ADVANCED DIVER MAGAZINE

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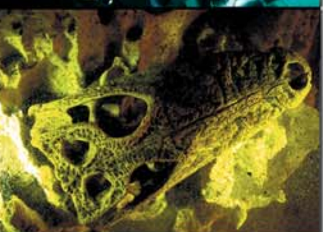


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Photo by Curt Bowen

PUBLISHERS NOTES

I woke up one morning with nothing to do, no projects, and no expeditions planned. Bored out of my mind, I decided I needed a new project, one that would keep me busy. That was over a decade ago when I decided to start a technical dive publication.

The road has not been paved in gold, and things have not gone smoothly. Sometimes I find myself burning both ends of the candle. It’s a daily struggle to find new editorial, good photography, new layout ideas, and the world’s latest underwater expeditions.

Has it been worth the long hours, lack of sleep, no pay, and added stress from press and postage bills? My accountant would say otherwise, but I say, “You bet it has.” I have traveled, explored, and discovered more in these ten years than most do in a lifetime. I have met, dove with, and became friends with thousands of divers from all around the planet. I have a staff of not just dedicated writers and photographers, but true friends and colleagues. With the birth of my only child, Savannah Bowen in 2003, my marriage has become much stronger and supportive. Even though I have never taken a paycheck, I feel I have been paid more than any business could ever pay.

It has been a long rocky road, but I think I can begin to see the smoother pavement ahead. Subscriptions are higher than ever, advertisement is strong, world contacts continue to pour in, and I have more expeditions and dive adventures than I could ever go on. My staff of eager divers are also out in the world exploring, making new discoveries and sending back stories of their adventures for our readers to enjoy.

As long as the economy stays strong, 2005 looks like it could be ADM’s best year, not only for business, but also in adventure and discovery.

Check out ADM’s updated website for extended articles, past expeditions, our new online store and much, much more.

Curt, Linda, and Savannah Bowen
Publishers ADM

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Publisher	**Curt Bowen**
Co-Publisher	**Linda Bowen**

Editor / Writer	Dave Miner
Master Diaper	Savannah Bowen
Web Master	Jakub Rehacek

Staff Writers / Photographers / Videographers

Michael Barnette	Scott Carnahan	Vlada Dekina
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Contributors (alphabetical listing)
Nancy, Michael & Brian Albury • Brendon Baillod
Eric Baker • Thaddius Bedford • Jack & Karen Bowen
Dick Boyd • Greg Doyle • Paul Ehorn • Erik Engberg
Lynn Gape • Andrew Georgitsis • Paul Heinerth
Ross Hemingway • Eric Hubschnieder • John Janzen
Lisa Jefferson • Andreas Kerner • Rob Polich
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Contact Information:

Write	P.O. Box 21222 Bradenton, FL 34204-1222
Phone	941-748-3483
Fax	941-745-8067
E-Mail	AdvDvrMag@aol.com
Fed Ex/UPS	Advanced Diver Magazine 327 SnapDragon Loop Bradenton, FL 34212 USA

Advanced Diver Magazine On-Line
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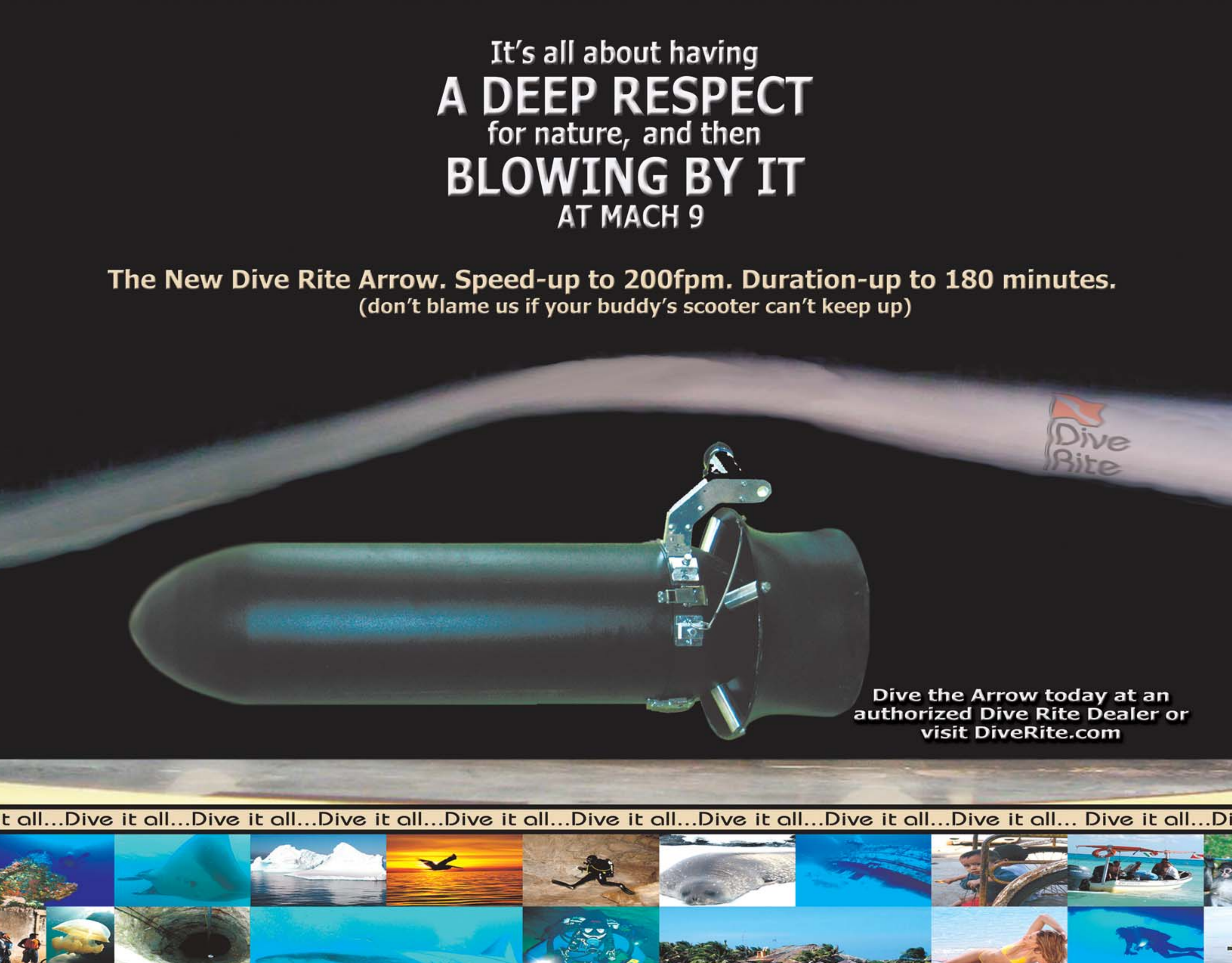
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In Search of Prehistoric Relics

Florida Fossil Diving

Editorial by Andreas Kerner
Photography by Curt Bowen

Florida's numerous rivers, lakes, and creeks contain a wealth of fossils, dating back to more than 40 million years. Technically speaking, the term "fossil" covers any remains of organic life, from bones and teeth of vertebrates to shells, sea urchins, and fossil plants. Our company specializes in recovery, preparation, and identification of these relics of the past. Our main focus is on vertebrates of the Pleistocene to Miocene — a time span covering roughly the last 10 million years. We work closely with the Florida Museum of Natural History (FLMNH) at the University of Florida in Gainesville, and we frequently donate important specimens to their comparative collection. Several new species, previously unknown to science, have been discovered by us and are currently being scientifically described.

Fossils can be found almost anywhere in Florida. Construction sites and shell pits are a great place to check, but since you bought this magazine, you most likely spend quite a bit of time underwater. The good news is — as a diver, you have access to the best fossil-bearing deposits imaginable. Unfortunately, you can't just plunge into any body of water and find a complete Mastodon skeleton (though it does happen from time to time).

The problem is that some animals were a lot more abundant than others and lived in an environment more favorable for fossilization. A good example is the group of fossils commonly referred to as "echinoids," sand dollars and sea urchins, among others. Some Eocene limestone outcrops in sinkholes or river bottoms are literally full of them. Even though these are some of the oldest fossils you can find in Florida,

Photo: Andreas Kerner with a fossil skull of a monstrous Alligator, *Alligator mississippiensis*, from the early Pleistocene (Irvingtonian) of Charlotte Co., FL. The fossil is about 1.8 million years old.

they are usually far from being rare. The trick is to find that one that looks a little odd or different than the others. This may be a different species and could be of scientific interest. Vertebrate remains in these early and typically marine deposits are rather uncommon. Once in a while, vertebrae and ribs of a small dugong, a relative of the manatee, are found. Most of the younger deposits usually consist of sands, clays, or gravel. A diver may find a bone or tooth exposed on the surface and pick it up without realizing that there may be much more underneath, often under just a few inches of sediment. With a little experience, you can determine if an area is promising or not simply by the color and/or consistency of the sediment.

Typical finds of Pleistocene age (the most common sediments in Florida's rivers covering the time period from 10,000 to about 1.8 million years ago) include giant beavers, horses, llamas, giant armadillos, ground sloths, tapirs, saber-toothed cats, mammoths, and mastodons. Some species, such as deer, alligator, bobcat, black bear, etc. survived unchanged. However, most of the "mega-fauna" became extinct 10,000 to 11,000 years ago. Usually, divers find isolated teeth or bones, which can be difficult to identify.

Other species like horses and camels, deer and alligators, and certain turtles are also common. Even the large mammoths and mastodons are frequently found. Carnivores, on the other hand, are typically rare. Usually there was just one large carnivore for several hundred herbivores, which makes finding one a lot more unlikely. The carnivore would have had to die in exactly the right spot, like a swollen river, not on land where it's devoured by other predators with its bones scattered and broken. Over time, even bones and teeth deteriorate and fall apart unless they're covered by sediments.

Finding fossils by diving in rivers, even though it's mostly shallow water, can be quite a different experience than diving in the clear, calm water of a spring or sinkhole. Often the visibility is bad or zero. Sometimes there is no point of even having your lights on, because of all the particles in the water reflecting it. Many times you grope around and identify items by feel. After storms, like last year's hurricanes, rivers can take months before they start to clear up. Additional weights are also a must. Forget being neutrally buoyant. I'm 5'11", 175 lbs and carry sometimes 60 pounds of weights plus equipment. This is no joke. Currents can be bad and staying in that "good spot" without having to waste time and air fighting to stay in one place is important. Having good kneepads is also important (limestone bottom + lots of weights = bad for your dive suit). For collection, use "goodie-bags" and plastic containers. Finally, never assume that boat operators on Florida rivers know or care about what a dive flag is!

Maybe you've already been hunting for fossils in your local river but didn't find anything? Well, keep in mind that rivers change their course frequently, so the area you dive in may not have been under water 10,000 years ago. Leisey Shell Pit in Hillsborough Co. is a good example of a rich deposit of vertebrate fossils from 1.4 to 1.7 million years ago. At the time, the area near Ruskin, FL, was the mouth of a river, with mostly brackish water and some stream channels in which animal remains accumulated. The river doesn't exist today. The site was discovered while dredging for road fill. Sinkholes are also tricky. It is often hard to determine when they opened, which is why even small bones from the bottom can yield a lot of information. If they're from animals that have been extinct for 10,000 years or so, the sink most likely opened prior to that and may hold a large number of fossils from animals that fell in and drowned. Basically, it's not easy and may take you some time to figure out where to look, but it can be a very rewarding.

Below: Lisa Jefferson searching for fossils in a fissure in the limestone bottom of a Florida spring

• Lower jaw of *Megalonyx leptostomus*, a rare species of ground sloth from the Blancan (late Pliocene). About 2.2 million years old

• Two fossil ground sloth claws from the late Miocene. *Pliometanastes protistus* (top) and *Thinobadistes segnis*. About 7 million years old.

• Four teeth of *Teleoceras proterum*, a rhinoceros from the late Miocene. About 7 million years old.

• Skull and lower jaw of *Macroclemys temminckii*, a large Alligator Snapping Turtle. Late Pleistocene, about 15,000 years old. Almost 9 inches wide.

• American Mastodon, *Mammut americanum*. Palate with upper dentition of a sub-adult male prior to restoration. Most vertebrate fossils have to be restored and/or hardened with preservatives after recovery. Early Pleistocene, Irvingtonian. About 1.5 million years old.

You need to understand the laws for fossil collecting before heading out. If a site is on private property, the fossils belong to the property owner, or to the collector if he or she had permission to collect (most sinkholes fall into this category). If the site is located underwater in a "navigable waterway," it's considered submerged state land and you need a permit from the University of Florida, Department of Vertebrate Paleontology to collect vertebrate fossils. Invertebrates (sand dollars, shells, etc.) and shark teeth can be collected without a permit. There are some other technicalities, so it's always a good idea to get a permit and be prepared. To obtain a permit, you simply pay a small fee. Go to www.flmnh.ufl.edu for more information or contact the Department of Vertebrate Paleontology at (352) 392-1721, ext. 259.

Permits are valid for one year. After that, you are required to send a list of your finds to FLMNH. If there is anything of scientific interest, the museum may require you to turn it over — however, that very rarely happens. Fossils that a collector finds interesting, such as a mammoth molar, are of little scientific interest. But a small carpal bone that would be thrown into a box, never to be seen again, may be a bone they don't have yet from that particular species. Some people are terrified of the idea that the Museum would actually want one of their fossils. Well, I look at it in a different way. You can help science and get credit for your donation. And who knows, you may discover something totally new.

An important note, the permit is *not* valid for the collection of artifacts of any age, from 19th century bottles to Native American spear points. A lot of different laws and regulations apply here, and it is a good idea to make yourself familiar with the important ones. As a rule of thumb, "isolated finds," such as a single arrowhead, can be kept by the finder. They ask that you send in a picture and all information about your find, so the scientists can compile a database as to where a certain style of point was found.

As you can see, a lot hinges on proper identification. Our company offers identification and authentication services, and we buy and sell fossils and artifacts. Items of scientific interest are made available to the FLMNH for study. Please feel free to contact us with any questions you may have.

The International Fossil Co.
c/o Andreas Kerner
P.O. Box 540868
Orlando, FL 32854
(407) 644-1321
intlfossils@msn.com

Left: Lisa Jefferson in a Florida spring. Above: Andreas Kerner with a complete Mastodon molar, recovered from a Florida spring. Late Pleistocene, about 30,000 years old.

ICE WATER MUSEUM
CARL D. BRADLEY

Text by John Janzen
Photography by John Janzen, John Scoles, and Capt. Greg Such

No less than 8,000 ships have disappeared beneath the icy and unforgiving waters of the Great Lakes. Lakes by name only, they are in reality, inland seas capable of producing legendarily treacherous conditions. The "Gales of November," well known for their particular fury, have led to the demise of many proud ships. It was a November gale on Superior that in 1975 swallowed the 729-foot (222 m) Edmund Fitzgerald so quickly that there was no time to call mayday.

Years earlier, on 18 November 1958, the Carl D. Bradley was steaming desperately across upper Lake Michigan. Gale force winds, forging 40-foot (12 m) waves, pounded and twisted her mercilessly. Her orders were to make one last run to Rogers City, Michigan for a load of crushed limestone. This was the final trip of the season before the ship would be dry-docked for needed repairs. Recently involved in a collision and a couple of minor groundings, she was tired from years of hard service. Her fate would be a prelude to the Fitzgerald's.

Frank Mays, the Deck Watchman, stared in horror as the huge Bradley shuttered violently, buckled amid ship and broke in two. The First Mate, Elmer Fleming, hailed a quick mayday, dropped the radiophone and evacuated the bridge. Moments later, as a huge wave pitched the bow section, Frank and Elmer were hurled off the ship, deep into the dark, freezing water. Miraculously, they surfaced near the ship's pontoon raft and hauled themselves aboard. The bow was completely gone and the stern, tipped vertically, lights still lit, screw high in the air, and was sinking rapidly.

The Bradley came to rest upright, 380 feet (116 m) below the surface. The bow and stern sections are separated by about 120 feet (37 m) and lie slightly askew to each other. Of the Bradley's 35-member crew, only four survived the sinking and found the raft. Of these four, only Frank and Elmer would be alive the next morning. I recently asked Frank how he was able to endure 15 hours of freezing wind and water while aboard the frequently overturning raft. Frank said the wind was

unbearable, feeling like a knife cutting his skin. He eventually found comfort from a layer of ice that formed over him, offering some protection from the wind chill. He knew if they could make it until daylight, they would be rescued. Nearly dead, they were rescued the next morning by the USCG cutter *Sundew*. Frank's incredible story is told in "*If We Make it 'til Daylight*," by Mays, Stayer, and Juhl.

The Bradley, completed in 1927 by the American Ship Building Company of Lorain Ohio, measured 623 feet (190 m) long and 65 feet (20 m) in beam. Weighing 7,700 tons (7 x 10^6 kg) empty, she held 5 million pounds (2.2 x 10^6 kg) of cargo and could unload herself through a huge conveyer boom mounted on her deck. The Bradley served admirably more than 30 years before she foundered and remained the largest shipwreck in the Great Lakes until the sinking of the Fitzgerald 17 years later.

In 2001, Mirek Standowicz successfully completed a bold solo dive to the Bradley's pilothouse, becoming the first SCUBA diver to visit her bow section. For two years, John Scoles and I had been working toward an attempt to be the first on the Bradley's stern. Practice dives were conducted at Lake Wazee in Black River Falls, WI, a former open pit iron mine. Wazee offers good visibility, cold water and its 350–foot (107 m) depth made it ideal. By the summer of 2004, we had completed more than 30 successful trimix CCR dives beyond 310 feet (95 m). Our Inspiration rebreathers performed reliably and breathed easily, even during heavy swimming exercises. We developed and tested an electric heating system for our drysuits, which would allow significant bottom time in the Bradley's ice water grave. Through these dives, we had explored more of Wazee's bottom than anyone previously, and I used this experience in writing *The Divers Guide to Lake Wazee*.

Left bottom: John Scoles (left) and John Janzen (right) celebrate after the final dive of the expedition

Top right: The Bradley's helm with binnacle and gyro repeater

Middle right: Pilothouse. Note the gyro repeater mounted on window frame

Bottom right: Lighthouse at Manistique, MI

380ft. Lake Michigan

One of the greatest obstacles was finding a suitable charter for the expedition. Foremost, we needed someone to take us to the Bradley, but also willing to accept the risks involved. After a yearlong search, we found Capt. Greg Such, owner of Shipwreck Adventures LLC, a training and charter firm specifically tailored to Great Lakes divers. What impressed me most about Greg was that he wanted to see us dive the Bradley as much as we did. Additionally, Greg shared our high regard for safety and contingency planning. The expedition team had been formed.

On 21 July 2004, a cool evening with a howling wind, we arrived in Manistique, Michigan, a small town about 25 miles north of the Bradley site. Greg arrived later with the Little Alexandria, his 27-foot (8 m) trailerable dive boat in tow. Waves on the open water were 8 feet (2.5 m) and the forecast for the next day was poor. Not surprisingly, the dive planned for the following day was scrubbed. We awoke on 23 July however, to calm seas and quickly embarked on the hour-long trip to the wreck. Having double-checked our gear, we relaxed and enjoyed the calm and sunny journey.

As the Bradley's stern appeared on the sonar screen, we helped Greg prepare a grapnel hook. Paying out the required length of line for the grapnel put the distance between the surface and the Bradley sharply into perspective. It was a long way down. On our third attempt, the grapnel bit and we secured the line to the Little Alexandria. Greg, with an ear-to-ear grin exclaimed, "Well, are you boys ready for this?" During kit-up, we speculated about the location of the grapnel, hoping it landed near the stern cabins, not out on the hatch deck where disorientation or the long distance to the cabins might be a problem.

Including safety checks, placement of contingency cylinders, plus cameras and a second mooring line to haul down, it took 7 minutes to reach the wreck from the surface. As we passed 300 feet (91 m), the faint image of a railing in the ink-black water emerged at the periphery of my light beam. Finally, cabins and the hatch deck materialized. Greg put us exactly on target, just forward of the stern cabins! "There it is!" I shouted to John through my mouthpiece. My first impression was the mammoth size of the ship followed by thoughts of the Bradley's lost crew. I had been on countless wrecks before, but never had such deep feelings for the crew. Perhaps it was inspired by the

incredible condition of the Bradley or the fact that I had met one of the survivors. In conversations with Frank Mays in 2003, he said he would not mind if divers visited the wreck, even though remains of lost friends are certainly there. We were grateful for the support and enthusiasm he showed as we discussed the possibility of diving the Bradley.

The stern was in remarkable condition, untouched for more than 45 years. With minimal silt, visibility was at least 30 feet (9 m) and there was a small current. We swam aft, past huge ventilators at the base of the smokestack and along the double-deck gangways on the port side. The condition of the paint was astounding. Labels painted above doorways such as “DINING ROOM,” “SECOND ASST ENGINEER,” and “OILERS” were perfectly intact. What a delight it was to have the doorways labeled! Fixtures that once lit the gangways remained, undamaged. Clearly, the ship had been rigged for heavy weather, with most doors and hatches dogged shut. She must be immaculate inside.

Upon returning to the up line at twenty five minutes bottom time, I noticed the leveling lights used during cargo loading, appearing ready for service. With the sting of the 39F (4C) water apparent on my fingers and well over two hours of decompression ahead of us, we began the ascent. Not until our 80-foot (24 m) stop did the water warm slightly, but by 20 feet (6 m) it was a comfortable 55F (13C). We allowed ourselves a congratulatory handshake at the last stop, although with well over an hour of decompression still to complete, the dive was not over.

The next day we did a second dive on the stern, focusing on the port side cabins and the fantail. Attached to a rope on the lifeboat davits was a wooden plank, torn from the port lifeboat. The unfortunate crew had no time to launch it as the stern plunged to the bottom. As we approached the fantail, CARL D. BRADLEY appeared large and bold across the stern. Underneath, the huge rudder ran far into the darkness below, with the top of the huge screw just visible. I paused in a moment of awe at the size of the screw. Above and forward of the fantail were two large decks. The lower deck housed a telegraph, an enormous winch, a red fire axe and a spool of fire hose that remained neatly stowed. Closed portholes and doors were all around. Reaching our turn-around time, we swam back along the lower port side gangway, past the ships gigantic aft searchlight.

Left page top: An example of the immaculate condition of the Bradley, painted label above crew's quarters on port stern

Left page second down: Carl D. Bradley’s pilot house

Left page third down: Oilers' quarters on the Bradley's stern

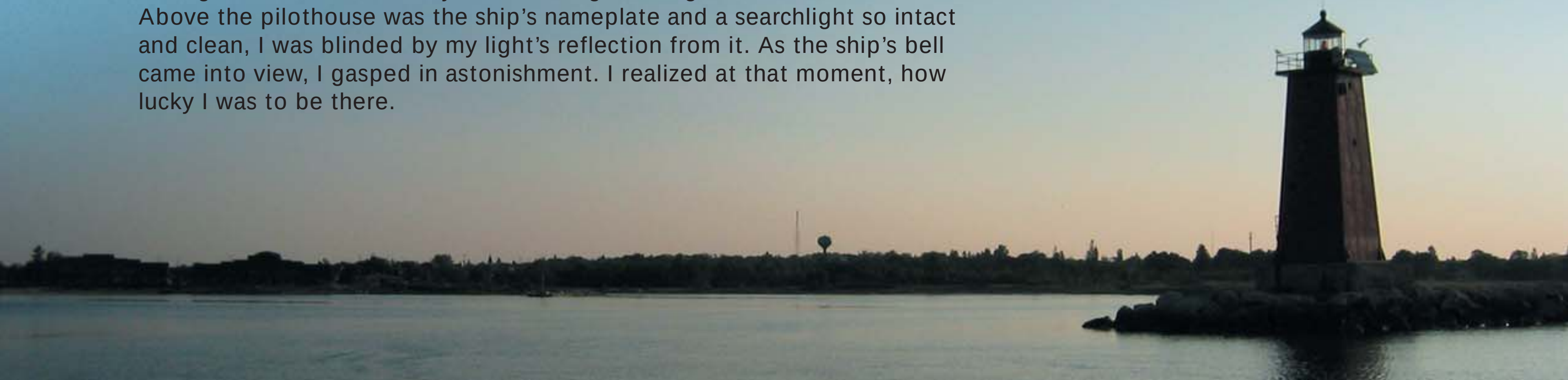
Left page bottom: John Janzen swims past the Bradley's gigantic stern searchlight

Left page bottom right: John Janzen climbs aboard the Little Alexandria

Upper right: John Scoles after a dive on the Bradley

On the third and final day, we explored the bow, landing just aft of the pilothouse at about 310 feet (95 m). A large door to the chartroom on the starboard side of the pilothouse was open and could be easily penetrated. Although the glass is gone from the pilothouse windows, red paint on the window frames is clean and bright. As I examined the area surrounding the helm, the ship looked practically ready to sail. The wheel, binnacle, radio direction finder, radar and gyro repeater appeared as if standing by, waiting for the crew to return. I envisioned Frank walking in the door, with hot coffee for the crew and Captain Bryan standing proudly behind the helmsman.

On the deck forward of the pilothouse were navigational instruments called gyro repeaters atop tripods. The crushing pressure had imploded their glass, but I could easily read bearing markings on the dials within. Above the pilothouse was the ship’s nameplate and a searchlight so intact and clean, I was blinded by my light’s reflection from it. As the ship’s bell came into view, I gasped in astonishment. I realized at that moment, how lucky I was to be there.



