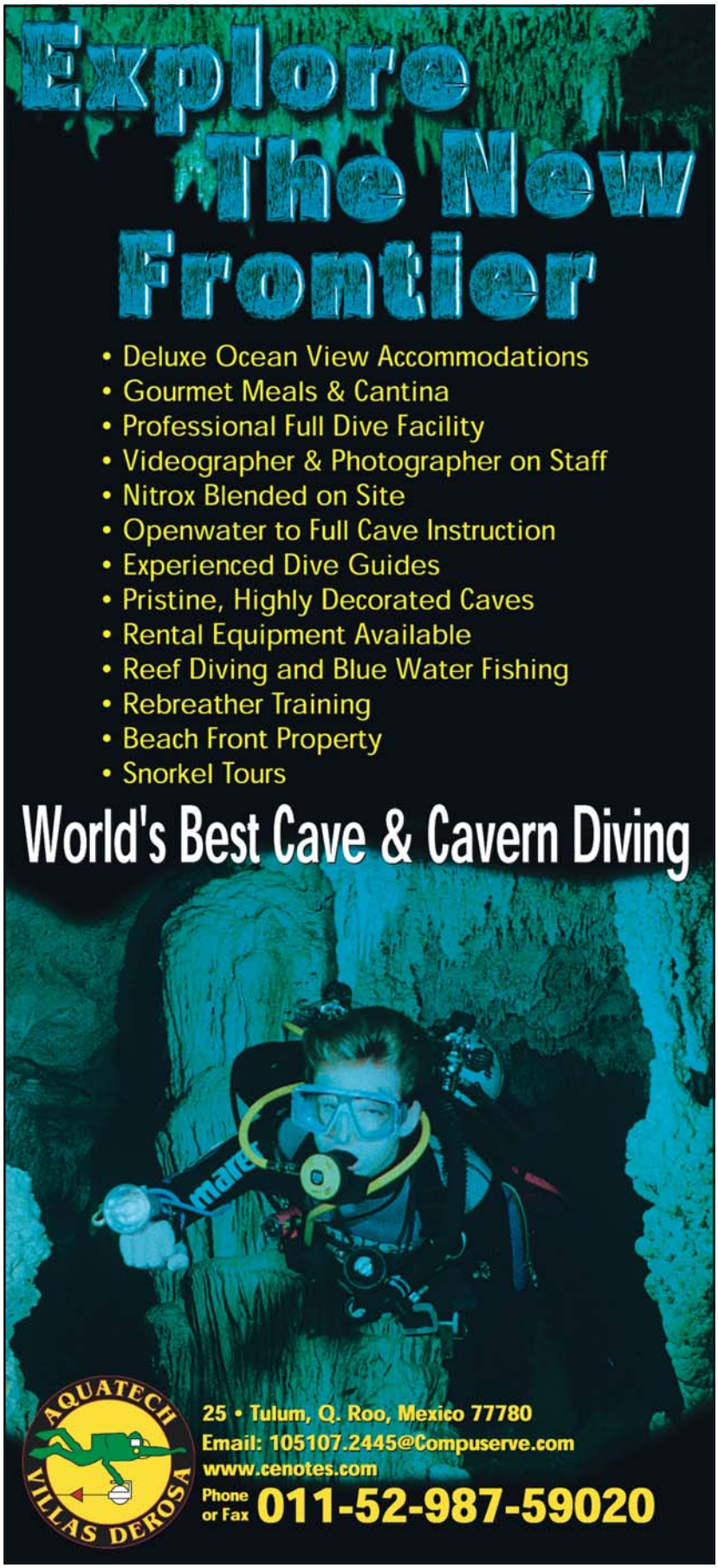
ADVANCED DIVER MAGAZINE

Advanced Openwater to Technical Explorer

- Cis-Lunar Rebreather•
- Wreck / Duane & Bibb•
- Wes Skiles / Capturing Nature•
- Bahamian Blue Holes Project•
- Cave Survey Techniques•
- K2 Rebreather•
- Artifact Preservation / Iron•
- British Cave Diver / John Buxton•
- Cenotes of the Riviera Maya•

EXPLORATION

Issue 4
U.S. $7.00



DEMA 2000 marks one year since the sale of DeepTech by my two ex-business partners. Being the original founder of DeepTech, the news of its sale without my knowledge or approval kinda, well lets say: rubbed me the wrong way. Not only was I concerned about all the years and thousands of hours of work I put into DeepTech but also about the subscribers who had paid their money for a subscription and now would not receive what they shelled out their hard earned cash for. My reputation not only as a publisher but also as a respected diver was immediately at stake.

Knocked back to step one after all these years was a hard blow but also a blessing in disguise. When I started DeepTech I had no connections, no advertisers and very little money. After 4 years in circulation I had thousands of connections, good rapport with my advertisers, and a little more money to start over from square one. Advanced Diver Magazine was born with no business partners, many of the same advertisers and a data base of good subscribers available.

One year has passed and the small staff at ADM has delivered what we had promised. An on-time, high quality, fully illustrated dive magazine like no other. Designed with a good balance of text, illustrations, photos and less than 20% advertising.

ADM will continue into the new millennium providing what we promised our subscribers with the quality and graphic design that I expect as the founder and publisher. After all, my reputation is at stake.

Curt Bowen
Publisher, ADM

GET PUBLISHED

Advanced Diver Magazine is constantly searching the globe for new discoveries made by divers like yourself. Historical or interesting shipwrecks, unexplored caves or ongoing exploration projects, diving techniques, scientific research, underwater archeology, etc... No writing or artistic skill required, the staff at ADM will assist your publishing needs. Submit your ideas or discoveries to:

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ADVANCED DIVER MAGAZINE

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Advanced Diver Magazine is published quarterly in Bradenton, Florida.
Subscription rates are $25.00 for one year (4 issues), $45.00 for 2 years (8 issues).
Canada and Mexico add $15/yr, other forign ad $25/yr.
Visa, Mastercard, American Express, company purchase orders and checks accepted.

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WARNING

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

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Cover: Wes Skiles camera captures Wakulla 2 / Cis-Lunar divers as they begin an exploration dive into the far reaches of Wakulla Springs.

TOC Backdrop: Floating in air, divers explore the labyrinth of passages located just below the surface in Mexico's Yucatan. Photo: Steve Gerrard

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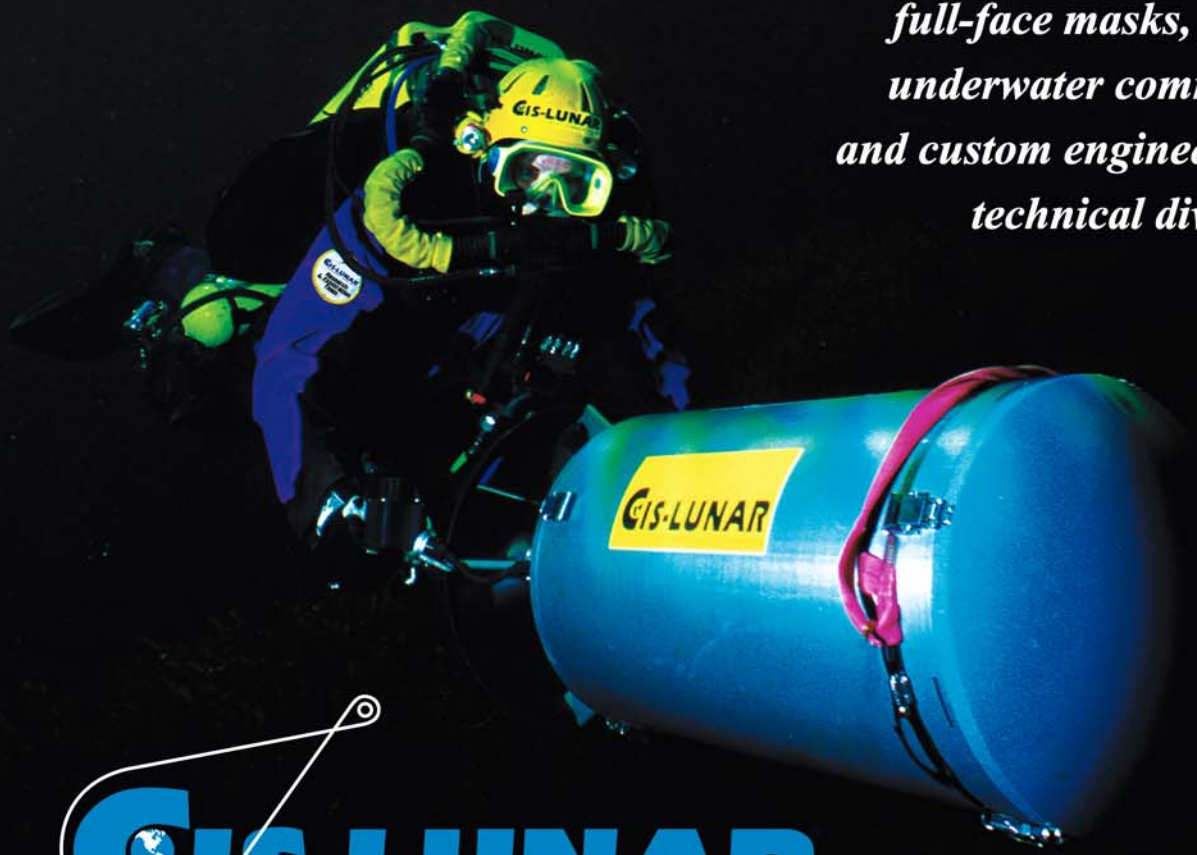

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Duane & Bibb
Key Largo, Florida

By Chris Williams & Linda Bowen

History of the Duane

The USCGC Duane was so named after William Duane, Secretary of the Treasury to President Andrew Jackson. Launched and commissioned in 1936, she was built at the Navy Yard in Philadelphia, Pennsylvania. The Duane was also a 327-foot Cutter, and her primary assigned duties were law enforcement, as well as search and rescue off the coast of California.

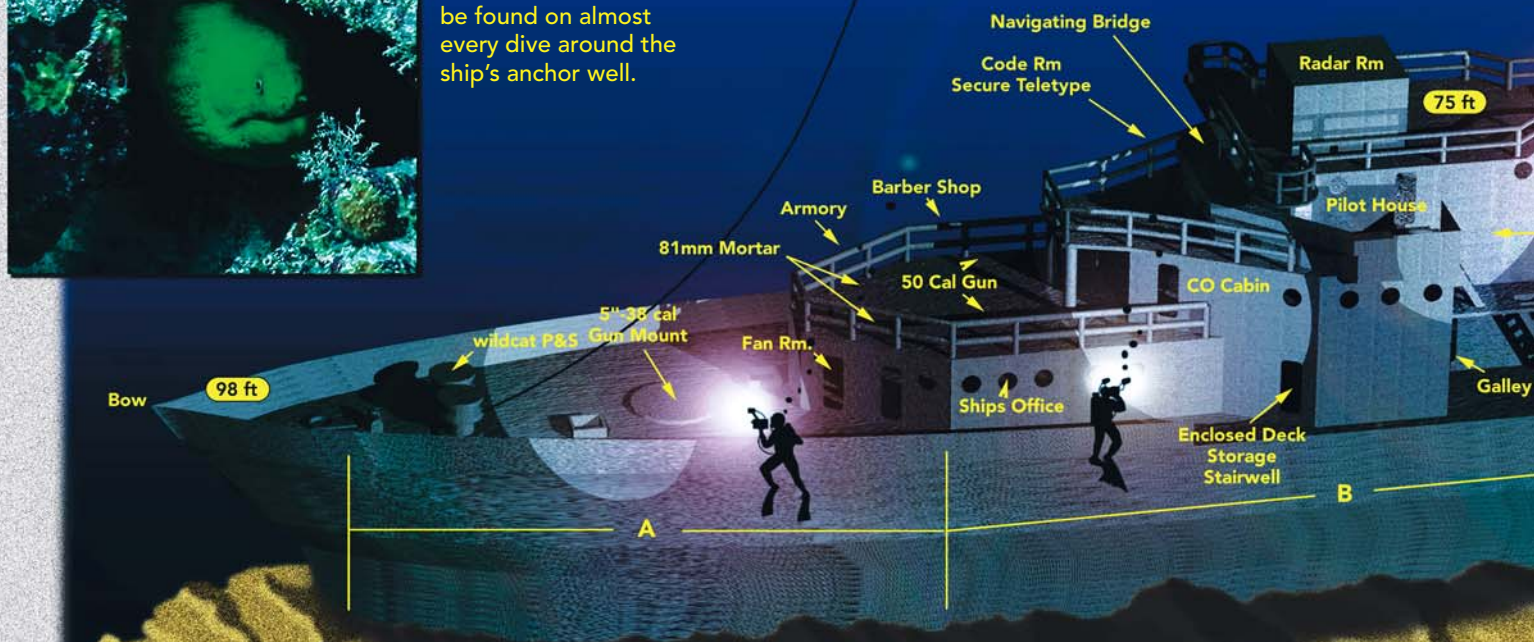
In 1939, the vessel was transferred to the East Coast to operate jointly with the Navy as part of a destroyer squadron that aided shipping across the North Atlantic, as well as detailed weather patrol. Some of her achievements during World War II included a rescue of 46 survivors from the Tresillian, A British merchant ship torpedoed by a German U-boat in 1941. In 1943 with the

50 Caliber machine gun turret plate on the Duane's deck.

A large Moray eel can be found on almost every dive around the ship's anchor well.

Divers City of Key Largo charters their 30 foot Island Hopper to the Duane upon request.

see page 42 for contact information



assistance of a sister ship named Spencer, The Duane sank a German U-boat and true to her rescue assignments promptly picked up the 22 crew members from the Nazi vessel.

One of the most histrionic episodes in the Duane's career occurred in 1942. For three days she aided the rescue of 250 survivors of a tragedy involving the U.S. Army Transport Dorchester. An accident that sadly claimed the lives of 350 crew members, 4 of them clergymen who graciously gave up their life preservers to save other men. An act of heroism that will continue to sound in our collective memory.

In Vietnam, the Duane served as part of the Coastal Surveillance Force from 1957-1968. Upon her return from Vietnam, she resumed her peacetime mission as an OSV. Suppression of drug trafficking along the East Coast of the U.S., training future officers, and maintaining military readiness were among her new duties. On August 1, 1985 she was decommissioned as the oldest active United States military vessel.

History of the USCGC Bibb

The 327-foot United States Coast Guard Cutter Bibb was built in 1935 and launched in January of 1937 by the U.S. Navy Yard in Charleston, South Carolina. Named after George Bibb, Secretary of the Treasury under President John Tyler, the ship was commissioned in March of that same year for a series of routine assignments before becoming one of the first cutters in the North Atlantic assigned to weather station patrol.

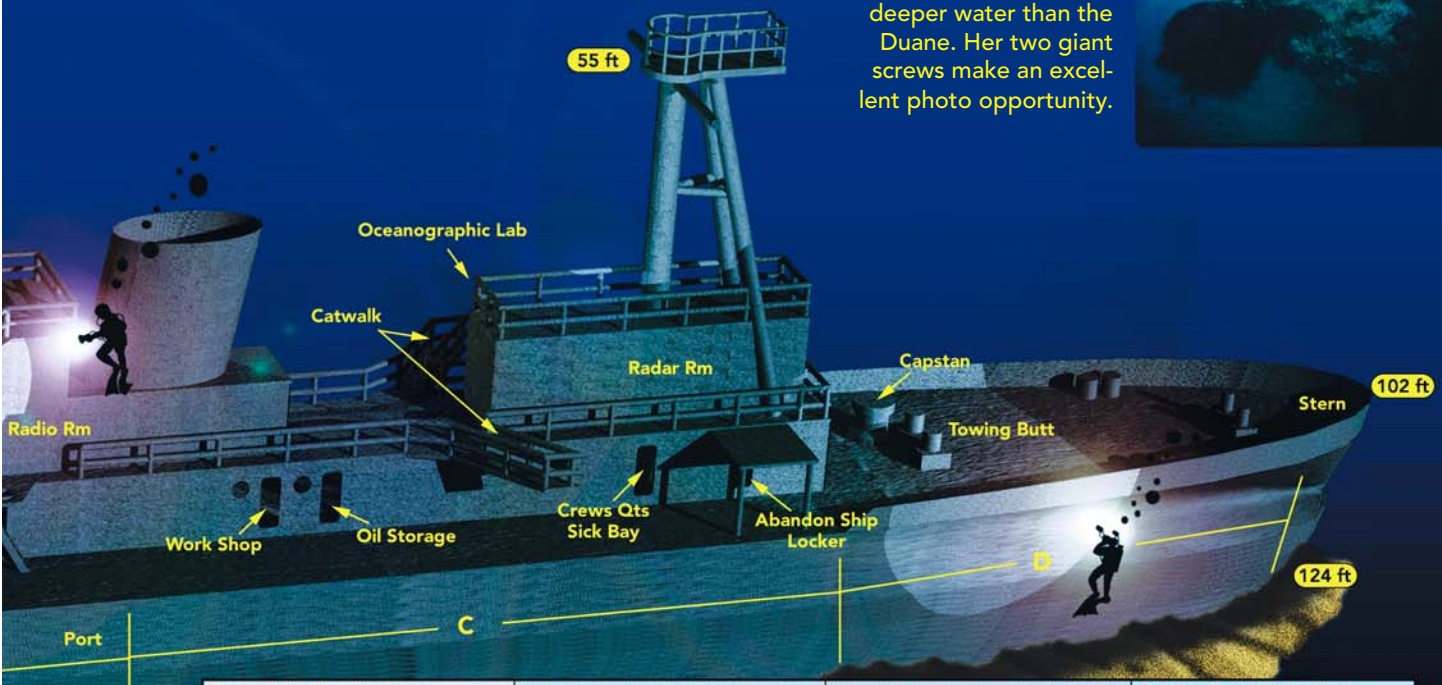
With America's involvement in World War II, the Bibb found herself transferred to the Navy by Executive Order in 1941. After undergoing extensive modifications which included weaponry, the Bibb now took on patrol and convoy duties in the North Atlantic, Mediterranean and Caribbean.

The Bibb enjoyed some notable successes during wartime. In 1942, she recovered 61 survivors from the British Merchant ship S.S. Penmar. In 1943, the crew of the Bibb rescued a total of 235 men. 202 came from the U.S. Merchant vessel S.S. Henry Mallory, and the remaining 33 were from a torpedoed Greek Merchantman called the S.S. Kaliope. This single-year rescue total was unequaled by any other ship.

After the war, the Bibb returned to her peacetime duties, and once again became a vital part of the Coast Guard's life

Duane and Bibb
Continued on Page 41

The Bibb lies on her starboard side in a little deeper water than the Duane. Her two giant screws make an excellent photo opportunity.



