is certainly worth it as, like Agen Allwedd, it breaks out into some of the most stunning caves in the UK totaling nearly 18 miles. Indeed, one passage known as the Time Machine is the largest cave passage in Britain. Much of Daren Cilau has only been discovered since 1984, as the tough entrance series has deterred most cavers from making a second visit to the site.

The Llangattwg caves, which also include the nine-mile long cave of Ogof Craig a Ffynnon (Rock and Fountain Cave), are obviously part of one big cave system — possibly the longest in the UK, though forging a link between them has proved difficult. Inspection of the map shows that the separation between the caves is tantalizingly close. Cave divers have played a major role in discovering parts of this jigsaw and continue to play a part in piecing it all together. The caves lie within the Brecon Beacon's National Park and access to the caves is carefully controlled for conservation reasons.

At its southern extremity, Daren Cilau ends in a sump with the water reappearing from a pothole in the bed of the River Clydach 2,000 feet away. The spring is known as Pwll-y-Cwm (Hole in the Valley), which up until 1985 was a six-foot deep pool blocked with brushwood and boulders washed down by the stream. Cave Diving Group members obtained permission from the park authority to construct a retaining wall so as to deflect debris from the hole and an airlift was employed to empty the 50-foot deep vertical shaft. Downstream of Pwll-y-Cwm is the cave of Elm Hole. This tight and nasty 180-foot-long rift ends in a sump that continues in the same fashion underwater to emerge in the gloomy flooded conduit linking Daren Cilau to Pwll-y-Cwm. It was from here that veteran British sump diver Martyn Farr established the connection with Daren Cilau in 1986. Despite a plethora of virgin sumps, diving operations within Daren Cilau were hampered by the arduous nature of the approach from the quarry entrance. Significant finds were, however, made by Ian Rolland and Rob Parker, including the aptly named 7th Hour Sump — seven hours from daylight. Sadly both cave divers lost their lives in Mexico and the Bahamas respectively. The cave passages they found at the extremities of Daren Cilau are a tribute to their determination.

It was not until 1990 that Elm Hole was revisited by cave divers. The team of Duncan Price and Rick Stanton started to dig their way up through the wall of boulders towards Pwll-y-Cwm. Success was finally achieved in 1993 after more than 100 working dives. This created a viable "backdoor" for further work in Daren Cilau. Using Pwll-y-Cwm as a point of entry, cave divers could now reach the bottom end of Daren Cilau after a 40-minute dive rather than the four hours it had previously required to reach this point the dry way. Furthermore, it is relatively straightforward to carry extra tanks for operations in the far reaches of the cave. Drysuits and a pair of sidemounted 100 or 120 cu ft tanks are used for



Gary Jones in the boulder choke in Pwll-y-Cwm
Photo by Duncan Price

Time Machine passage in Daren Cilau, Britains's largest cave passage
Photoby Clive Westlake

the initial inwards dive (1400 ft, maximum depth 65' ft), whereupon the divers change into wetsuits and use smaller 40 or 30 cu ft tanks to traverse the dry cave passage and dive the sumps beyond. Because of the constricted nature of the route through the base of Pwll-y-Cwm, the divers mount their extra tanks and cave packs holding wetsuits across their chest for ease of removal. The conditions at this site are typical of a British sump; the water temperature is a chilly 45 degrees Fahrenheit, with visibility rarely better than three or four feet.

The first major sump that fell following the opening of Pwll-y-Cwm was that in the Gloom Room. Although the site had been examined by Martyn Farr in 1986, it was not until 1994 that Rick Stanton, supported by Duncan Price, passed the 750-foot sump to discover over 3,000 feet of majestic river cave known as the San Agustin Way. Two more sumps were passed to reach an above-water collapse of boulders very close to the terminus of Agen Allwedd's Sump Four. Despite digging operations by the divers involving the use of explosives, the connection between the caves has still not been made. Turning his attention to other sumps, Duncan Price dove the 7th Hour Sump in 2000 to discover a large dry chamber. Boulders also block this sump. Further work would require the divers to establish an underground camp, since the last trip here took over 17 hours. Like the Gloom Room, this site is of strategic importance as the water emerging from the sump has been dye traced from Llangattwg Swallet — a surface sink on the other side of the mountain.

Moving to sites closer to the entrance, the team of Gary Jones, Tim Morgan and Duncan Price have recently discovered over 2000 feet of sumps and dry passage in an area known as Saturday Night at the Movies. This region of the cave is hydrologically complex, being the confluence of the water from the Gloom Room and 7th Hour Sump. Whilst this area is unlikely to yield a significant extension to Daren Cilau or a connection with Agen Allwedd, exploration here will add to our understanding of the cave's development.

Although Pwll-y-Cwm is the present day outlet to the water from the Llangattwg caves, it may not have always been so. Ogof Craig a Ffynonn represents a fossil spring for the system before downcutting of the Clydach valley caused it to be abandoned. It is possible that water from Daren Cilau once flowed beyond Pwll-y-Cwm southward to springs up to 30 miles away. This theory is backed up by the observation that under drought conditions Pwll-y-Cwm acts as a sink for the river water that normally flows around its edge. Beneath the hillside to the south of Pwll-y-Cwm is Ogof Draenen (Hawthorn Cave), which was discovered in 1994 and is now the longest cave in Britain (42 miles). As of yet, exploration in Ogof Draenen has not revealed any significant sumps, but it is entirely feasible that the postulated southerly continuation of Pwll-y-Cwm intercepts the drainage from Ogof Draenen. Such a cave system would have a combined length of well over 100 miles. It is these possibilities that drive cavers and cave divers to explore the open spaces beneath the countryside of Wales.