After the expedition, I called Frank Mays, now retired and living in Florida, to tell him of our incredible dives. He was excited to hear the news and after viewing the images we sent him, said it was wonderful to see the Bradley resting so peacefully.

I am fortunate to have had the opportunities to meet Frank and to work with talented people like John and Greg. Without them, I would be limited to dreaming about the Bradley. The enormity of the ship and the limited bottom times ensured by her depth, mean many dives will be required to explore her. I know that Frank longs to return to the Bradley and wishes he could touch her once more. I feel honored in bringing him a bit closer to his lost ship through our descriptions and pictures. To dive on a wreck like this was an incredible experience made still better by the opportunity to speak with someone who had witnessed the event. That is very rare indeed.

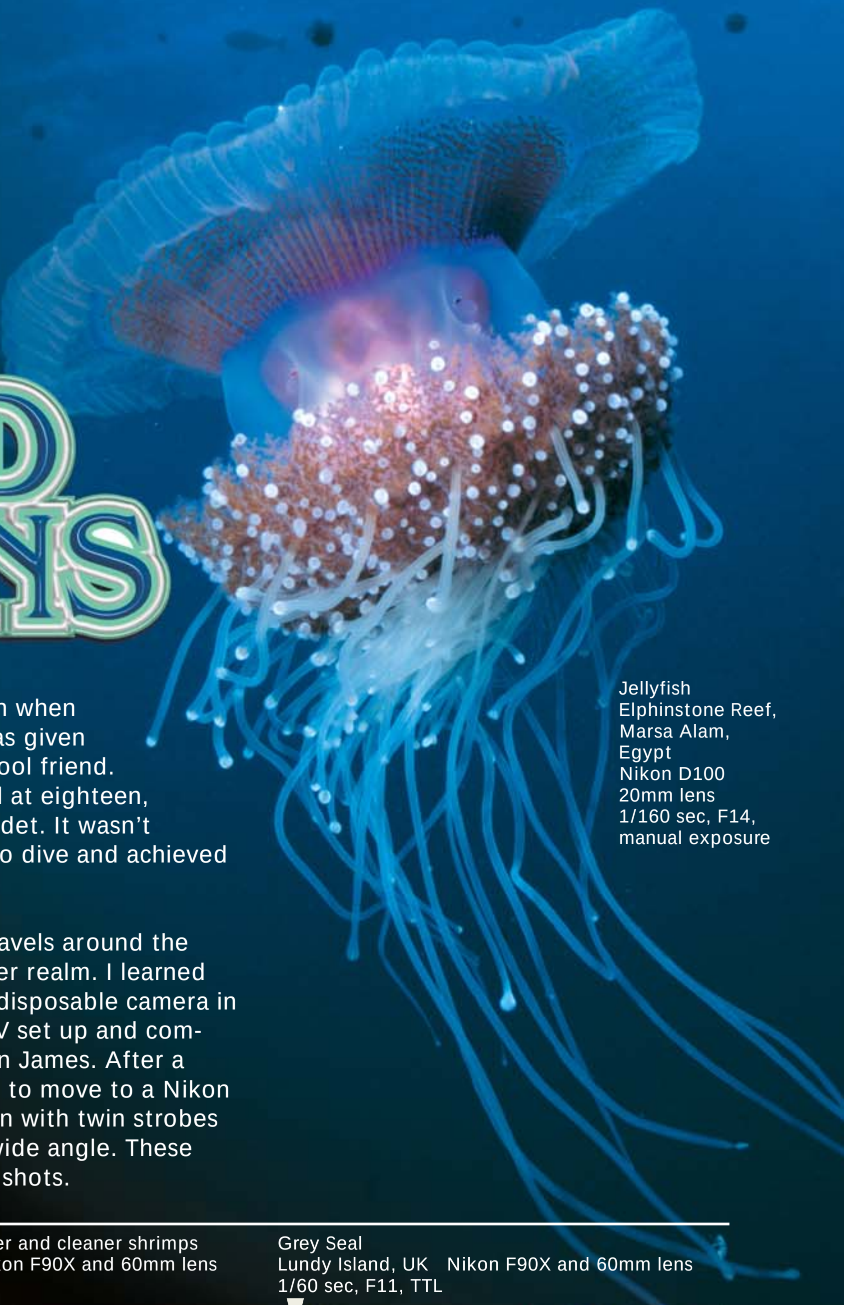
The Bradley is more than a shipwreck. She is a gravesite and a museum-quality time capsule from a distant era. Strict laws protect nearly all Great Lakes wrecks from artifact removal and fortunately most divers and charters of the region share a perspective of stewardship. To any future divers on the Bradley, I respectfully ask that an extra level of care be employed when visiting this magnificent ship.

John Janzen performs pre-dive checks at the surface

e-mail: janzen_john@hotmail.com

ADM Featured Photographer

DAVID STEPHENS



Jellyfish
Elphinstone Reef,
Marsa Alam,
Egypt
Nikon D100
20mm lens
1/160 sec, F14,
manual exposure

My fascination with fish and the sea began when I was seven or eight years old when I was given a few tropical fish to look after by a school friend. This interest grew and on leaving school at eighteen, I joined the Merchant Navy as a deck cadet. It wasn't until several years after leaving the navy that I learned to dive and achieved the divemaster qualification.

I had become interested in photography from my travels around the world and this immediately transferred to the underwater realm. I learned the basics with an Aquashot system that consisted of a disposable camera in a small housing. From here, I progressed to a Nikonos IV set up and completed a basic underwater photography course with Alan James. After a disastrous flooding incident with the Nikonos, I decided to move to a Nikon F90X SLR camera in a Sea&Sea housing. I used the Nikon with twin strobes and four lenses: 105 and 60 mm macro, 20 and 16 mm wide angle. These lenses gave me plenty of flexibility for a wide variety of shots.

John Dory Penzance, Cornwall, UK
Nikon D100 / 60mm lens
1/160 sec, F32, manual exp

Red Mouthed Grouper and cleaner shrimps
Nuweiba, Egypt Nikon F90X and 60mm lens
1/60 sec, F11, TTL

Grey Seal
Lundy Island, UK Nikon F90X and 60mm lens
1/60 sec, F11, TTL

John Dory   Penzance, Cornwall, UK
Nikon D100 and 60mm lens
1/160 sec, F36

Curled Octopus and sponge
St Abbs, Scotland, UK
Nikon D100
20mm lens
1/160 sec, F22

Moving to an SLR set up enabled me to vastly improve my favorite area of underwater photography, fish portraits. In 2004, I made the progression into the world of digital photography with a Nikon D100 in a Sea&Sea housing. I am now very pleased with this set up although I found the lighting a little frustrating at first after using TTL for years. The opportunity to view the results immediately has helped me achieve more pleasing images with no more wasted slides.

My interest in diving and underwater photography has taken Tracey, my wife, who used to be my underwater model before picking up a camera herself, and I to many fascinating locations around the world. These include: Wakatobi in Indonesia, Mexico, Bonaire, Maldives, Grand Cayman, Israel, Sri Lanka where we got married, Cuba, and many visits to the Egyptian Red Sea including the Brothers and Daedulus.

I have been fortunate to have my work featured in several British publications and I have had front covers in Sportdiver, Scubaworld, Diver, and Tropical Fish magazines. Additionally, I have had photographs in several books: “Into the Maelstrom,” “The Wreck of HMHS Rohilla,” “SAA Club Diver Manual,” and the recently launched “Dive-The Ultimate Guide.”

I live in Newport, South Wales in Great Britain. My favorite British sites are in Devon, Cornwall, and St. Abbs in Scotland. To help me continually improve, I joined two clubs, the Bristol Underwater Photography Group and the British Society of Underwater Photographers (BSOUP). This has enabled me to compare my work with other like-minded photographers and to pick up new ideas and techniques.

I’m a very competitive and enjoy entering photography competitions. I have had several successes including winning the first two splash-ins at Stoney Cove, an inland site in the UK. First, second, and third places in the annual BSOUP splash-in that is held in Plymouth, UK, and my main success was winning the best overall of British photographs in the Image 2001 competition. I recently came in third at the annual portfolio competition held in London by BSOUP.

David Stephens
44William Morris Drive
Newport   South Wales   NP19 9DN   UK
email: davidpstephens@supanet.com
www.underwater-photography.co.uk.

Hawksbill Turtle
Wakatobi, Indonesia
Nikon D100 and 105mm lens
1/160 sec, F16

Wild Bottlenose Dolphin
Coral Hilton hotel, Nuweiba, Egypt
Nikon F90X and 16mm lens
1/60 sec, F5.6, natural light

Mating Cuttlefish
Babbacombe, Devon, UK
Nikon F90X and 20mm lens
1/60 sec, F11, TTL

Curled octopus and sea urchin
St Abbs, Scotland, UK
Nikon D100 and 20mm lens
1/160 sec, F22, manual exposure

Male Cuckoo Wrasse
Penzance, Cornwall, UK
Nikon D100 and 60mm lens
1/160 sec, F18, manual exposure

Basking Shark
Cornwall, UK
Nikonos IV and 15mm lens
1/60 sec F5.6, natural light

www.underwater-photography.co.uk

Diving into British Naval History

HMS REPULSE

Text by Greg Doyle
Photography by Andrew Georgitsis, Erik Engberg, and Greg Doyle

The British battle cruisers, HMS Repulse and HMS Prince of Wales, lie deep in Malaysian waters about 50 nautical miles north of the resort island of Pulau Tioman. Unknown to the thousands of divers that pass through Tioman every year, these ships offer some of the world's greatest wreck diving.

In November 2003, Erik Engberg was a tired and bored videographer living in Khao Lak, Thailand, filming newly certified divers bouncing over the Similan reefs. Erik needed a new challenge, he found all he could hope for and more when he teamed up with Greg Doyle, a TDI Trimix Instructor, who was setting up Penetration Divers (*www.penetrationdivers.com*), an outfit dedicated to Asian wreck exploration and technical diving.

Greg put Erik to work as a jack-of-all-trades on board MV Grace, his 36-meter technical live-aboard vessel and Erik quickly developed a passion for diving the massive battleship and supertanker wrecks that Grace visited most weeks.

One of the first wrecks Greg introduced Erik to was HMS Repulse, the British battle cruiser lost in the early days of the Pacific war to a combination of Japanese tactical superiority and the British Navy's ignorance of the potential of aerial warfare against ships. After one dive on the Repulse, something changed forever in Erik and he became obsessed with the wreck, to the point of having almost no interest in diving other wrecks or any of the many tasks required of him on-board.

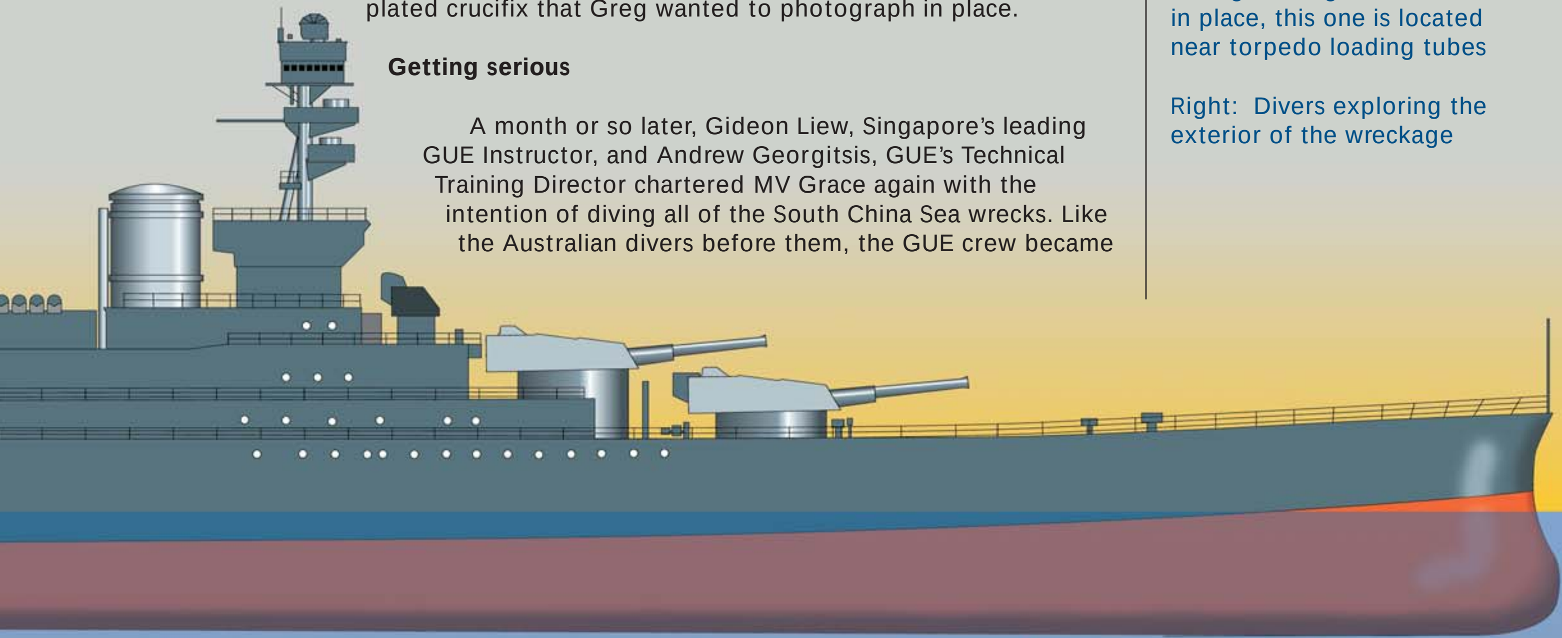
Exploration

Throughout March, MV Grace dived the Repulse at every opportunity. Greg and Erik maximized exploration by diving solo from each end of the ship pushing towards the middle. They quickly exhausted the lines of earlier divers on the upper deck levels and started laying new lines into the furthest interiors of the ship. Over Easter 2004, a group of Aussie divers led by Chris Law chartered Grace to explore all of the WWII wrecks in the South China Sea but Erik's stories of the pushes into the Repulse convinced them to join his effort to fully map the interior of the wreck and find routes to both the engine room and the chapel and forget about the other wrecks. Between them, these divers racked up over sixty exploration dives on the Repulse to add to the fifty or more that Erik and Greg had undertaken since March.

Even with more than 110 dives into every opening in the wreck, by the end of the Aussies' charter, nobody could find a way into the engine room or the chapel both of which had become the Holy Grail for the Repulse divers. Greg was particularly concerned to find the chapel as from the ship's blueprints, it appeared adjacent to the Captain's wine locker and he had become obsessed with the idea of toasting the men of the Repulse. The chapel was also an intriguing target as it was thought to contain stained glass portholes and possibly a large gold plated crucifix that Greg wanted to photograph in place.

Getting serious

A month or so later, Gideon Liew, Singapore's leading GUE Instructor, and Andrew Georgitsis, GUE's Technical Training Director chartered MV Grace again with the intention of diving all of the South China Sea wrecks. Like the Australian divers before them, the GUE crew became



Left Page:

Left: Cable Drum with cable still well-greased below main hangar

Center: Beer bottles in seaman's mess; full beer bottles are still often seen on Repulse

Right: Searching for new passageways deep in the lower levels

Right Page:

Left: Singapore GUE Instructor Gideon Liew in-front of MV Grace waiting for the rest of his team

Center: One of the dozens of engineering controls still in place, this one is located near torpedo loading tubes

Right: Divers exploring the exterior of the wreckage

obsessed with the Repulse after the first day diving her and abandoned plans to dive the Prince of Wales and the submarines.

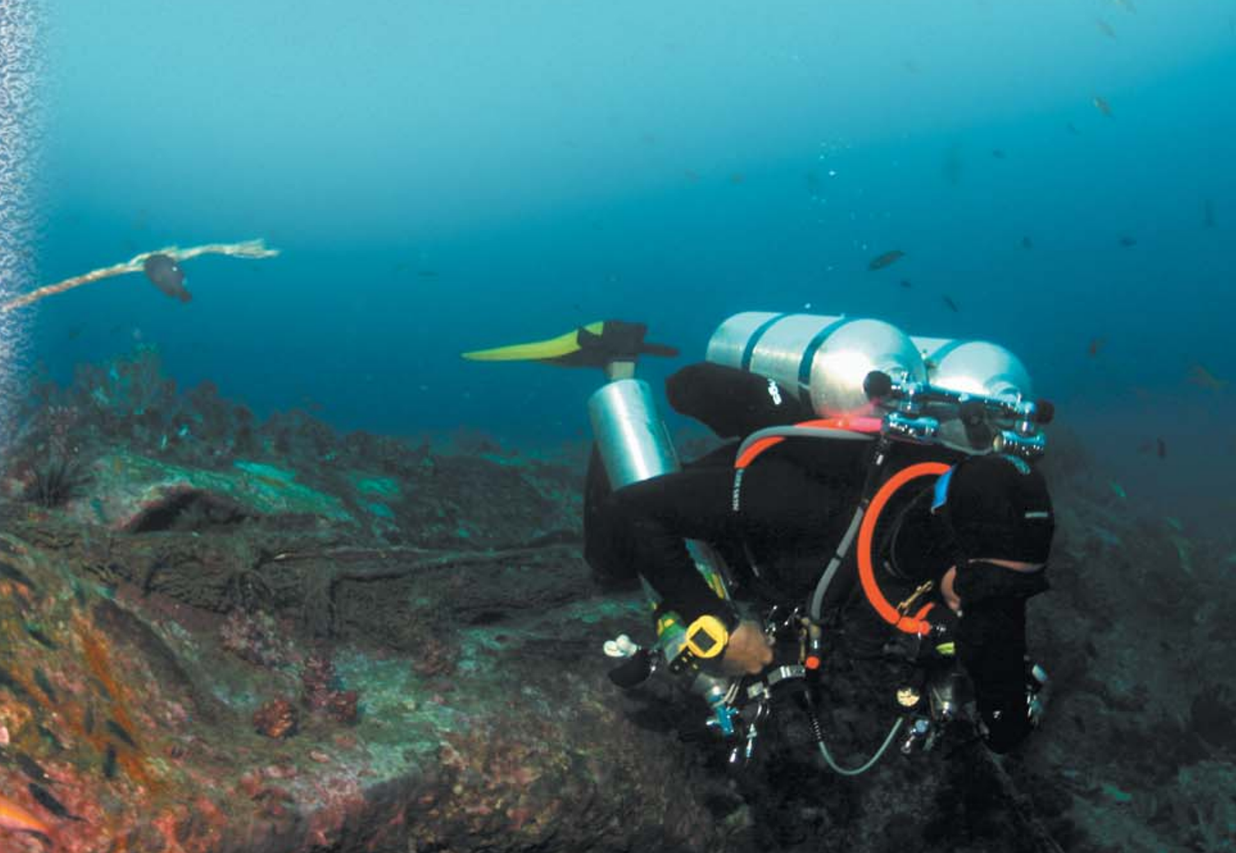
Since the GUE guys preferred to do their own gas mixing, Erik and Greg were off the hook on the dive deck and able to restart their four dive a day exploration regime. Each diving solo, and using Silent Submersion scooters, this allowed them a total of eight dives into the furthermost interior of the wreck each day.

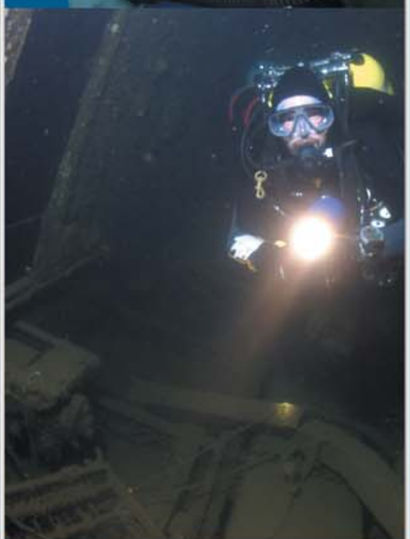
The difference now was that the divers had full blueprints of the Repulse provided by local diver Brooks Jacobs. With these plans, Erik identified a definite route to the engine room. Unfortunately however, the route was filled with debris and the hatch blocked by collapsed steel. Over several dives, Erik slowly cleared the debris. The steel blocking the hatch proved immovable and remained a very tight squeeze without removing gear.

At this point, Erik thought he had the engine room penetration nailed, with the plans showing a short route through two passages and into the engine room. Starting early on 26 April, Erik set off on what he believed was a straight run to the engine room. Unfortunately, after squeezing through the obstructed hatch and speeding through the corridors laying line, Erik was disappointed to find that what he thought to be the door to the engine room was rusted shut. Believing that the door could not be opened, Erik started searching for other entrances. The plans showed a similar door on the other side of the engine room but the passage way to it was blocked by silt. Neither could he find a passage via the engine room vents passing through the upper decks, although a group of English divers led by famed British wreck diver Jack Ingle diving on the Repulse from another boat at the same time claimed such a route was possible.

After four fruitless dives searching for alternate routes, Erik decided to give the original door one more try with the aid of a crowbar. Thus armed, he spent twenty minutes at over 50 meters working on the door in zero visibility. But sixty years seemed to have rusted the door shut forever, and Erik was forced to admit defeat. Back on the boat, however he started to think that all that was needed was more muscle and that a team effort might make the difference. As Grace was being chartered that week by some of the world's leading exponents of team diving, Erik was able to draw on their considerable experience for assistance.

Illustration © C. Bowen





Left Page:

Bottom left:
Open circuit diver exploring the exterior of the wreckage.

Right Page:

Above: One of many sets of remains seen throughout the wreck - *MV Grace* employs a strict look but do not touch policy

Top right:
Swedish RB-80 diver at 45 meters exploring the amazing soft coral growth that covers the ships hull

Second down:
Dr Mike, a well-known local Inspiration diver on deco

Third down:
Regular Repulse divers Ben (who) and Martin (who) some 100 meters inside the hull

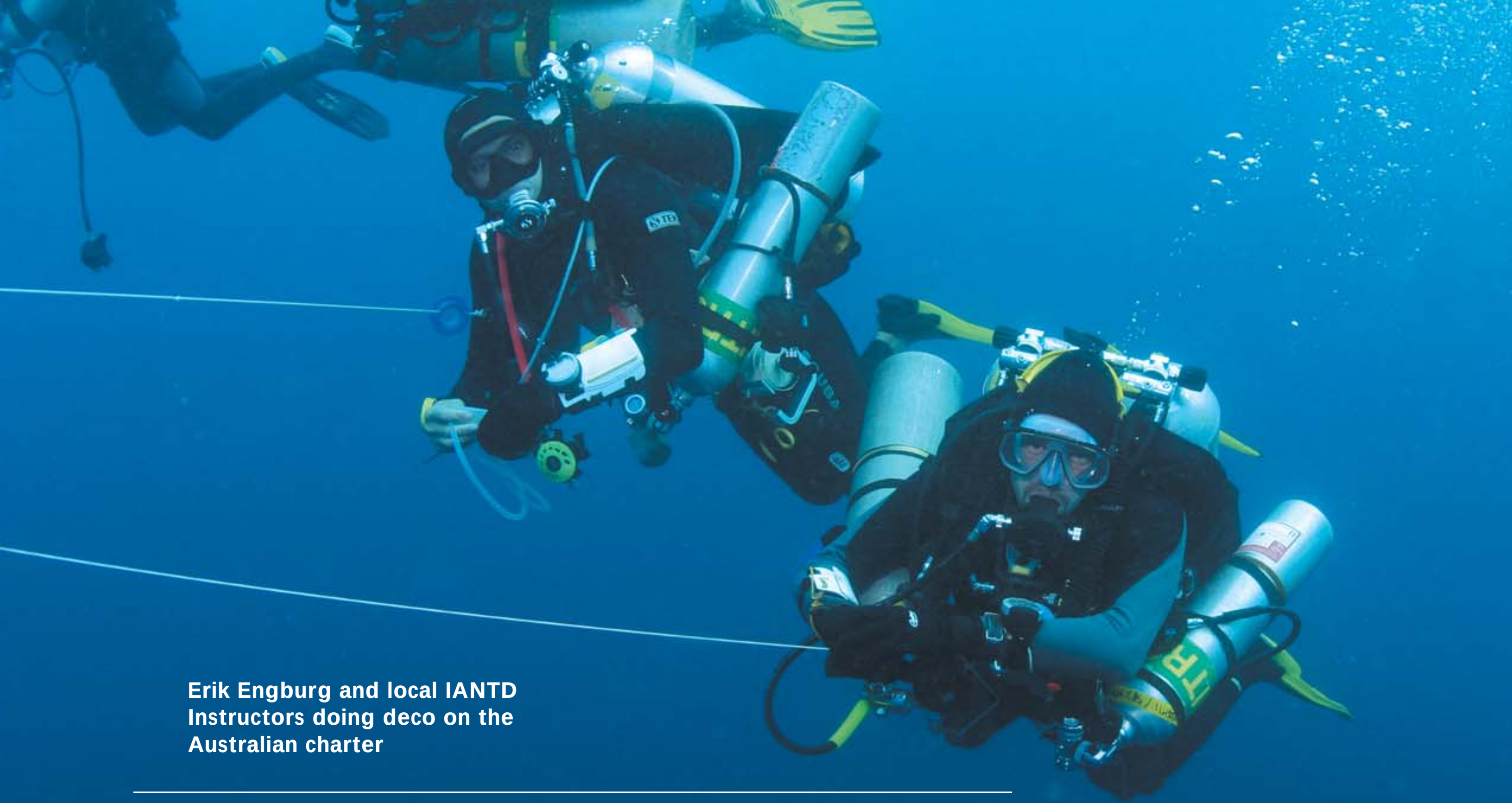
Bottom right:
Unknown object resting on the hull at 40 meters

Some lessons on teamwork for the solo diver

Erik turned to Gideon Liew and Andrew Georgitsis to make up a team to crack the door and the three divers, armed with video and still cameras, headed off to give the door another go. To Erik's embarrassment, Andrew was able to open the door easily by unlocking the last remaining hatch dog holding it shut. Despite being the man at the very edge of history, Andrew selflessly moved aside to let Erik make the final push followed by Gideon. Unfortunately, in Erik's haste to get into the engine room, he laid his line straight towards the final hatch, which meant there was very little room for his teammates to get out of the silt cloud and into the newly opened room, making it difficult for them to follow safely and see what was going on.