Section A Bow to Stern	Section B Bow to Stern	Section C Bow to Stern	Section D Bow to Stern
Second Deck	**Second Deck**	**Second Deck**	**Second Deck**
Boatswain's Stores • Windlass Rm Crews Showers & Qts 5" Gun Handling Rm	Crews Qts • Scullery • Crew's Mess	Passage • W.R. Pantry • Ward Rm	Country • Ward Rm • Passage Storage • Laundry Rm
Platform Deck	**Platform Deck**	**Platform Deck**	**Platform Deck**
Chain Locker • Paint Locker Canvas Storage • Dry Stores	Medical Storage • Cold Storage Gyro Compass Rm • Fuel Oil	Boiler Rm • Engine Rm Aux Mchry Rm • Dry Provisions	Generator Rm • Diesel Oil Engine Parts Rm • Steering Rm
Lower Level	**Lower Level**	**Lower Level**	**Lower Level**
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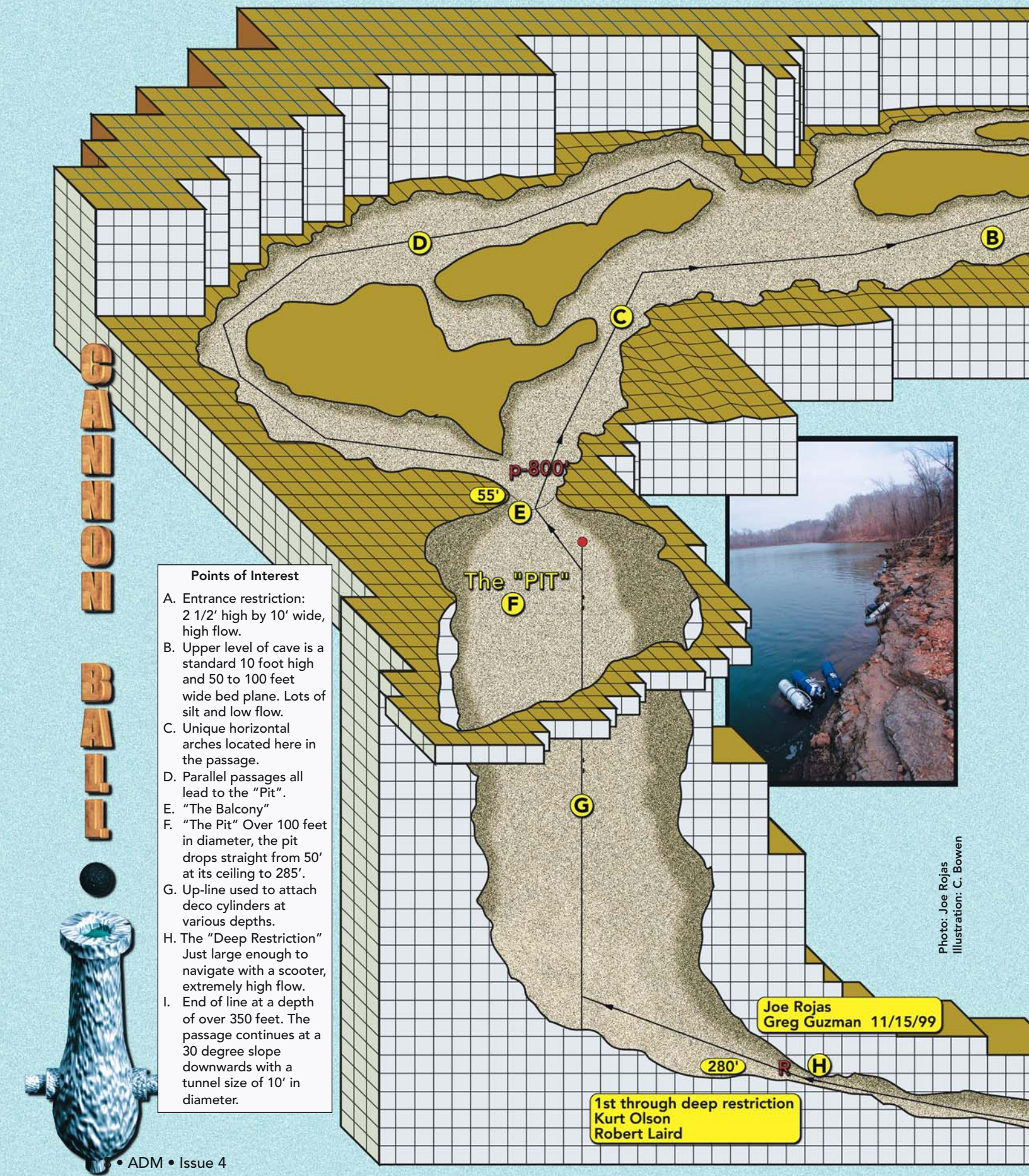
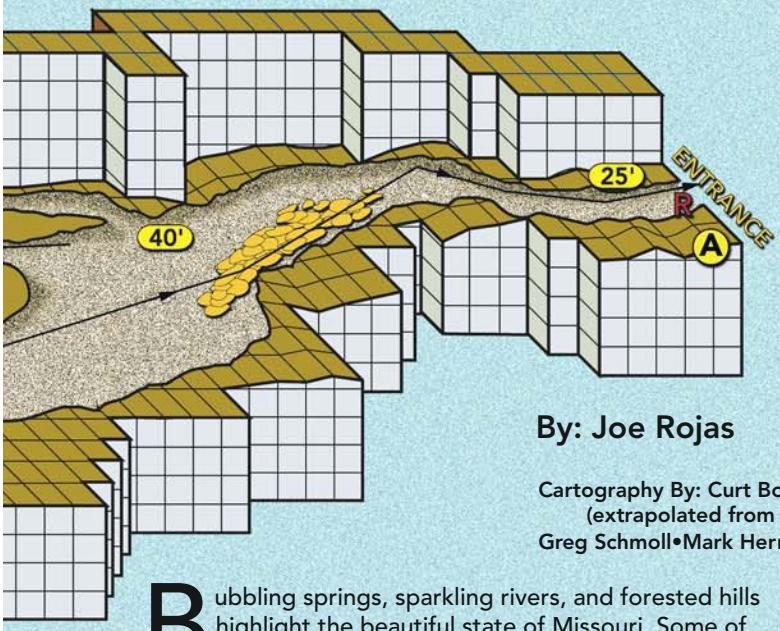
Video Capture: Leroy McNeal
Illustration: C. Bowen



Points of Interest

A. Entrance restriction: 2 1/2′ high by 10′ wide, high flow.
B. Upper level of cave is a standard 10 foot high and 50 to 100 feet wide bed plane. Lots of silt and low flow.
C. Unique horizontal arches located here in the passage.
D. Parallel passages all lead to the "Pit".
E. "The Balcony"
F. "The Pit" Over 100 feet in diameter, the pit drops straight from 50′ at its ceiling to 285′.
G. Up-line used to attach deco cylinders at various depths.
H. The "Deep Restriction" Just large enough to navigate with a scooter, extremely high flow.
I. End of line at a depth of over 350 feet. The passage continues at a 30 degree slope downwards with a tunnel size of 10′ in diameter.

Photo: Joe Rojas
Illustration: C. Bowen



CANNON BALL CAVE
Lake Wappapello, Missouri

All Passages Underwater
January 1st, 2000

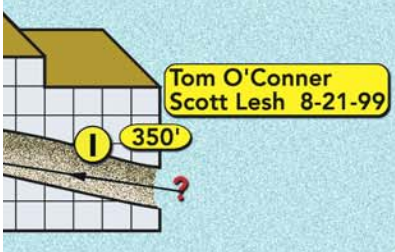
By: Joe Rojas

Cartography By: Curt Bowen
(extrapolated from the original map created by:)
Greg Schmoll•Mark Hermerding•Ralph Walter•Bob Foster

Bubbling springs, sparkling rivers, and forested hills highlight the beautiful state of Missouri. Some of these springs contain aquatic cave systems that are unique to dive, however Missouri has never been recognized as a quality diving destination and, as a result, Missouri caves are rarely visited or explored. Roubidoux is the most popular of the Missouri caves, but even the yearly attendance at this choice spring is only equal to a single day at some of the more popular Florida caves. The Missouri cave systems of Roubidoux, Meramec, Blue, Bennett Cave (Devil's Well), and Cannonball, are less than 2 hours from St. Louis. The extent of Missouri springs have not yet been reached and as exploration continues, local divers are confident that there are more caves within the springs to be discovered. The jewel of the Missouri caves is Cannonball. It is a unique system due to its location, depth, and difficulty in diving.

Cannonball cave, formerly known as Davidson's Blue Hole Outflow, created a hillside pool and a small creek that fed into the St Francis River 100 yards to the west. It had a flow of approximately 31.7 million gallons per day, which is small in comparison to some of the other Missouri springs. In 1939, the U.S. Army corps of engineers built a public flood control reservoir for the St. Francis River and all its tributaries. The dammed river flooded over the spring's mouth and surrounding area, creating a reservoir called Lake Wappapello. The entrance to the spring now lies at an average depth of 28 feet depending on the dam's water level. On a calm day it isn't uncommon to see the boil that is created by the turbulent spring water in the murky-still reservoir.

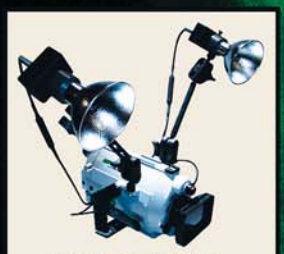
A problem with diving Cannonball is that the nearest parking area (within a few hundred feet of the spring) is on top of a hill that is over 100 feet above the water's edge with a 40-60 degree decline. The hill is not bad going down as long as you are taking it slow; the problem is walking back up with doubles, stage tanks, and scooters. It is definitely a test of physical ability and can put divers at risk of the bends after doing a 300-foot dive. Fortunately there are alternatives to trekking the hill. One is a boat landing to the west of the spring, it is possible to scooter to with an estimated distance of 500 to 800 feet. The best choice is to come by boat, mooring it right off the spring with a designated person tending the boat and assisting the divers on entry and exit. It is important to bring a dive flag, as this area is also favored by fisherman. As you enter the water, the river temperature can vary from high 70's to low 40's depending on the season. It takes time to find the cave entrance since the surrounding water has zero visibility, but once the spring outflow is discovered, the visibility becomes remarkably clear.



On a recent visit to Cannonball with my dive partner Greg Guzman, the river temperature was around 55 degrees Fahrenheit, and spring temperature was 57 degrees Fahrenheit. We found the entrance at 26 feet. A resident catfish almost 3 feet in length was found guarding the opening of the cave. The entrance has a restriction that is 30 inches in height at it's largest point and an overall width of 10 feet. The restriction continues past the opening with a length of 10 to 12 feet that finally opens up to the system. By following the main line you first make your way around a large boulder, then the line makes a 60-degree northeast turn. You will notice the dark walls and silt floors, which marks this cave's difference from popular Florida cave systems. The first 50 feet is a step over of rocks that have fallen from the ceiling. The cave continues in a northeasterly direction at a depth of 40-45 feet, there are parallel passages on the right of the main line which are reachable with a gap or jump reel. These side tunnels lead back to the main tunnel and make for an enjoyable dive, being careful of the low ceilings and the buildup of silt. The visibility fluctuates in the system from 5 feet to 60 feet during the year depending on rainfall and lake height.

This is truly one of the most beautiful cave systems in Missouri. There are unusual rock formations at approximately 500 feet, where natural stone bridges divide the cave horizontally. Passage can be made above or below them. At a distance of 750 feet you reach a room that drops to a black abyss. The room has a width of 150 feet at the top and an average width of 60 to 80 feet further down the tube. In the drop off there is a dropline that is being held up by a truck innertube so that divers can place their stage tanks at specific depths. On the way down we dropped our decompression gases off at 70, 120, and 220 feet. Our back gas

Cannon Ball Cave
Continued on Page 43



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RGBM Deep Stop Modeling

Author's Timothy O'Leary and Bruce Wienke

At DEMA 2000, NAUI Worldwide introduced a new training CD for Mixed Gas Diving, which includes ranged trimix and helitrox decompression tables developed by Bruce Wienke, Ph. D. These tables employ the Reduced Gradient Bubble Model (RGBM) that incorporates tissue halftime compartments ranging from 1 to 720 minutes for gas mixtures composed of helium, nitrogen and oxygen. However, unlike pure dissolved gas models that assume all inert gas stays in solution, bubble separation and growth is the central focus in RGBM decompression calculations. And as such, calls for much deeper initial deco stops and slower ascents to limit microbubble formation and evolution. The effects of this are reductions in shallow stop-times as well as total decompression times compared to the schedules for identical profiles generated with traditional Haldanian decompression models. Addressing both free phase (bubbles) and dissolved gas phase, their interplay and impact on diving protocols is welcome news for mixed gas divers!

Is this new? Certainly not! At DEMA 1999, Suunto premiered the VYPER nitrox dive computer that uses RGBM and another manufacturer is working to implement limited RGBM code into its mixed gas computer for no-stop dives. NAUI mixed gas instructors working with NAUI Technical Operations have been using RGBM generated schedules for nitrox, helitrox, heliox and trimix dives with great success for several years now. Extended range dives have included gas switches during ascent to accelerate stage decompression, but also the use of alternative bailout mixtures as a safety option during mixed gas training dives.

Doppler technology, decompression computer development, theory, statistics and observations by exploration divers pushing the limits of depth and time have stimulated a safer diving consensus and new look at algorithms and gas switching. The result has been dramatic changes in diving protocols and table procedures. It's probably not readily apparent to new divers, but everyone else has witnessed the shift to shorter NDLs, slower ascent rates, discretionary safety stops, more restrictive repetitive profiles, lower critical tensions (M values) and longer flying after diving surface intervals.

Although the face of diving has been transforming all along, change is hard when it flies against conventional thinking. Understanding the basic differences between free-gas phase modeling and dissolved gas modeling should make it clear why NAUI Tech Ops chose to go with the RGBM for mixed gas diving.

No one fully understands the origin, dissolution mechanisms or migration patterns of bubbles, but bubble size, amount (total volume) and growth rates need to be controlled along with the amount of gas remaining in solution. Biophysical models of inert gas transport and bubble formation all try to prevent decompression illness (DCI), however, they differ on a number of basic issues, most of which are still unresolved today.

1. The limiting process for both diffusion and perfusion.
2. The composition and location of the bends sites.
3. The mechanism of bubble formation and growth.
4. The critical trigger point best delimiting the onset of DCI symptoms.
5. The nature of the critical insult causing DCI.

Traditional dissolved gas models limit degrees of tissue saturation and elimination by maximum critical tensions, called M-values. They assume perfusion and diffusion — the two mechanisms of inert gas and oxygen exchange between tissues and blood — are the controlling factors for inert gas elimination. Perfusion refers to the rate of gas delivery via blood, while diffusion refers to gas penetration across tissue -blood boundaries.

For a single bounce dive, dissolved gas models are limited by the saturation of a slow, single compartment, such as the 120-minute halftime for the US Navy Standard Air Decompression tables. For repetitive dives, multiple controlling compartments come into play to gradually decrease no-stop limits and increase desaturation times for staged decompression dives. The key point is that the elimination gradient is maximized as the diver approaches the surface and the model seeks to do this in as short a time as possible.

Gas phase models assume 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.

Many mixed gas divers appreciate the physiological benefits of deeper stops. But when generating deco schedules from solution-based desktop decompression software, the addition of deep stops dramatically increases shallow stop times. However, the deeper staging format inherent with bubble models actually reduces shallow stop times.

RGBM Deep Stop Modeling
Continued on Page 43

Survival at Sea

By: Andrew White

The world's oceans are one of the last, true frontiers. Covering four fifths of the Earth's surface, they present a hostile environment, and one of the most difficult in which to survive. As open water divers we routinely trek into the oceans to explore the wonders of this alien world. Our adventures often lead us far off the beaten path, and many times we take for granted the fact that we can get home safely, but emergency situations arise when we least expect them. Being prepared for an emergency and committing to memory a few survival techniques can be invaluable should a disaster occur.

In this day and age of satellite technology, exploding populations, and a truly global community, it is hard to imagine being cut off from the outside world; yet each year a surprising number of people find themselves in just that situation. Legends about divers left behind by charter boats, or being swept off a wall dive never to be heard from again, are common in the diving community. While many of these stories may be exagerrated, the possibillity of this happening is very real. Add diving in a remote location, strong currents, and long decompression obligations and the level of risk increases exponentially.

Any number of variables can turn an otherwise great dive trip into a survival situation. Weather conditions are perhaps the most formidable and should be monitored closely before making a decision to venture out into the ocean. Weather is the leading cause of accidents on the high seas. Bad weather not only hampers rescue efforts, but also makes for much more hazardous survival conditions. Keep abreast of your local marine forecast and plan dive trips accordingly.

The shrewd diver recognizes the dangers of maritime travel and the need for a plan should an emergency come about. The first information you should know is what emergency equipment you have on hand and how to operate that equipment.

Emergency Equipment for the Vessel

All commercial and charter boats operating in US waters must meet strict guidelines for emergency equipment. On a day charter, or even a liveaboard vessel, a divemaster usually gives a briefing of the emergency equipment and procedures while en route to the diving destination. Take the time to listen to this speech and familiarize yourself with the location of safety gear like life jackets, throw rings, first aid kits, and communications equipment. Should an emergency arise, you may need these items in a hurry.

Important boating safety equipment includes:

VHF (Very High Frequency) radio: Your link to other boats and land-based rescue stations. VHFs normally operate on a line of sight basis between antennas and can be good for 5-25 miles. Channel 16 is the designated emergency channel and is constanly monitored by the Coast Guard and other rescue personel.

Single Sideband Radio: A long range communication unit designed for vessels that routinely travel great distances in the open ocean. The single sideband operates much the same as a HAM radio and has a signal that far outreaches that of a VHF.

Emergency Position Indicator Radio Beacon (EPIRB): One of the most valuable pieces of emergency equipment, EPIRBs are small transmitters that send an emergency signal to rescue services. When activated, an EPIRB emits a constant, internationally recognized distress signal to a satellite network that relays the information to rescue personel. They are limited to mayday types of emergencies and should only be used in the most dire of situations. EPIRBs are waterproof, they float, and many have an activation switch that automatically turns the unit on when submerged in water. Check each EPIRB individually for instructions on their use before you need to use them.

Life rafts: Designed to keep captain and crew alive until rescue, a life raft can be the best friend of a crew whose boat has gone down. Life rafts come in many different types and classes, with the best including canopies for protection from the elements, locator lights, boarding ladders, and ballast bags for stabillity. Most life rafts use a high-pressure cylinder for self-inflation. They generally do not include much lifesaving equipment, so always remember to bring what you can if an abandon ship is called.

All Life rafts are designed to carry a limited number of occupants. Exceeding this number can put the lives of all aboard in jeopardy. The young, infirm, and injured should be placed in the life raft first, followed by as many healthy survivors as the raft can accomodate. The rest of the survivors must then hang on from the water. Able-bodied survivors should then rotate in and out of the raft on a regular basis. This gives the entire party the best chance of survival.

Emergency Equipment for the Individual

As divers we must deal with the risks normally associated with boating, but are at a significantly higher risk for being left alone in the open sea. Drift decompression is

probably the highest risk activity, but it can happen to any diver. Currents can change direction, weather conditions can quickly deteriorate, or the crew of a charter boat may simply forget about you. In any event, it is important to carry a few pieces of survival equipment to make sure your stay in the water is a brief one.

If you should find yourself alone and treading water on the high seas, your first priority, other than keeping your head above water, will be to draw attention to yourself. Sound carries surprisingly well over water, so splashing and yelling can be very effective, but even the loudest scream cannot compete with the diesel engine of a boat that may be passing by. Lucky for us there are many quality emergency signalling devices on the market that can easily be kept on a diver's person.