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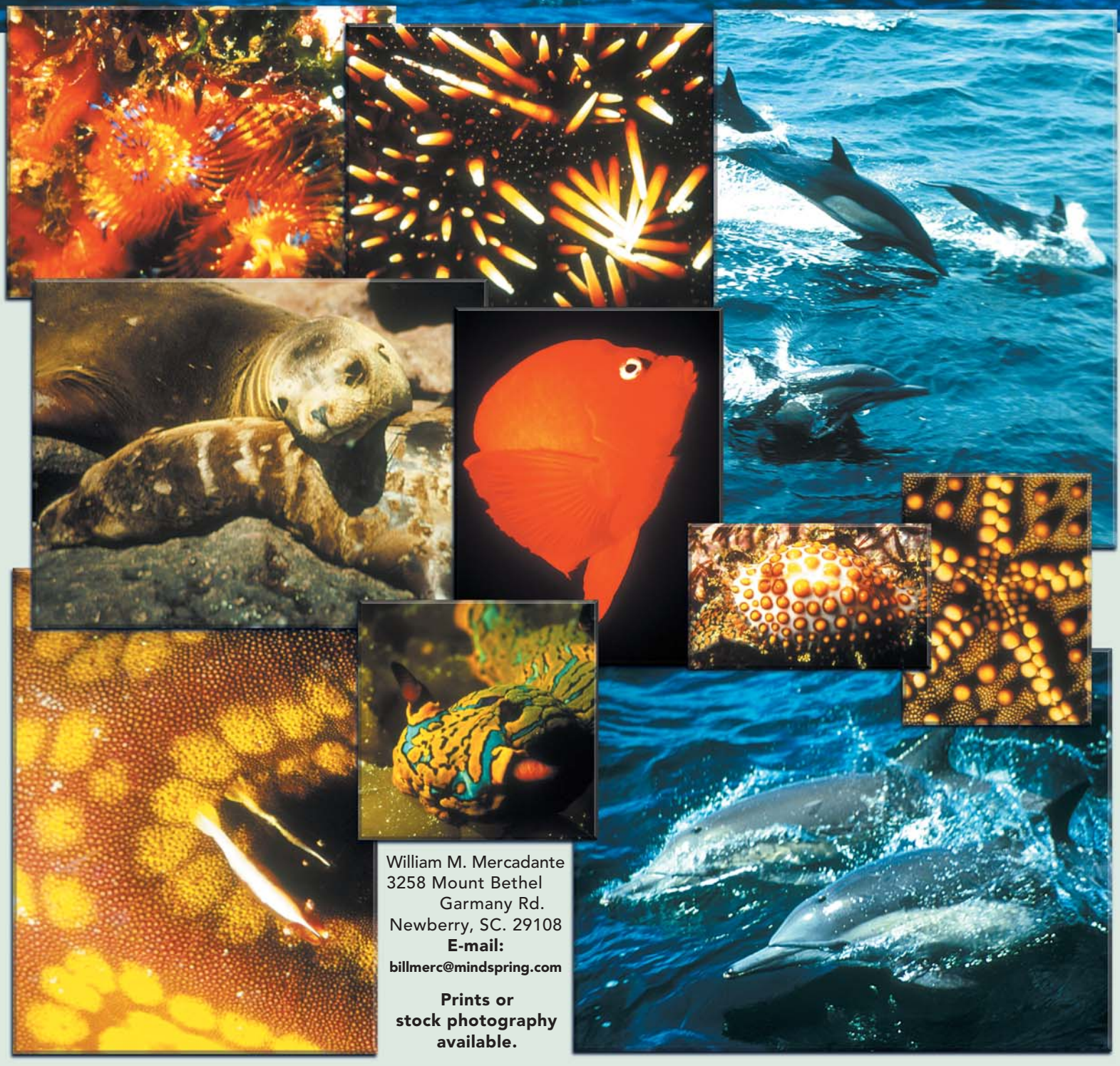

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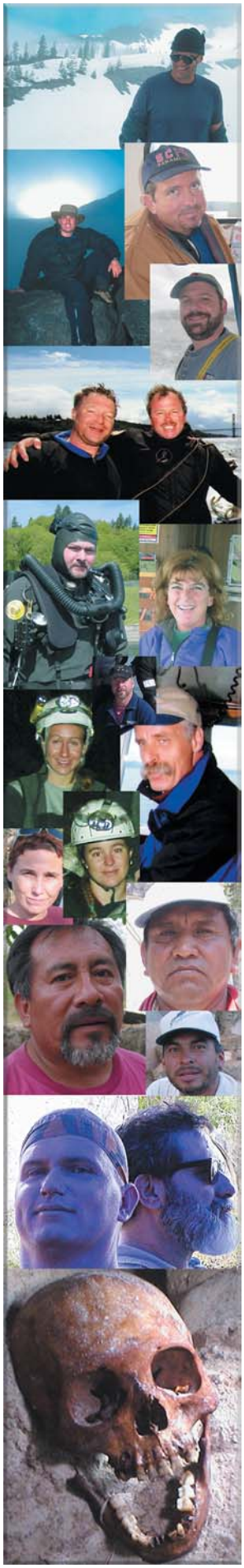

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