Eventually, Erik made it through to the engine room and found it so large his HID light was unable to penetrate the gloom to the other side. Despite the murky conditions Erik says, the wow factor was "pretty high." Once Gideon had made it through, it was time to turn the dive and with a quick glance around the room and a bit of snappy video work to prove they'd been there, the dive ended.

Erik continued a bit into the room tying off his line with the intention of leaving it permanently in place. Realizing that he was reaching thirds on his air and the agreed upon time limit, Erik had to hurry the tie off a bit but still took the time to secure the line to the reel as not to get entangled on the way back. This done, he turned to meet Gideon near the hatch leading to the exit route. However, the intense silt induced by the divers exhaust bubbles reduced visibility to zero and navigating the line back through the very narrow passage with machinery, piping, and spars obstructing the way proved time consuming. By his own admission, Erik began to feel the stress at this point, and as a solo diver, he was further stressed by having not one, but two, divers between him and the exit. In addition, his primary light gave out, leaving him in absolute



Erik Engburg and local IANTD Instructors doing deco on the Australian charter

darkness until one of the backups could be deployed. Eventually, Andrew and Gideon navigated the obstructions and got through to the larger passages leading to the exit. However, Erik got jammed up in the hatchway while going down head first and took several minutes to work himself loose, all the time desperately trying to control an increasing breathing rate as his stress levels rose in response to the constricting conditions.

Diving and respect for the dead

Diving on the Repulse is legal under both British and Malaysian laws, but diving it remains controversial. The Force Z survivors association is highly active in monitoring and protecting the wreck. After, the GUE team members publicized the dive, Alan Matthews of the Survivors Association sent letters to Andrew Georgitsis indicating the group's opposition to diving of any sort on the wreck.

According to Greg Doyle, owner of Penetration Divers, which runs charter trips to both the Repulse and Prince of Wales, the survivors association can be very difficult to deal with. However, Greg is sympathetic to the concerns of survivors and requests that divers visiting these wrecks agree not to disturb any remains or artifacts on the wrecks.

Brief history of HMS Repulse

HMS Repulse was a World War I *renown* class battle cruiser hopelessly pitted against far superior forces, strategy, and tactics in a very different war than that she was designed for. First laid down on 25 January 1915 at John Browns Clydebank shipyard in Scotland, she was commissioned on 18 August 1916 and served in the North Sea until the end of the war. Even then, the naval authorities were very concerned about the light armor carried by this class of battle cruiser and immediately following the armistice, they embarked on a massive refit of the Repulse, increasing her total displacement by over six-thousand tons from here original 26,500 tons.

From 1922 when the refit was completed through 1936, the Repulse proudly toured the world demonstrating the apparent might of the rebuilt British military. Perhaps in anticipation of the coming conflicts in continental Europe, Repulse again went through a major refit and modernization. This time, she received strengthened deck armor and the capacity to store and launch aircraft. Enhancements we also made to her antiaircraft capability.

After serving as part of the Home Fleet in the North Sea and Atlantic from 1939 to 1940, she was sent to Singapore together with the new battleship Prince of Wales to strengthen the then colonial outpost from a potential Japanese push southwards. At the time, it was believed that Force Z, of which Repulse and Prince of Wales were the major components, would act as a deterrent force to the Imperial Japanese Navy. Immediately after the Japanese attack on Pearl Harbor, both ships rushed northwards to stem what was believed to be a major Japanese invasion force. On the return journey to Singapore on 10 December 1941, a fleet of more than 80 Japanese bombers and torpedo planes mounted a sustained attack on both ships in the waters North of Tioman Island off the East Coast of Peninsula Malaysia. It is believed traitors in the British forces in Singapore guided the Japanese in for the attack.

Although only suffering moderate damage from bombs and successfully evading some nineteen torpedoes launched from the Japanese 'Betty' bombers, Repulse eventually succumbed to five torpedo hits and sank rapidly at 12:35 hours. A total of 513 men were lost in the attack and sinking. Many were strafed in the water by the Japanese planes. It took the Japanese 34 land based bombers and 51 torpedo bombers to sink the Repulse and the Prince of Wales over three separate attacks.

The sinking of these two ships was notable for several reasons. First, it was the first time that Capital ships succumbed to air attacks on the open sea (as opposed to in port such as was the case at Pearl Harbor). Secondly, it was the Royal Navy's largest loss in a single engagement. Historians generally agree that hubris on the part of British Naval authorities caused them to underestimate the strength of the Japanese forces and their then superiority in air to sea combat.

The wreck of the Repulse was located in 1959 lying on her port side in 54 meters (173 feet) of water with the highest point of the wreck at 40 meters (130 feet).

Diving the Repulse

The best time to dive the Repulse (and the other South China Sea WWII wrecks) is during March/April and September/November. At those times, current is negligible, visibility is around 40 meters (130 feet) and water temperature is a comfortable 30 degrees Celsius (86 degrees F) — however diving is possible the whole year from late February to the end of November.

At the time of printing, Penetration Divers had vacancies in trips planned for the following dates:

- August 14 to August 25, 2005
- September 11 to September 22, 2005
- October 9 to October 20, 2005

Trips depart Singapore and cost U.S. $2,000 for 10-days technical diving. The boat is equipped with all the equipment you would expect for a technical charter from booster pumps and surface supplied O2 to helium analyzers and large capacity twin tanks.

RETURN to the MYSTERY

Story and photos by John Rawlings

On July 3, 1929, while driving home from the town of Port Angeles in Washington state, Russell and Blanche Warren mysteriously disappeared from the face of the Earth. The only traces of their passing were some torn branches and scrapes near the shore of Lake Crescent and a car visor found in shallow water. While law enforcement was convinced that the Warrens lay in the deep waters of the lake, the technology wasn't available at the time to prove it, let alone recover any remains.

In 2002 the Warren's vehicle was discovered in 170 FFW and various artifacts were recovered and given to the Warren family. The story of that discovery was told in ADM # 13. No human remains were located, however, leaving some questions unanswered……

At the request of the Warren family, our team was asked to return some of the artifacts to the lake as a memorial. The team happily agreed and returned to the lake on Memorial Day weekend, 2004. Along with members of the Warren family, several other divers from the surrounding communities arrived as well to participate. On May 29, the best wishes and thanks of the Warrens ringing in our ears, the team swam out from Ambulance Point and dropped down into the cold, clear waters. Team member Randy Williams lovingly clutched the container holding the artifacts as he led the way down the steep underwater cliff-side toward the sunken car. As we plunged deeper the shape of the car began to appear, slanting forlornly with its roof pointing downward, partially buried in loose shale. The events surrounding this car had played a significant part in our lives for several years and as my depth increased and the outline of our target became razor sharp my thoughts began to fill with emotion. I thought of Rollie and Geneil Warren, their daughter Kristine and grandson Nicholas – all of them waiting up on the beach for word that the deed was done – reaching out to lovingly touch their ancestors through the mists of time. As I dropped the last few feet and arrived at the car I reflected that everything we had done here had been well worth it.

From the corner of my eye I saw Randy reach in and carefully place the artifacts inside the cab of the car. The rest of the surrounding divers hovered back respectfully so as not to disturb him – eyes staring from their masks as if mesmerized. His task done, he eased back out of the cab and slowly made a circuit of the vehicle, attempting to remember every detail, most of the other divers following suit.

As the team began their slow ascent, my dive buddy, Jerome Ryan, and I began our assigned task. Only half of the hood ornament from the Warren car had been found, and we were to search the slope directly

A diver films the undercarriage of the Warren vehicle - 170 feet beneath the surface of Washington's Lake Crescent.

below the car to see if the missing half might be recovered. We planned to drop down to separate depths – myself to 200 FFW and Jerome to 300 FFW - and then conduct a visual search. Moving slowly, I concentrated on looking for anything that might appear man-made, finding the occasional beer can or bottle dropped by fishermen long ago. I reached the end of my planned bottom time and turned upward toward my first deep stop at 180 FFW. Continuing upslope the rays of the sun now penetrated downward through the sapphire-blue waters. Approaching my second planned deep stop at 150 FFW I saw a beautiful old tree lying on its side, its roots branching up toward the surface like a starburst with sunlight dancing along the roots. Thinking that this would be a good spot to spend my time, I glided over the trunk, glanced downward – and froze. Lying on the bottom was an unmistakable human femur. Hardly believing my eyes, I noticed a skull-cap resting in the silt just slightly above it. Hurriedly, I took out my slate and drew a map of the site, showing the depth, the tree itself, the location of the bones, and other immediate features. Holding my own leg next to the femur, I noticed that it was large and probably that of a man.

My brief stop time would be over in seconds, so I shot a compass azimuth directly toward shore and proceeded to follow it as precisely as I could up the steep incline wall. I maintained my slow 10 fpm ascent rate and stuck to my plan, making all of my planned stops. I was pumped with excitement, but I had no desire to rush to the surface and pay for that excitement with a chamber ride or worse!

Finally, I broke the surface and discovered that I was approximately 150 feet or so east of Ambulance Point and immediately next to the highway, traffic rushing by only feet away on the other side of the guardrail. I could see the rest of the team and the Warrens on the beach, but they couldn't hear me over the noise of the traffic. Ultimately, Geneil Warren glanced my way and the NPS boat was sent over. Fellow team member, Ranger Dan Pontbriand, was at the helm and his jaw dropped when I hollered out "I just met Russell Warren!" Dan passed the boat over a depth of 150 FFW and hit the GPS when I signaled him that he was crossing my recorded azimuth, enabling the discovery site to be plotted. He and Randy then helped me onto the boat and we headed toward the Point, where a small crowd had now gathered.

Once on shore there was just one thing I needed to do and, staggering under the weight of my doubles, I proceeded to do it – I looked Geneil and Kristine in the eyes and with my voice trembling with emotion said "I just found Russell for you". Their eyes glistened and smiles lit up their faces. Once more I realized that somehow I had again been blessed by being at the right place at the right time.

Other members of the team dived at the site shortly thereafter using the coordinates and my map and were able to film the remains. This footage was provided to the National Park Service to be used in the subsequent investigation. Standard procedure meant that the site was now regarded as a "crime scene". The NPS immediately placed a moratorium on diving in that portion of the lake in anticipation of the investigation and recovery.

In early December three members of the National Park Service Submerged Resource Center team arrived at the lake. Their tasks were to document and map the site, locate any additional human remains, and recover any remains found for analysis. Dave Conlin, marine archaeologist, Jim Bradford, terrestrial archaeologist, and Brett Seymour, photographer, had just come from a survey of the USS Arizona in Pearl Harbor. The cold, clear waters of Lake Crescent in Olympic National Park

Warren family members Kristine Coachman (Great Granddaughter), Nicholas Coachman (Great-Great Grandson), and Jim Warren (Grandson) watch from the beach as the team does its work.

are a clear contrast to those of Hawaii and these two sites provide ample evidence of the versatility and adaptability of their team. With only a limited number of days available for the dives, the team assigned a separate task for each of the days. The first day was devoted to surveying and filming the bottom surrounding the Warren car and the bones utilizing a Remote Operated Vehicle (ROV). The second day would be used for measuring and mapping the extended site, while the third day would be used for the recovery of all human remains located during the previous days.

At the request of the Warren family I was present during each of the three days, although because the site was regarded as a crime scene I would not be able to dive with the team as I was not a member of law enforcement involved with the case. While understandable, I bit my lip in frustration at not being allowed to accompany the team on their dives – I'm not used to staying behind. My good friend, Dan Pontbriand, however, was able to participate in the dives as a full team member since he is by profession within the law enforcement arm of the National Park Service. Though proud of him and happy for him, I was also green with envy! I spent the three days observing and photographing topside activities involved in the investigation and the dives themselves.

The first day began rather monotonously as we watched the small screen linked to the ROV as it criss-crossed the bottom scanning for additional remains. After several hours, however, excitement built as a second femur was discovered downslope of the first in approximately 190 FFW. It was partially covered by rocks and appeared to have been there as a result of a rock-slide. No other obvious bones were located, although smaller "splinters" were thought to have been seen on the screen by some of the team members. Members of the Warren family were able to join the team and examine the dive site through the "eye" of the ROV.

The divers entered the water on day two in two separate buddy teams, the second not entering the water until the first had surfaced and was safely aboard. The first team, consisting of Dave Conlin and Dan Pontbriand, was tasked with measuring various aspects of the site using reels and measuring tapes. The tapes were then left in place so that the second buddy team, Jim Bradford and Brett Seymour, could make use of them while photographing the site utilizing both still and video equipment. The teams used a Heliox 80/20 mix as their bottom mix with EANx 30 as a travel gas. 100% O2 was used for decompression, regulators hanging down from the stern of the primary dive boat to a depth of 20 FFW. It was during these dives that the "splinters" thought to have been seen with the ROV were determined not to be bone fragments.

The following day Jim Bradford and Brett Seymour dived first, tasked with the recovery of the bones while simultaneously photographing the actual recovery. Special containers were used to hold the skull and the femurs while keeping them in the lake water they had been in for decades, thus maintaining the same chemical balance and preventing deterioration. The second team then wrapped up the project by recovering the measuring tapes utilized throughout the site. Both dives went without a hitch and the bones were turned over to the King County Medical Examiner's office for analysis and DNA testing.

Upon arrival at the Medical Examiner's office a forensic anthropologist examined the bones and determined that they are from a white male adult approximately 5'10" to 6'3'' tall. The femurs were of the same length and are a matching set,left and right leg.Pr oblems arose when the bones became very fragile during the air drying process after having been out of the water for only a few minutes. They appear to have been in the lake for decades due to the amount of deterioration.The condition of the bones suggests that DNA extraction may not be possible.However , the facts that the remains were in such close proximity to the Warren car, are of approximately the same age, and are from a tall white male, lead us to believe they are likely the bones of Russell Warren. Not the definitive results we had hoped for but certainly far more than we had before.

The mystery continues.....

National Park Service Divers Dan Pontbriand and Dave Conlin prepare to drop down into the cold, clear waters of Lake Crescent.

Siberia's Frozen Underground

Cave Exploration in the Russian Winter

Texy by Phill Short

After three 24-hour days of driving South from Moscow through numerous checkpoints, we finally arrived in the town of Sochi. In the summer, this area on the Black Sea with the Caucus mountain range as a backdrop is the Russian Riviera. Sadly, we weren't here in the summer but mid January. The whole drive had been in thick snow with an air temperature of –20ºC/4ºF, and we still had a long way to go to reach our goal.

This was the beginning of my first trip to Russia. After completing a full cave certification for three Russian students in the Dordogne region of France, they invited me to Russia to dive a cave they had visited before that went beyond 50m/164ft, and they wanted me to help them continue exploration. This trip lead to three further trips between 2001 and 2004 in both the Caucus mountains in Southern Russia and the Ural mountains in central Russia.

The fourth day was spent driving, digging, towing, and pushing three 4X4s full of equipment to our base in the Caucus foothills through increasing amounts of snow. Our base was an abandoned government building about 10K/6.2 miles from advanced base camp, which was the cave entrance. The only way to get the gear there was by foot in rucksacks and frames. This was achieved mainly due to the hard work of a team of 20 cavers who were our support team for the next two weeks and involved carrying 25 cylinders, a generator, a compressor, and many bags of cave diving and camping equipment. They hiked the gear through the forest, into a gorge, and then up the gorge to the cave entrance. Several sections of the journey required rope hand lines, abseils or wire ladders, and the main drop into the gorge required a rope and pulley haul system to lower the gear diagonally down into the gorge and across a river.

This was certainly the most remote cave I had yet to dive, and I was very exited to see the sump and do a recognisance dive to see the existing line that the Russian divers had laid. By many standards, the trip to the sump was straightforward. We could walk to the sump with only two short crawls and one ten foot climb with a hand line while wearing twin tanks or a rucksack of gear so it did not take long to get to the sump pool.

The cave is an active resurgence for several deep SRT caves high in the mountains above, and the reason we were here midwinter was to get low water flow in the cave as the sinks on the mountain were all frozen solid. The last 100m/328ft to the sump followed an active stream with the entire flow, which was low and made visibility good.

Alexi Rechetniak and I were diving separately on the first dive. Visibility swimming into the flow was around 10m/33ft and at 4ºC/39ºF was not as cold as I expected. The passage was clean white limestone with a heavy gravel floor. The light from my HID light reflected from the walls lighting the 4m/15ft diameter descending tube. The passage covered 100m/328ft and slowly

dropped to 10m/33ft following a corkscrew of sweeping turns in the passage. It then descended rapidly in several steps to a ledge at 30m/100ft then dropped vertically to a flake at 40m/133ft where the line ended. I tied in my primary real and dropped down the shaft to reach a dark black gravel floor at 50m/164ft, where the passage continued down at a 35-degree angle and up to 8m/25ft wide but only a 2m/7ft high. The height of the cave dropped further to a single meter. I moved forward slowly laying my line tight to the right wall using orange rock flakes on the ceiling as belays. This was the recognisance dive, so I had elected to use double 12 L/ 72 ft3 cylinders of air and a 10 L/66 ft3 cylinder of EAN80% for decompression. When I reached 65m/213ft at a large flake of rock, I tied off the line leaving the reel for the next dive and began my return swim. The decompression was calculated by my VR3 set to air and EAN80% and excluding deep stops throughout the return swim required 22 minutes of decompression.

We sat around the campfire talking through the dive and the 60m/196ft of new line added to the sump. We also began to plan for the next dive while drinking copious quantities of hot tea, which was kept in a huge pot over the open fire all day and was the ideal way to warm up after the dive.

The next day was spent mixing gas from the cylinders of helium and oxygen we had carried up the gorge and topping off with air from the 3 CFM compressor. I mixed trimix 16%O2/40%He for my double 15 L/98 ft3 cylinders, a 10 L/66 ft3 stage of EAN50% and two 10 L/ 66 ft3 stages of EAN80% for the dive. Again, the decompression on my VR3 set to 16%O2/40%He, EAN50%, and EAN80% was to be followed, but we cut a backup table in case of computer failure or gas failures.

In the morning, the previous days sunshine and a rise in the air temperature had caused snowmelt on the mountain and the water level had risen 8m/26ft. This meant that the sump was now 100m/323ft longer and my limit of 65m/213ft yesterday would now be at 73m/ 240ft. Flow had increased but still easily diveable, so we carried the gear to the sump for a dive.

To deal with the cold, I used Fourth element as a base layer, a fleece one piece mid layer, then a 400 gram high grade thinsulate under an Otter technical skin, a 3mm hood with an 8mm hood over the top and 3mm neoprene gloves under 8mm two-finger mittens for my hands. This paid off on this dive, as the melt water had lowered the water temperature to 3ºC/37ºF.

I set off into the sump in reduced visibility, down to five meters, breathing my travel gas of EAN50% and clipped both cylinders of EAN80% to the line at nine meters. At a depth of 20m/65ft, I switched to my bottom mix and stowed my travel gas second stage, leaving the cylinder on to allow for suit inflation and continued down the shaft to my reel now at 73m/240ft and 470m/1540ft into the sump. I quickly passed

through the low 1m/3ft high section of passage to a descending 4m/14ft wide by 3m/10ft high gravel floored passage. I continued to a point 70m/230ft from my previous limit where at 86m/258ft I belayed the line at the start of a steeply descending passage that continued deeper to the limit of visibility and turned my dive due to reaching the MOD of my mix. Excluding deep stops, the dive generated a chilly 72 minutes of decompression with gas switches to EAN50% at 22m/70ft and EAN80% at 9m/30ft.

One year later at two in the morning, Alex arrived at the cave entrance again to find vast quantities of dirty brown water flowing out of the entrance and through the previous years advanced base camp. The pleasantly warmer conditions meant we would not be continuing exploration of Hosta this year, but the next day we drove further south to Alex's plan B site, a cave called Glbokiy Yar.

This was to be more like the caving I'm used to in the UK, sections of vertical cave, climbs and abseils, sections of stream passage and dry cave, and multiple sumps.

The entrance to the cave was reached by following two water pipes 10K/6.21 miles along the river then up an inlet through the forest. The water pipes take water from the lake in the cave entrance to the town and were installed by German POWs in World War II. The cave entrance is situated at the base of a large cliff behind a 50m/165ft high waterfall. To reach the first sump, four separate SRT pitches were rigged and a tension wire haul line and pulley for the gear. These pitches and haul line got the team the first 100m/320ft into the cave and up the inner 30m/100ft high waterfall. The stream passage had to be followed for a further 200m/656ft to sump 1.

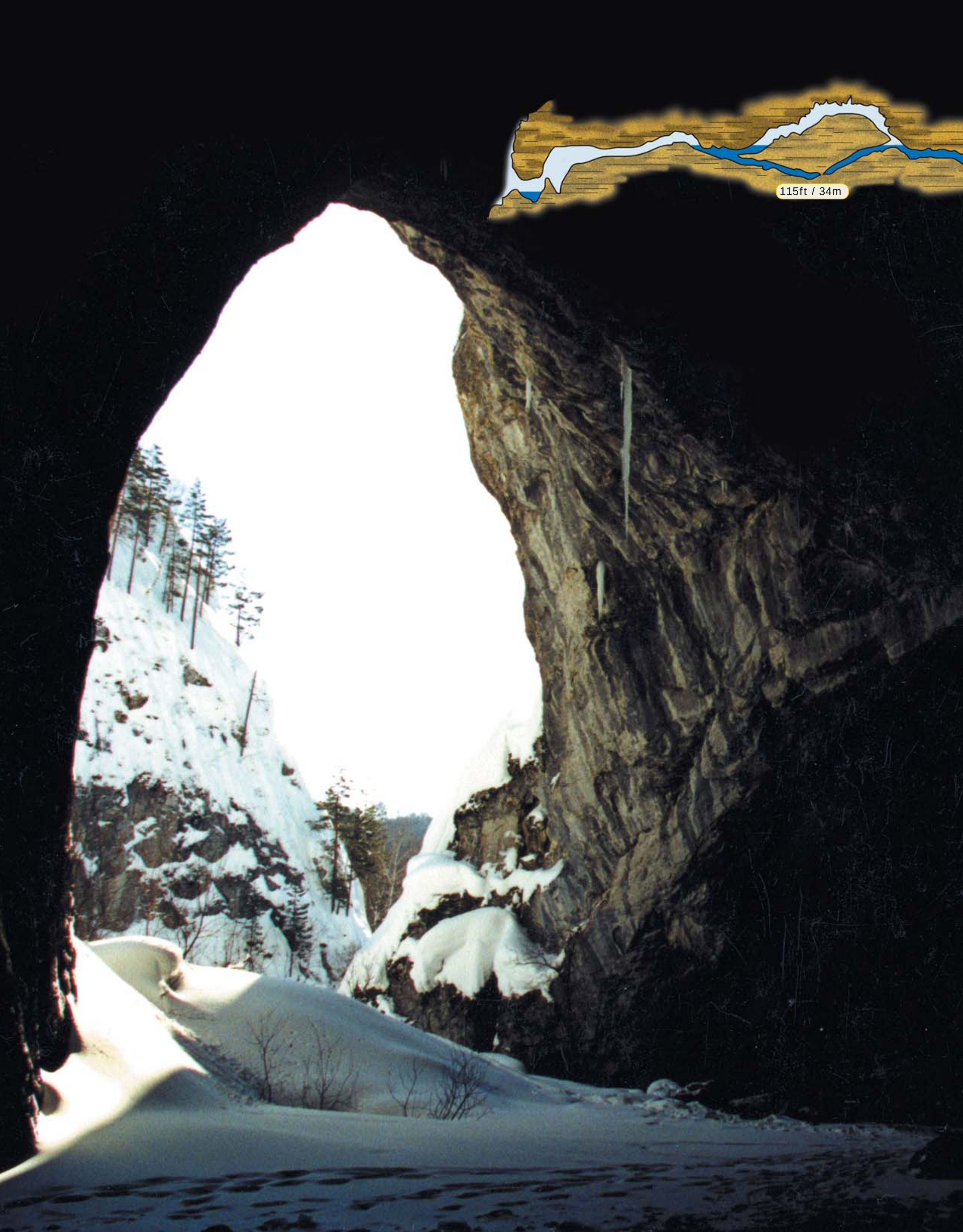
It took four days of rigging, hauling, and carrying to get the gear to sump 1. We then did a recognisance dive. Sump I can be followed in rapidly descending passage to a depth of 30m/100ft where the entire water flow issues from a low, wide slot only 15cm/6 inches high just beyond the elbow of the sump. Looking into this slot, the passage can be seen to ascend and enlarge to the limit of visibility. Further back at 14m/45ft, a sideline leaves the main water flow and passes through boulders to surface in a small muddy pool at the base of an ascending vertical rift. This continuation leads up via 30m/100ft of easy free climbing to a 50m/164ft hands and knees crawl and a large boulder floored chamber. From the chamber, a very unstable 45-degree boulder slope must

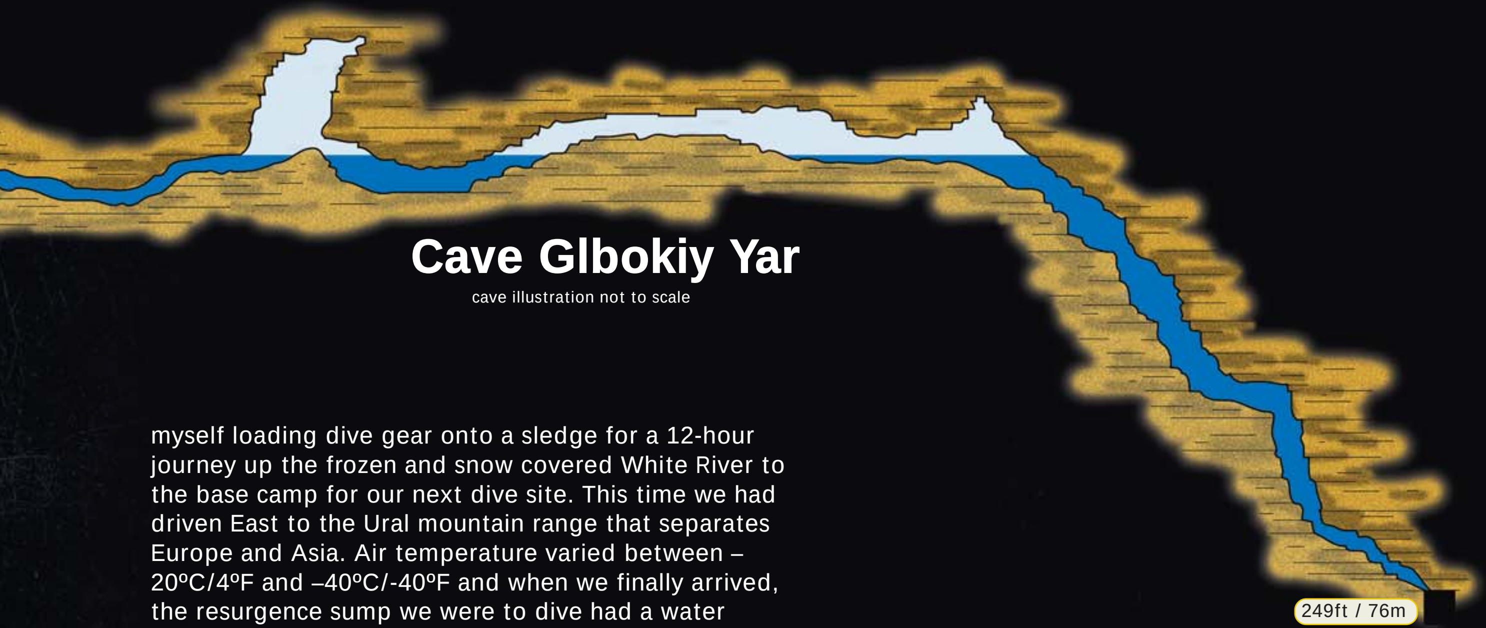
be descended using a rope and descender to a small and very uninviting pool of brown water, which is sump 2.