Signal Mirror: Light, compact, and very functional, a signal mirror is one of the most effective signalling devices for the diver left out to sea. A mirror can reflect the sun over long distances (up to 10 miles), creating a bright flash that is easy for potential rescuers to see. Some signal mirrors come with a rangefinder grid that helps aim the mirror for best results.

Whistles: The most popular of diver safety equipment. A whistle produces sound that exceeds the human voice, and can be heard over longer distances. Some whistles are now made to attach to a low pressure inflator hose. These "super whistles" enable a diver to create sounds that can be heard up to a mile away with a simple touch of a button.

Inflatable Safety Tube: Also known as a "dive sausage," these brightly colored, compact tubes can fit in most pockets for storage. When inflated they reach sizes up to 10' with a high visibillity distress signal.

Dive light: A number of lost divers have been saved by their dive lights. This is a vital piece of equipment that should always be on hand, even during daytime dives. During the day, the beam of a dive light can reflect against a signal mirror for a precise, concentrated flash. At night, the light may be your only means to attract the attention of a rescue party. Even camera strobes have been used to bring rescuers to a lost diver's position.

Personal Waterproof Flares: These come in two different styles, red to signal an emergency and white to aid in location. They are normally worn on a belt and are unobtrusive to other gear. Flares are by far the most prolific of emergency signalling devices and are very effective. They are a universal distress signal that can be seen clearly over great distances. When purchasing flares be mindful of their capabillities, most are only waterproof to 130fsw.

Balloons: A small bag of balloons in your BC pocket can be used as a trail for the rescue boat to follow. Fill each ballon with a small amount of sea water for added weight, blow the balloon up to about 3/4 maximum size and tie the end, then let the balloon drift away from you. Every 10 to 15 minutes repeat the process with another ballon. Even when the wind and current are coming from different directions the string of ballons will help pinpoint your location.

The Plan

If you get separated from your boat, are left at sea, or even if your boat has sunk, the best initial course of action is to stay put. If a distress call has been put out, rescuers are probably all ready on the way. If you have become separated from your boat, the captain will have a general idea of your location once you turn up missing. In areas of strong current, rescuers can obtain a search line from the dive site to where you are if you let the current take you; and even the mightiest of ocean currents will only carry you a few miles each day. NEVER try to navigate unless you can see land; If you can see the shore, swim toward it.

If you are wearing dive gear, drop your weight belt and inflate your BCD, this should keep you safely afloat for a good deal of time. Keep an eye out for any flotsam that might provide support and tie it together with whatever is available: survey tape, reel line, and speargun cord work well. If it is at all possible, get out of the water as soon as you can. Exposure is an immediate danger to a person lost at sea. Clothing and wetsuits can help to protect you from exposure and should remain on the body at all times. In colder water, body heat retention is very important. Do mild exercises to keep the blood flowing. If in a group, have survivors huddle together to share body heat.

Probably the most important thing to remember is to remain calm. Panic not only clouds rational thinking but wastes valuable energy as well. As divers we are better prepared to handle this than the average person, for since the very first class of Open Water I we have been conditioned not to panic in an emergency. This is a great start, and gives divers a little edge over someone with no survival training. Technical divers take it a step farther. Each time we dive in an overhead environment, without a direct line to the surface we are, in fact, putting ourselves in a controlled survival situation. It is how we think and the decisions we make that are going to get us out alive. Surviving a disaster at sea is much the same. Keeping your head and having confidence in your abillity can mean the difference between life and death.

Dont believe it cant happen to you! The publisher of ADM has been on a number diver rescue missions where fleets of vessels searched out missing divers. It is a very big ocean and even with today's technology, the chances of being rescued are less than you would expect. Even if you are rescued, floating helpless for many hours, perhaps even over night off a Bahamian wall or The North Atlantic with thousands of feet of ocean below your feet can be very tramatic. In our next installment we will deal with the mental and physical stresses associated with a survival situation, and the longer term objectives of a diver lost at sea.

OMS, Dive Rite and Halcyon produce specialty equipment for emergency lost at sea situations. Access through www.AdvancedDiverMagazine.com to all their web sites is now available. Check it out and be prepared!

CDG Cave Diving Group

John S. Buxton

50 Years of Cave Diving

Interview by: Jim Rozzi

JOHN, WHAT ATTRACTED YOU TO CAVE DIVING IN 1952?

I was a dry-caver in my college days 1948/1949. Alot of caves ended in pools of water (Cave diving was in its infancy in those days) Some had a wire going into the "sump." When I inquired as to what was at the other end I was told that divers had been through.....I couldn't become a diver fast enough!

TELL US ABOUT THAT FIRST CAVE DIVE.

The first cave dive was at Keld Head, Kingsdale, North Yorkshire, England at August Bank Holiday in 1952 (31st. August). I had previously done some 5 hrs. underwater to get over any initial breathing reaction to holding a mouth-piece between my teeth. I was using a Siebe Gorman Amphibian MK.II--an unmodified Rebreather with a 6 cub.ft. Oxygen cylinder: this was used with a "Frogman" 2 -piece dry suit with a hood and a full-face mask, and bottom walking boots. I was escorted by a qualified diver, was on a rope, and was allowed to go in 50ft.!! .. the limit of the 1st dive. I believe my escort was Bill Davis. Two other new boys were taking turns, Ken Hurst and Phil Price. I was very engrossed during the dive, the viz was poor, bottom walking I could only see 2 ft. in front of my boots, rather disappointing after training in swimming pools and rivers with 15ft. viz I found that there was a very isolated feeling when not being able to see much!

WHY DO YOU SIDEMOUNT?

British divers slowly developed and adopted sidemounting because A) Caves were small and B) they tended to be bedding plane shaped (low) and unsuitable for open water backmounts. (I should strongly emphasize that British cave divers have shallow pockets!! --Do-it-Yourself)

DO YOU NOTICE ANY DIFFERENCES BETWEEN BRITISH AND AMERICAN SIDEMOUNT TECHNIQUES?

Alot of British divers do not use buoyancy aids, especially in small tight caves, and add lead to the harness if needed. It should be emphasized that we do not meet many large, deep Sumps so small cylinders are often used. This is doubly convenient where the sump may be a long carry from daylight. By design we have redundant cylinders and valves. By tradition, British divers tend to carry "torches" on a helmet, the latter being both a hands-free carrying tool and a head protector. But to be honest the large battery with a hand-held head is gaining popularity, especially with divers doing more extreme dives. To be truthful, I have not met a lot of American sidemount divers since the diving I have done on the other side of the pond has been mainly in Wakulla and the Bahamas. British side mount harnesses are usually simple belt and braces with an attaching smaller width waist belt that goes through loops on the larger waist belt and on the cylinders. These are usually aligned along the leg, but there is a tendency to follow the American style with D rings near the kidneys. Nothing is new in this world--the whole set up was developed from an English open water harness that in turn was probably a copy of a Cousteau Aqualung harness.

IN OVER FORTY YEARS OF CAVE DIVING WHAT DIVES HAVE SPECIAL PLACES IN YOUR MEMORY?

Firstly. Keld Head....1st. cave dive. Wookey Hole....Blue Green water! Bahamas Blue Holes...Deep, warm and good viz and Wakulla....Just awesome.

Far Left: Buxton at the age of 70 exploring deep caves (275'+) in the 1999 Bahamian Blue Holes Research Project.

Left: 1956, Buxton equipped with a military oxygen rebreather, leather dry suit and walking boots prepares to enter Wookey cave.

Right: 1961, Buxton equipped in an early rebreather and one of the first accounts of divers using wet suits in a cave.

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WES SKILES

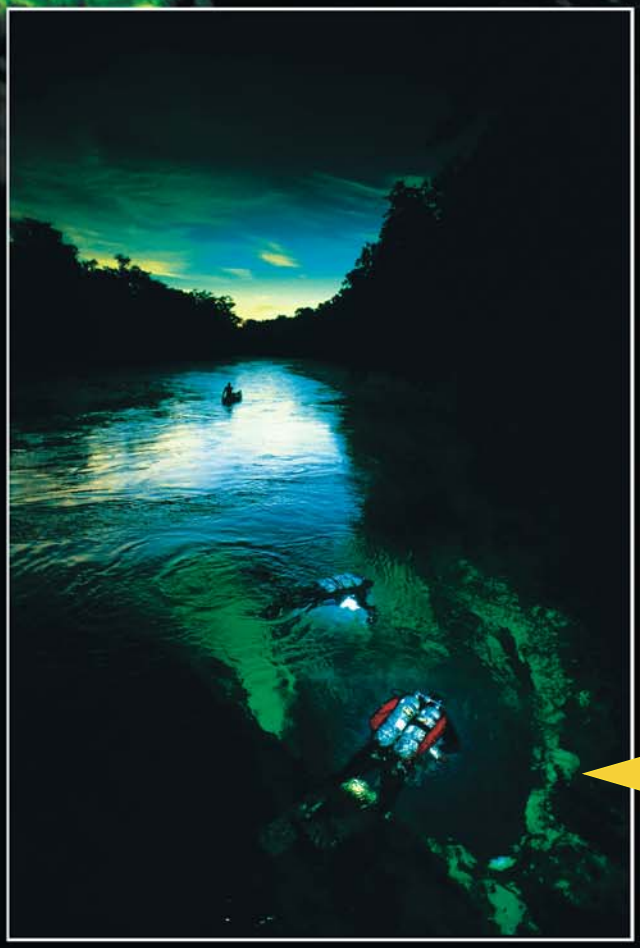
Capturing Nature

Earth, Rain and Fire
Groundwater flowing out of the earth coalesces with the tannin stained rain waters of the Santa Fe River at Ginnie Springs.

8″/12″ print 125.00
11″/17″ print 155.00

Throughout my life I have always had a deep desire to capture images of the natural world. My first big purchase as a kid was a Nikonos camera. I knew back then that photography was something I had to do, a language to let me communicate what I could not express any other way.

North Florida's rivers, and springs are the canvas that I choose to focus my effort. Born and raised here, I feel fortunate to have grown up in the land of mysterious waters. The first time I pulled back the bushes and saw a spring I knew these magical places would be a permanent part of my life. Our area offers one of the greatest natural wonders on earth. A giant, three-dimensional karst terrain that produces a renewable resource of the finest water on earth. I can think of no place on the planet more worthy of my attention and love than my own backyard.



Secrets to be Explored
The Devil's Ear in the basin of the Santa Fe River beckons explorers in.

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Earth's Sweet Breath
A golden steam rises from water born of the earth on a crisp winter morning on the Santa Fe River

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11"*17" print 95.00

The Jade Grotto
Troy Springs, one of Florida's most beautiful first magnitude springs

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The first objective of my image making is to capture what I am experiencing. This varies greatly from most image makers, which have a talent for capturing what they see. It is extremely rare that this happens for me spontaneously on a photographic outing. More times than not my images represent an evolutional crafting that may keep me working on an image for years. Honestly, I'm never sure of what I'm doing until the right elements of light, technology, mood, and the environment all line up for that one magical moment.

Certainly, one of the greatest challenges for me has been the forced mixing of technology with artistry. In the alien and aqueous world of subterranean caves this has proven to be a greater challenge than one might ever imagine. The goal, to drag an enormous amount of expensive, flood-prone, tempermental and dangerous electronic equipment into an

Ichetucknee
The Crown Jewel of Florida's pristine rivers and springs.

8"*12" print 95.00
11"*17" print 125.00

DiePolders II
No place on earth better exemplifies the beauty, wonder and intrigue of cave diving inside of the Floridan Aquifer than Diepolders II.

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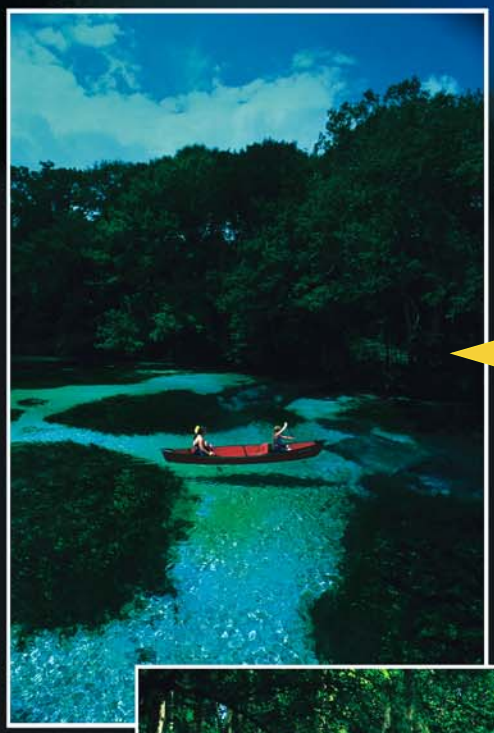


Fantasy of Flight
Seemingly suspended in mid-air, canoers enjoy the sensation of flight above the air clear waters of Cypress Spring.

8″/12″ print 65.00
11″/17″ print 95.00

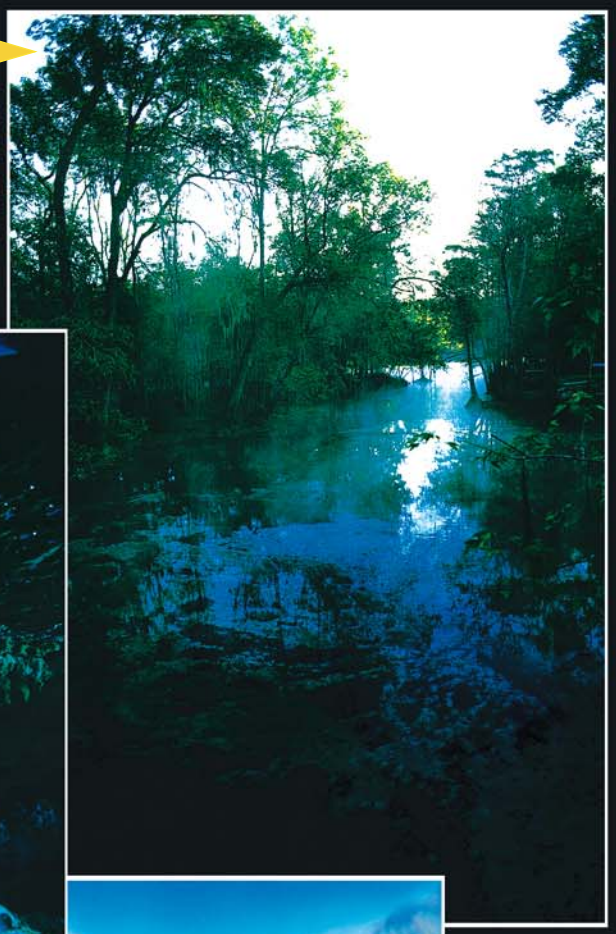
environment of perpetual darkness and hope everybody and everthing does their job. It has to be the only form of photography where you have no idea what you have created until after you get the film back. The quest to build equipment, techniques, and methods necessary to capture these images has lasted decades and has required a tremendous amount of patience and support from a team of the best dive buddies I could have ever hoped to find.

River Rise
Morning light reveals springtime beauty on the Santa Fe River.

8″/12″ print 95.00
11″/17″ print 125.00

As divers we get to live out a Peter Pan fantasy of flying weightless within a dreamscape of unparalled beauty. The things we see and the places we explore have a deep and profound impact on us all. For me the goal has always been to share our world with others in hopes of touching someone's heart. It could be a smile, or a moment of awe, but the best result is when an image reveals beauty and wonder that you never knew existed. My greatest pleasure is when my images impower others to act on behalf of our fragile ecosystems. In those moments, I trust the passions that I have placed into my images are being applied to their highest and best use.

Wes Skiles



Ginnie Spring
Dawn's light reveals the rising of the earth's most precious resource.

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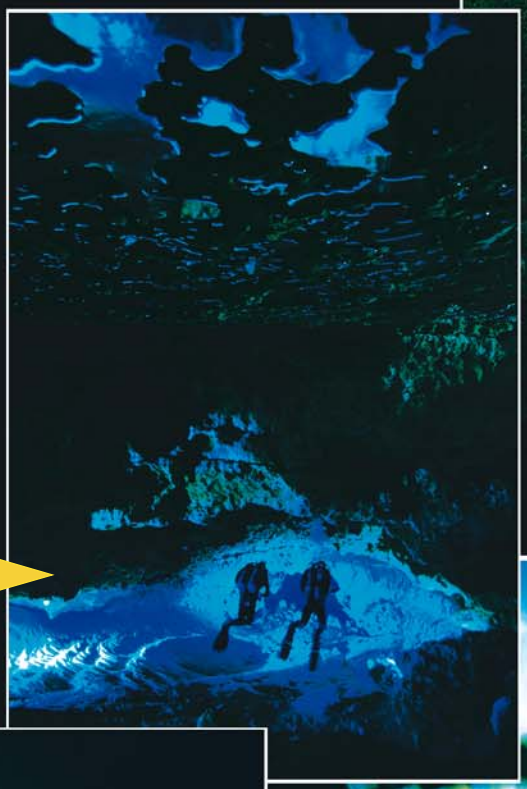

Lure of the Labyrinth
Descending into the wonders of Ginnie Springs.

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Sweetwater Cave
Explorer Mark Long in the Upper Level of Sweetwater Cave.

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Fanning Spring Manatee
The warm waters of Florida Spings are home to the endangered manatee.

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K2 Advantage Rebreather

By: Bill Delp and Jack Kellon

The K2 Advantage is a depth compensated, passive addition, semi-closed, recirculating underwater breathing apparatus. After having been involved in the design end of the rebreather business for over thirty years, it is the designer's choice of the best combination of safety and operational features for the entry level user, yet still retains the features needed to satisfy the needs of more severe dive profiles.