This turned out to be quite an intimidating dive as after descent in zero visibility the passage narrows like entering a funnel and becomes so tight that I had to remove stages and unfasten my waist belt to allow myself to pass this short section with cylinders scrapping the ceiling and belly and chest scrapping the floor. On passing this restriction, the passage continues in poor visibility and small dimensions until reaching an opening that drops into a crystal clear large dimension passage in the main water flow. Downstream, this passage reaches the other side of the 15cm/6 inch high slot seen at the end of sump 1. Upstream, it continues for 300m/1000ft to surface in a large lake leading directly into sump 3, which is 200m/650ft long and surfaces in stream passage where you have to crawl out of the water through thick mud for 50m/164ft before dropping back into the stream. The stream follows for 100m/325ft to sump 4, the objective of our trip. It took us three dives to reach this point due to spring melt floods. Each year the lines in sumps 2 and 3 are been broken in many places and have to be repaired. Eventually, with two support divers with us at sump 2, Alex and I were able to reach sump 4 with all the cylinders needed for me to reach the end of Peters line in sump 4 at 50m/164ft and hopefully go on.

We had planed the dive the previous day, and I had elected to carry double 15L/98ft3 cylinders of trimix 15%O2/50%He, a single 12L/72ft3 stage of EAN32% and two 7L/45ft3 stages of 100% O2. Suit inflation was again to be from my travel mix stage and decompression was to follow my VR3 computer set to 15%O2/50%He, EAN32%, and 100% O2 and backup being a second VR3 set the same. After entering sump 4, the passage descended rapidly in a series of steps and shafts to 47m/154ft where the line ended at the lip of another shaft. I tied on my reel and continued to descend into a large passage full of large car size slabs and breakdown ending in a large rock splitting the passage. Passing the rock at a depth of 60m/196ft lead to a gravel floored continuation of the descending passage. After laying 70m/230ft of line, the passage levelled out and reached a restriction at 72m/237ft of depth where I turned my dive on thirds. Excluding deep stops, I did 37 minutes of deco before surfacing in the canal to rejoin Alex for the trip out through sumps 3, 2, and 1.

Alex had decided that having been to Russia twice now that the next trip the following February would be somewhere cold! So after another four-day drive, I found


115ft / 34m



Cave Glbokiy Yar

cave illustration not to scale

myself loading dive gear onto a sledge for a 12-hour journey up the frozen and snow covered White River to the base camp for our next dive site. This time we had driven East to the Ural mountain range that separates Europe and Asia. Air temperature varied between –20ºC/4ºF and –40ºC/-40ºF and when we finally arrived, the resurgence sump we were to dive had a water temperature of 2ºC/35ºF.

Following Alex up the frozen river through the wilderness with blue sky and sunshine and no wind was a truly fantastic experience. The cold was nowhere near as bad as expected, but I found that the two weeks we were there I had to consume a large amount of calories and fluids to stay warm.

The cave was known as Shoulgan Tash. The dive site was a well-known and well-studied cave that despite its remote location was gated due to ancient prehistoric paintings found deep in the dry sections of the cave. I was fortunate and privileged to be able to see the paintings of Mammoth, Bear, Horse, and abstract in the cave during my visit but our aim was to dive the resurgence sump outside the cave.

A small part of the resurgence was free of ice, but the cave mouth was full of ice Stalactites and stalagmites and the view out was stunning.

We did a series of set up dives over the first few days to check the condition of the line already laid in the cave by Alex to a depth of 50m/164ft. We then got ready for a push dive by planning the deco and mixing the gas. Again, deco was to be calculated using two VR3s set to trimix 15%O2/50%He double 15L/98ft3 cylinders, two 12L/72ft3 stages of EAN32%, two 10L/66ft3 stages of 100% oxygen and a 2L/13ft3 argon suit inflation cylinder.

Alex dived first and placed the two oxygen cylinders at six meters and one of the EAN32% cylinders at 35m/115ft on the line. I then entered and breathed the second EAN32% cylinder to 35m/115ft where I switched to my bottom mix and continued to the end of the line at 50m/164ft. I tied on a new line and continued following a steeply descending passage over a gravel floor passing a restriction at 70m/230ft then another at 77m/252ft, which was only passed by entering feet first and pushing the gravel floor down the slope to make a big enough gap to squeeze through. I then entered a little gravel floored room at 81m/266ft where the line was tied to a 2kg/4.5lbs lead block and pushed into the gravel in the left corner of the room where the flow came out of a small slot too small to enter.

I turned to exit to find that the restriction I had kicked through had slumped closed behind me. I had to pull the gravel around the line towards me in arm fulls to dig my way through the restriction, which reduced the visibility to zero. After passing the collapsed restriction, I got back into clearer water and began my return swim, which required 60 minutes of deco excluding deep stops.

I've had the opportunity of visiting many other sites in both the Ural and Caucus regions all of which have huge potential. We are currently planning our 2005 trip. All three trips have only been possible due to the hard work of Alexi Rechetniak and all the support divers and cavers.

The CAVE
The Movie

Text and Photos by Jakub Rehacek, Ph.D

Wes Skiles and his company, Karst Productions, are known for their edge-of-the-seat, hold-your-breath underwater imagery like that in the Antarctic adventure *Ice Island*, the IMAX epic *Journey into Amazing Caves*, and the award winning PBS special *Water's Journey*. So when the call came from Wes one Sunday afternoon, "Can you take 3 months off work?" I didn't have to ask for details, nor did I hesitate to give an enthusiastic affirmative. A three-month block of time with Wes Skiles, renowned underwater filmmaker, could mean only one thing – an exciting adventure!

Wes and his producer Jill Heinerth were assembling a team of cave divers to work as an underwater film unit for a major Hollywood feature film – **The Cave.** The movie, produced by Lakeshore Entertainment and Screen Gems, follows a team of expert cave explorers and scientists who become trapped in an underground cave system in Transylvania. The group encounters various cave-adapted creatures during their fight for survival.

The movie stars Cole Hauser, Morris Chestnut, Eddie Cibrian, Rick Ravanello, Marcel Iures, Lena Headey, Piper Perabo, Daniel Dae-Kim, Kieran Darcy-Smith. All actors were trained to at least Open Water status by Jill Heinerth in the early stages of the production. Meanwhile, all stunt doubles finished rigorous training on the Megalodon closed circuit rebreathers by Mark Meadows. The production ordered eleven custom-built Megalodon CCRs from the Innerspace Systems Corp. The "Megs" were selected for their ease of operation as well as their ruggedness and durability under the harshest of conditions. They more than lived up to their reputation. All the stunt divers had to complete 50 hours of diving between the end of training and start of filming.

Photo by Wes Skiles

A tougher order by far was Wes Skiles's parting shot to me personally: "Oh, by the way, you will need to lose 30 pounds because you will be one of the stunt divers doubling for the actors." Apparently it was going to be hard to match my 6'3" 220 lb. body frame to any of the actors without some serious weight loss.

The first part of the movie was slated to film in Romania. Jill Heinerth, film producer for Karst Environmental, went to Bucharest as a technical advisor to director Bruce Hunt in all things diving related. Since no one else from the movie crew could match her knowledge of the subject, she soon acquired additional "jobs". She became a advisor on prop design, costume design, cave set design, and dive equipment technician.

Brian Kakuk accompanied Jill to take on the job of Diving Safety Officer, undoubtedly the most difficult job on the set. He had to balance the safety of the entire cast and crew in and around the water with the demands of producers and directors for more exciting stunts and faster work tempo. "Do you know how much each minute costs?" was often heard at ritual morning stand-offs during GFC testing. The 3-5 second delay for a breaker to shut-off the 220 V power leaking into the pool seemed "acceptable" to the Romanian electricians, but quite the opposite to Kakuk and the dive crew. These issues were always quickly resolved and safety was never compromised.

The movie was filmed in Mediapro Studios in Buftea near Bucharest, Romania, where the production crew built five huge film sets of cave environment out of fiberglass and scaffolding. All five sets were molded and remolded into an elaborate cave system. An actual cave map was part of the script. One of the sets was a football field -sized black pool fifteen feet deep enclosed in a lightproof steel building. Inside, the production built a maze of cave passages and rooms with fiberglass walls and real sand and gravel floors. The pool was just filling with 2 million gallons of water when our team arrived. The next day we sorted through tons of excess luggage, assembled our dive gear, and went for our first "cave" dive. As soon as we submerged, we realized that something was wrong. The paint and glue from the cave walls were leaching into the water and the visibility was reduced to 2-3 feet, a condition not particularly favorable to High Definition filmmaking — although excellent for perming your hair. Fortunately, the underwater unit came to the rescue. Our key grip, Woody Jasper, had extensive experience in water purification and filtration. He was able to redesign the filtration system with use of diatomaceous earth filters, and the visibility quickly improved. This earned our team quite a reputation with the rest of the crew. When the water cleared up, and the director and producers saw the breath-taking clarity of our high-definition footage, requests for new shots started to pour in.

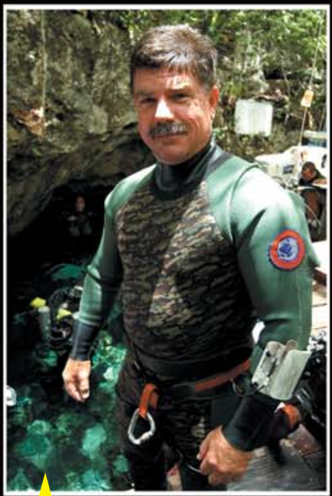
With visibility improved, and our team complemented by a group of Romanian gaffers and support divers, we were ready to start filming. Hollywood's idea of technical diving, especially cave diving, is a little different from our accepted practices. As stunt divers, we had to endure all sorts of configuration transgressions in the name of the silver screen:

Have you ever tried to frog-kick in a pair of bright yellow split-fins and aquarium-sized mask, while pulling a fully loaded underwater "sled" through narrow winding cave passages, while simultaneously being bombarded by an avalanche of boulders and sand? Air cannon explosions smash you into the walls as underwater "volcanoes" erupt in the background. Copious amounts of "movie blood" flow from assorted "wounds" glued to your body, and various cave-dwelling creatures surprise you behind every corner, while tank and scooter explosions add flair to the scene. That is cave diving a la Hollywood.

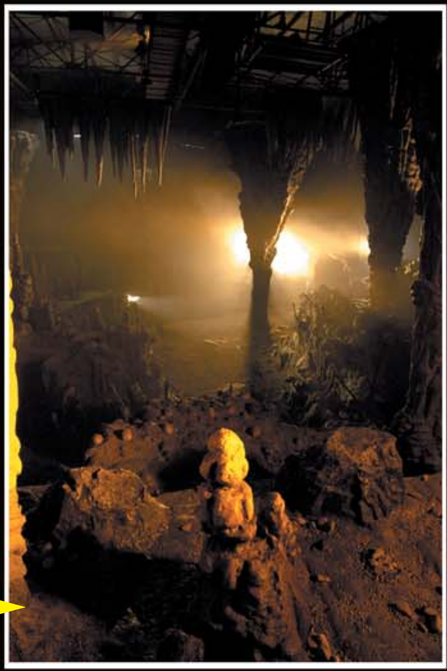
The most exciting parts of filming in Romania were the stunt sequences. We were jumping into the waterfalls, being blasted by water cannons, tumbled along the cave passages, and dragged along the pool bottom with feet tied to the length of rope, manned topside by a bunch of gleeful Romanian support divers. Often we were breath-hold swimming through cave passages from one regulator to another without a mask or fins. Our reliable safety divers, Brian Kakuk and Andreas "Matt" Matthes, always made sure that we reached the next air source in time. The most spectacular stunt involved a diver – Joel Tower, stunt diver extraordinaire – having to dive against the flow of bubbling propane while holding his breath. He had to submerge before the propane ignited and exploded on the water surface, but late enough to make it look like a close call. While breath-holding, his only safe way was down to the regulator of a waiting safety diver, since the water surface was a raging inferno of burning propane.

Some of the stunt divers, namely Jitka Hyniova, Jill Heinerth, and Joel Tower, doubled for several actors. That often resulted in a frantic exchange of costumes, rebreathers, wigs and assorted props. Some of us spent an hour or more a day in the hands of make-up artists who tried to make us look older or younger, darker, hairier, or just plain bloody and decrepit. Each of us had several sets of gear in different stages of disrepair, and our wet suits were in shreds with broken bones sticking out. Did I mention that this was a horror movie?

Wes Skiles and Karst Productions are known for their stunning underwater imagery in the High-Definition digital format. While the topside portion of the movie was shot on film with traditional cameras, the underwater footage was shot exclusively in HD (HDCAM SR format) on a Sony CineAlta™ HDW-950 and Fujinon lenses in Amphibico housing. The camera was connected via hundreds of feet of fiber optic cable to the surface engineering and recording setup manned by none other than Señor Nick "Bangs" Theodorakis. This setup provided Wes and Jill with unique opportunity to view the footage in real time on a 36" LCD monitor, and to make immediate corrections on the fly. Watching Nick "tweak" knobs and dials on his engineering deck was like watching a performance of a piano virtuoso. His hands were effortlessly flying over



Stunt Diver Brian Kakuk in costume.



Main set during filming.

Movie set 5.

the controls while his iPod blared the latest techno grooves. The fact that we could swap tapes without taking the camera out of the water improved our productivity tremendously; but it also made for quite long days: two four-hour-in-water shifts were the rule rather than the exception. The tanks and scrubbers were swapped at the edge of the pool, and sandwiches and coffee were served in the water. Wes's battle cry "Dive, Dive, Dive!!!" could be heard above and below water surface thanks to the communication systems tirelessly maintained by our second cameraman and technical guru, Anthony Lenzo. The full-face masks that were worn by cameramen facilitated communication with both the surface and the divers. All divers had earpieces, so they could hear and respond to directions.

The ingenuity of our grips, Woody Jasper and Tom Morris, had earned our team a place on the official "call" sheet, where Woody's SFX department listed a daily set of requirements for underwater special effects that were too specialized for the regular special effects department. Is that clear to everyone? We were constructing underwater volcanoes, fiber cable splicing/fusion boxes, building rock avalanches, designing scooter explosions, and setting up a safe sandbox for filming the actors under water. Every day brought new challenges and new opportunities for creativity. The scrap heaps around the set were a constant source of materials for our resourceful special effects crew.

After six weeks of filming in Romania, the underwater film unit packed all their gear into several hundred boxes and shipped everything to Yucatan, Mexico. Two weeks later we were all assembled in beautiful villas in Akumal, Quintana Roo. Here we were joined by a group of local cave divers, many with experience from previous underwater movie-making endeavors. We spent four weeks in a cave system called Dos Ojos filming the "beauty shots" for the first part of the movie. The scenes we shot had stunt divers scootering through beautifully decorated halls of the cave system, as well as crawling through silted out passages. "Act panicked, act panicked!" blared Wes' voice through the earpiece. Swimming through silt-out with voices in your head, only able to feel the leg of the diver in front of you ... then suddenly there was a camera lens right in your face. Scary situation!

The most challenging aspect of filming in these beautiful locations was the logistics of moving hundreds of feet of electrical cables through the decorated halls without causing any damage. We often had up to ten "cable wranglers" suspended in mid water with coils of fiber optic cable in their hands waiting to unspool as Wes was riding with his hundred-pound HD camera on the back of a stunt diver on a scooter. It was an underwater ballet. This was all happening under the watchful eye of the safety divers who made sure that the fragile cave decorations were safe.

The local descendants of Mayans were indispensable in setting up and maintaining our jungle camps. Electricity, running water, and generators were set up around a small hole in the ground in the middle of the Yucatan jungle. Charging stations had to be built, wardrobe tents set up, and an air-conditioned "field studio" for director Gary Philips and engineer Nick "Bangs" was erected in no time thanks to the efforts of the entire crew.

Stunt diver Jakub Rehacek. Photo: Jitka Hyniova

Stunt diver Jitka Hyniova in costume. Photo: Andreas Matthes

Anthony Lenzo, Nick Theodorakis and Wes Skiles,

The ultimate compliment to the work of our team came from the producer Andrew Mason in a form of an e-mail:
"When we look through the script we realize how vital the underwater action is to both the storytelling and the building of the fear factor, and your work has been spectacularly successful in both areas. I once worried that we might create greater interest in cave diving and send too many amateurs out into your world, but now that we have the footage (and of course the rest of the film built around it) I'm pretty sure that by the time we've finished with an audience there will be no-one who ever wants to go anywhere NEAR a cave, let alone in the water !!"
When producers saw the real cave footage, they requested many more new "beauty" scenes, and our shot-list almost doubled. Eventually, however, our time had run out, and we left Yucatan at the end of August.

The divers spent a total of 2,507 hours underwater. 30 divers were submerged for 1,702 hours in Romania, and 24 divers were under water for 805 hours in Yucatan. All dives were completed without an incident, and the eleven Megalodon rebreathers performed flawlessly in chlorine and epoxy rich waters in Romania as well as in harsh jungle conditions in Mexico.

That's cave diving Hollywood style.

The filming is completed, and the editing floor is collecting the fruits of our work. The movie should be released on August 19th, 2005 in US theaters.

See you at the movies.

U/W Photography Unit / Romania and Q. Roo, Mx

U/W Unit Director of Photography	**Wes Skiles***
U/W Unit Supervisor	**Jill Heinerth***
U/W Assistant Director	Jitka Hyniova*
HD Digital Imaging Engineer	Nick Theodorakis
U/W Operator/AC/ Communications	Anthony Lenzo
U/W 2nd AD	Mark Meadows
U/W Diving Doubles & Grip/Lighting	Jill Heinerth*
	Jitka Hyniova*
	Brian Kakuk*
	Anthony Lenzo
	Andreas Matthes*
	Mark Meadows
	Jakub Rehacek, Ph. D*
	Joel Tower
U/W Gaffer	Ted Overton
U/W Key Grip, Special Effects	Woody Jasper
Dive Safety Officer/2nd AC	
Romania U/W Unit	Brian Kakuk*
Topside Gaffer	Tavi
Topside Grip	Duro
Lead Utility Diver	Atilla Szallos
Support Divers	Marius Beju
	Adi
	Alex
	Manu
U/W Props	Sorbon Boncea
Dive Coordinator Romania	Bogdan Gheorghiu
Quintana Roo, Mexico U/W Unit	
U/W Production Manager	Doug Dresser
Unit Manager	Ross Ambrose
Dive Site Ops Manager, Safety	Lenny Bucko*
Asst. Digital Imaging Engineer	Nick Bangs
2nd AC	Mark Long
Best Boy Grip	Tom Morris
U/W Grip and Lighting	Kenneth Broad
	Nate Skiles
	Chuck Stevens
Safety Officer	Steve Bogarts*
Utility & Safety Divers	Paul C. Heinerth*
	Bil Phillips
	Chris Stanton
Utility Diver	Imanol Zubizarreta
Lighting & Battery Technician	Scott Braunsroth
Topside Gaffer	Candelario Perez
Grip & Electric Crew Chief/Translator	Simon L. Manses
Wardrobe & Props Mexico	Heather Moore
Topside Equip Tech / Best Boy	Manual Guavara
Electrician	Effrain Flores
Generator Operator	Oscar Velazquez
Dive Operations Support	Martin Argerich
	Scott Carnahan*
Cozumel Unit Manager	Marco Polo
Production Accountant	Steve Taylor
Catering/ Support	Shannon Caraccia
	Martina Jeising
	El Ranchito Castro
Team Caretakers	Denise Taylor
Production Office Coordinator	Elisheba Solis
Production Assistant	Enrique Estrada
Transport/ Swing Captain	Derek Raser
Drivers	Angel Escobedo
	Miguelito
Site Security	Gabriel Ruiz
	Emmanuel Chan Tun
	Zacarias Balam
	Jose E. Guitierrez
U/W scenes filmed on location at Hidden World's Cenote Park, Q. Roo, Mexico	
Rebreathers Provided by	Innerspace Systems
	Leon Scamahorn*
Dive and Sport Equipment Provided by	Body Glove
	Oakley
	North Face
	Dive Rite
	Bare

* Advanced Diver Magazine staff or contributor

DISCOVERY OF SACRED WATERS
YUCATAN 2005 EXPEDITION

By ADM staff and team member Rusty Farst

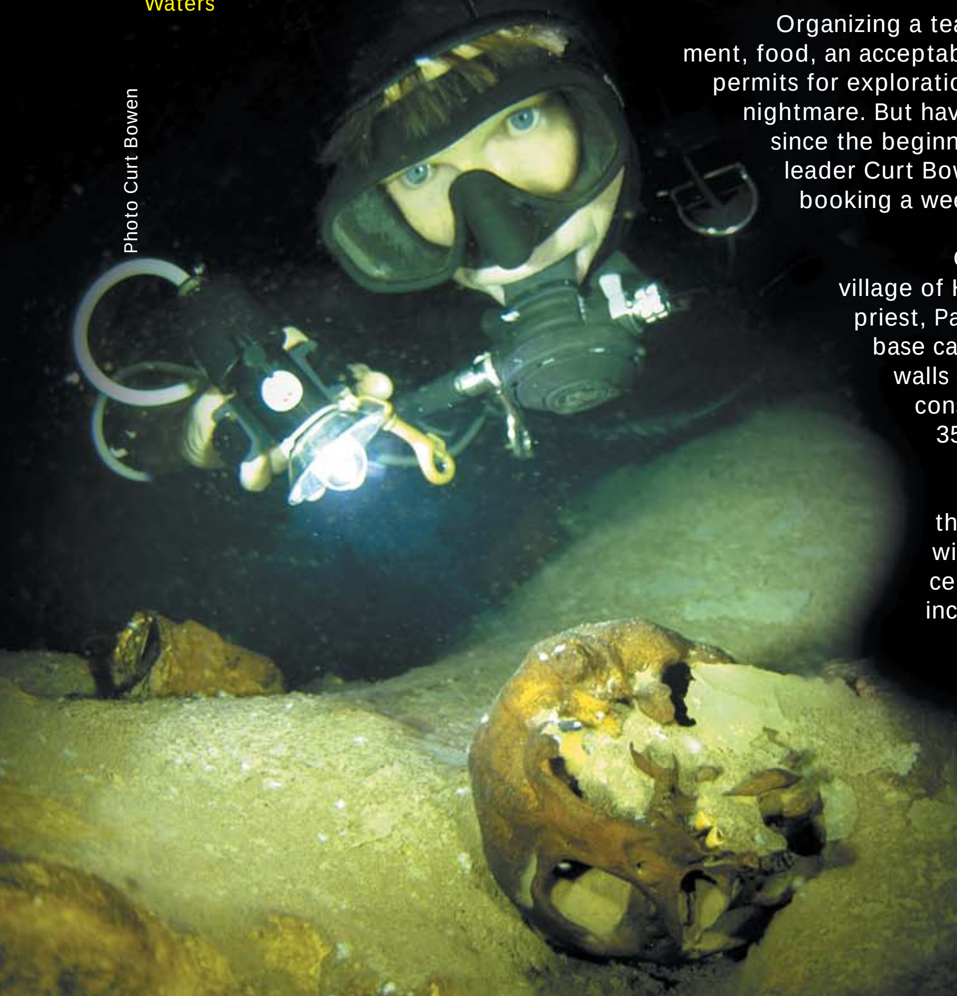
Mayan mountains are what the local villagers call the enormous undisturbed piles of stone. In reality, they are ruined cities, forgotten in time, overtaken by a thousand years of jungle growth. A Maya culture thrived in this location a thousand years ago, with raised roads, market places, houses, and religious temples. The fall of the ancient Maya brought abandoned cities left forgotten by man and reclaimed by nature.