The unit's operating system is completely contained within a single device in the loop called the system valve. This valve determines how much of each exhalation is expelled from the loop and how much is returned to the counterlung, based on depth. O2 fractions are very stable regardless of diver work load. Water introduced in to the loop at the mouthpiece is expelled with every exhalation in the normal swimming position. The proportioning mechanism utilizes new technology to make the unit far safer to swim hard at the surface than any other semi-closed rebreather on the civilian market. The valve's gas expulsions are totally silent and reduced to small bubble sizes to minimize intrusiveness. This valve is extremely durable and reliable and is not user serviceable. It is the manufacturer's policy to exchange the valve as a complete unit at no cost during the warranty period and at a nominal cost thereafter. When a system valve is

A. Quarter turn light weight mouth piece. Designed for an optional open circuit regulator for emergency instant backup.

B. Durable, flexible breathing hose. Exhaled gas flows through this hose to the system valve.

C. The genius piece of the K2 rebreather. This valve controls gas exhalation, addition and depth compensation.

D. Easily maintained scrubber containing 4 lbs of absorbent.

E. Ergonomically designed front-mounted counterlung for ease of inhalation. Easy to maintain.

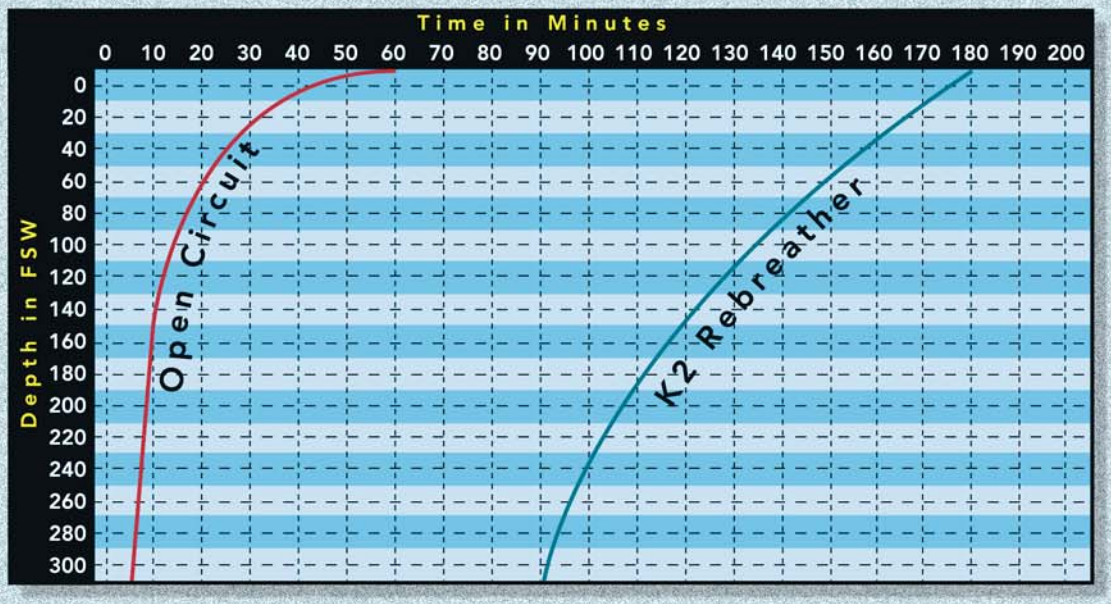
F. Supply gas, typically nitrox but can easily accommodate other mixtures.

G. Gas addition regulator, operates on diver's respiratory work load.

H. Hose from counter lung to mouth piece.

Illustration: C. Bowen

K2 Rebreather performance advantages compared to open circuit (80 cubic foot cylinder) for time durations at depth.



received, a replacement is shipped the same day. To date, there have been no system valve failures.

The counterlung is proportioned to minimize negative lung loading and is situated in the loop in such a manner as to allow floods to be cleared with a minimal chance of caustic solution getting to the diver. An additional regulator is mounted on the front of the counterlung for ease of access and is manually adjustable during the dive to tailor its operation to the taste of the user. This regulator also functions as the manual addition valve when the cover is depressed.

The scrubber is a rectangular, large cross section axial flow unit that is very easy to load. When out of the rebreather, it can be sealed with its own hose connections with no additional components. The scrubber is available in several capacities, the smallest being 2.5 to 3.5 pounds (recommended for most users).

A small single action loop/open circuit mode valve is provided at the mouthpiece, and both it and the hoses are neutrally buoyant in the water.

The standard unit carries a 60 cu. ft. gas supply inside the case. The amount of available gas eliminates the need for additional open circuit bailout gas in most cases, and allows the user to conduct saw tooth dive profiles that would not be possible otherwise. The gas mix is chosen exactly as it would be for technical open circuit diving with 26% O2 being the recommended minimum for surface terminus dives. Standard nitrox or trimix tables, or decompression computers may be used, as the system is fraction constant rather than PO2 constant. Buoyancy is slightly negative and balance in all positions is exceptional. A small set of "wings" is provided on the standard unit (60 cu. ft.) and the internal gas supply inflates them.

The standard unit can be disassembled for travel so that the loop components can be mounted on rentable scuba equipment at the destination with optional brackets. A separate K2 rebreather will soon be available in this configuration. The unit will cost considerably less than the standard K2 because it comes without a case, buoyancy compensation, backplate, tanks, valves, manifold, frame and single action loop to open circuit mode switching.

Different capacity tanks can be mounted on the standard unit, but the outer case only fits the twin 30 cu. ft. arrangement. Although some protection is compromised, the modified units are still extremely easy to swim (less drag than a single 80) as long as the tanks do not exceed 6 inches in diameter.

Although no rebreather design is a panacea, the designer and manufacturer believe the K2 Advantage provides the optimum blend of cutting edge technology, safety, ease of operation, low initial and operating costs, and satisfaction of the widest range of operational needs.

Configuration:

Standard model includes - Operating system, counterlung and scrubber with component cover and twin 30 cf cylinders.

Options Available:

K3 full face mask designed specifically for rebreather use.
Breathing loop oxygen analyzer.

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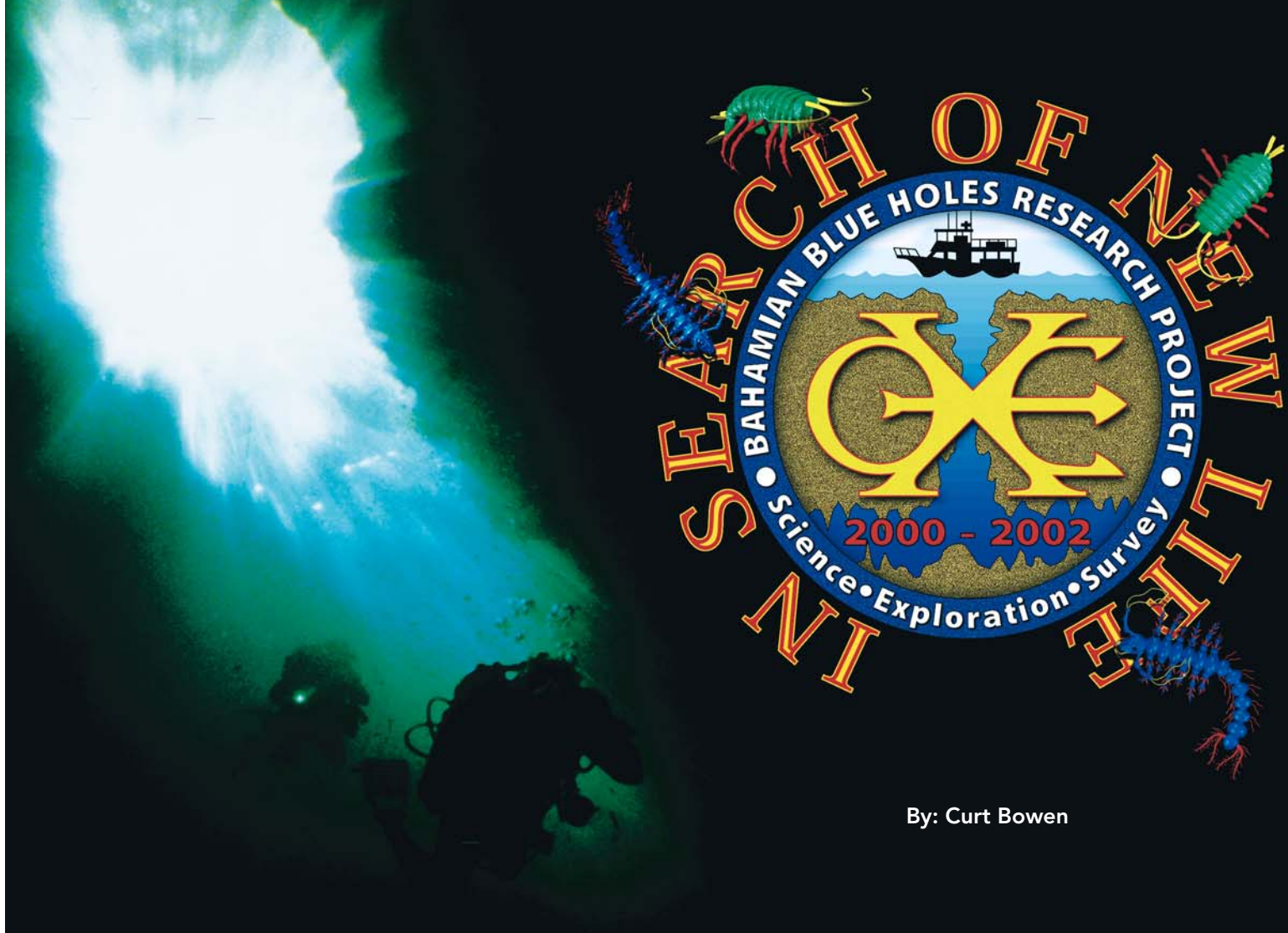

By: Curt Bowen

Deep underground, in eternal darkness, alien creatures live in a truly alien world.

Imagine a world of complete darkness. A hostile world where food is scarce and opportunistic predators lie around every corner. You are the hunter and the hunted. Your only link to the black environment around you are the tiny, vibration-sensitive hairs that cover your body. You sense movement in the distance, could it be food? Or is it a larger predator, slowly stalking your every move, waiting to snatch you up in razor-sharp claws and make you its next meal.

Such creatures do exist, inhabiting submarine caves known as blue holes in the Bahama Islands. The Bahamas consist of 18 major islands plus 700 smaller cays distributed on several "banks" that make up the 62,137 square mile (100,000 km2) Bahama platform. This entire block is composed of vast, limestone flats covered with shallow water, and deep ocean trenches extending to known depths of at least 14,600 ft / 4450 m. Ancient stress cracks in the limestone were created during the past Ice Ages when sea level was as much as 400 feet (120 M) lower. Typically running north to south along the eastern side of Andros Island, these giant, water filled, "fracture caves" commonly reach depths exceeding 300-450 feet (90-135 M).

The marine cave life of the Bahamas is among the richest and most diverse in the world. Isolated from the outside world for millions of years, life in these deep caverns has evolved into unique, individualized ecosystems.

The list of explorers who have attempted to solve the mysteries surrounding blue holes ecosystems is long: Benjamin, Palmer, Exley, Mount, Martz and many others. A group of veteran Bahamas underwater/underground explorers and scientists is currently preparing for a three year project that will delve into the unique systems of the Bahamas in a combined effort to educate the world on these little known ecosystems.

This project, known as the Bahamian Blue Holes Research Project (BBHRP), will be co-led by Dan Malone, veteran blue holes explorer, videographer and owner of the M/V Ocean Explorer, and Brian Kakuk, Diving Safety Officer for the Caribbean Marine Research Center and leader of many blue hole expeditions in the Bahamas. The scientific aspects of the project will be directed by Dr. Tom Iliffe, A marine biologist from Texas A&M University at Galveston. Iliffe is one of the foremost authorities in underwater cave biology and is responsible for the collection and description of scores of new species.

The BBHRP was spawned during the group's last expedition, known as Expedition Andros 99, which investigated 15 blue hole systems around Andros Island, during October of 1999. The goals of the BBHRP are to collect as much data on as many underwater cave systems as possible. Research conducted during the project will include geological sampling of cave formations to chronicle ancient sea

level changes, biological collections for the identification of new species, and the ongoing search for biologically derived chemical products for medical research.

In addition to the standard exploration and survey of each cave, a biological, geological and hydrological profile will be created enabling researchers to compare systems within the Bahamas as well as globally. All of the information collected will be presented on the world wide web at two different web sites. The first is Iliffe's cave biology site at cavebiology.org. This site includes information on cave adapted marine life from all over the world. The second will be www.blueholes.org, a site created by Kakuk for the collection and distribution of Bahamian blue holes related information.

During the project, two to three expeditions per year will be conducted in various parts of the Bahamas on board Malone's 55 foot M/V Ocean Explorer (OEX). The OEX is capable of carrying 8 divers, 4 crew and an array of exploration and scientific equipment to some of the most remote places in the Bahamas, while still allowing all of the comforts of a world class liveaboard. Cave dives on board the OEX run the gamut from long range, mixed gas, scooter, and side mount dives, to slowly finning down massive, single passage, fracture caves in conventional back mounted configuration.

Sidemount diver Robbie Warke

Entrance to the Guardian Blue Hole system.

Brian Kakuk
U.S. Navy salvage and R/D diver.
Diver for U.S. Navy's Atlantic Undersea Test and Evaluation Center (AUTEC).
Diving safety officer for the Caribbean Marine Research Center. Founder/ President of the Bahamas Cave Research Foundation.

Brian Kakuk

Each expedition will allow for 6 cave divers to come aboard and participate in not only the exploration of virgin caves, but help in the scientific aspects of the project as well. Participants help conduct biological and geological collections as well as operating hydrological analyzing instruments within the caves. In the field of land based science, the discovery of completely new species of animals is a very rare occasion. In the underwater caves of the Bahamas, finding new species is almost commonplace. Some Bahamian caves have revealed up to 12 new species of crustaceans from a single site.

The collection of cave formations (speleothems) is scheduled for future expeditions. Because these crystalline formations can only form when the cave is above sea level, samples collected from varying depths within the caves will help geologists validate how low sea levels were during the Ice Ages and how long they stayed there. As it stands now, formations have been found

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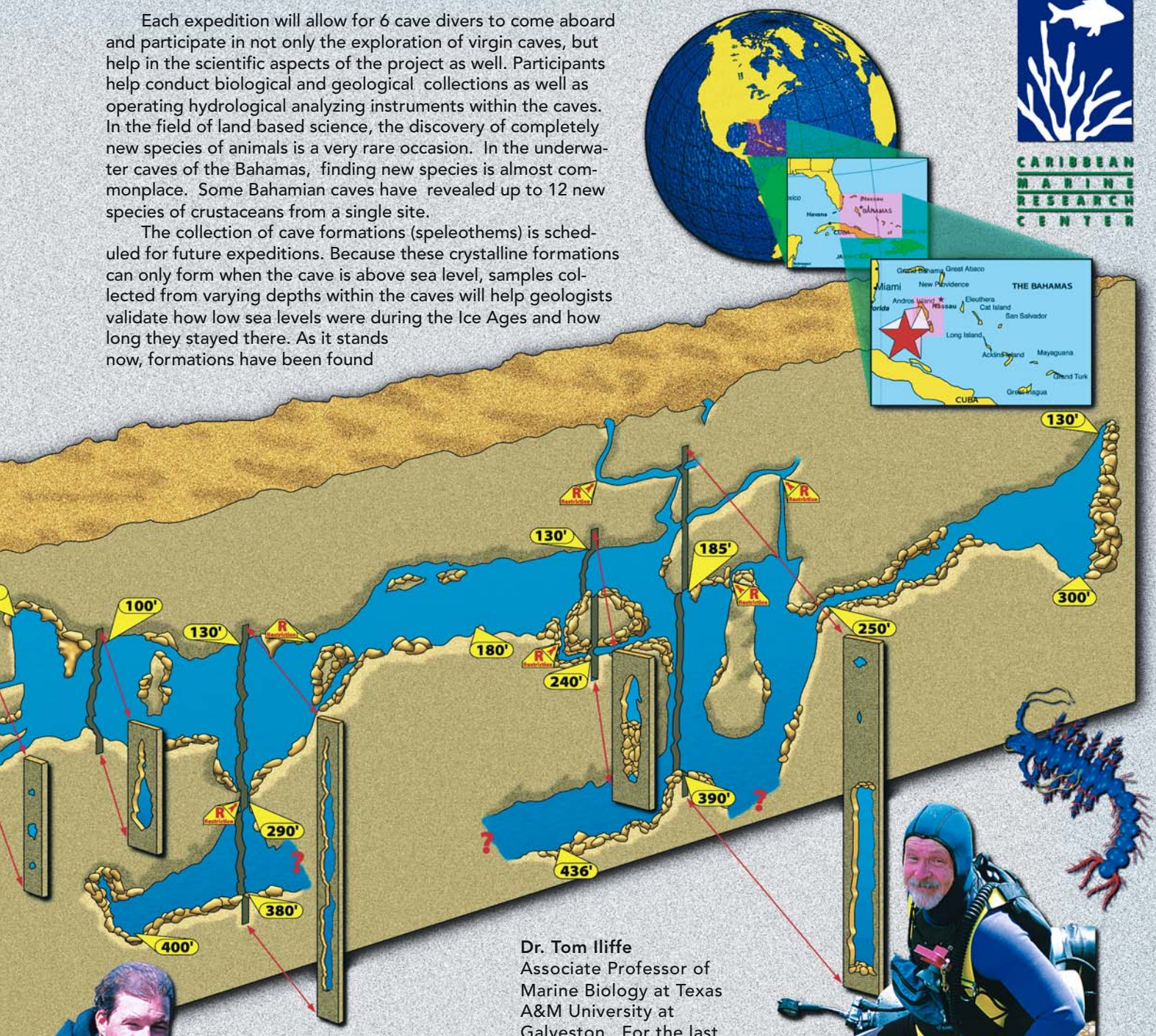
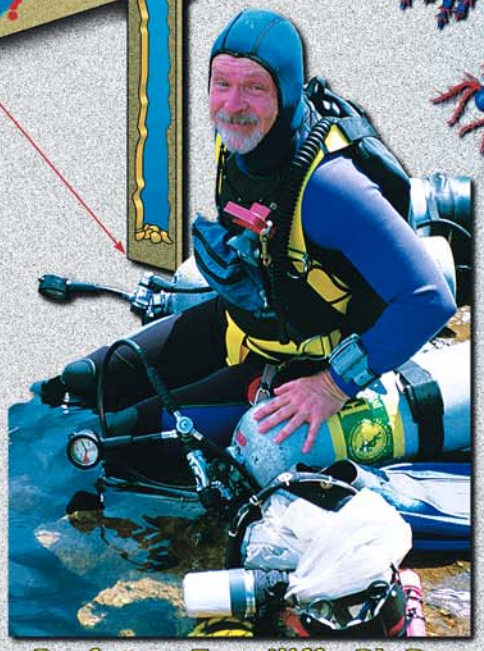


Dan Malone

Dan Malone
Master of Arts, University of Miami, USCG Captain / Owner of the livaboard M/V Ocean Explorer & Ocean Productions specializing in wildlife encounters, blue hole exploration, and film expeditions.

Dr. Tom Iliffe
Associate Professor of Marine Biology at Texas A&M University at Galveston. For the last 20 years, he has been collecting and describing new marine cave animals and has published more than 100 scientific papers on these investigations. He has led cave biology expeditions to the Caribbean, Eastern Atlantic, Mediterranean, and South Pacific. He has been a cave diving instructor with NSS/CDS since 1981.



Professor Tom Iliffe Ph.D.

Photography: C. Bowen
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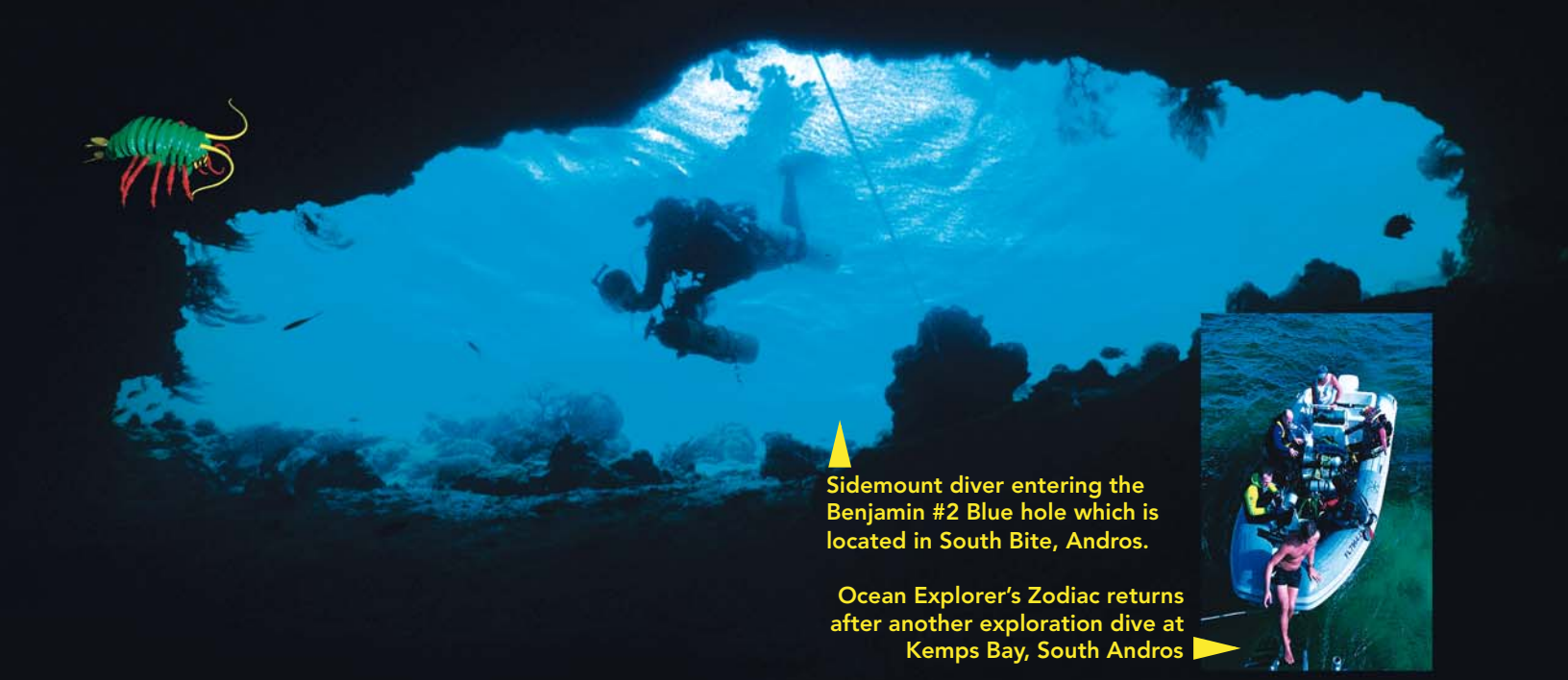

Sidemount diver entering the Benjamin #2 Blue hole which is located in South Bite, Andros.

Ocean Explorer's Zodiac returns after another exploration dive at Kemps Bay, South Andros

near depths of 300 feet (90 M). But some experts believe that the sea was at one time more than 100 feet (30 M) lower than that. This is just a small portion of the types of data that the BBHRP will be collecting over the next 3 years. In addition to these, Kakuk has recently been approached by the Bahamas Reef Environmental Education Foundation (BREEF) to supply overlay surveys of as many blue holes (and associated passages) as possible, to coincide with a new Bahamas Global Information System (GIS) mapping project. This will allow the Bahamian Government to know exactly where underlying passages are, so they may identify areas too unstable for development. This will also help blue holes conservation efforts throughout the Bahamas.

Now more than ever, divers can play a major part in true exploration of the underwater world. As Iliffe notes: "Exploration is the first step in scientific research." Scientists would have nothing to study without the explorer leading the way.

If you are interested in participating in one or more of the BBHRP expeditions to explore underwater caves "for a reason," you can obtain information from the following sources:

Dan Malone
M/V Ocean Explorer
Phone: (800) 338-9383 or (561) 288-4262
Fax: (561) 288-0183
E-mail: OCEAEXP@aol.com
WEB SITE: www.oceanexplorerinc.com

Brian Kakuk
Caribbean Marine Research Center
Phone: (242) 345-6039
Fax: (242) 355-5557
E-mail: bahamacave@aol.com

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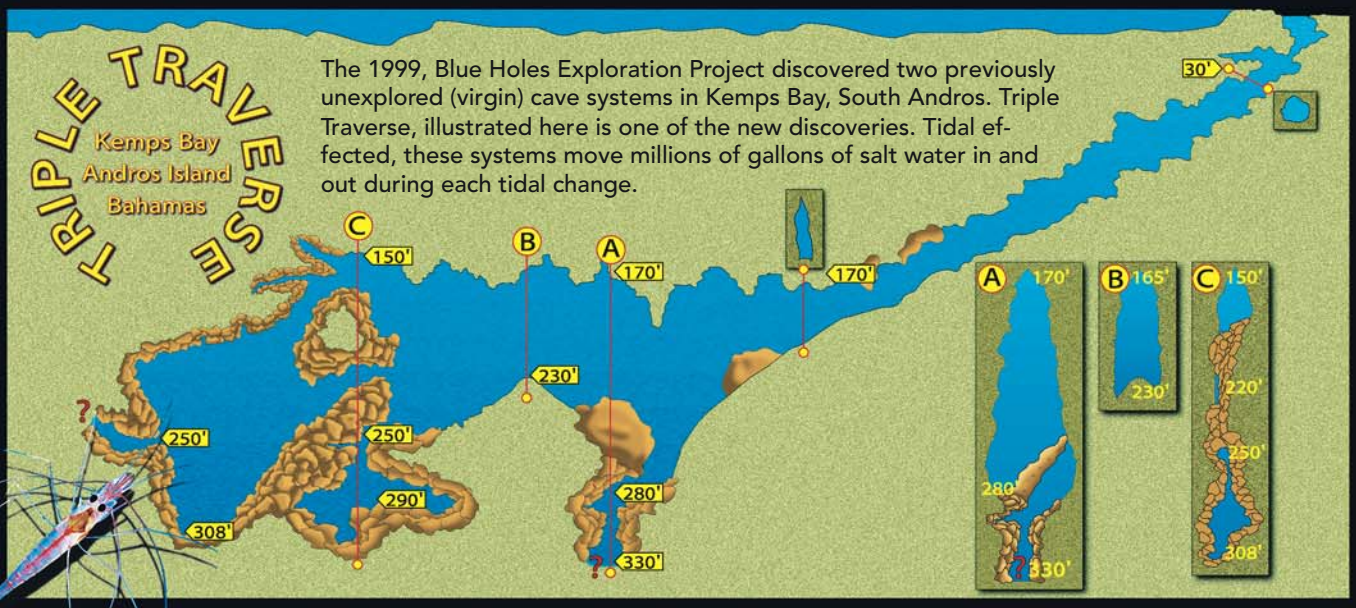
www.AdvancedDiverMagazine.com



The Millennium Diving Technology For Today

By Richard R. Nordstrom, President Cis-Lunar Development Laboratories, Inc.

Introducing The MK-5P Electronic Closed Circuit Rebreather

The MK-5P ECCR is not just a cave diver's dream. This is a serious system for everyone. Be it cave divers, shallow divers, deep divers, wreck divers, underwater photographers, filmmakers and many more. Why would so many people with such diverse needs be interested in the same device? The answer lies in its technology and the company that designed and makes the MK-5P.

The attraction starts with basic premise that professional, semi-professional, and sport divers always look for in their equipment: It's simple. Reliability, redundancy and recoverability. Each of these points encompass a wide range of functionalitys in the MK-5P. Reliability comes from simplicity of design, quality of construction materials, tight manufacturing standards, and client support by the company. Redundancy contributes to reliability of the system and also allows functionality paths or outs that cannot be found to such a degree in other CCR or SCR systems. Recoverability speaks of the MK-5P's system ability to flood its scrubber area; lose a computer; damage a cable while underwater and yet still resolve the issue with minimum diver stress and come home entirely on the system.

The basis of these characteristics is what attracts the wide diversity of users and applications for the MK-5P ECCR. The MK-5P can operate in many modes. It allows the diver to operate the system in open-circuit; semi-closed circuit; manual controlled closed–circuit or automatic controlled closed-circuit. That flexibility is why so many divers wanting a Cis-Lunar MK-5P.

3D Schematic of the MK-5P Rebreather

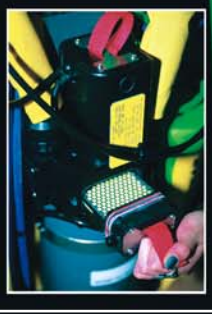
1. Patented mouthpiece design with an integrated open-circuit regulator. A quick quarter-turn valve immediately switches from closed to open-circuit.

2. Durable, yet flexible breathing hose.

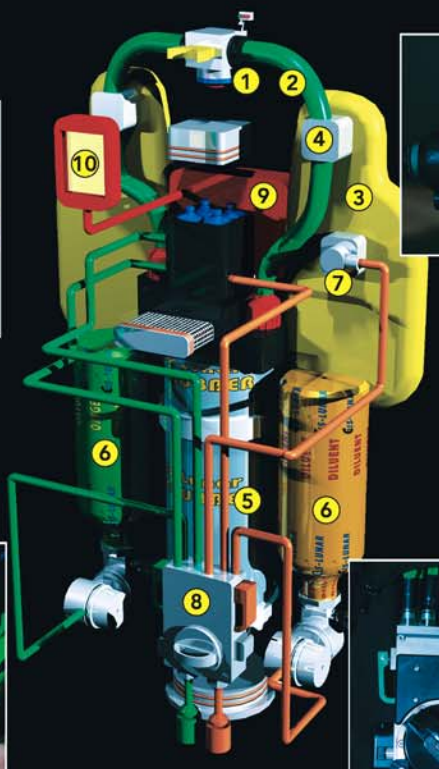
3. Ergonomically designed over-the-shoulder split counter lungs reduce breathing effort by remaining near the hydrostatic equilibrium.

4. Specially designed water traps divert water from condensation or leakage directly into the counter lungs, where it can be purged from the loop.

5. Specially designed modular, easily removable CO2 absorbent canister. Even in a complete breathing loop flood the CO2 absorbent material remains completely dry.



6. Gas supply includes one 20 cf diluent and one 13.3 cf oxygen cylinders.



7. Automatic diluent valve adds diluent to the breathing loop whenever the right counterlung is bottomed-out.

8. Gas control manifold provides easy control of gas supplies to the rebreather.

9. The "brains" of the MK-5P consist of an integrated triple-redundant, networked computer control system. Used to change a wide variety of dive parameters, display critical dive information and warning signs.

10. Primary display screen consist of a high-contrast, backlit LCD display that provides all pertinent information during the dive. A redundant oxygen display is located on the back of the primary display screen. This allows verification of the readings indicated on the primary display.

11. Oxygen injection solenoid valve ensures constant PPO2 setting, no matter how hard the diver works.

Under the ice on a technical diving foray into the Arctic wilderness keeps Andy Driver of Mad Dog Expeditions busy. He doesn't have time to mess with unreliable equipment above the Arctic circle. He relies on his MK-5P to simplify his process so he can keep an eye on his clients as they make their first dives under the Arctic ice. The closed-circuit breathing loop contributes to a warmer diver. Body heat is retained in the loop, thus making this a more comfortable exposure.

Once under the ice the MK-5P's long duration ability almost eliminates resource constraints to allow the diver time to enjoy and concentrate on the tasks at hand.

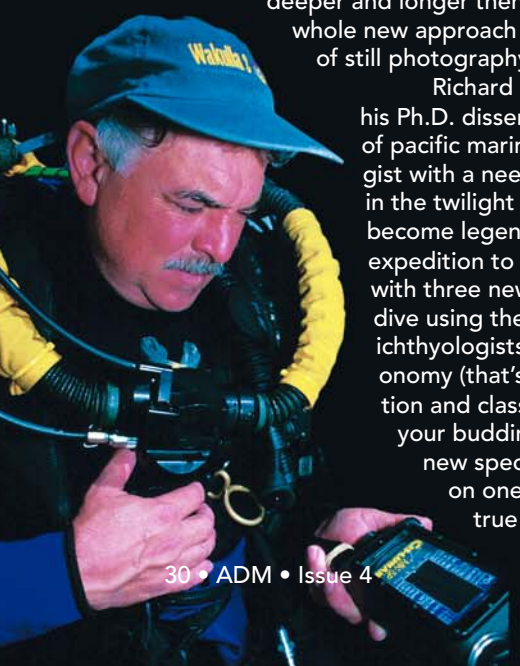
Environmental conditions are harsh and demanding on everyone's equipment. Thermal physiology problems for the divers and the need to make the most of your precious gas that was dragged for hundreds of miles. The MK-5P resolves these issues and makes the most of your gas supplies through its incredible gas efficiency

Nick Jewson and David Wilkins from England take their MK-5P's on the most daring explorations of deep wrecks off the coast of the United Kingdom. Two World Wars and centuries of fighting on the seas has provided them with a most awesome selection of wrecks to explore. The only problems are cold water; very long periods of decompression due to 100 m plus depths; expensive gas sources; and the weight of numerous gas cylinders on the diver.

The MK-5P's technology allows for significant reduction in decompression through user access to multiple inert gas decompression; user changeable oxygen partial pressure; and the system's ability to accurately maintain these constant PPO2's on the fly. The increasing efficiencies of MK-5P closed-circuit with depth allows major weight reduction in equipment and longer bottom times. Nick and David see the MK-5P as being a reliable gas mixing device on their backs while working their way through the tight constrictions and complex maze of a destroyer at 110 m.

Nick Caloyianis and D.J. Roller see the MK-5P as a very useful tool. The quiet side of the MK-5P allows access they have never experience before when filming underwater life. For once they are able to sit down on the bottom and let the animals come to them. No longer do they need to make tiring speed swims chasing the critters. They are now part of the family that resides in the deep blue.

Maintaining higher PPO2's and staying silent allow these professionals to capture marine behavior deeper and longer then ever before. It brings a whole new approach to the underwater world of still photography and film making.



Richard Pyle is almost done with his Ph.D. dissertation on the taxonomy of pacific marine fish. He's an Ichthyologist with a need for the deep. His work in the twilight zone (200 - 500 fsw) has become legendary. On one collection expedition to Palau, Richard returned with three new species of fish on one dive using the MK-5P. It's rare for an ichthyologists with a mind for taxonomy (that's the scientific identification and classification of animals for your budding biologists) to discover new species of fish. Richard's haul on one dive is a dream come true for any scientist.

The MK-5P has helped to make Richard a safer and more productive scientist by reducing decompression, allowing access to depths up to 450 fsw and allowing Richard to become a part of the undersea twilight environment.

If you want to make a 20,000 foot trip in an overhead environment with plenty of spare resources the MK-5P is your piece of equipment. Jill and Paul Heinerth (family team) from the Wakulla2 Expedition earlier this year made such a trip to allow 3 dimensional mapping of the Wakulla Springs aquifer. This type of dive was made 2-3 times a week for almost three months. The MK-5P supported them and other divers up to 5 hours at over 300 feet deep and then another 6 hours into decompression on each dive. There was still plenty left, but they decided to enter the warm and comfortable Personal Transfer Capsule (PTC) that whisked them away to the topside chamber for some dinner.

The reliability had to be perfect on these types of deep cave penetrations. See the Wakulla2 web site and learn more on how the Mk-5P played a key role in this expedition's success.

You can fill a large book on the variety of applications for Cis-Lunar's MK-5P Closed-Circuit Rebreather technology. The bottom line is that it works and you can rely on this technology well into the next millennium without looking for anything else.

General Information:

Weight: 80 lbs / 6 Kg (ready to dive)
Dimensions: 32" H x 19" W x 14" D
Construction Materials: ABS, 316SS, Delrin
Buoyancy: (Onboard Cylinders Only)
Empty CO2 Absorbent Canister: -1.1 lbs
BCD Maximum Lift Capacity: 58 lbs
Maximum Operating Depth: 375 fsw
Breathing Loop: Max 3.5 Liters (x2) Optimal 1.5 Liters (x2)
CO2 Absorbent Canister Capacity:
Volume: 2.5 Liters
Weight: Sofnolime 5.5 lbs
Lithium Hydroxide (LiOH) 2 lbs
CO2 Absorbent Canister Duration:
Sofnolime 6-8 hours
Lithium Hydroxide (LiOH) 10-15 hours

Training Requirements

Level I:
A seven day introduction course required by all users. Successful completion of this course is required prior to obtaining ownership of an MK-5P unit. This course qualifies divers to use their MK-5P with EAN, to a maximum depth of 165 fsw.

Level II:
MK-5P training for the use of heliox and trimix diving procedures. MK-5P divers must have 75 hours of level I experience before continuing to level II.

Level III:
Qualifies MK-5P divers to the maximum range of the unit. (375 ft). Must have 50 hours of level II experience.