Traveling deeper into the Yucatan's inner jungles, a hundred miles from the tourist cities located on the eastern Riviera coast are where our team of eager cave explorers ventured. Far from the easy tourist caves of Quintana Roo, we seek new unexplored territories containing centuries old ruins, adventure, and submerged caverns no man has ever explored before.

Organizing a team of eight divers, vehicles, climbing equipment, food, an acceptable base camp along with proper government permits for exploration in the Yucatan can become a logistical nightmare. But having traveled and explored in the Yucatan since the beginning of this decade, team coordinator and leader Curt Bowen seemed to make it look as simple as booking a weekend at Disney.

Our team was based in the small Mayan village of Homun. Curt struck gold when the local priest, Padre Tibel Aaron May invited us to make our base camp in a section of his church. Ten foot thick walls and 30 foot arched cathedral ceilings all constructed of cut stone and laid by hand over 350 years ago, a construction marvel of its own.

Our team had several objectives during the ten-day expedition. Explore and document with video and photography as many new cenotes and caves as possible. Documentation included, recording GPS locations, maximum depths, size and shape, going passages, biology, pollution, and archeological discoveries. All of this data is then compiled and turned over to the Yucatan Ecology Department who adds it to their ever-growing list of cenotes.



Below: Explorer Eric Osking illuminates ancient Maya human remains discovered in the Chamber of Sacred Waters

Photo Curt Bowen

It has been 18 months since I accompanied the last expedition to this area. My memories of the discoveries we made then, fueled my enthusiasm. I felt sure there were many more discoveries to be made to the east and southeast of Homun. Each morning at 0530 hours, before the sun even cracked the horizon, our Gestapo leader, Adolf Bowen in his gruff voice and right eyebrow raised would begin the daily barking of orders. "Get your butts out of bed, daylights wasting" or "You can sleep when you're dead," echoed throughout the church halls. I think even the lonely church mouse, which could be easily seen nibbling at our food supplies stood to attention, ready to explore.

Packing the vehicles with the days food supplies of breakfast bars, fruit, a jar of peanut butter and bread along with each persons dive equipment, climbing ropes, and ten scuba cylinders filled with the only mixed gas available, EAN21 or air as it used to be known.

Our guide Elmer, a man in his middle to late 60's has lived in the area of Homun his entire life, and it was his job to build and fix all of the local farmers' water pumps. Since these pumps were placed at the openings of cenotes, Elmer was justifiably the local cenote expert by trade.

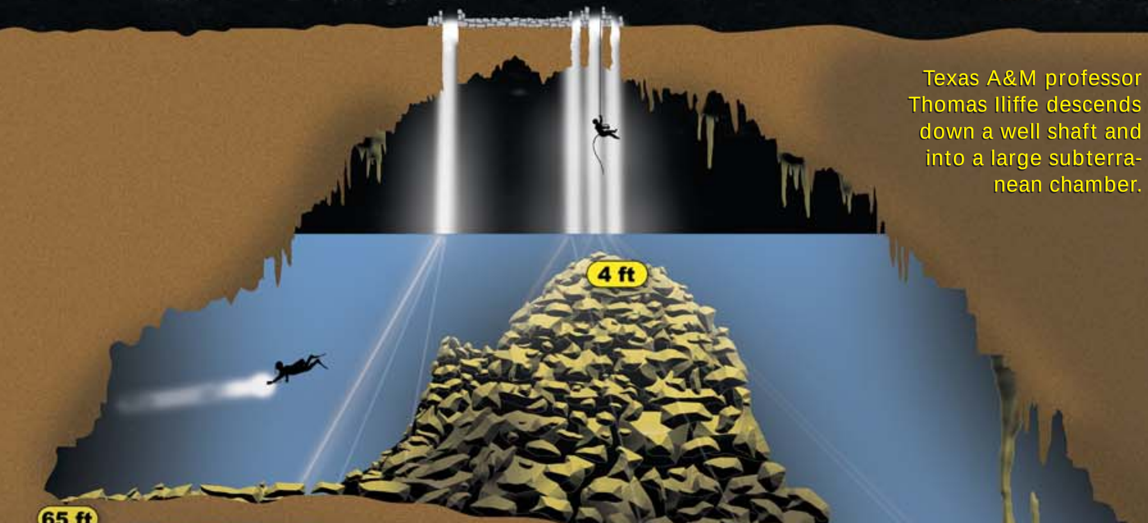
Photo Curt Bowen

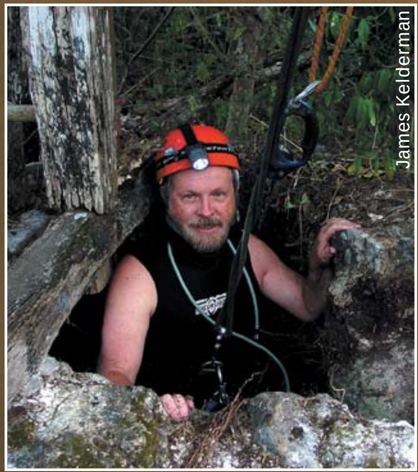
Photo Curt Bowen

Right: The Chamber of Sacred Waters reveals three-foot tall Mayan pottery laying undisturbed for over a millennium

Photo Curt Bowen

Below: Professor Thomas Iliffe poses within newly discovered crystal clear aqua caverns





Texas A&M professor Thomas Iliffe descends down a well shaft and into a large subterranean chamber.

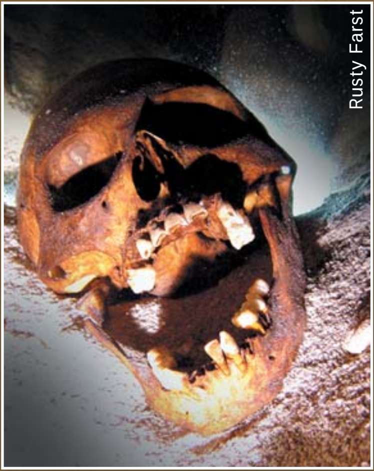
Left: Triple well shafts are the only entrance into the deep caves of Cenote San Mogel

Below left: Explorer James Kelderman rappels into the enormous cavern of Cenote San Mogel

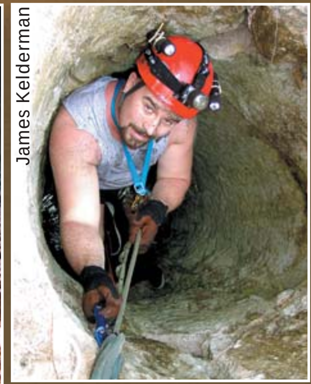
As the days of exploration accumulated, so did the list of newly explored cenotes, but not without a price to the health of the team members. The Yucatan holds many unique animals and plants that I am sure are placed on earth to irritate and cause pain to visiting white “gringo” explorers. In past expeditions, we have been plagued by swarming mosquitoes, biting horse flies, poisonous burning plants called Pica Pica, thorny trees, and the ever burning heat of the sun. Picking the cooler month of January and the Yucatan’s dry season, we assumed we would miss these past plagues. What we didn’t know about were the swarms of freckle-sized ticks that thrive during the cool dry season. By day three, each explorer proudly showed off their hundreds of tick bites during the evening scrub down. All respect is lost for yourself when you agree to pick ticks off and wash your buddies back if he agrees to do the same for you. On day four, we were able to locate a bar of dog flea and tick soap at a local pharmacy. The church might have smelled like a dog grooming boutique, but the tick problem was solved.

Our team consisted of eight explorers, each with their own special talents and personal idiosyncrasies. Curt Bowen, team coordinator and owner of this magazine was kept busy making sure all activities ran smoothly along with being extremely anal about rope safety, knots, and anchor configurations. Any stupid question was quickly answered with no words, just by how high his right eyebrow would raise as he peered over his glasses in your direction. Brett Hemphill, veteran explorer was noted as the teams “Go Man.” Any little hole that looked uninviting because of its small size or possibility of being infested with some type of undesirable critter, Brett was quickly called upon. “Brett you’re up!” could be heard on many occasions echoing throughout the thick jungle. Within minutes, the appearance of the long, bushy haired, always smiling face of Brett Hemphill would dart by and seem to slip effortlessly into whatever insane hole that the rest of the team was to chicken to crawl into. Minutes later he would magically appear with news of massive tunnel, always bigger then he has ever seen before.

Eric Osking, new to this type of exploration cautiously watched and questioned most of Curt’s knots, anchors, and rope techniques. Of course, Curt fueled his concerns by his typical softly spoken comments such as, “I think that small tree I tied to will hold? or “I’m not really comfortable with that knot, but it’s OK because you’re on the rope.”

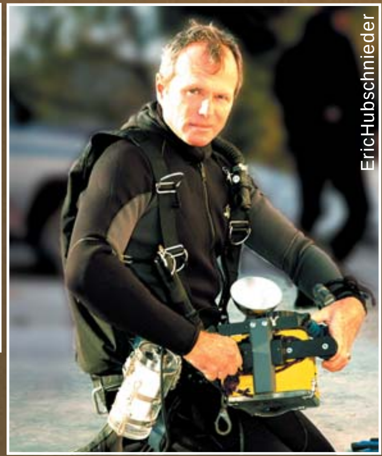


Screaming Skull in Cenote Kanun



Thaddius Bedford ascends out of a farmers well shaft that connects to an underground chamber

Triple bell towers above the church in the village of Homun. This amazing three story cut stone building was built by hand over 350 years ago



Rusty Farst prepares for an exploration dive with his video equipment.

The climax for the Yucatan 2005 expedition was the discovery of the Chamber of Sacred Waters. An extraordinary cenote of beauty, fascination, and archeological significance exposed its secrets of human tragedy, Mayan history, and mid 1800's military revolution.

Right: Explorer Eric Osking examines a flintlock long rifle used during the Mexican revolutionary war. Uninterrupted for over 150 years, this flintlock rifle still appears to be in decent shape.

Photo Curt Bowen

One of the most magnificently decorated cenotes ever discovered in the state of the Yucatan (see left illustration) revealed itself for the first time to Explorer Brett Hemphill. Squeezing through a small hole (see above right photo) he dropped through the roof of an immense crystal clear chamber filled with enormous stalactites and the Yucatan's largest standing stalagmite measuring over 15 feet in diameter and standing over 40 feet tall. After exploring the depths of the Cenote, we discovered that we were not the first human to dive into its depths. A misfortunate Mayan, probably attempting to raise water from the small entrance must have slipped and fallen to their death. His/her complete skeleton was discovered laying half buried in white calcite at a depth of 120 feet. (see above photo)

Professor Thomas Iliffe, one of the worlds leading cave biologists and 25-year veteran explorer provided the team with enormous credentials. Tom could be seen darting around in the darkness of the newly discovered caves either pulling around his miniature minnow net or hand-capturing pinhead sized critters in small white-capped bottles. He seemed overly excited after several dives as he hunched over his newly captured monsters. A few times I swore I could hear him mumbling the words, "my precious."

Thaddius Bedford, a Great Lakes wreck explorer, photographer, and videographer joined the team with his sidekick, Eric Hubschnieder. Thad, as we called him, kept his eyes pealed for new video angles and photography ideas. His camera lens was always in someone's face as they prepared their gear, rappelled down well shafts, or relieved themselves on the closest thorn bush. Eric Hubschnieder, photographer assistant for Thaddius and expert rock climber quickly became the, "I don't think that hole goes anyplace but lets send down Eric just to make sure." He was given the most bee stings (36) of the expedition award when he stuck his foot into a hornet's nest. If only you could have seen Curt, Eric Osking, and James yank his butt out of that hole; good thing he only weighs about 135 pounds.

James Kelderman, explorer returned on his second Yucatan expedition. Obviously the torture he endured on the last trip was not enough. Thin and agile, James quickly became a master on rope making the heavier guys look somewhat pathetic.

During the ten-day expedition, the team was able to explore and document 32 new cave systems. We were chased away from several still unexplored systems by swarms of killer bees; seems they like to build their VW bug sized nests in the cenote walls. Several of the cenotes explored contained archeological discoveries of importance from broken pottery shards, full pottery, stone walls, ancient Mayan human remains, and Mexican revolutionary war weapons. All of these sites have been noted, closed to further exploration, and reported to the appropriate authorities. Landowner relationships must be respected along with written approval from each municipal president for exploration in his/her county.

Preparations for Yucatan Fall 2005 are underway for another 10 days of discovery. A few slots will remain open for new, qualified explorers to join the team. Virgin cave, along with pain and suffering are guaranteed.

Note: The disturbance of any archeological artifact, no matter its significance or size is strictly forbidden by the Mexican government and punishable by imprisonment. Proper permits are required for exploration in the state of the Yucatan.

For additional photos, video clips, and cenote data sheets, see ADM Online for the extended Yucatan 2005 article.

Above: Explorer Brett Hemphill squeezes through a tight restriction entrance and drops 50 feet into an immense dome covered chamber (see left illustration)

Right: Wadding through half water-filled cave passage, our team discovers a chamber of colorful limestone and a pool of cobalt water

Above: Explorer Curt Bowen drops into a dry cenote with his photography equipment.

Below: Yucatan 2005 Team Photograph

Dr. Thomas Iliffe • Thaddius Bedford
Enrique Soberanes
Eric Osking • Rusty Farst
Brett Hemphill • Curt Bowen
Eric Hubschnieder • James Kelderman

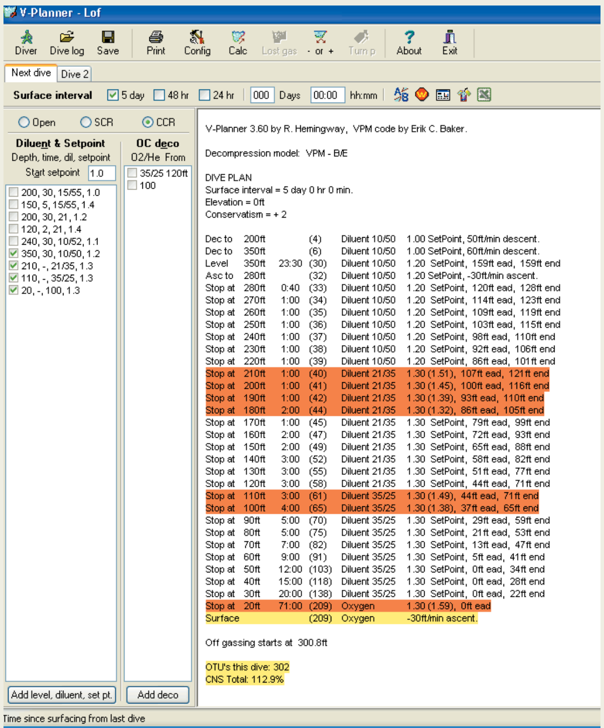
The new VPM-B/E deco model and V-Planner deco software

by Jakub Rehacek, Ph.D., with Ross Hemingway and Erik Baker

The Varying Permeability Model (VPM) was devel oped from laboratory experiments that investigated bubble formation in both gelatin and living species after exposure to various pressure cycles. The VPM presumes that microscopic gas-filled cavities (called nuclei) exist in the fluids and tissues of the body before the start of a dive. Depending on the maximum dive depth (exposure pressure) and initial ascent profile, all nuclei larger than a specific “critical” size will grow into bubbles upon decompression. The VPM aims to limit the total number and volume of these growing bubbles throughout the entire decompression and post-dive surface interval.

Over the past 10 years, sport decompression divers have almost uniformly adopted ascent procedures that start decompression stops much deeper than conventional tables and diving computers recommend. In the field, deep stops were originally set through ad-hoc modifications of conventional tables and algorithms, using techniques described by Richard Pyle (Pyle-stops) and Erik Baker (gradient factors). These recent adaptations of decompression procedures based on field experience emphasize the generation of personalized tables, driven by a bottom timer and depth gauge rather than a wrist decompression computer.

The VPM, or so-called Hawaiian “Tiny Bubble” model, is a first-principles decompression model that was developed by researchers at the University of Hawaii. It naturally incorporates deep stops into ascent profiles. The VPM decompression algorithm was originally calibrated to produce ascent times for air dives comparable to the U.S. Navy diving tables — and is accelerated from Bühlmann-Keller based computations.

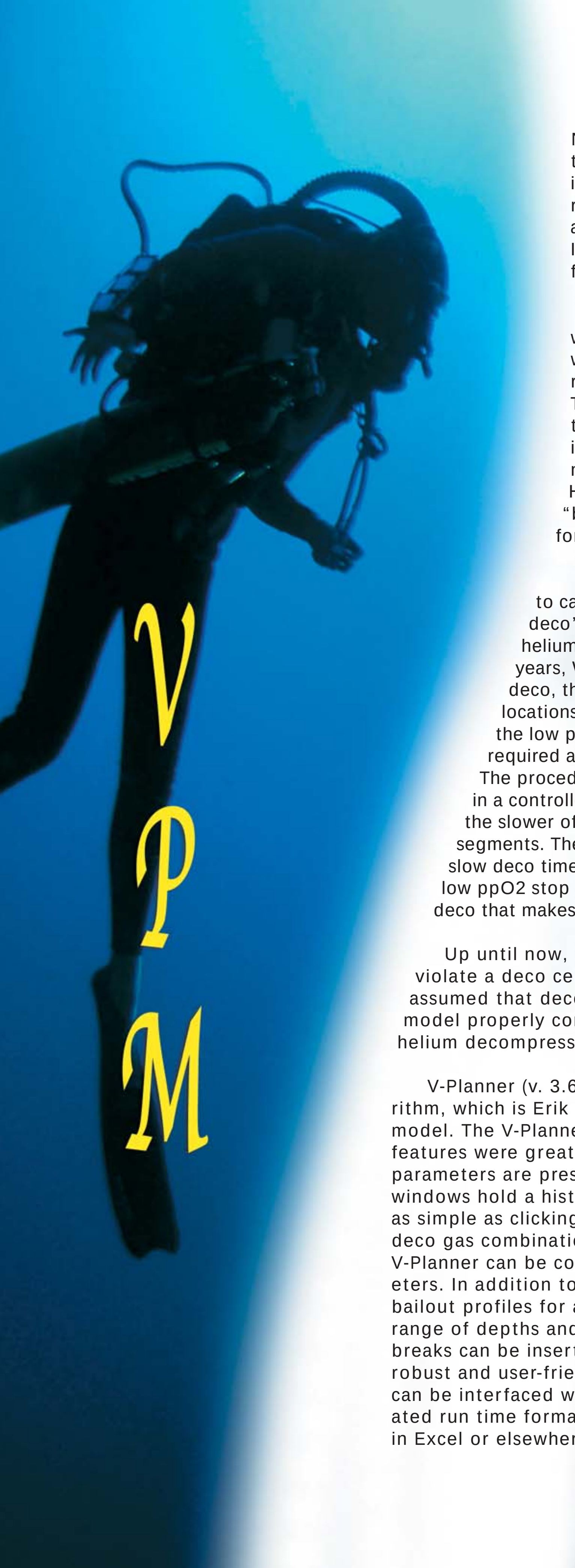


Why the change to VPM-B?

The original VPM performed well for technical dives from 40 to 80 meters (130 to 260 feet) depth but did not produce acceptable plans outside this range. Diver feedback confirmed that the schedules were too long for shallow dives and too short for deep dives. The model was re-examined and a problem was recognized with one of its original assumptions. The algorithm did not properly account for the Boyle’s Law expansion of gas bubbles after their initial formation and during ascent. This oversight was corrected in the model extension VPM-B (with “B” for Boyle’s Law).

The main difference between the original VPM algorithm and VPM-B is that during the decompression calculation, the allowable gradients for each compartment are modified (reduced) at each stop by a Boyle’s Law compensation routine. In the original VPM, the allowable gradients remained fixed throughout each deco schedule iteration and were only modified for the next deco schedule iteration.

With the addition of the Boyle’s Law correction into VPM-B, the algorithm produces acceptable schedules across a wide spectrum of diving. It naturally intercepts the transition from NDL to deco correctly at every depth and makes plans that correspond to the experiences of modern day tech divers. It handles complex multilevel or CCR plans without the need to adjust or manipulate internal parameters.



The VPM-B was introduced in February 2003 prior to the NAUI Deep Stops Conference in Tampa, Florida. Over the past two years, V-Planner with VPM-B has grown in popularity and is now widely used for tech diving. The IANTD has incorporated it into their training program and the model has been approved by Danish Maritime authorities for commercial work. It is also used by a variety of individual instructors in classes for tech diving training.

The VPM-B/E model option (E for Extreme or Extended) was released in January 2005. This option applies for dives with extensive deco requirements (i.e. deep and long rebreather divers, or OC divers with extra staged bottom gas). Typically, over 1-1/2 hours of deco is required for VPM-B/E to take effect. Feedback from divers doing these long dives indicate that they prefer using both deep stops from a bubble model and the longer shallow stops from conventional Haldanian plans. They tend to combine details of both into a “best of both worlds” type plan. The VPM-B/E now does this for them automatically.

The latest V-Planner version also includes a first attempt to capture the “helium is your friend” theory or the “fast helium deco” concept and address the notion that “deco models handle helium badly.” This feature is called accelerated stops. In recent years, WKPP divers have found through the use of helium based deco, that they can shave time off the basic deco obligations at key locations in the ascent. When going through the last of a deco mix at the low ppO2 stops, a diver could skip over some of the deco normally required and jump ahead to the next stop with the higher ppO2 values. The procedure forces an increased off-gassing gradient temporarily, but in a controlled manner. In effect, the diver borrows a little deco time from the slower off-gassing segments and pays it back during the faster off-gas segments. The end result is shorter overall run times due to some of the slow deco time being “accelerated.” It is the combination of accelerating a low ppO2 stop and extending a high ppO2 stop along with helium based deco that makes this manipulation of stop times possible.

Up until now, deco programs would not let the diver intentionally violate a deco ceiling like this. Some in the diving community therefore assumed that deco programs failed to handle helium correctly. A deco model properly configured to handle this skip-ahead procedure can handle helium decompression as desired.

V-Planner (v. 3.61), created by Ross Hemingway, uses the VPM-B algorithm, which is Erik Baker’s latest extension to the VPM decompression model. The V-Planner interface has its roots in the Z-Planner “skin,” but many features were greatly enhanced. Multiple users can use the software and all parameters are preserved for each diver. Bottom, travel mix, and deco gas windows hold a history of dive profiles for each diver. To set up a new dive is as simple as clicking the check boxes next to each depth/gas mixture and deco gas combination and hitting a Calc button to generate the deco profile. V-Planner can be configured with fine detail including the VPM model parameters. In addition to deco profile calculations, the software can calculate bailout profiles for any combination of lost deco gases, as well as profiles for range of depths and times. CCR and SCR dive plans are also supported. Air breaks can be inserted and accounted for in the deco profile. V-Planner is a robust and user-friendly implementation of the VPM deco model. The profiles can be interfaced with the MS Excel program, output in plain text, in abbreviated run time format, and also in the CSV data format to allow for further use in Excel or elsewhere.

Selected V-Planner features:

- VPM-B/E model option is for exceptional, extreme, or extra long dives and exposures. This option becomes effective during dives having extensive deco times — usually 1 to 1-1/2 hours or more. Divers who carry out very long deco dives often prefer this combination "the best of both worlds" approach to planning, and the VPM-B/E generates a plan to meet this requirement.

- VPM-B model for all technical, recreational, and decompression dive planning, in open circuit, closed circuit rebreather and several variations on the semi-closed rebreather.

- Accelerated Stops. For those wanting faster deco times on helium based deco mix. This feature reduces the stop times when using specific triox and heliox deco mixes. It pushes your deco stop times during the weak ppO2 periods just prior to a switch onto the next mix. It requires use of O2 to finish and is very specific on the allowable gas choices used. It gives a plan similar to current "faster helium deco" concepts.

- Set deco gas switch points to specific depths if required. It can override the automatic ppO2 selections in configuration setup.

- IBCD (Isobaric Counter diffusion) checks and warnings

- Tank capacity checks and warnings. Monitors for low/high ppO2 conditions.