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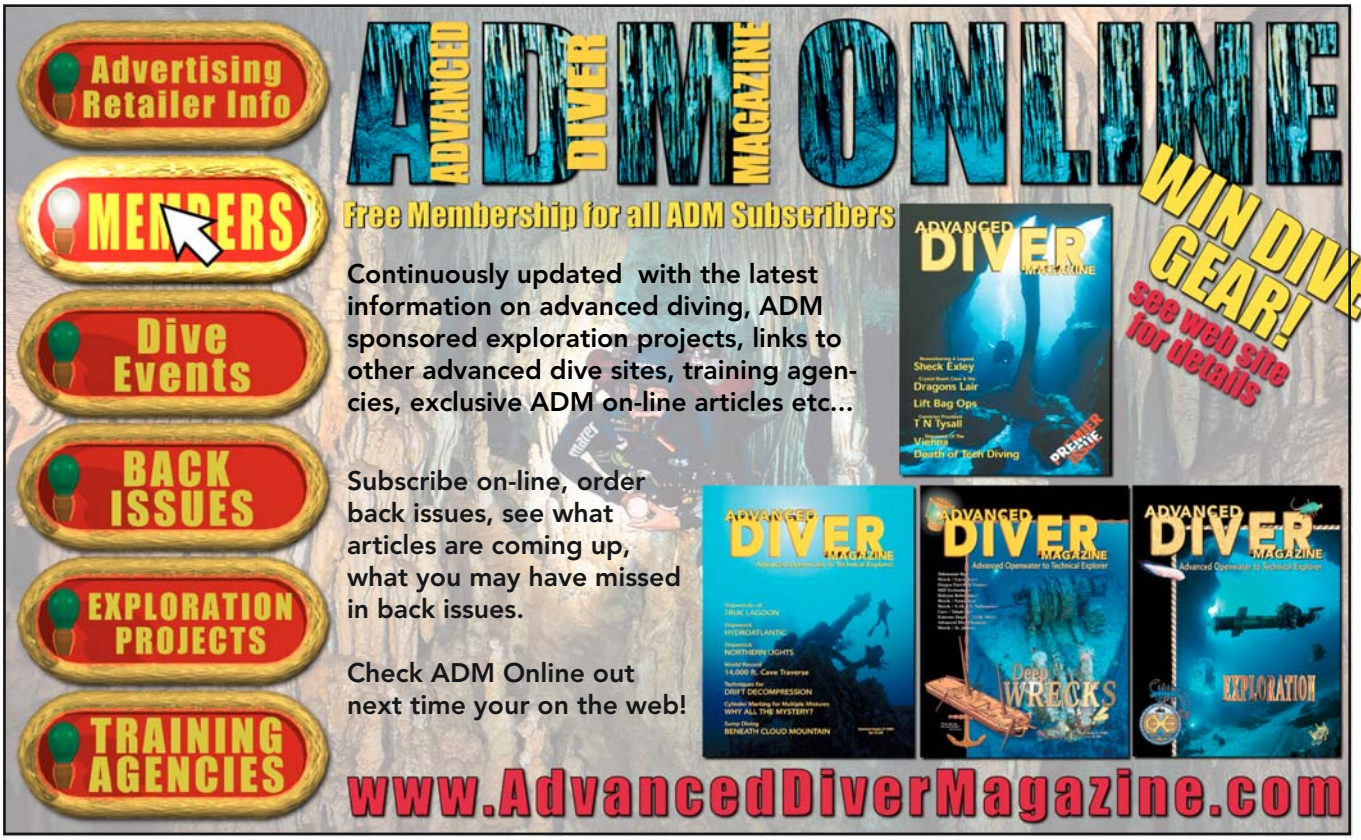
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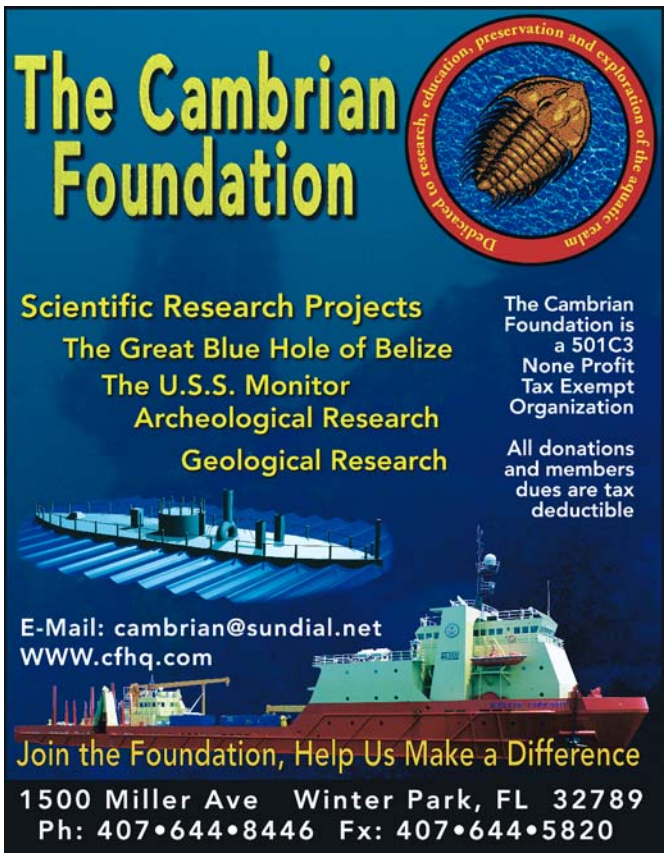
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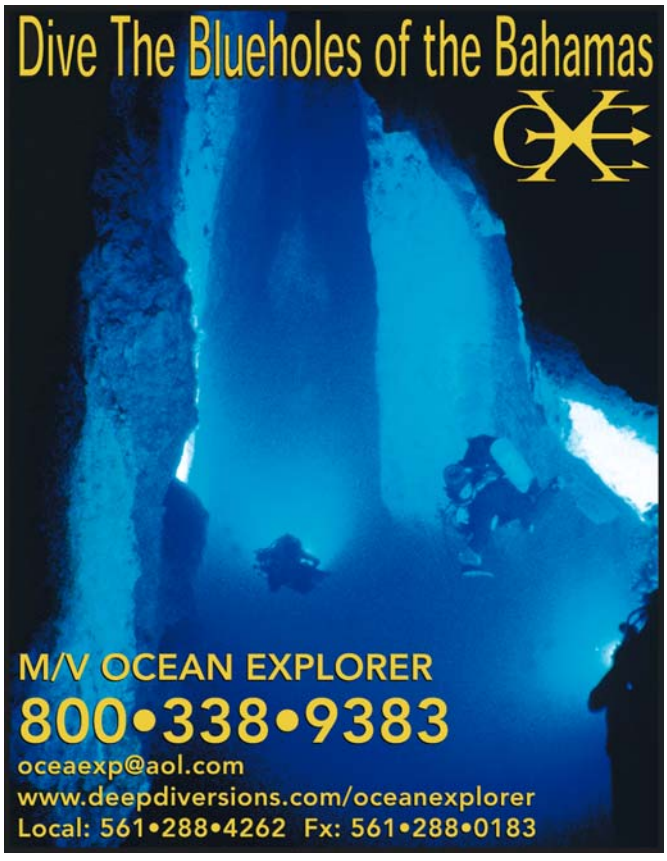
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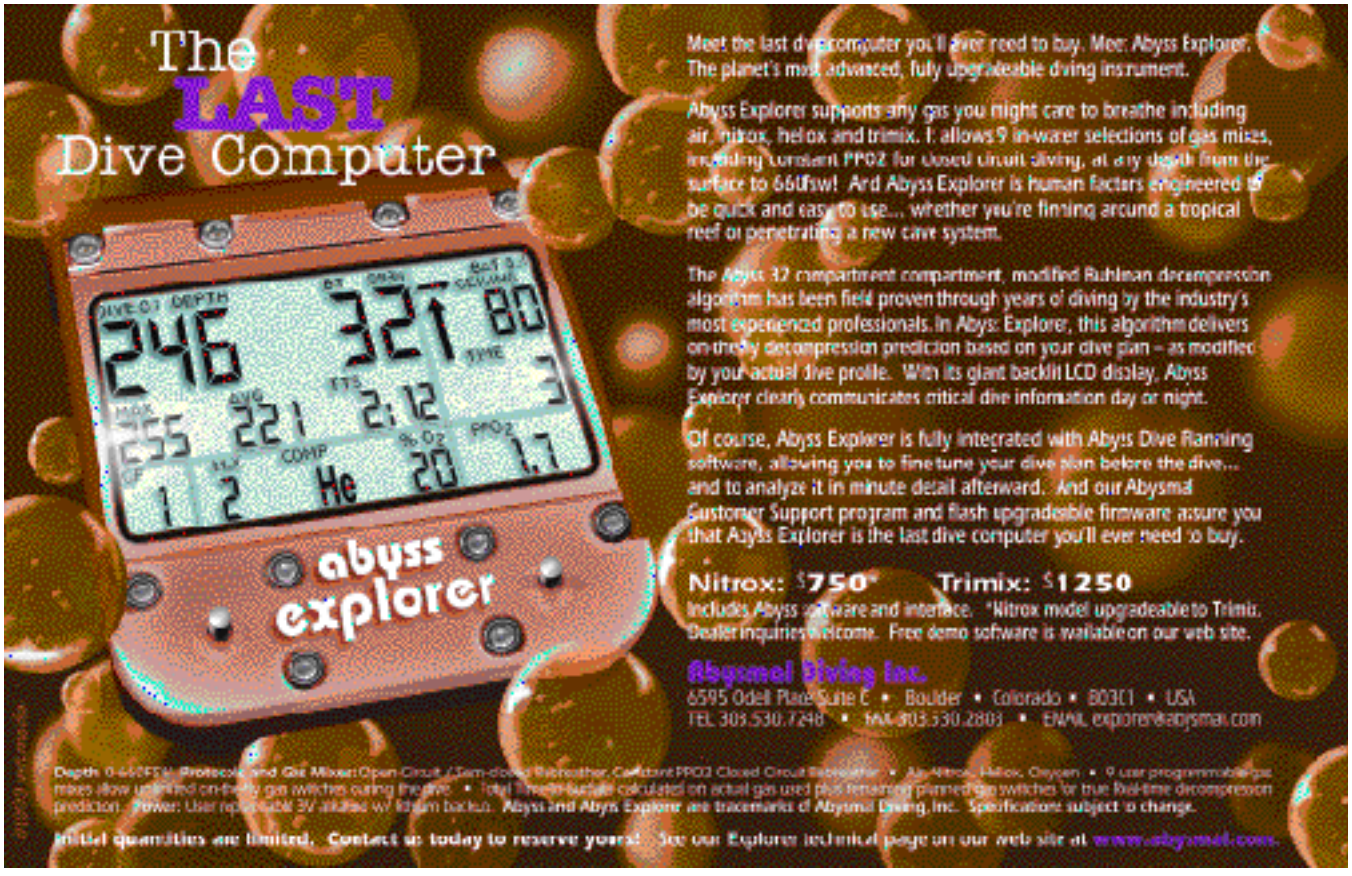
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The Abyss 32 compartment compartment, modified Buhlman decompression algorithm has been field proven through years of diving by the industry's most experienced professionals. In Abyss Explorer, this algorithm delivers on-the-fly decompression prediction based on your dive plan – as modified by your actual dive profile. With its giant backlit LCD display, Abyss Explorer clearly communicates critical dive information day or night.
Of course, Abyss Explorer is fully integrated with Abyss Dive Planning software, allowing you to fine tune your dive plan before the dive... and to analyze it in minute detail afterward. And our Abysmal Customer Support program and flash upgradeable firmware assure you that Abyss Explorer is the last dive computer you'll ever need to buy.
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Cenotes of the Riviera Maya Pictorial

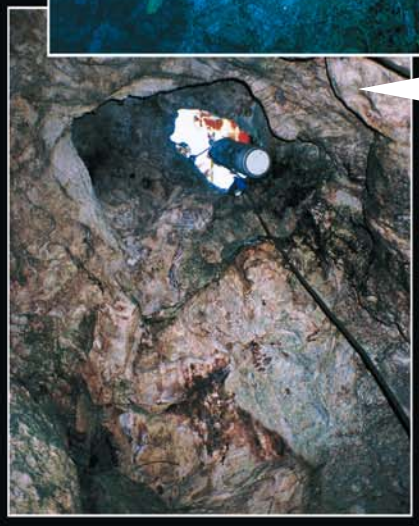
By: Steve Gerrard

All of these photos and hundreds of other breath-taking shots are available in Steve Gerrard's new book "Cenotes of the Riviera Maya". To be released January 2000.

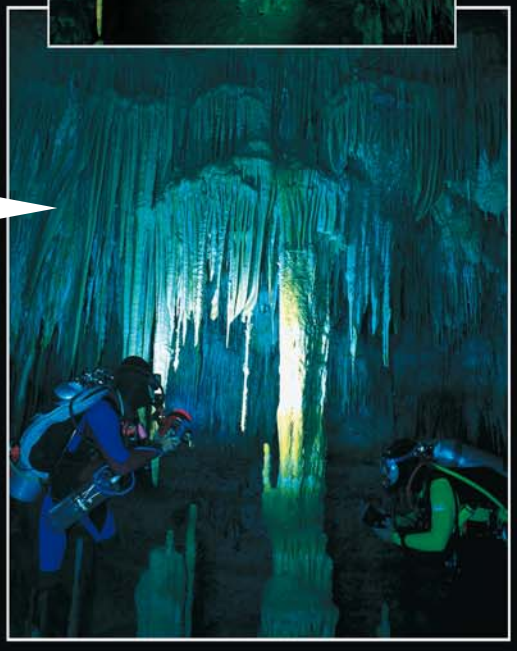
Two openwater divers explore the giant cavern zone of cenote Carwash.

Each system has its own natural beauty displayed by countless flow stone formations and air clear water.

Sistema Chac Mool (Jaguar Cave). The world's longest underwater stalactite in the Room called "The Monster House" known in Mayan as CAUAC NA. The dripstone is called Xix Ha Tunich known as the Drip Water Stone.

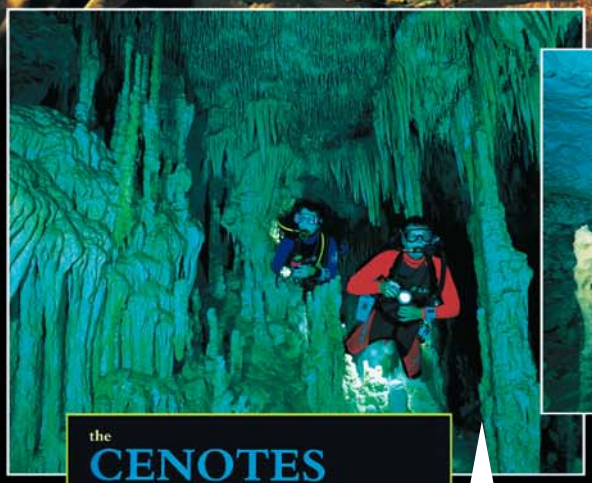


The entrance to Sistema Mundo Escondido (Hidden World) which requires ropes to lower equipment 30 feet to the water from the land surface through a small shaft.
The ONLY entry into this beautiful cave system. It's located exactly between Sistema Nohohoch Nah Chich and Sistema Dos Ojos. Some say this is the prettiest cave system of them all.



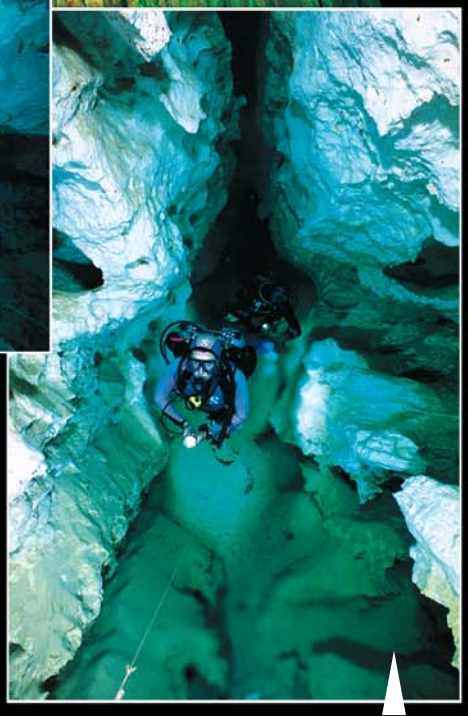
This is the NEW Room in SISTEMA TAJ MAHAL called "THE CHINESE GARDEN" found during the fall of 1998

Diver poses for a photo in the room called "THE CHINA SHOP".

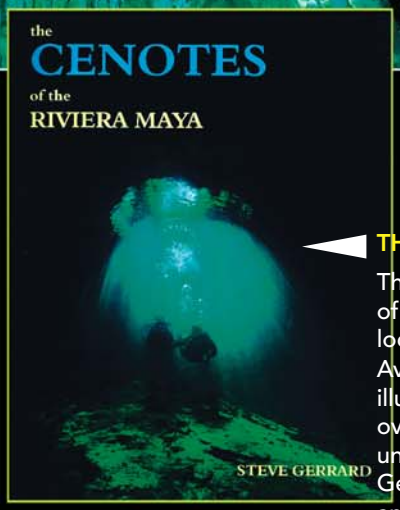


Tony & Nancy Deosa in Sistema SAK AKTUN near the Cuzan Nah loop.

This is SISTEMA NARANJAL entering from Cenote Mayan Blue. The passage is called "The Death Arrow".



Divers explore SISTEMA ABEJAS. This passage is called "The Chasm".



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14. 53 Dodge @ 175ft.
15. 64 Corvair @ 187ft.
16. 62 Olds @ 200ft.
17. VW Bug @ 210ft.
18. 8 x 16 Platform @ 15ft.
19. 8 x 16 Platform @ 30ft.
20. 8 x 16 Platform @ 40ft.
21. 8 x 16 Platform @ 60ft.
22. KeyHole Cave @ 236ft.
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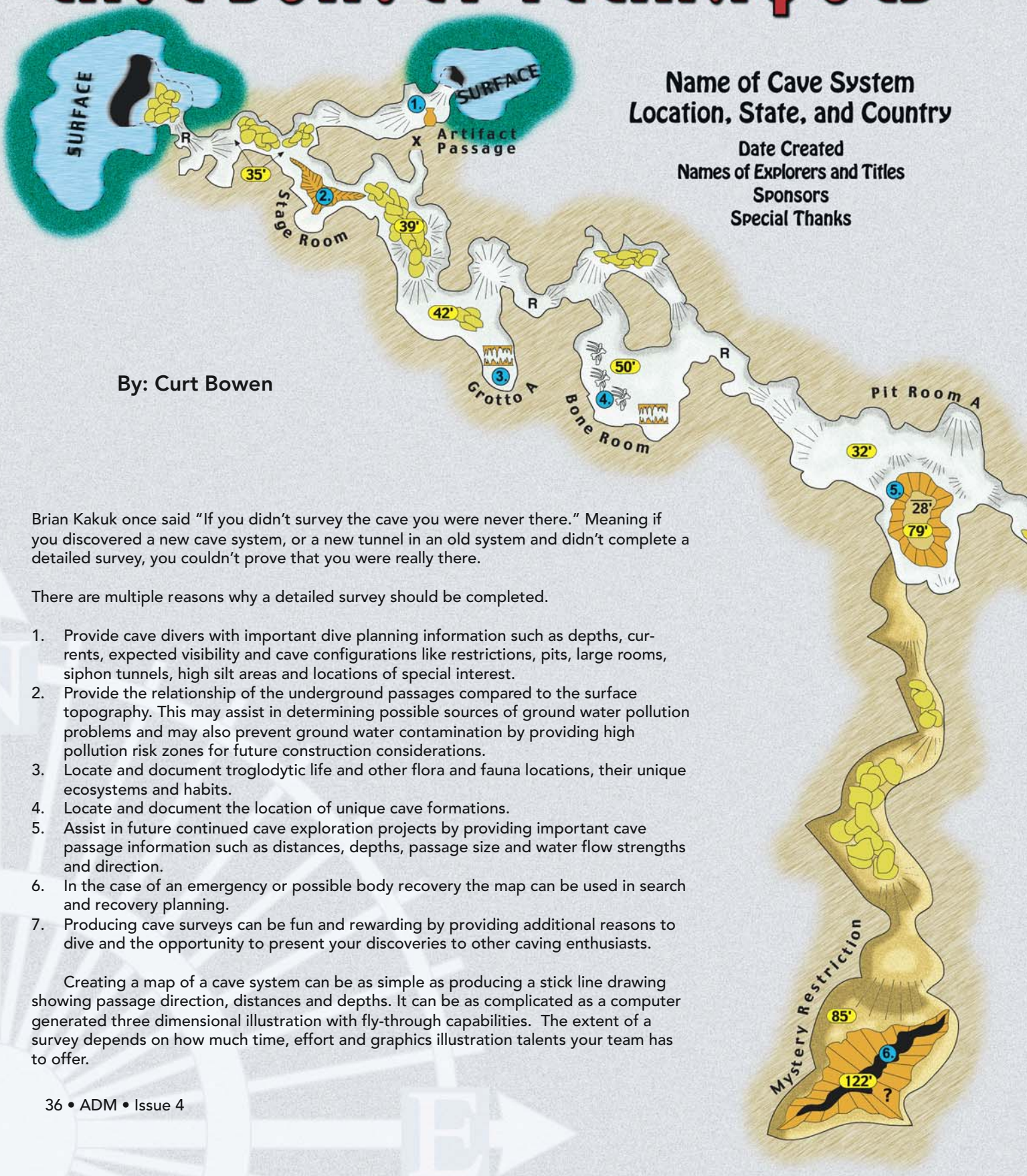


By: Curt Bowen

Brian Kakuk once said "If you didn't survey the cave you were never there." Meaning if you discovered a new cave system, or a new tunnel in an old system and didn't complete a detailed survey, you couldn't prove that you were really there.

There are multiple reasons why a detailed survey should be completed.

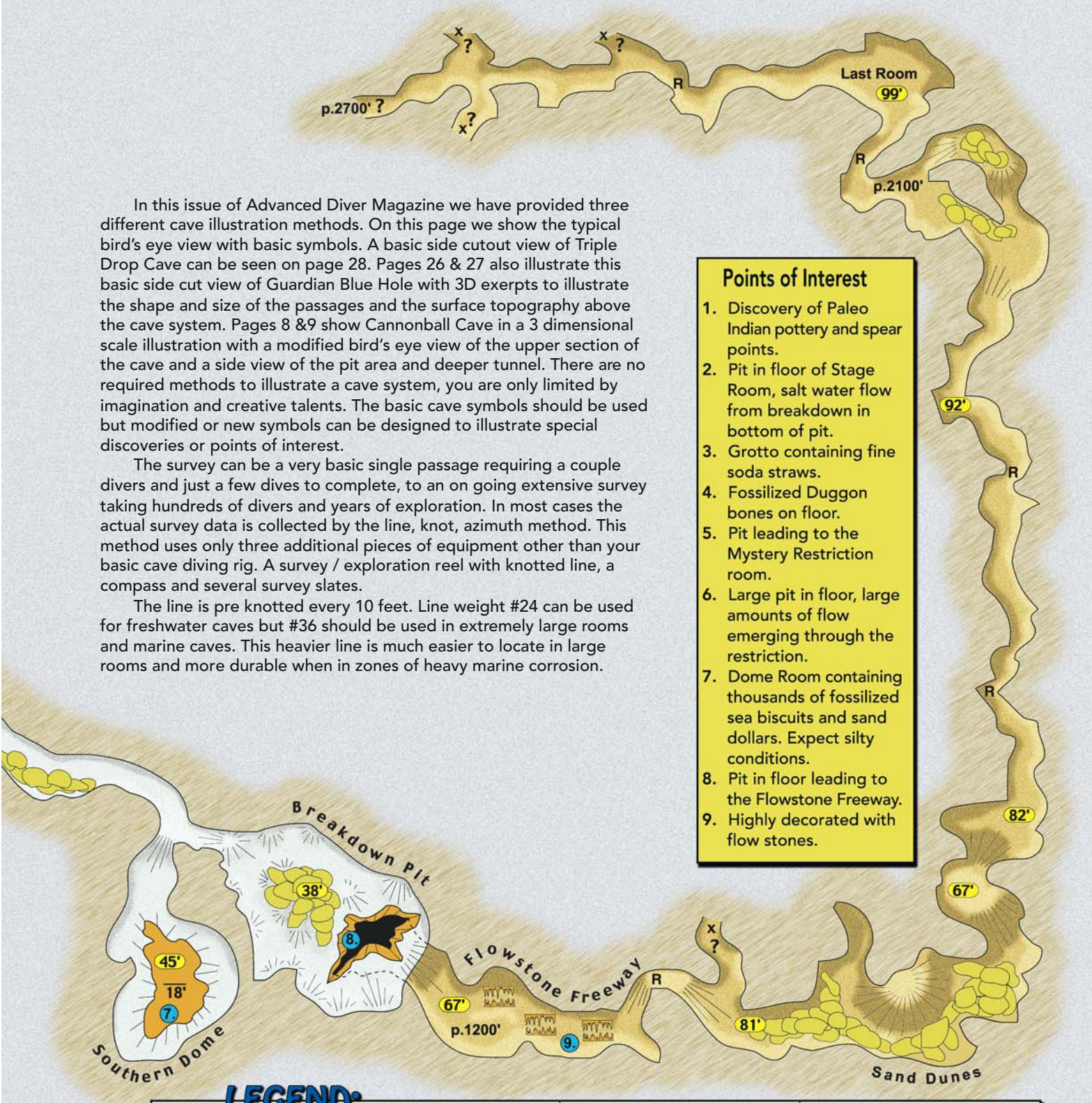
1. Provide cave divers with important dive planning information such as depths, currents, expected visibility and cave configurations like restrictions, pits, large rooms, siphon tunnels, high silt areas and locations of special interest.
2. Provide the relationship of the underground passages compared to the surface topography. This may assist in determining possible sources of ground water pollution problems and may also prevent ground water contamination by providing high pollution risk zones for future construction considerations.
3. Locate and document troglodytic life and other flora and fauna locations, their unique ecosystems and habits.
4. Locate and document the location of unique cave formations.
5. Assist in future continued cave exploration projects by providing important cave passage information such as distances, depths, passage size and water flow strengths and direction.
6. In the case of an emergency or possible body recovery the map can be used in search and recovery planning.
7. Producing cave surveys can be fun and rewarding by providing additional reasons to dive and the opportunity to present your discoveries to other caving enthusiasts.

Creating a map of a cave system can be as simple as producing a stick line drawing showing passage direction, distances and depths. It can be as complicated as a computer generated three dimensional illustration with fly-through capabilities. The extent of a survey depends on how much time, effort and graphics illustration talents your team has to offer.

In this issue of Advanced Diver Magazine we have provided three different cave illustration methods. On this page we show the typical bird's eye view with basic symbols. A basic side cutout view of Triple Drop Cave can be seen on page 28. Pages 26 & 27 also illustrate this basic side cut view of Guardian Blue Hole with 3D exerpts to illustrate the shape and size of the passages and the surface topography above the cave system. Pages 8 &9 show Cannonball Cave in a 3 dimensional scale illustration with a modified bird's eye view of the upper section of the cave and a side view of the pit area and deeper tunnel. There are no required methods to illustrate a cave system, you are only limited by imagination and creative talents. The basic cave symbols should be used but modified or new symbols can be designed to illustrate special discoveries or points of interest.

The survey can be a very basic single passage requiring a couple divers and just a few dives to complete, to an on going extensive survey taking hundreds of divers and years of exploration. In most cases the actual survey data is collected by the line, knot, azimuth method. This method uses only three additional pieces of equipment other than your basic cave diving rig. A survey / exploration reel with knotted line, a compass and several survey slates.

The line is pre knotted every 10 feet. Line weight #24 can be used for freshwater caves but #36 should be used in extremely large rooms and marine caves. This heavier line is much easier to locate in large rooms and more durable when in zones of heavy marine corrosion.

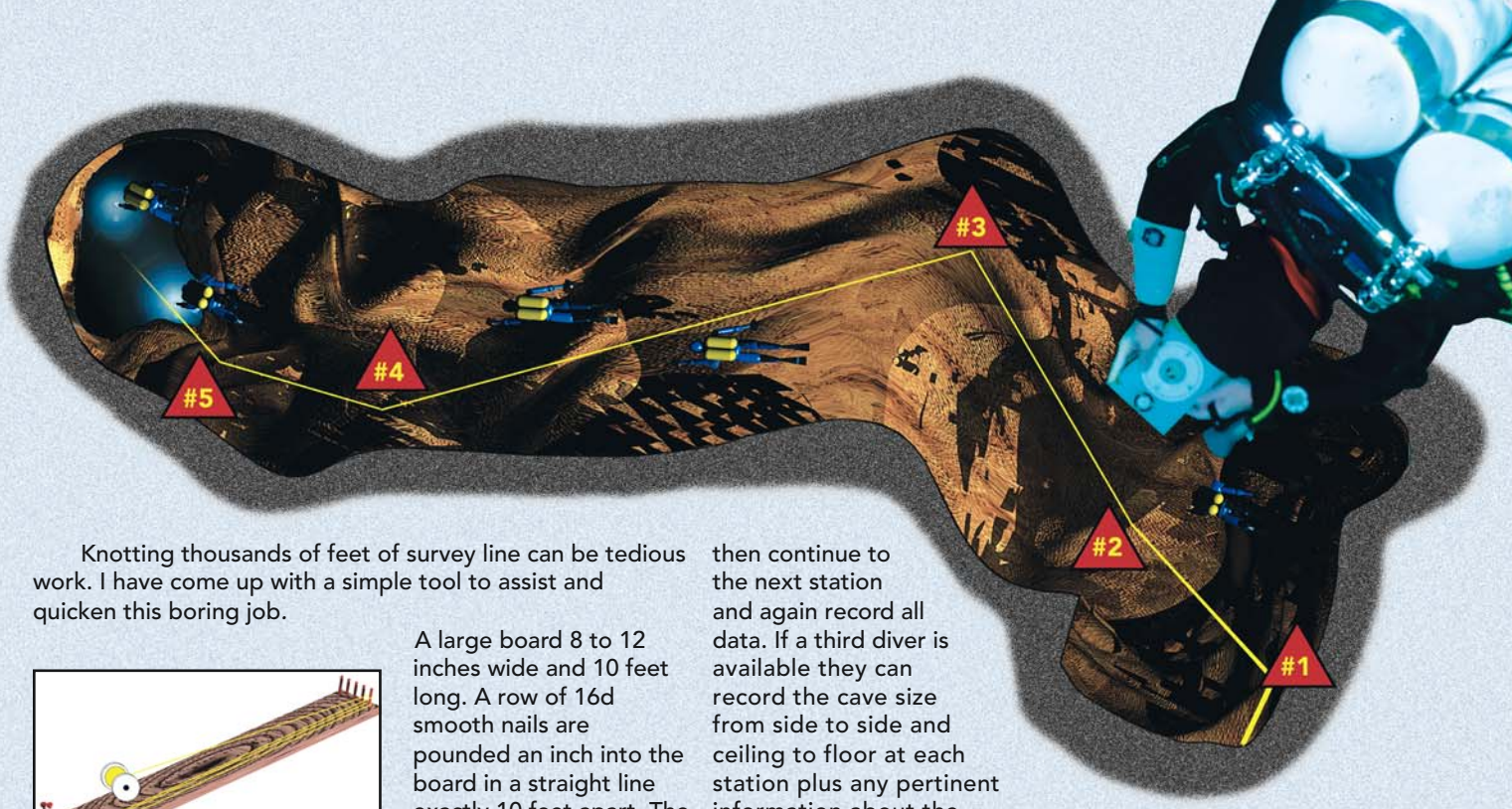


Points of Interest

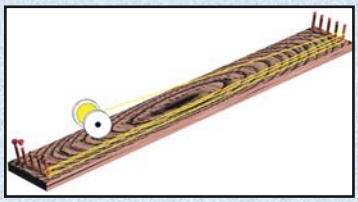
1. Discovery of Paleo Indian pottery and spear points.
2. Pit in floor of Stage Room, salt water flow from breakdown in bottom of pit.
3. Grotto containing fine soda straws.
4. Fossilized Duggon bones on floor.
5. Pit leading to the Mystery Restriction room.
6. Large pit in floor, large amounts of flow emerging through the restriction.
7. Dome Room containing thousands of fossilized sea biscuits and sand dollars. Expect silty conditions.
8. Pit in floor leading to the Flowstone Freeway.
9. Highly decorated with flow stones.

LEGEND:

- Surface Pool
- Rock Pile or Breakdown
- 35' Depth @ Floor
- 28' Depth @ Ceiling
- Slope in Floor
- Pit in Floor
- Pit in Floor Connecting two Levels
- Artifact
- Fossils
- R Restriction
- x Impassable Restriction
- Flow Stone Formations
- ? Unexplored Passage
- p.1200' Penetration Distance from Nearest Exit
- sm Sidemount Passage
- Dome in Ceiling
- Z Major Restriction
- Direction of Flow
- 7 Points of Interest
- Survey Station at which Data was Collected



Knotting thousands of feet of survey line can be tedious work. I have come up with a simple tool to assist and quicken this boring job.



A large board 8 to 12 inches wide and 10 feet long. A row of 16d smooth nails are pounded an inch into the board in a straight line exactly 10 feet apart. The heads of the nails are removed by a hack saw or drummel tool. The end of the line to be knotted is tied to one of the corner nails then reeled out to the other end of the board and a basic knot is tied loosely in the line and placed over a nail and the line tightened between the nails. This process is repeated back and forth until either the spool is emptied or all the nails are full. Upon completion the line can be removed from the nails by pulling it off the ends. While the line is spooled back onto the survey reel the knots should be counted to determine the line length. Write this measurement on a piece of duct tape and attach it to the reel.

Any underwater compass will work but the highest quality available should be used for increased accuracy.

Several underwater slates can be made into survey slates. A standard survey slate is divided into 5 columns, station number, distance, azimuth, depth and line placement. A compass can be mounted to the survey slate to reduce the amounts of movements at each survey station.

Cave Survey Slate

Sta #	Dist	AZM	Dth
#1	10'	328°	31'
#2	24'	315°	49'
#3	25'	320°	52'
#4	38'	270°	65'
#5	12'	285°	75'

The illustration at the top of the page shows how a basic cave passage is surveyed. The survey line is strategically placed in the cave by the leading diver. The second diver follows behind counting the knots between stations. Stations are locations in the cave where the survey line takes a direction change such as around a corner or a tie off. Once at a station the station number is written down, the distance from the previous station, azimuth in degrees the line is running and the depth at the station is recorded onto the survey slate. The divers then continue to the next station and again record all data. If a third diver is available they can record the cave size from side to side and ceiling to floor at each station plus any pertinent information about the cave's formation between stations.

After the dive the data can be transferred to a survey log. Either this information can be placed onto a large paper map or into a computer cad program to form a stick map of the cave passages. A photo copy should be made of the survey slate in case the survey log or slate is lost during transport. (a tip learned from experience) Once this data has been entered, additional information such as passage width, height, break downs, pits, domes, points of interest etc. can be added.

Once the map has been completed it should be submitted to the NSS-CDS and NACD for proper recording and placement in the archives.

Publisher Curt Bowen has coordinated or assisted in multiple cave exploration / survey projects. Awarded the Bill McFadden award for outstanding underwater cave cartography in 1994 from the NACD. Currently assisting the Bahamian Blue Holes Research Project (BBHRP) with the 2000-2002 exploration project along with several other on-going projects around the world. Also conducted several wreck surveys in the Cayman Islands, Florida and the Great Lakes.

See what you may have missed in the first three Issues of ADM. Back Issues Available

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Scientific Diving

By: Joe Rojas

There are five professional fields, or disciplines, recognized by today's dive industry and by the federal government: Military, Commercial, Recreational, Rescue and Scientific. Of these, the one least familiar to the general diving community is scientific diving. Scientific diving is done solely as a necessary part of scientific research, or as an educational activity for employees whose sole purpose is to perform underwater research tasks. The scientists that work in the profession as scientific divers are not the stereotypical pocket protector-wearing men and women who have poor social skills, but scientists that wear specialized dive equipment and spend endless hours underwater conducting research.

Scientific diving, like all other related fields, exists within its own distinct domain complete with standards, qualifications, protocols, and certifications. Like all other professional dive-related fields, scientific diving is regulated by the government (in case you didn't know - even recreational diving at the professional level must conform to federal regulations!).

In the early years of scientific diving there was no uniformity in proper training and the safety of divers became an issue. Standards and dive manuals were drawn up by several university, private, and governmental scientific diving programs that shared a common ancestry to the program designed at the Scripps Institution of Oceanography, which established its standards in 1954.

In 1977 standards were implemented for commercial diving from the Occupational Safety and Health Administrations (OSHA), and scientific diving had to follow the same set standards. The American Academy of Underwater Science (AAUS) was established in 1977 to petition OSHA for a scientific diving exemption to commercial standards. In 1982 OSHA granted the exemption for scientific diving under special guidelines that had to be followed.

Listed below are the OSHA guidelines that outline the exemption for scientific diving.

This appendix contains guidelines that will be used in conjunction with 1910.401(a)(2)(iv) to determine those scientific diving programs which are exempt from the requirements for commercial diving. The guidelines are as follows:

1. The Diving Control Board consists of a majority of active scientific divers and has autonomous and absolute authority over the scientific diving program's operations.
2. The purpose of the project to use scientific diving is the advancement of science; therefore, information and data resulting from the project are non-proprietary.
3. The tasks of a scientific diver are those of an observer and data gatherer. Construction and trouble-shooting tasks traditionally associated with commercial diving are not included within scientific diving.
4. Scientific divers, based on the nature of their activities, must use scientific expertise in studying the underwater environment and therefore, are scientists or scientists in training.
5. The scientific diving program shall contain at least the following elements:

Diving safety manual which includes a minimum of procedures covering all diving operations specific to the program; including procedures for emergency care, recompression and evacuation; and the criteria for dive training and certification.

Diving control (safety) board, with the majority of its members being active scientific divers, which shall at a minimum have the authority to: approve and monitor diving projects, review and revise the dive safety manuals, assure compliance with the manual, certify the depth to which a diver has been trained, take disciplinary action for unsafe dive practice, and assure adherence to the buddy system for scuba diving.

The purpose for scientific standards is to guarantee the safety of the divers. The American Academy of Underwater Science developed the standards that I am required to adhere to for my scientific diving conducted at the Aquatic Research Institute in the southeastern tip of Lake Michigan.

In the AAUS standards, the minimum requirement for entry-level training for a non-diver to become a scientific diver is to dive under the auspices of an organization that subscribes to the AAUS. The diver has to pass a full medical examination from a physician and complete a rigorous swimming evaluation equivalent to a dive master program. There are one hundred hours of dive training dealing with physics, physiology, confined water training, hazards, planning and supervising dive operations that need completion with exams. A vitally important required training standard is emergency care with CPR, Oxygen administration, and first aid for diving accidents. Last are the five open water dives with a cumulative of one and a half hours of bottom time. With the minimum certification you are limited to thirty feet and authorized to use only standard scuba. There are additional levels of certification with special requirements for certifications such as: Nitrox, Stage decompression, surface supplied diving, rebreather and deeper depth ratings.

Diving is not something you can master by simply reading a manual. It takes divers years just to learn proper buoyancy skills, which are crucial in scientific diving. Being comfortable underwater, with proper breathing, and knowing one's limits are all essential in the safety of being a diver.

In Scientific Diving the main objective is to get answers, these answers are achieved in scientific investigation through observation, measuring, and quantifying a pattern. Depending on the research being conducted, the procedures of data collection may differ but they share the same methodology, known as the scientific method. As a scientific diver, diving is a tool that the researcher would use to assist in observing or collecting data. The scientific method works the same in a lab as it would 100 feet in Lake Michigan. There is a great deal involved in underwater scientific research, from marine biology, Limnology and other sciences such as chemistry, geology, meteorology, and much more.

The best education is through experience: strive to learn more, and keep an open mind. It is very important in science to have good procedures and accuracy in measurement. Being objective, and systematic are key components of the scientific diver.

What does this mean for the average diver who isn't science oriented or doesn't have time to read volumes of text from a library? Diving as a recreational sport is based on observing the aquatic and marine life underwater in their natural environment. Observation is the basis of science. Improving your observational skills will open your eyes to better dives and help you to be environmentally aware. As divers we practice our science skills every dive, through observation, and experience in the aquatic environment. By improving your perspective on the environment and using careful observation, you can make even an average dive your best.