- Individual diver layouts (dive legs and deco mixes), now loads separate details for each diver name.

- Dive profile graphs and charts. Links directly into Excel for displaying dive profiles and raw data. Allows for custom template and chart designs.

- Add in extended stops for any depth and gas switch options. Control the oxygen window effect.

- Half time deep stops. Set the deepest stops rounding up time to half of the regular stop time — makes a smoother transition into the deeper stops.

- Altitude calibration to your depth meter. Matches the program output to your depth meter's calibration.

- Turn pressure / gas matching calculator. Create special formula to find turn pressures for any dive condition.

- END, EAD, and OTU values tracked

- Insert air breaks into plans, and compute them into the final profile.

- SCR inspired mix fiO2 adjustments. Set the fsO2 versus fiO2 rates across the whole dive, and V-Planner will adjust the inspired mix accordingly.

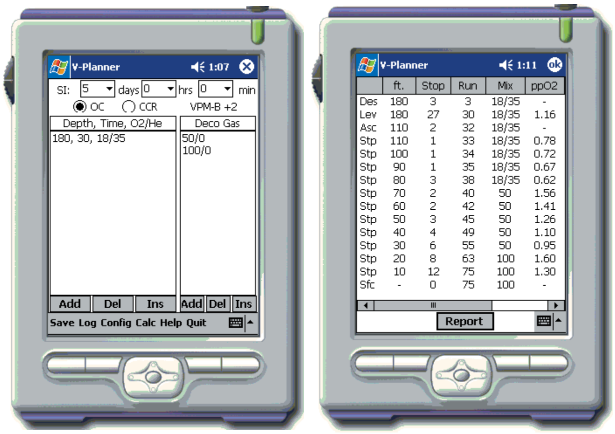
- SCR and OC planning inside CCR plans for bailouts

- More/less planning gas mix option using changes to the bottom mix. Have a backup plan when the dive shop doesn't quite make the mix as requested. You can also experiment to find which mix best suits the dive for run times.

- More/less range planning of dives produces a series of range plans for use underwater to satisfy any changes required during the dive.

- Commercial Diver Edition — with improved time sheets, dive logs, printing, supervisor features, database, data backups, and diver activity tracking — all designed for the commercial work environment.

- It is available for Windows, Linux and Pocket PC handhelds



http://www.hhssoftware.com/v-planner/index.html

Gas phase models assume that a distribution of seeds (parent media for potential bubbles) is always present and that some number of these seeds will be excited into growth during compression-decompression. Slower and deeper ascent staging seeks to control bubble growth rate and their collective volume. The bubble elimination gradient is maximized with increasing depth, while dissolved gas elimination is maximized with decreasing depth. These models call for much deeper initial decompression stops and slower ascents to limit micro-bubble formation and evolution. An effect of this is reductions in shallow stop times as well as total decompression times compared to the schedules for identical profiles generated with traditional decompression models.

Varying Permeability Model (***VPM***), developed by the late Professor David Yount and extended for diving by Eric Maiken and Erik Baker, presumes that a distribution of microscopic surfactant-stabilized nuclei exist in the water and tissues of the body. Depending on the allowable supersaturation gradient, which is related to the difference between maximum exposure pressure and dissolved-free gas tension, all nuclei larger than a specific "critical" radius will grow to become bubbles. The VPM aims to control the total number of bubbles and volume of free gas allowed to form during decompression. VPM-B extends the algorithm to compensate for Boyle's Law expansion of bubbles with reduction of ambient pressure.

A "HOT" EXPERIENCE
Thermal Cave Diving in Hungary

Editorial by Peter Schneider

Above: Aerial photo of Lake Hevis

Below right: George Kovacs explores the deeper reaches of the thermal heated cave. Water temperatures can reach as high as 100 degrees Fahrenheit

After a nine-hour flight from Chicago to Budapest and a drive of nearly 130 miles from Budapest to Heviz to meet up with my Swiss friends, we finally reached our destination. The town of Heviz is located on the southwestern tip of Lake Balaton and is known for its thermal lake. Visitors from all over Europe come to swim and bathe in Lake Heviz, because the content of sulfur and other natural elements make a great source for healing arthritis and other physical ailments.

Lake Heviz is 47,500 square meters and it's estimated to be about 22,000 years old. The water that erupts into the cave is also old. The thermal water is believed to be about 10,000 years old, where as the cold water is "only" 8,000 years old. The water emerges from a depth of about 1,000 to 2,500m / 1500 / 8000 feet. Every 83 hours the lake replenishes itself.

The lake's temperature never drops below 23ºC/74ºF in the coldest of winters. In the summer months, the water temperature is usually between 27ºC/80ºF and 29ºC/84ºF. The average depth of the lake is 2 to 5 meters. The lake bottom is covered with a thick layer of very fine silt. Almost in the middle of the lake is an asymmetrical crater, with a wall running east and west, reaching depths of 38m/124ft. Average visibility in the lake is around 3 to 5 meters all year.

Around 1908, the first dives were attempted by hardhat divers to explore where the hot water was coming from, but those dives were aborted because of bad visibility. After WWI and WWII, in 1953, the desire to explore the lake returned. The resources for diving gear were very limited and not accessible because of the Communistic regime. But, dives were still being made to 16 meters and still no answers were found about the origin of the hot water. In 1958, after exploring the crater further, they thought they found the spring that was delivering the thermal waters, which was buried under tons of rubble and tree trunks. During many dangerous dives, they

removed the tons of rubble, sediment, and tree trunks, and discovered at 40 meters a cave entrance where hot and crystal clear water poured out. George Kovács and Istvan Plózer made the discovery and first exploration of the cave on March 16, 1972.

Between 1986 and 1990 there were numerous underwater construction developments in Lake Heviz. First, a multi-person deco chamber was built for the safety of the deep construction workers. The work included removal of 80 cubic meters of rubble and sediment in the cave entrance and in the cave itself. Two artificial walls were installed; one at the cave entrance, so sediment wouldn't slide from the crater into the cave, and the second was installed just beyond the entrance corridor inside the cave. The opening helps to measure the water flow per second. Currently, the cave spits out 420 liters/second of 38.1 degree Celsius (100 degree Fahrenheit) thermal spring water.

There were also temperature-measuring devices installed in the cave along with two sets of large pipes that bring hot water into the bath house for the spa guests. During those years, about 3,000 cubic meters of sediment was removed from the lake. During the four years of construction, there were only two incidents of Type 1 DCS (skin bends).

When we arrived, George Kovacs, who is the head of dive operations in Heviz, greeted our group. George is one of a handful of commercial divers in Hungary. He is a Padi and CMAS instructor and also an IANTD trimix instructor. He currently also serves as the president of the Hungarian Cave Rescue Association. George started diving in 1962 and became a commercial diver in 1966. He has logged over 28,865 hours underwater. George also has two guides who help him with dive operations, Bea Borocz and Sandor Irsai.

After an extensive dive briefing, we loaded up our gear and headed over to the spa area of the lake. We were assigned a few cabins where we could change, gear up for the dive, and leave our gear. Last year, I dove open circuit with twin 10-liter tanks. This year, I brought my Draeger Ray SCR. Since I use an Uwatec Air Z O2 dive computer in conjunction with the OXY II (outfitted with adapters for the Ray rebreather), I chose to use a 35% O2 mix with my 40% O2 orifice. This gave me about 28% O2 in the loop. I used an 8-liter steel tank, and I also brought along a 4-liter bail out tank with air.

Photo: W. Pölzer / www.underwater-photos.net

Above Illustration: Artistic side profile of the submerged cave system.

Above left: Spa building built upon poles above the spring

Left: George Kovacs during a dive in lake Heviz

Left: George Kovacs gearing up for a dive to the hot vents 150 feet below

Below: Left to right Peter Schneider, Jorg Muller, and Nic Megret after a successful "hot" cave dive in Lake Heviz.

After gearing up, Joerg, Nic and myself made our way through the pool area to the front platform where we entered the water. We waited for George, he was our guide on this dive, but he was on his last deco stop with his first group. About 20 minutes after George surfaced and after a thorough gear check and cave entering procedure, we begin our dive. First, we descended to about 3 meters, swam over to two large pipes, these pipes supply the hot water to the indoor area of the spa, and then headed down the silty slope to 9 meters. At 9 meters, the wall starts.

At 25 to 30 meters, I turned on my dive light to illuminate the green water. I felt the warm water rising from beneath us and at about 35 meters, the wall along with the pipes sloped inwards. At 38 meters, everything silted out. I kept moving along the rope until the water turned crystal clear and very warm. I had reached the entrance. The opening was 90 cm wide and 60 cm high. The crystal clear water coming out of the cave was a balmy 38 degrees Celsius (100 degrees Fahrenheit). The water rushes out of the cave through the opening at about 420 liters per second (roughly 111 gallons per second), creating a washing machine effect with the silt in front of the entrance.

George, then Joerg and Nic entered the cave. I followed in the rear. I checked my O2 and PPO2 level and took off my bail out tank. I completely vented my BC and made my way into the opening. I got through the first opening fine and pulled myself along the wooden planks. I continued my way towards the second opening. The water was still rushing at high speed against me. I was almost afraid to look down because I wasn't sure if doing so would knock off my mask. I pushed my bail out tank through the second opening, where it almost slid into the silt. I tried to get through the second opening, but was stuck. On the second try, I made it through, and entered the cave.

The fast current was now gone, the water was warm, and the visibility was amazing. The cave is spherical, 17 meters from top to bottom and 16 meters in diameter. Our bottom time was planned for 20 minutes. We started our exploration tour of the cave. Along the right side, we saw several other cracks in the wall where hot water poured out. On the right side, there were 10 cracks where water of various temperatures came through. The warmest water was 41.6 degrees Celsius. The left side was the "cooler" side where the water was about 24.6 degrees Celsius. Mixed together, the water temperature was 38.1 degrees Celsius.

After checking the openings and other cracks in the ground and taking pictures, George reached into the wall with his fingers. It looked like he was digging something out. Before long, he pulled out pyrite gems and handed one to each of us as a souvenir. We then ascended to the top of the cave to a gas pocket where you can surface but should not breathe the air. Our depth was 34 meters.

After 20 minutes, it was time to exit the cave and start our ascent. One after the other, we laid down on the platform, venting all of the air from our BCs and inching our way forward through the cave opening. The current quickly picked you up and flushed you through the cave opening and into the lake.

George Kovacs and his crew offer diving in Heviz between the months of October and April every year. Nitrox is available and trimix is also available upon prior request. Languages spoken are Hungarian, German, and English.

Contact information:
George Kovács
Nyuszi stny.3fsz.3
H-1213 Budapest Hungary
E-mail: diver1@ax.hu

About the Author:
Peter Schneider is a Swiss native living and working in Chicago as a cameraman. Whether it is the Great Lakes, icy mountain lakes of Switzerland, the Mediterranean, or Malpelo and Cocos in the Pacific, he loves to travel and dive. His special love for Hungary is because he is of Hungarian descent.

Photo: W. Pölzer / www.underwater-photos.net

The Scow Ocean Wave

Lake Michigan Wreck

Editorial by Tamara Thomsen and Keith Meverden
Photography by Tamara Thomsen

The crew of the fish tug, *Robin B* hauled in their nets after a long day on the water to find that fish was not their only catch one August day in 2003. A wooden mast from a long-lost sailing vessel had tangled in their nets and was pulled from 110 feet of cold Lake Michigan water. Cutting it free, the mast returned to the bottom, but not before the crew carefully recorded the snag's location to avoid further entanglements with an unknown shipwreck. The location circulated amongst the northeastern Wisconsin wreck diving community throughout the fall and winter of 2003, but the wreck was not located until June 2004 when Randy Wallander of Manitowoc, Wisconsin, finished first in the race to find and dive Wisconsin's newest wreck. Four miles offshore of Whitefish Dunes State Park, Wallander descended to find the unusual remains of a small scow schooner with only the bow standing erect amidst a scattered debris field of wood and stone.

Over subsequent dives, the wreck was measured and photographed. Compared with the historic literature, only one vessel to sink in the vicinity fit the wreck's description, the *Ocean Wave*. The *Ocean Wave*'s loss was first reported on September 30, 1869, when the Door County Advocate (a local newspaper) noted: "We learn from Mr. Carrington of Bailey's Harbor, that the scow *Ocean Wave* loaded with stone sunk in Lake Michigan off White Fish Bay and ten miles from shore. The crew arrived safe at the Bay." Although the *Ocean Wave*'s description and dimensions fit that of the wrecked scow (72.5 feet long, 19.7 feet in beam, and 6.8 feet depth of hold), the wreck's location was much too close to shore than that reported by the Advocate.

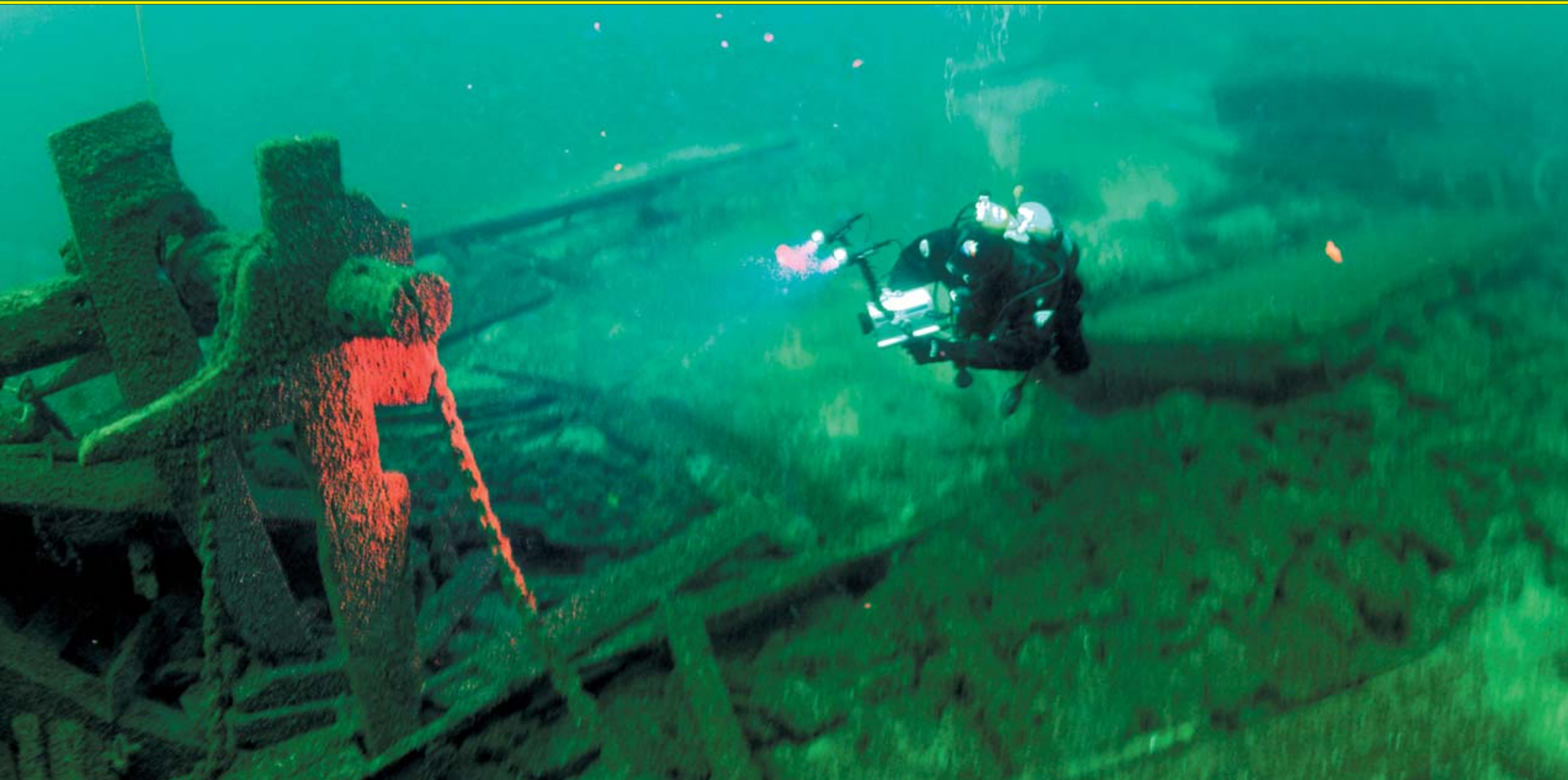
Built in 1860 by Robert Chambers for George Fish at the remote and primitive yard on Harrison's Island, Michigan, the *Ocean Wave* foundered in a storm just after 3 AM on September 23, 1869. Under the command of Captain Fletcher Hackett, the *Ocean Wave* had loaded 23 cords of limestone at Moonlight Bay, Wisconsin, bound for a harbor improvement project in White Lake, Michigan. While in route, the Milwaukee Sentinel reported the *Ocean Wave* "struck a deadhead or floating wreck and went down with only enough time for her crew to launch a boat. The vessel went down in about 360 feet of water."

Further research uncovered more descriptive accounts of the *Ocean Wave*'s loss. The Milwaukee Sentinel reported "The vessel filled so quickly after striking that the crew had barely time to lower the small boat and secure an offing before she went down. They lost everything except the clothing upon their backs. Capt. Hackett also lost besides his clothing, one hundred and sixty dollars in greenbacks, which he had in his room." Rowing throughout the night, the exhausted crew finally made landfall at Whitefish Point early the next morning. Considering the last known location, cargo, vessel type, and dimensions, and the fact that no other scow schooners were reported lost in the area, the team of Jon Paul Van Harpen, Russ Leitz, and Paul Creviere determined the wreck must be that of the *Ocean Wave*.

The story of the *Ocean Wave* is not unlike that of other vessels lost on the Great Lakes – she struck a deadhead and sank. Wooden vessels were vulnerable to deadheads or floating debris that could hole a vessel and quickly send her to the bottom. Unlike modern steel ships, the wooden planks of early vessels were vulnerable to damage and leaking if stuck by a heavy object. It is also not unusual that the crew overestimated their distance from shore. Imagine yourself cramped into a small rowboat with several men, bobbing in the middle of open water in the black night after having watched your vessel and all your possessions slip beneath the waves. Four miles would easily have felt like ten under those circumstances. Suspicions are raised, however, when it is learned that only three weeks prior to her loss, Captain Hackett took out an $8,000 insurance policy on the *Ocean Wave* (owned by George Fish and John Abram), which was valued at only $5,000 at the time of her loss. Sinking in 360 feet of water in 1869 meant there was no hope for salvage, and no one would have attempted to search for the *Ocean Wave* after Captain Hackett reported the loss of his vessel ten miles offshore. The vessel sank at three o'clock in the morning, so there would not have been witnesses, either. Did Captain Hackett deliberately sink the *Ocean Wave* in an insurance scam?

The Ocean Wave Today

Today, the *Ocean Wave* rests in 110 feet of water, 4 miles offshore. Bottom temperatures during the summer average 41 degrees Fahrenheit, and visibility ranges from 25 to 100 feet. The bow is the most intact part of the wreck, with the bowsprit and jib boom still standing. Unusual for small coasting schooners, a griffon-like figurehead stands guard below the bowsprit. The crudely carved bird is perched with open mouth and tongue extended. Red paint is still visible in the creature's mouth and on it's eyes. Two iron-stock anchors, knocked loose from the catheads, lay in the sand. A smaller auxiliary anchor lies on the fore deck. The anchor chains remain wrapped about the windlass.



At the chines, the ship's sides have collapsed outward. The rear deck with cargo hatch and intact cabin has separated and dropped onto the sand. A hole for a stovepipe can be located in the forward ceiling of the cabin, and the companionway gives entrance at the starboard quarter. The rudder lies against the cabin's aft wall, having been pushed up through the decking. The centerboard trunk has fallen to port, but remains along the vessel's centerline. A boom and rigging can be located in the sand to the port side of the wreck, with the limestone cargo strewn beyond the wreckage. The mast raised by the fishermen has yet to be relocated. Zebra mussels, although present, have not completely covered *Ocean Wave*.

Why are Scow Schooners so interesting?

With a flat bottom and sides connected by a hard chine and a blunt bow and stern, scow schooners more closely resembled modern day barges than other sailing vessels of their time. Their appearance was box-like and unglamorous, in sharp contrast with the elegant lines of the clipper-type Lake schooners. Considered a poor-man's boat by many, the scow was denigrated to the lowest caste of vessels on the Lakes. Often the brunt of jokes from larger boats, the scow nonetheless provided a livelihood for untold numbers of people. Their small size and shallow draft allowed scows to call on small, shallow ports unreachable by larger vessels, providing an essential link between large city markets and small frontier towns.

Scows were typically small, two-masted vessels of less than 100 tons, and usually employed in the coasting trade. Because of their straight lines, scows did not require sophisticated shipbuilding skills or large, expensive timbers for construction. Carpenters with only basic skills could easily build a scow under primitive conditions in a rather short amount of time, making scows the only affordable vessel to those with limited resources. The scow's unflattering appearance also translated into a notorious sailing ability and sometimes-questionable seaworthiness. Their blunt bows did not slice through the water, but rather plowed through the waves much like a bulldozer's blade. Their flat bottoms lacked a tuck in the stern that resulted in inefficient water flow over the rudder, preventing responsive steering. Insurance companies had little confidence in scows; even the best-built examples could not receive higher than a B rating by Inland Lloyds, relegating them to low-dollar bulk cargoes. For these reasons, scows infrequently ventured into open, unprotected waters on long voyages.

Although scow schooners were once common on the Great Lakes, very little evidence remains, and even less is known of their existence today. Scows were not the products of important men or the competition between wealthy corporations. They set no records for the greatest tonnage carried, nor the fastest voyage sailed. The lack of contemporary accounts testifies to the mundane role scows filled in the late nineteenth century. Scows were so overlooked by contemporaries that few bothered to document their role in Great Lakes commerce, and as a result, we know little about them today. The rarity of scows in the archaeological record of Great Lakes shipping that now occupies the lakebed makes the wreck of the *Ocean Wave* a very important part of our maritime heritage. Most of what we will ever learn of these small vessels now lies within wrecksites like the *Ocean Wave*.

Tamara Thomsen manages the U.S. office for Delta P Technology UK, Ltd., makers of VR2/VR3 Dive Computers (www.vr3.co.uk) and owns Diversions Scuba in Madison, WI. www.diversions-scuba.com

Keith Meverden works as an underwater archaeologist with the Wisconsin Historical Society and owns Points North Diving, a dive charter operation on the Great Lakes. www.diversions-scuba.com/pointsnorth

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Crocodile Cave

Great Abaco Island, Bahamas

Text by Brian Kakuk Photos by Curt Bowen

As usual, it all started out with a phone call. "Hey Paul, how would you like a free cave diving trip to the Bahamas?" I asked. Paul Heinerth is well known in the cave and technical diving community and has more than his share of exploration and research expeditions to his credit. He quickly blurted out, "sure," as if the offer was only good for a few seconds. Then I could hear the question churning in his head… "What do I have to do?" He knew he wasn't going to get something for nothing, and I knew he had visions of sun, sand, and sea, so before he asked, I explained the offer.

A few months earlier, I had been cave diving with Jim Pickar on Great Abaco Island in the northern Bahamas. During a dive in one of the inland sinks, we had discovered some very old looking crocodile skulls and two huge land tortoise shells on the thick peat covered talus mound of the cave opening.

After sharing the discovery with my friends Michael and Nancy Albury, both local environmentalists and residents of Great Abaco, Nancy decided to notify Bahamian Officials and members of the scientific community. The response was one of great excitement, and thanks to Nancy, a joint project of Bahamian Environmentalists, Government Officials, and American divers was assembled.

I explained to Paul that the Bahamian Government had requested that I and two others come to Abaco to excavate, recover, and document the finds and that he and Curt Bowen from ADM were my choices. Curt would do his usual digital imaging magic and Paul would shoot the required video footage of the excavations and recoveries for the Bahamian Government.

Above: Crocodile Cave entrance pool

Right: Explorer Brian Kakuk emerges from the hydrogen sulfide layer

The plan was for me to head to Abaco a few days early for a meeting with Government Representatives, and Paul and Curt would fly out a few days later, after the permitting process and protocols had been put into place. Once I arrived in Marsh Harbor, Nancy set up the meeting in the conference room of Friends of the Environment, an Abaco based environmental not-for-profit organization, of which both she and her husband Michael were members and officers.

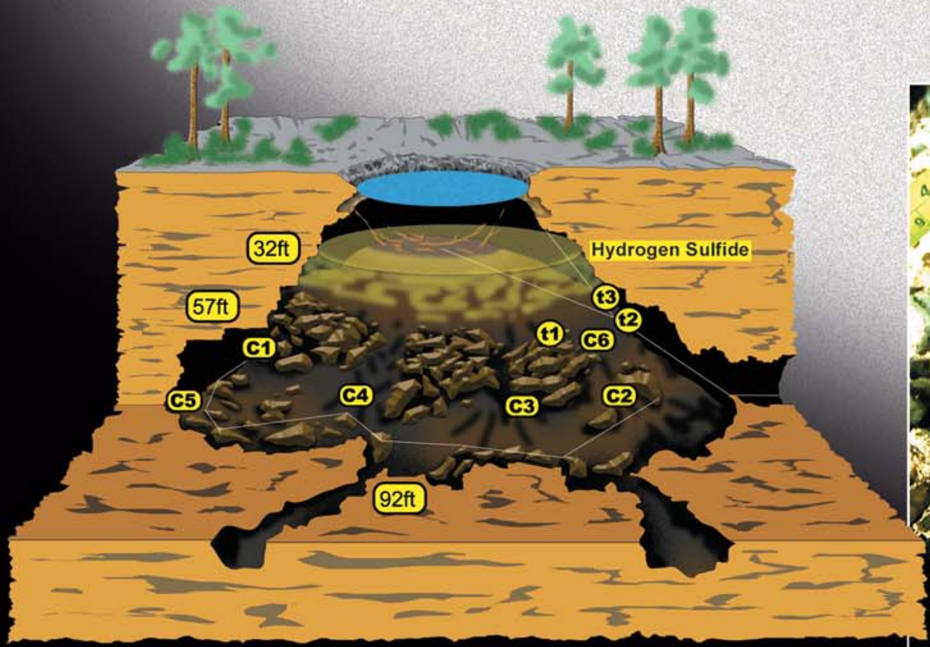
I was pleased to see the amount of interest and enthusiasm shown by the Bahamian representatives from many different governmental ministries. During the course of the meeting, it was decided that the find was significant enough to warrant an immediate recovery effort and Archaeological Research Permits were granted by Dr. Keith Tinker, Director of the Bahamas National Museum - Antiquities, Monuments and Museums Corp. (AMMC). Excavation and recovery plans were organized via e-mail and telephone with the guidance of Richard Franz, a Paleontologist from the Florida Museum of Natural History, considered an expert in this area. Paul and Curt were also notified and they flew to Marsh Harbor two days later with their equipment to do the still and video documentation of the excavation and recovery efforts.

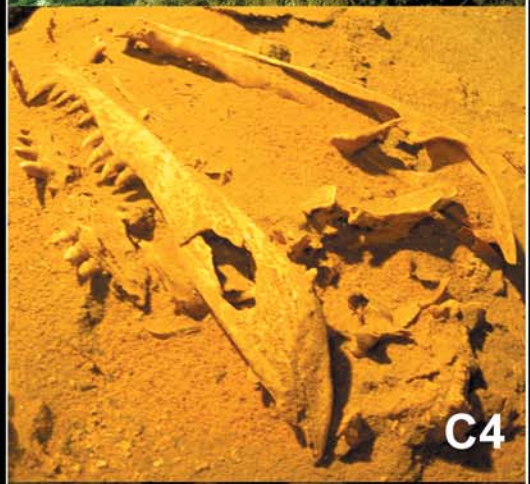
Sawmill Sink

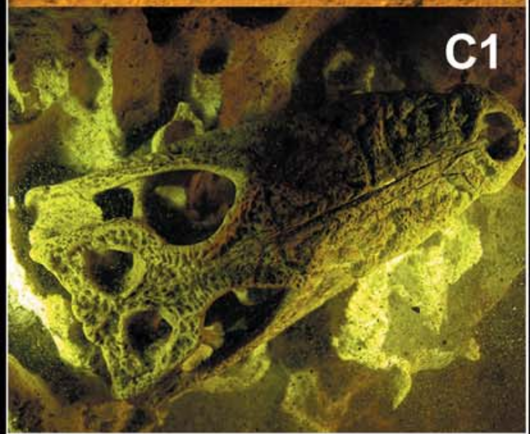
The sinkhole or “blue hole” as they are known in the Bahamas, is located within the quiet, rocky pine forest in the interior of the island, a few miles south of Marsh Harbor. Locally known as Sawmill Sink, this remote inland sinkhole was first discovered by the Owens Illinois Pulpwood Co. in the early 1900’s. The company had used the site as a fresh water source for the locomotives that hauled the Bahamian pine trees out of the “bush,” where it was later broken down into pulp. After the closing of the mill, the site was quickly reclaimed by the pine forest, and the site was only used as a swimming hole until cave divers from the United States began to trickle into the Bahamas. Some of these divers included George Irvine, Dan Malone, and Fred Davis.

Left: Veteran explorer Paul Heinerth prepares for a dive with his Cis Lunar rebreather

Below: Cover Photo, Brian Kakuk measures a crocodile skull (C1)







The cave associated with this sink is an interesting mix of solutional passages, eroded speleothems, and unique, deep mud banks that show evidence of drying and cracking during ancient low sea levels, the latter item being found as deep as 170 feet in some parts of the system.

The water chemistry within the system is fairly common, though somewhat exaggerated for a Bahamian Blue Hole. A fresh water lens sits atop the denser seawater that permeates the porous limestone of the island. Heavy organic input, in the form of tree leaves and branches has created an aggressive and very stinky hydrogen sulfide (H2s) zone between the depths of 30 and 37 feet. Within the H2s is an active layer of bacteria, which consumes the foul smelling gas. This biological process removes most of the oxygen from the water in this zone and below. It is the lack of oxygen within the thick organic peat of the talus mound that protected, and to a certain extent, preserved the bones and shells found by the divers.

Recovery methods and equipment

During the initial dives at Sawmill, I quickly realized that any time spent on the peat talus mound would need to be done on rebreathers if the recovery team was to maintain any decent visibility. Curt and I brought Megalodon CCR's, while Paul brought his "Cadillac" Cis-Lunar Mk-5P CCR. Medical grade oxygen was ordered through a local Marsh Harbor distributor, while the Sofnolime 8-12 grade was shipped to Abaco from a recently completed research project on Long Island, Bahamas.

Air diluent was sponsored by Mr. Keith Rodgers of the Marsh Harbor based "Dive Abaco," and this air was also used as drive gas for the team's Jetsam Technologies baby booster pump, allowing us to do all of our fills right out of the office of Friends of the Environment.

The Actual work sites varied in depth from 47 feet, up on the talus mound, where three tortoises were found (two males and one female), to 108 feet near the base of the mound where most of the crocodile remains were located.

Prior to excavation, tags were placed on the guideline as close to each site as possible. Each tag indicated what the item was thought to be, and its depth in relation to the guideline, so that the team could find the items more readily. Tortoises were labeled T-1 through T-3, in the order they were found, while the croc remains were labeled C-1 through C-8 (later the C category would be extended to over 14 sites).

Above: Brain Kakuk emerges with smiles after a discovery of a third tortoise shell

Above: Bahamas officials and the U.S. dive team pose with the first ever discovery of a Bahamian tortoise

As per Richard Franz' instructions, a two meter long by one meter wide PVC grid was fabricated and subdivided into half meter increments with cave line. The grid was then placed over each site as it was photographed and worked. The grid was "pegged" in place on the steep peat mound by two PVC rods that were carefully pushed down into the peat. The rods would allow the grid to be removed and replaced without losing the exact location of each site. Curt and Paul photographed all of the sites with the items in-situ, prior to any material being disturbed. After the photography was completed, the grid was placed on first tortoise site at a depth of 57 feet just below the H2s layer.

The first item removed was the crocodile skull C-6 (see graphic for locations). Crocodile skull C-6 was actually found while photo documenting the grid area around tortoise T-1, on the peat talus mound. While waiting for the sediment to settle for a photograph of T-1, I inadvertently placed my hand down in the sediment within the lower part of the grid. As my hand slid into the peat, I felt a sharp bite on my fingers and quickly pulled my hand out of the goo. I moved a small amount of peat where my hand had been, and quickly realized that I had just been bitten by what could possibly be a 3,000-year-old crocodile skull!

The ten-inch long C-6 was carefully uncovered within the grid, while keeping an eye out for other small bones from the specimen. It was slowly removed from the sediment and then placed in an appropriate sized Tupperware container while still in the low oxygen water environment of the recovery site. The skull was then taken to the surface where Nancy took possession.

The next items removed were tortoises T-1 and T- 2. These required a bit more planning due to the large containers, and the weight of the water that would be in the container preserving the shells. The task loading involved with juggling the containers, cameras, lights, grids, and measuring devices was, at best, intense in the near zero visibility of the peat mound. Regardless, after three days of diving, digging, measuring, mapping, photographing, and hauling, the team had two ancient tortoises, one crocodile skull and several bags of associated skeletal remains safely on the surface.

Throughout the 10-day project, many more sites were found around the circumference of the blue hole. The count is now up to 14 crocodiles and 3 tortoises. There will undoubtedly be more. This project has raised more questions than it has answered. Was Sawmill Sink a trap for the animals of that time period, much like the La Brea Tar Pits of California? How long were these animals in this area? Are all of the sites within Sawmill Sink roughly from the same era? Were the tortoises dragged into the sink by the crocs? Are the tortoises possibly a new species yet unknown to science? The list goes on and on.

Sawmill Sink has since been declared a closed archaeological area, and diving activities are conducted under a strict permitting process through the AMMC. It is the hope of both Dr. Tinker and Richard Franz that this find will lead to more formal and continued research at this site. The peat on the mound is so deep in some areas, that the team has been unable to find the hard bottom of the talus mound. Who knows what kind of archaeological treasures will be found even deeper in the stinky goo of Sawmill Sink?

The team would like to thank the following participants

- Dr. Keith Tinker, Director of the Bahamas National Museum and the Antiquities, Monuments, and Museums Corp. (AMMC)
- Mr. Michael Braynen, Director of the Bahamas Department of Fisheries
- Dr. Livingston Marshall, Science Advisor to Prime Minister of the Bahamas
- Mr. David Knowles representing the Bahamas Department of Agriculture
- Mrs. Lynn Gape, Director of Education and Public Relations for the Bahamas National Trust
- Mrs. Anita Knowles, representing Friends of the Environment
- Mrs. Nancy Albury, Project Supervisor
- Mr. Michael Albury, Council Member of the Bahamas National Trust

Special thanks go to:
Michael and Nancy Albury for financial support and for opening their home to the dive team; Friends of the Environment for letting the team turn their conference room into a dive shop; Keith Rogers of Dive Abaco for donating all of the compressed air to support the diving operations; Richard Franz for his guidance on the excavation, recovery, and preservation methods; Dr. Keith Tinker for having the insight to make this project happen on such short notice and the financial support of the AMMC.

For more information on the Crocodile Cave Project, contact Brian Kakuk at: bahamacave@aol.com

Above: Nancy Albury hands down equipment to the U.S. dive team

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The Mystery Anchors

Wreck of John M. Osborne

Text and Photography by Vlada Dekina

It can not be done…impossible… they would have to break the bow to get them out… they cannot be there just for decoration, could they? These and other perplexing thoughts raced though my brain as I was reviewing my pictures of the anchors proudly attached to the bow of the shipwreck John M. Osborne. Although, "embedded into the bow" would be a more suitable description. The anchors in question had their flukes crossed inside the ship with the stocks outside, and neither flukes nor stocks appeared to be removable. No matter how long I stared at the photos from all available angles, I still could not figure out how those anchors could be deployed because each shank went through a very small hole in the side of the ship.

A few weeks of research later, I found my answer. In the process of searching for that explanation I also learnt the history of Osborne as well as the details of the ill-fated collision which sent her to the bottom of Lake Superior to become one of the premier wrecks in Michigan's Whitefish Underwater Preserve.

John M. Osborne was a propeller-driven freighter made of wood and designed for carrying bulk cargo. Built in 1882 by Morley & Hill Shipyards at Marine City, Michigan, those vessels types were also known as "steam barges".

At the time of Osborne's launch steam technology had almost completely displaced wind power, however that replacement had not fully run its course as most new steamers built in the 1880's were still being outfitted with two or three masts and carried basic sail rigging to be used in addition to the steam power, or in case it failed.

When launched, Osborne had three masts and was 178 ft long. It could carry 700 tons of bulk cargo in its holds, but almost never ran alone – the common practice of the times was for a steamer to tow a string of up to five schooner-barges. So efficient and profitable was this practice that most schooners of those days were built to be barges with the basic sail riggings and were never expected to raise their sails unless it was to assist the steamers in a favorable wind conditions or in order to survive in an emergency. Cutting the consort schooner-barges loose in case in cases when the steamer ran into troubles was an accepted practice and often resulted in both vessels surviving.

On July 27, 1884, two years after its launch, still relatively new Osborne was underway on its usual route between Marquette, Michigan and Ashtabula in Ohio. It was heavily laden with iron ore. In addition to the ore in its holds, Osborne was also towing two ore laden schooner-barges, the George Davis and Thomas Gawn.

Approaching Whitefish Point, about ten miles northwest, Osborne encountered a sea of dense fog common for the area. Checking down his vessels' speed to just five miles per hour, the Captain ordered the fog signal to be sounded at regular intervals.

Unknown to the mariners in Osborne's pilothouse, the 260 ft steel passenger steamer Alberta, on her regular trip between Owen Sound and Port Arthur, was rounding the point in the opposite direction. Upon entering the same pea soup fog, Alberta's Captain gave orders for the fog signal, but did not reduce speed in accordance with the conditions and powered onward at the usual speed in excess of 10 miles per hour.

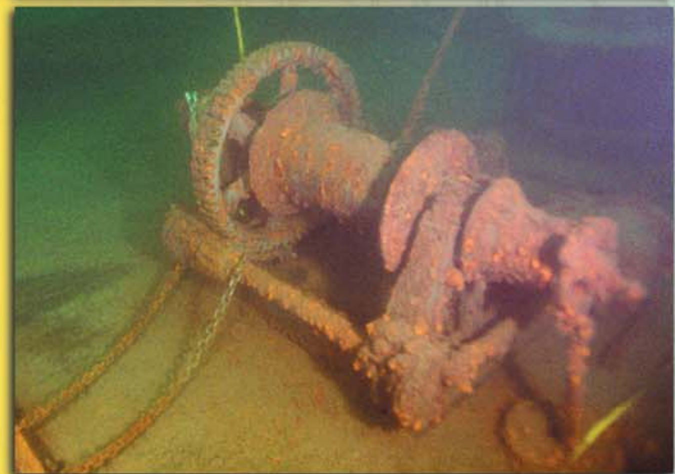
With radio, radar and other modern technologies of navigation years in the future, the fog signals alone did not provide enough warning so when the bow of Alberta suddenly materialized out of the fog steaming towards Osborne there was little either Captain could do. The steel bow of Alberta penetrated sixteen feet into Osborne's starboard side near the stern, fatally puncturing her boiler. So deep was the gash it almost cut Osborne in two despite the sturdy cargo of iron ore.

While it was later determined Alberta's excessive speed played a role in the collision, the inertia generated by that speed likely saved the lives of most of Osborne's crew. The momentum generated by Alberta speed caused the two vessels to remain connected for a few minutes, with Alberta's bow temporarily plugging the massive hole in Osborne's side. This precious time allowed most of the crew to make their way to the Alberta. Only three of Osborne's crew were lost along with one from the Alberta who went overboard trying to save Osborne's fireman.

When the ships drifted apart Osborne rapidly plunged to the bottom 165 ft away while Alberta slowly made her way to Sault St. Mary for repairs costing almost $22,000. Osborne was deemed to a total loss and the damages were assessed by insurance company at $88,000. Osborne's consorts were successfully taken under tow by a passing vessel.

Tragically, this was Alberta's fourth collision of the season. Built in Scotland in 1883 for its Canadian owners, she had to be cut in half in order to fit through the Welland Canal and was then reassembled in Buffalo, NY. Along with her sister ship, Athabasca, Alberta became one of the first large steel steamers in the Great Lakes. Trying to impress the passengers and other ship lines with her speed, Alberta terrified other vessels on the Lakes and earned the nickname "the menace of the lakes". Two weeks after she sent Osborne to the bottom, Alberta was involved in yet another collision, with the steamer Campana at Sault Ste. Marie.

Despite her propensity to run into other innocent vessels, Alberta managed a very long and productive life toiling the Great Lakes trade routes. She was lengthened in 1911 to 305 ft long to increase her cargo capacity and survived until eventually being scrapped in 1947.



With the passage of time, the victim of Alberta terror John M. Osborne became one of the most visited wrecks in Whitefish Underwater Preserve. As one of the popular wrecks Osborne is typically buoyed during the summer dive season. At the time of our visit, a team of amateur archaeologists associated with Great Lakes Shipwreck Museum was running a survey, accounting for the tape measure showing in some of the photographs. The Museum features a small model of Osborne as well as some exceptional artifacts recovered from this wreck as well as other wrecks in the area. The main attraction of the museum is of course the bell from Edmund Fitzgerald as well as other exhibits devoted to that famous wreck.

Sitting upright in 165 feet of frigid Lake Superior water, Osborne is remarkably intact near the bow and past amidships slowly gives way to the debris field that once was the stern. In the midst of that debris field two boilers tower silently above the destruction. Some remains of the piping and well as few ceramic dishes are also located nearby, the mementos from Osborne's working days above water.

The engine is still in place and it is an unusual one. It appears to be covered by wooden slats – was it done to reduce the noise? This strange engine also has some interesting and rare inscriptions that consist of separate characters around the bottom on the cylinders, painted in yellow.

Heading from engine and boilers towards the bow, the wreck slowly begins to take shape with the deck appearing to be more and more intact and even sporting high railings on the sides. The heavy mechanical winch sits on top of the main deck and currently serves as a tie-in point for visiting dive boats.

The deck is littered with the remains of the three masts with crosstrees and blocks still attached. The fife rail for the main mast still contains four intact belaying pins. The yardarms and remains of the rigging cris-cross the masts in unpredictable patterns. Looking at the erratic arrangements of masts, yardarms and rigging, one gets the feeling that the trip to the bottom was anything but nice and gentle.

The forward cabin was blown off during the sinking, but other than that, the bow is remarkably intact with capstan, windlass and its twin anchors still in place as they were before the collision. The anchors are crossed inside the bow, creating confusion in the minds of visiting divers who are not aware of the secret of their deployment.

So, what was the answer to the anchor mystery? The solution was so remarkably logical I was surprised it did not occur to me earlier: the bow has flush-fitting doors on either side of the stem post that would swing open to deploy the anchors.

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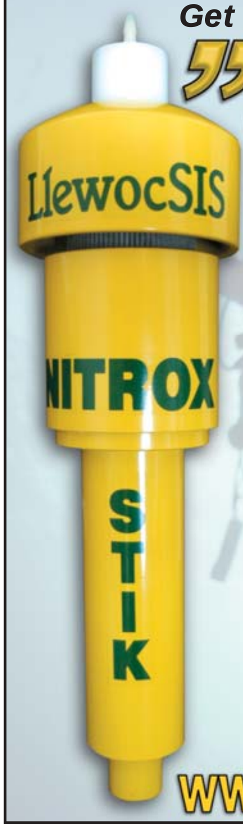

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CCR - SCR CALCULATIONS

by B.R. Wienke and T.R. O'Leary (NAUI Tech Ops)

A rebreather (RB) is any self-contained breathing apparatus that recycles a diver's breathing mixture. Recycling requires a closed loop for the breathing source and exhaust gas. Additionally, to reuse breathing gases, a scrubbing agent is needed to remove carbon dioxide from the loop. A bag or counterlung is needed to capture the diver's exhaled breathing gasses. The combination of gas mixtures, hoses and mouthpieces, counter lung, and scrubber is called a breathing loop. Operationally, RBs vary widely in design and efficiency, but they are generally broken into two categories, closed circuit rebreathers (CCRs) and semi-closed circuit rebreathers (SCRs). Furthermore, CCRs can employ both pure oxygen or another mixed gas (diluent) plus oxygen. SCRs usually employ just a mixed gas diluent.

What are the concerns of RB divers?

Divers using RBs must concern themselves with both oxygen toxicity and possible decompression constraints. On pure oxygen, oxygen toxicity is the only concern, but with mixed gas diluents, decompression may be required. Of course, the higher the oxygen partial pressure, *ppO*2, the shorter the decompression requirements on mixed gas diluents, but the higher the oxygen partial pressure, the greater the risk of oxygen toxicity. Most RB divers maintain a *ppO*2 near the 1.4 *atm* level, which has an oxygen time limit in the 140 *min* range.

Crucial to the operation of RBs is a constant and continuous mass flow of breathing gas, subject to oxygen metabolic requirements and depth. Mass balance simply requires that the flow into the breathing bag equals the amount used by the body plus that exhaled into the breathing bag or exhalation bag. Denoting the breathing gas flow rate, *F*, the metabolic oxygen (consumption) rate, *m*, the source oxygen fraction, *fO*2, and inspired (breathing bag) oxygen fraction, *iO*2, mass balance is determined, (*see formula 1*). The source flow rate, *F*, and oxygen fraction, *fO*2, depend on nozzle and mixture. The metabolic rate, *m*, depends on workload, and the inspired fraction, *iO*2, is uniquely determined with the other three specified. Or, for requisite inspired fraction, *iO*2, and metabolic rate, *m*, the source rate, *F*, and oxygen source fraction, *fO*2, can be fixed within limits. Workload rates, *m*, range 0.5 to 20.5 *l/min*, while source flows, *F*, depend on depth, cylinder and nozzle, with typical values, 5 to 16 *l/min*. As seen, the source oxygen fraction, *fO*2, is uniquely determined by the maximum depth, *dmax*, and maximum oxygen pressure (typically 1.6 to 1.4

Formula 1:

$$fO2F = iO2F + (1 - iO2)m$$

Formula 2:

$$F = \frac{F_0}{1 + d/33}$$

Formula 3:

$$fo2 = \frac{ppo2}{1 + d/33}$$

Formula 4:

$$ppo2 = fo2(1 + d/33)$$

Formula 5:

$$f_i = 1 - fo2$$

Formula 6:

$$ppo2 = (1 + d/33)$$

Formula 7:

$$f_i = f_{He} + f_{N2} = 1 - fo2$$

Formula 8:

$$f_{He} = (1 - fo2)\frac{fd_{He}}{(fd_{He} + fd_{N2})}$$

$$f_{N2} = (1 - fo2)\frac{fd_{N2}}{(fd_{He} + fd_{N2})}$$

Formula 9:

$$pp_{N2} = f_{N2}(1 + d/33)$$
$$pp_{He} = f_{He}(1 + d/33)$$

atm). Always, inspired oxygen partial pressures are kept between hyperoxic and hypoxic limits, roughly, 0.16 to 1.6 *atm*. At depth, d, the source flow rate, F, decreases according F_0, the surface rate, (*see formula 2*) unless the flow is depth compensated.

Want constant oxygen partial pressure or constant oxygen fraction?

All RBs strive for either constant oxygen partial pressure, ppO_2, or oxygen mix fraction, fO_2, or something in between for dive depth limits, through a combination of injectors, sensors, and valves. High operational oxygen partial pressures coupled to lower inert gas partial pressures minimize decompression requirements, obviously, but oxygen toxicity concerns are raised. For fixed oxygen partial pressure, ppO_2 in *atm*, the oxygen fraction, fO_2, depends on depth, d, (*see formula 3*). For fixed oxygen fraction, fO_2, oxygen partial pressure varies, *(see formula 4*). In both cases, the total inert gas fraction, fi, is always given, *(see Formula 5)* and varies little when fO_2 is relatively constant.

How do CCRs and SCRs differ?

They all deliver constant ppO_2 or (roughly) constant fO_2, but there are some major difference's impacting the RB diver.

Closed circuit RBs

Pure oxygen CCRs are relatively simple devices, employing just oxygen in the breathing mixture. Obviously, there are no inert gas decompression requirements on pure oxygen. Oxygen toxicity (CNS and full body), however, is a major concern on oxygen CCRs. In such a device, the volume of gas in the breathing loop is constantly maintained, and oxygen is added to compensate for metabolic consumption and increasing pressure. On ascent, the breathing gas must be vented if it is not consumed metabolically. Oxygen CCRs inject pure oxygen into the breathing loop, so that $fO_2 = 1$, with corresponding oxygen partial pressure (*atm*), (*see formula 6*) for sea level activities. Because of oxygen toxicity concerns, oxygen CCRs are limited for diving, somewhere in the 20 to 30 *fsw* range to keep the ppO_2 below 1.6 *atm*.

Mixed gas CCRs allow deeper excursions than pure oxygen CCRs by diluting the breathing mix with inert gases, notably nitrogen and helium. Fresh oxygen is injected into the breathing loop only as needed to compensate for metabolic oxygen consumption. Partial pressures of oxygen are measured in the loop with oxygen sensors, and oxygen is injected to maintain constant oxygen partial pressures called the *set point*. Operationally, mixed gas CCRs are simpler to use than their sisters, mixed gas SCRs. Efficiency and safety concerns obviously track directly to oxygen sensors. Mixed gas CCRs maintain constant oxygen partial pressures, ppO_2, with a combination of diluents and pure oxygen. The oxygen fraction, fO_2, varies with depth, (*see formula 3*) and the breathed total inert gas fraction, fi, makes up the deference, (*see formula 7*) for the general case of helium and nitrogen diluents. The oxygen, helium, and nitrogen breathed gas fractions, fO_2, fHe, and fN_2 vary continuously with depth, d. If the (fixed) diluent helium and nitrogen fraction are denoted, $fdHe$ and fdN_2, the breathed helium and nitrogen fractions become (*see formula 8*). Partial pressures at depth for the inert gases are then simply, (*see formula 9*) and the oxygen partial pressure, ppO_2, is constant.

Semi-closed circuit RBs

A semi-closed circuit rebreather (SCR) is very similar to a CCR but operates with an overpressure relief valve to vent gas in maintaining ambient pressure in the loop. A metering valve is necessary to assess metabolic oxygen consumption and breathing gas injection rates. A number of injection systems exist and all are designed to compensate for metabolic oxygen consumption:

1. Constant Ratio Injection

SCRs in this category have an oxygen and diluent gas source. Diluent injection varies with depth and oxygen injection links to a mass transport control system. The injection strategy approaches constant *ppO*2 performance in the breathing loop. In this case, the fraction, *fO*2, varies with depth, (*see formula 3*) and breathed total inert gas fraction, *fi*, makes up the difference, (*see formula 7*) as before for mixed gas CCRs. Retaining diluent fractions, *fdHe* and *fdN*2, breathed helium and nitrogen fractions remain, (*see formula 8*). Partial pressures at depth for the inert gases are still (*see formula 9*).

2. Constant Mass Flow Injection

A set gas mixture point controls a constant flow of diluent into the loop. Exhaust is vented through an overpressure relief valve. A single diluent source is employed, while in constant mass flow SCRs, both oxygen partial pressure and oxygen fraction are more variable than in all other RB devices. For depth ranges anticipated, minimal and maximal values of oxygen fraction, *fO*2, can be determined from the mass balance equation and used for dive planning contingencies, such as oxygen toxicity and decompression, from the above set of equations (*see formula 4*).

3. Respiratory Volume Injection

This SCR is a variant of the constant mass flow device. The injection rate of diluent is coupled to the diver's breathing rate, maintaining an almost constant fraction, *fO*2, in loop oxygen. A single diluent source is again used. Operationally, a fairly constant *fO*2 results, and oxygen partial pressure, *ppO*2, varies with depth, (*see formula 4*) and breathed total inert gas fraction, *fi*, makes up the difference, (*see formula 7*) as above. With the same diluent fractions, *fdHe* and *fdN*2, breathed helium and nitrogen fractions are roughly constant also, (*see formula 8*).

Breathed inert gas partial pressures vary at depth, (*see formula 9*) and the oxygen partial pressure, *ppO*2, varies as indicated above. To achieve such ends in flow programming, RBs are very complex systems. Extensive diver training and technical knowledge are keynoted in RB diving and usage. Are RBs the most efficient means to deep and extended diving short of surface supplied gas and decompression pods? I guess we would vote yes.

Formula 3:

$$f_{O2} = \frac{pp_{O2}}{1 + d/33}$$

Formula 4:

$$pp_{O2} = f_{O2}(1 + d/33)$$

Formula 7:

$$f_i = f_{He} + f_{N2} = 1 - f_{O2}$$

Formula 8:

$$f_{He} = (1 - f_{O2})\frac{fd_{He}}{(fd_{He} + fd_{N2})}$$

$$f_{N2} = (1 - f_{O2})\frac{fd_{N2}}{(fd_{He} + fd_{N2})}$$

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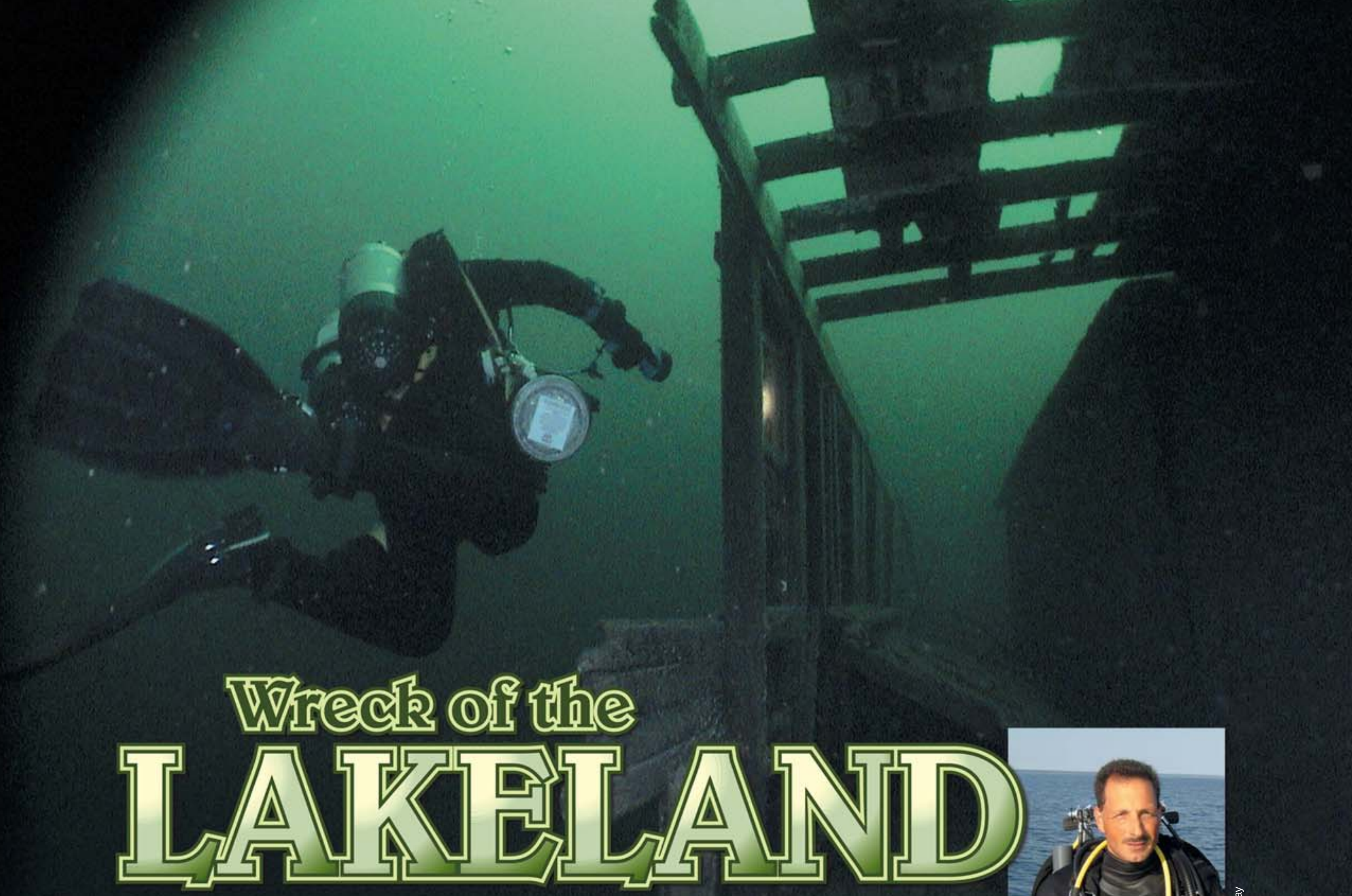
$$pp_{N2} = f_{N2}(1 + d/33)$$

$$pp_{He} = f_{He}(1 + d/33)$$



Wreck of the LAKELAND

Photo by Lori Doubleday

Text and Photography by Rob Polich

On December 3, 1924, the steamer Lakeland foundered nearly abreast of the Sturgeon Bay Canal six miles off Lake Michigan's coast. While she sank with no loss of life, her sinking would be one of great controversy and twenty-nine of her thirty 1924 automobiles would never see the light of day again.

The vessel was built by the Mutual Transportation Company as a bulk freighter in 1887 and was christened the Cambria; she was 280 feet long, 40 feet wide, with a draft of 20 feet. The Cambria sailed the lakes for 23 years before being purchased by the Port Huron and Duluth Steamship Company in 1910 who then renamed her the Lakeland. In 1919, she underwent a significant refit to convert her into a passenger and automobile carrier. The conversion took place at the Wolverine Dry Docks Company in Port Huron Michigan. In the post World War I era, the automobile industry was growing by leaps and bounds, and the Lakeland owners intended to take advantage of this economic trend.

The Lakeland was a historically significant vessel, breaking ground in a few areas of maritime engineering most notably in regard to propulsion and dimension. The ship boasted the first triple expansion steam engine on the lakes, a technology that would become the mainstay of maritime propulsion for many years to come. She also was the first vessel to have an overall length of just over 300 hundred feet.

On December 3, 1924, the Lakeland was up bound from Chicago with a cargo of new automobiles when she sprang a leak and foundered in modest seas a short distance from the Sturgeon Bay Canal. All aboard were rescued prior her sinking.

The Lakeland's sinking was quickly surrounded by controversy; her so called foundering leaving many questions unanswered. The underwriters of the vessel were convinced that she was scuttled for her insurance value. The ship came to rest in only 200 feet of water; significantly less water then the captain of the Lakeland originally had believed lied below his keel.

Above photo: Diver Bruce Bittner exams the remains of the Lakelands starboard stern wooden upperworks, the glass still intact within each of the double hung windows.

The insurers decided to challenge the Port Huron and Duluth Steamship Company's claim. A consortium from the insurance industry was established, their interest apparently driven by other pending worldwide maritime claims that were thought to be potentially fraudulent in nature. Through the prominence and influence of these corporations, a group of divers would be assembled to boldly go where no one had gone before.

This elite dive group was composed of the U.S. Navy's best divers, including world record holder Frank Crilley who set a depth record of 306 feet in the warm waters of Hawaii. The U.S. Navy inexplicably granted leave to each of these divers, a testament to the politically influential men who headed the maritime insurance industry of the time.

By the fall of 1925, the divers were ready for operations on the Lakeland. A controversial decision was made to conduct the dives on a helium-based mixture called heliox. The planners insisted a barge be brought in from the East Coast equipped with a recompression chamber because of the deep and complex nature of the dives, this would prove to be a wise decision.

Apparently dive physiologists of the era were more interested in helium's rapid absorption and assumed release rate then they were in its ability to reduce narcosis or oxygen toxicity. They were convinced that a helium based mix would require much less, if any decompression. This created dive profiles that were completely inappropriate and as a result, all of the divers were recompressed after almost every dive. These dives would mark one of the earliest known uses of heliox breathing gas in the world.

To determine whether or not the wreck was scuttled, the divers would need to inspect the vessels seacocks. The divers gained entrance to the engine room and slipped below to her hull carrying with them a long wooden rod. The rod was placed on top of the lever located on the valve body. Then a notch was cut out of the area where the rod met the spokes of the cocks' on-off wheel. Since the arm linkage rotated up when open and down when closed, the height of the notch would accurately reflect the position of the valve. The valves were found on the open position; the underwriters now had the proof they were looking for. An identifiable piece of the engine room's iron catwalk was also torched off in order to show the divers were in fact on the Lakeland and inside her engineering spaces.

During the trial, an exact duplicate valve was brought in from the manufacturer. The wooden rod was then placed on top of the valves arm linkage and the notch compared to both open and closed positions. This simple and ingenious method demonstrably showed to the court that the seacocks were in fact open and the vessel scuttled.

Unfortunately, the insurance companies were never victorious because they lacked the ability to prove collusion between the crew and the Steamship Company itself. In the 1970's, an unsolved mystery's TV pilot considered using the Lakeland's controversial case as the basis for their episode. Apparently they had one of the surviving Lakeland crewmembers who was willing to admit and discuss the planned loss of the vessel by both company and crew. Unfortunately the show never aired.

Diving the Lakeland

The wreck of the Lakeland is a dive site known for her share of adversities. Poor visibility, fishing line, and a confusing structure are just some of the concerns that are expressed by local divers.

My dives on the wreck were early in the season so little if any thermocline was expected. As I rolled into the 42-degree water, I could feel the cold envelope my head and bite at my face. I reminded myself that the one reward for such discomfort was increased visibility. This seems to be due to the lack of suspended particles that are concentrated and pushed deeper in the water column by the warmer water layer later in the summer.

I descended through cold water noting its clarity and hoping it would continue to the bottom. At a depth of around 150 feet, the wreck came into view below me, her relief and dark decks shimmering in the clear green water, the cold now gone replaced by elation over the 50-foot plus visibility. Eagerly, I press the record button on my video housing and start shooting, my emotionless mouthpiece outmatched by my widening smile.

The wreck is broken into two distinct pieces. The bow section is noticeably longer then the stern section, the two separated by approximately 50 feet. Each is upright on an even keel. Strangely they lie at an almost right angle to each other. This would explain the boomerang like side-scan images that were shown to me by Great Lake diver and shipwreck hunter Paul Ehorn the previous year.

The bow section contains the only intact automobiles, which are present in every hold. Much of her main deck has collapsed and is now lying on top of the vehicles within and a few cars have escaped completely unscathed. Regardless, each vehicle is interesting to study and have amazing distinct features even after their eighty years of being submerged. Spoked wheels, hood ornaments, dashboard gauges, and even the whitewalls on the roadsters are easily distinguishable.

In 1979, legendary Great Lake shipwreck hunter Kent Bellrichard even managed to raise one of the vehicles. Unfortunately, it quickly fell apart after being exposed to the air. I was recently told that this vehicle is still in a local junkyard in the Algoma area. Other vehicles lie in varying states of intactness both on and off the wreck.

I depart the bow section and swim across the open lake toward the stern portion of the wreck. Debris surrounds me; her wooden upper works, which blew off during the sinking, now lay like stacked popsicle sticks everywhere. Tires; an automobile comes into view, it is upside down and on top of another car that is upside down where they meet tire to tire. Wood and more wood, a pump, pipes; an air scoop, the sheer amount of debris on the Lakeland is staggering.

The stern section contains a towering bulkhead that rises some 25 feet from her deck, which is the remains of her coal bunker. I swim down her starboard side and am surprised to find several double hung windows still intact on her outer wall. A few ceiling boards are in place, some of the white paint still visible on them.

Left page top: Remains of the Lakelands stern -port side wooden upper works

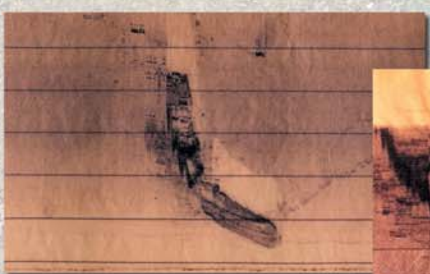
Left page second down: A birds eye perspective ofthe LakelandsT riple Expansion Steam Engines (the first of their kind) the steel catwalks surrounding the engines are visible

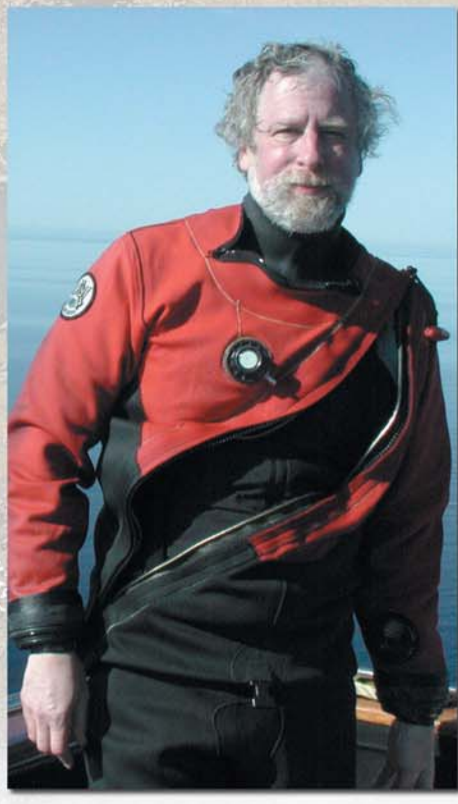
Left page third down: A large 1924 coach car inside the bow section of the wreck; the instrument gauges are visible on thedashboar d

Left page bottom: The Lakeland's faintail winch

Lower left: A Side scan image taken with a Klien 100khz sonar -the dramatic "hocky-stick" shape of the wreck site clearly visible (Image by Paul Ehron)

Below: Diver / Videographer Bob Epsom (photo by Bob Broton)





Hazardous lines are apparent throughout the stern section. Monofilament, heavier fish line, net, abandon cave lines, etc... every variety seems to be present, some even looped over her side or draped across natural swim through areas.

As I swim aft, I notice her stack off toward her port side appearing thinner and longer then I would have imagined. I head toward her engines, the upper portion of the engine room exposed by the missing decking. Three large round riveted cylinders lay below me. I slip into the narrow slot between her deck and the iron catwalk rails that surround the engine lowering myself onto the grating. It is a thrill to examine these mechanical marvels with the knowledge that they were the first of their type on the Great Lakes. I cover a short distance before reaching a restriction to tight to allow me to continue. Looking behind the engines, there is barely enough room for a man of slight build to slip sideways around them with no dive gear on.

I am amazed to think that back in 1925 hardhat divers were able to penetrate this extremely cramped compartment. Of course at that time, the decks were upright and more structurally intact giving the wreck continuity and the divers a bit more room to work. Nonetheless, getting below those engines to her seacocks with the equipment and physics of the day had to be a daunting task to say the least. As a wiggle out of the engine room, I notice a piece of grate missing; could this be the piece the divers torched off and brought into the court room to prove they were actually on the Lakeland?

I kick by a large winch on her fantail and head over the rail toward the bottom eager to inspect her screw and rudder. To my surprise, both are absent. The rudder has been torn from her hinged mounts with enough force to cause stress marks on her hull. A few feet below, a naked shaft slightly protruded from her hull. The large diameter solid steel shaft severed clean off. In the sand a few feet from the shaft is the unmistakable shape of a blade, short on time and already over plan, I head up and decide to swim down her port side to take a look on the way back.

A hallway is still partially intact on this side of the coalbunker as well. No windows are present, but it's still a dramatic site and an interesting area to explore. I aim for the bow section of the wreck, it comes into view sooner than expected. The visibility seems to have increased. The distance has to be close to 75 feet! The extraordinary visibility is more reminiscent of a wreck off the Outerbanks than a wreck in Lake Michigan.

On ascent, I look down enjoying my birds-eye perspective of the wreck. Soon, the cold creeps back into my body numbing my extremities reminding me where this wreck came to rest. It matters little, the Lakeland is like many of the wrecks in the Great Lakes - always deser ving of our efforts.

The author would like to thank the following contributors: Dick Boyd, Brendon Baillod, and Paul Ehorn.

Rob Polich e-mail: robdive1@sbcglobal.net

Photo by Lori Doubleday

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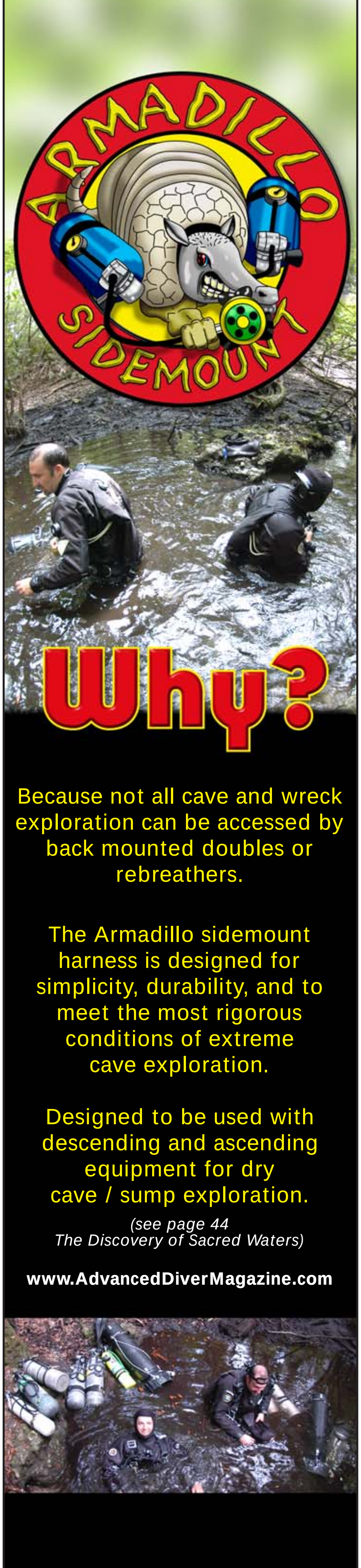

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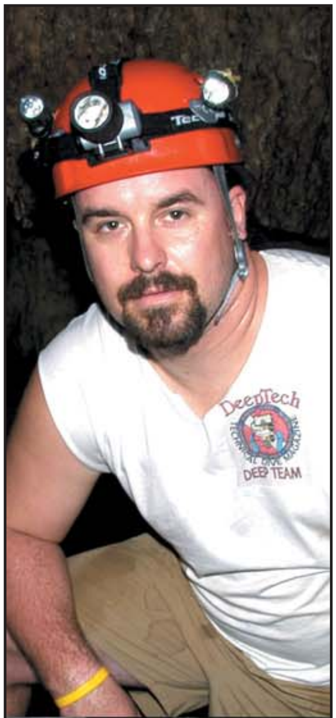

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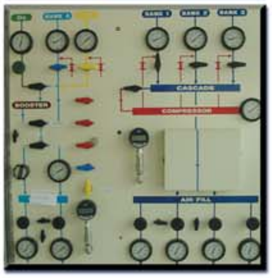

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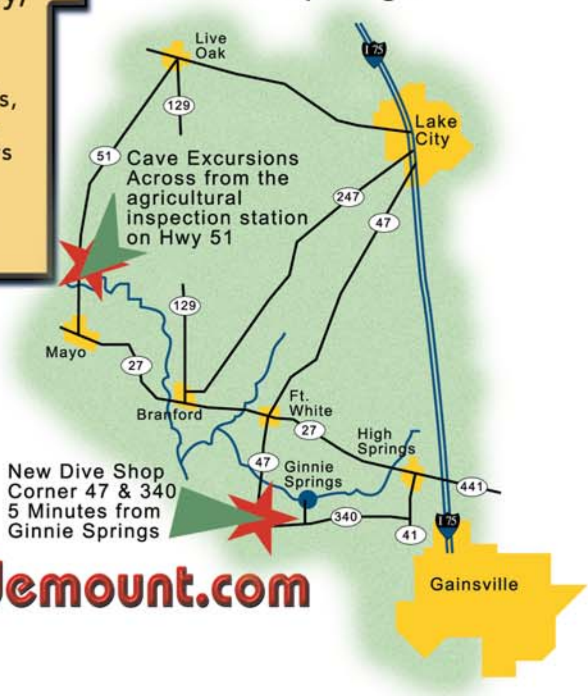

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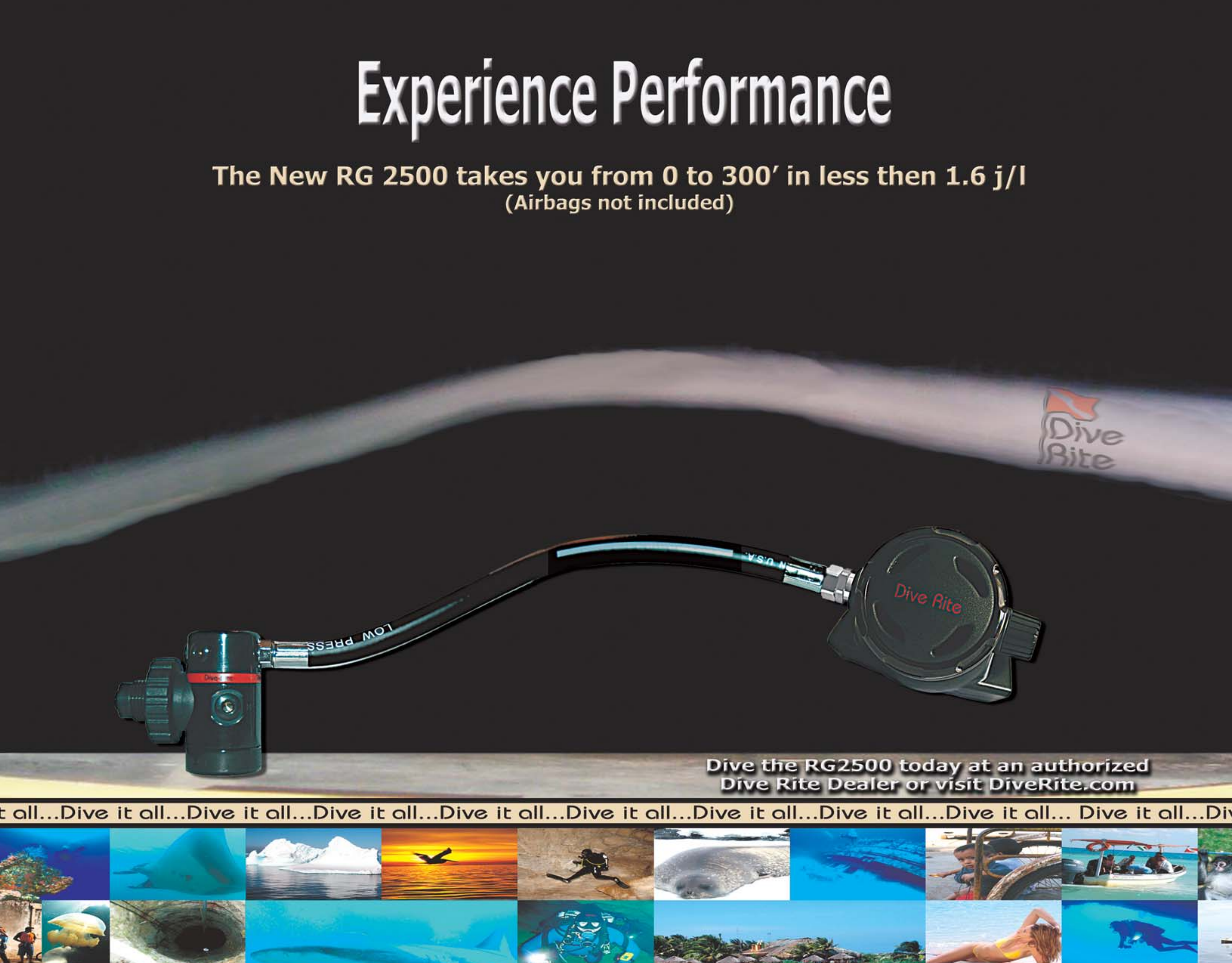
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