Ox Bel Ha

Third Largest Water Filled Cave in the World

The jungles of Mexico's Yucatan boast the three longest water filled caves in the world. The newest to join the impressive list is Ox Bel Ha, meaning Three Paths of Water.

The 1998 expedition from Cenote Esmeralda and Amber Sun resulted in 38,000+ feet of new passages. The 1999 expedition resulted in the connection of the system Chikin Ha, surveyed to 65,000+, and system Yax Kai with 43,000 feet of surveyed passage. The connection of these systems resulted in the discovery of the world's 3rd largest underwater cave system with over 146,000 feet.

System Ox Bel Ha is unique from the other cave systems in the Yucatan because its three major systems drain directly into the Caribbean Sea. It also possesses a multitude of conduits, passages and galleries like no other systems. Colossal chambers stretch out in all directions decorated with impressive amounts of peleothems, halagtites, draperies and flowstones. Huge canyons, up to one hundred feet deep contain stalagmites reaching 30 plus feet in length. Hallways are filled with the fossilized remains of conch, urchin, seashells, and gigantic fossilized sponges, some as large as four feet tall.

Expedition continues to expand on this impressive system.

Explorers include: Bernie Birnbach, Fred Devos, Christophe Le Maillot, Sam Meacham, Bil A Phillips, Daniel Riordan, Sabine Schnittger and Samentha Smith.

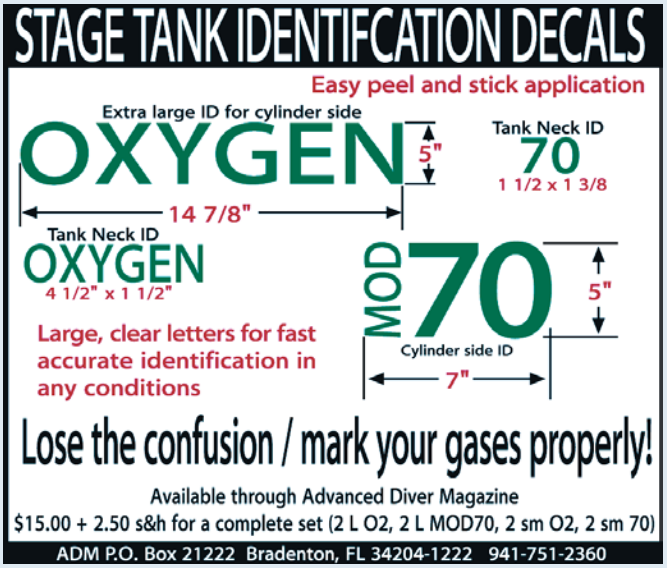
Reverse Dive Profiles Acceptable!

At a recent workshop held at the Smithsonian Institute, reverse dive profiles were studied with some interesting conclusions.

Bruce Wienke, Hugh Van Liew, David Yount, Peter Tikuisis, and Ron Nishi discussed various aspects of bubble models. Wienke's presentation covered, in part, how the size of delta-P (change in pressure between dives) relates to the incidence of DCS.

John Lewis and Glen Egstrom discussed the history of the prohibition against reverse profiles, finding that it seems to have begun more as a way of optimizing bottom time than as a safety issue. Bill Hamilton pointed out that reverse profiles are commonly undertaken without incident. A number of presentations were made reviewing actual dive data from various sources to see whether it supports the premise that reverse profiles are dangerous.

The workshop's finding is that the data does not prove reverse profiles are more dangerous than forward profiles. However, since the data may not be complete, and since the bubble models show that there could be problems with reverse profiles, the participants were reluctant to advocate a complete abandonment of the prohibition. Therefore, the workshop conclusion is that prohibitions against reverse profiles can be relaxed within the scope of no-decompression diving to the limit of 130 fsw/40 msw and pressure differential (delta-P) of 40 fsw or less between repetitive dives.



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KEY:
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GB = Gas Blender
AGB = Advanced Gas Blender
TX = Trimix • **IT** = Instructor Trainer
CV = Cave / Cavern

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Cannon Ball Cave
Continued from Page 9

was mixed for a 350 foot maximum operating depth (MOD). We had two additional stage tanks, one with the MOD of 350 feet and a second stage tank with a MOD of 400 feet to leave for the next dive. The large room drops to a horizontal restriction at a depth of 285 feet. With the recent absence of rain in the area it was fairly easy to maneuver by pulling along the bottom or using a scooter on full throttle to bypass the high flow in the restriction. At times, strong water flow (dictated by the season and recent rainfall) can make it very difficult to navigate this tight restriction. After the restriction, the ceiling height drops with a clay bottom to a depth of 315 feet. 200 feet past the restriction the cave begins to open up and has another drop off that slopes slowly to an estimated 350 feet depending on water levels. Unfortunately most dive computers stop at 328 feet, which made a problem determining the cave depth. The end of the line is approximately 650 feet past the restriction, in which there is more of the cave to be explored in the future. We stopped just shy of the last tie off and turned on the available time that we set for ourselves.

The problem with dives in Cannonball that require multiple gas decompression is getting the stage tanks in the first restriction. It is difficult enough just getting through with a set of doubles, but with 3-6 additional tanks it can be very time consuming. This is why having a setup dive is crucial. Another difficult circumstance to overcome is the long decompression in the 55-degree water; our dive had a total runtime of 3 hours and 20 minutes. Special steps must be taken in preparation and training for these dives.

In Missouri cave diving there is endless enjoyment and challenge, from the diver who wants to stay above 60 feet to the diver who desires to go past 300. I find myself lucky to have been able to experience these caves and find them an interesting change from the caves of Florida and Mexico.

RGBM Deep Stop Modeling
Continued from Page 11

The RGBM is a dual phase model that couples a weighted split between free-blood and dissolved-blood gradients, with the weighting fraction proportional to the amount of separated gas. Bubble volume constraints control deep stops and blood-flow rate serves as the boundary condition for tissue gas penetration by diffusion for shallow stops. In addition, because body tissues and blood are normally undersaturated with respect to ambient pressures at equilibrium, RGBM considers this debt, called the "Oxygen Window," in its calculations.

RGBM NDLs are tuned to recent Doppler measurements and the added effects of new bubbles reduce bubble volume limit points. This and bubble elimination and buildup during surface intervals, dependant on tracking critical bubble volume reductions over time and the addition of seed bubbles to existing bubbles in calculations, restricts multidiving.

Repetitive applications:

1. Reduces permissible bubble numbers and thus bottom time.
2. Reduces permissible gradients and thus, multiple day exposures.
3. Penalizes deeper than pervious dives.
4. Affects all compartments (fast and slow).

The RGBM recovers Haldane's approach with regards to tissue compartments while tracking bubble volume and radius for dives shallower than about 200 ft. (61 m), but schedules are shorter for deeper dives.

We all acknowledge, there are no decompression tables or devices that guarantee protection against the bends, but surfacing cleaner with less decompression stress is the reason for NAUI Technical Operation's decision to go with RGBM mixed gas tables.

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Global Underwater Explorers
BRITANNIC EXPEDITION

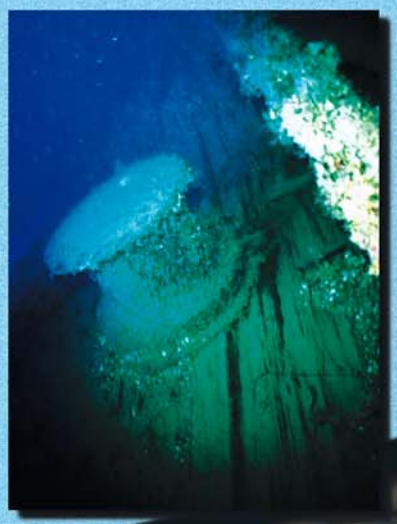
By: Anthony Rue

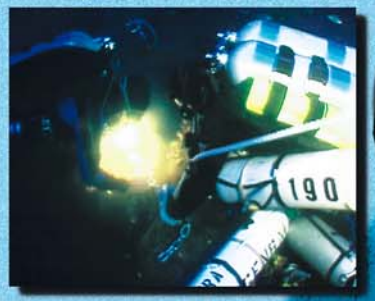
Nearly 100 years after the sinking of the world's most luxurious liner, the Titanic continues to captivate public sentiment. The tragic mystery surrounding the sinking of the Titanic becomes even more remarkable when taken together with the fate of her larger and more enigmatic sister- the Britannic. While extreme depth and a remote Atlantic location limits access to the Titanic, exploration of the Britannic is finally becoming a possibility to a select few organizations willing to commit the resources to further our understanding of the last great ship of the White Star Line. Global Underwater Explorers, under the leadership of Jarrod Jablonski, brought together an international team of two dozen trimix and support divers to explore the Britannic during the summer of 1999.

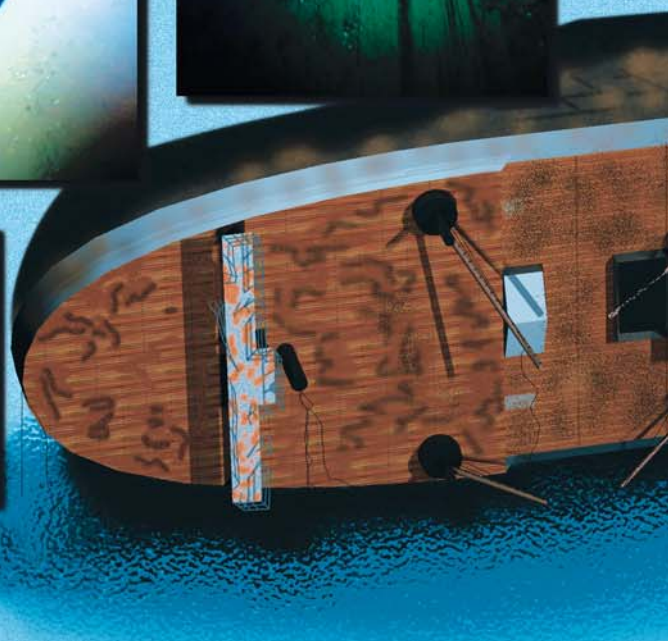
Weighing nearly 50 thousand tons and just under 900 feet long, the Britannic was approximately 20 feet longer than the Titanic. Plans to outfit her with greater opulence than her infamous sibling were forsaken at the outbreak of World War I, when in requisition by the British Admiralty she was redressed as a hospital ship before ever being put into service as an ocean liner. On November 21, 1916, just over four and one half years after the loss of the Titanic and a little over 18 months after the torpedoing of the Lusitania, the British hospital ship HMHS Britannic sank on her sixth voyage as she passed the Greek island of Kea. An unexplained explosion sent her to the bottom of the Aegean Sea in a mere 55 minutes.

Although only 30 of the more than 1,000 hospital staff and crewmembers were killed, the loss of the ship caused considerable concern. Many survivors claim to have seen torpedo tracks prior to the explosion, lending credence to the belief that the Britannic had not hit a mine but had in fact been the victim of German aggression. Also, despite the numerous and costly improvements after the loss of the Titanic, the Britannic sank with amazing rapidity-less than an hour from impact to the bottom of the Kea Channel.

In 1975, underwater explorer Jacques Cousteau located the Britannic in 400 feet of water. Closer inspection the following year revealed the wreck to be lying on its starboard side with a large hole visible in the port side through to the seabed. Interestingly, the steel plate around this hole was bent outward, despite the fact that the mine had reportedly detonated to starboard, leading to speculation that a secondary explosion from an unknown cause had occurred. Controversy persists as to whether this hospital ship was secretly carrying munitions or whether she was the innocent victim of a secondary explosion from another source.







Obtaining diving access to the Britannic is a difficult and politically sensitive process. Global Underwater Explorers is one of only three organizations, since its rediscovery by Cousteau, to be permitted access to the shipwreck. Because it is considered a war grave by the British government, diving is strictly regulated. Furthermore, access to the Britannic must be obtained from both the British owner and the Greek government as the ship lies in Greek territorial water. Access to the wreck is granted no more than one time each year and is limited to only the most qualified, all operating under a limited time window with very limited resources.

Exploration is made all the more difficult considering that SCUBA diving is all but prohibited in Greece. Reacting to a long history of plundering of Greek antiquities. To stage a multi-week trimix exploration, GUE had to build an on-site facility capable of supporting up to a dozen gas divers a day. Team members arrived on Kea just ahead of the equipment: two transport trucks, with over three tons of gear, compressors and gas cylinders, made it over on the last ferry on the 18th of August. Arrangements for transportation of the gear required the cooperation of GUE, Baltic Sea Technical Divers, and the Greek Dive Center.

Britannic 99's advance team of Andrew Georgitsis, Steve Berman, and Richard Lundgren were able to attach a thin lead for the upline on their first shot at the wreck. The Britannic rests on her side in 400 fsw, just under a mile off of the island of Kea. Georgitsis later commented on the enormity of the Britannic: as he swept across the floor of the Kea Channel, the ship's profile appeared like an eight story building out of the darkness. She is perpendicular to the Kea Channel, the passage to the south of Athens that carries much of the heavy tanker traffic between the east and west Mediterranean.

As soon as the team's lift bag broke the surface, the second team of Jablonski, Todd Kincaid, and Ted Cole departed with the goal of securing a one-inch upline and liftbag to the surface. The line was secured a few meters up from the wreck's stern. In order to reduce the risk of damage to the upline by a passing freighter, the team established a series of segmented uplines near the stern of the Britannic, bringing the divers as near to the surface as currents would allow. Surface currents are typically fierce in this region and the depth of their

Digital video photos by: Barry Miller & Jarrod Jablonski
3D Illustration by: C. Bowen

Britannic Facts: Launched February 26, 1914
Length: 882 ft Beam: 94 ft Keel to stack height: 175 ft.

influence can vary. Therefore, an upline was established from the bottom in stages, i.e. from 400' to 150', from 150' to 70' and from 70' to the surface. Although it wasn't required, the system would have allowed GUE divers to cut individual sections and drift when absolutely necessary without compromising the stability of deeper upline stages. In addition, several chase boats worked in concert with the main support vessel to coordinate emergency drifting decompression or to waive off cargo ships approaching decompressing divers. Kincaid coordinated efforts with Lundgren, Johan Berggren, Bob Sherwood, and Joakim Johansson; the group worked tirelessly to ensure this system was as safe and flexible as necessary.

In the following two weeks, Britannic 99 placed approximately seventy five man-dives on the wreck. Significant effort was made to document the passages from the forward holds to the main ballroom. Other areas of investigation included surveying damage across the Britannic's bow and searching out watertight doors and open portholes, both objects of speculation as to how the ship sank so quickly.

Jablonski, Cole, and Kincaid worked diligently prior to the project to establish decompression logistics that would minimize the divers' time in the water while insuring safe and reliable decompressions over the course of at least ten diving days. Two sets of tables were constructed using GUE's Deco Planner decompression software, which allows divers to plan exposures relative to individual conservation, acceptable risk, and consistent safety margins.

Most dives were kept between 15 and 20 minutes, with several teams following a more aggressive 30 minute profile to allow for extended penetrations. Most dives utilized a 10/70 or richer bottom mix with decompression mixes that include 21/35 @190', 35% @ 120', 50% @ 70', and pure oxygen at 20'.

GUE's primary objective in diving the Britannic was to provide the most comprehensive video documentation of the wreck ever attempted. Every team down on the Britannic carried at least one digital video camera, and most teams carried two. Short-bodied Gavin scooters were the requisite transportation for each diver, allowing a complete circuit of the wreck in just over fifteen minutes. GUE was able to shoot over three hundred minutes of high quality digital video. As both a British war grave and as a wreck in Greek territorial waters, the taking of any artifact from the Britannic is strictly prohibited. Teams made significant penetration along the Britannic's haunting passageways, providing the first glimpse of Britannic's cavernous interior since 1916. Footage is currently being assembled for a feature length documentary on the project.

Global Underwater Explorers: www.gue.com
Deco Planner: www.gue.com/decoplan

Duane and Bibb
Continued from Page 7

saving force. The ship's most dramatic rescue came in 1948, as the vessel braved gale force winds and dangerous seas to rescue all 69 survivors of the Bermuda Sky Queen, a transatlantic airliner which plunged into the icy cold waters of the Atlantic. Though her greatest contribution lay in saving lives, the Bibb's successes also included several drug seizures before being decommissioned on September 30, 1985.

Both the Duane and the Bibb were turned over to the U.S. Maritime Administration for disposal after being decommissioned. An association of Florida Keys' businesses lobbied successfully to have both ships sunk off of Key Largo for the purpose of becoming artificial reefs. In November of 1987, the two proud cutters were sent to the Keys to carry out their final mission-a one way trip to the bottom. The utmost care was used in sinking the two ships, without the use of dynamite in order to protect their structural integrity. The Duane was the first to go on the 27th and the Bibb followed on the 28th. Two new artificial reefs were now gained in the Florida Keys.

You may choose to dive either the Duane or the Bibb. However the Duane is dived more frequently because of her shallower depth. Lying on a flat, sandy bottom the Duane rests upright with her stern at a depth of 120ft, approximately 1 mile south of Molasses Reef past the Sanctuary borders. Her position is indicated by a large yellow marker and mooring buoy visible even in choppy seas. On good days, visibility can exceed 100 feet, however due to her location in the Gulf Stream, strong currents can make this wreck undivable.

The Bibb overturned while sinking and rests on her starboard side at a depth of 140 feet. At present, she is designated by a lone buoy, and is slightly more difficult to locate. As with the Duane, the currents here are also extremely powerful. Visibility is about the same as the Duane given the type of day. The two ships rest about a quarter mile from each other.

In order to make the Duane and Bibb safer for divers to explore, openings, hatches and doorways to areas below the main deck were welded shut. Doorways above the main deck were welded open in most places to lessen the chances of trapping divers. Most areas are accessible and safe above the main deck. They are still in relatively good condition with an abundance of marine life inhabiting numerous crevasses and spaces of the two vessels. Both ships are equally rewarding and despite being comparatively modern, both ships possess an equally interesting history.

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Shipwrecks of WhiteFish Point Lake Superior

Vessel Name	Configuration Wood or Steel	Weight (Tons)	Cargo	Year Built	Date Sunk	Depth (ffw)	Method Sank
John M. Osborn	178 ft. Wooden Steamer	891	Iron Ore	1882	Jul 27, 1884	180	Collision/Alberta
Comet	181 ft. Wooden Steamer	621	Silver Ore	1857	Aug 26, 1875	240	Collision/Manatoba
John B. Cowel	420 ft. Steel Steamer	4,731	Coal, Iron	1902	Jul 12, 1909	220	Collision/Issac Scott
Superior City	429 ft. Steel Steamer	4,795	Iron Ore	1898	Aug 20, 1920	265	Collision/Willis King
Zillah	202 ft. Wooden Steamer	1,100	Yacht	1890	Aug 20, 1926	252	Winter Gale
Miztec	194 ft. Schooner Barge	777	Salt	1890	May 14, 1921	50	Storm
Myron	186 ft. Wooden Steamer	676	Lumber	1888	Nov 22, 1919	50	Storm
Panther	237 ft. Wooden Steamer	1,373	Wheat	1890	Jun 27, 1916	105	Collision/James Hill
Drake	201 ft. Wooden Steamer	1,102	Unknown	1882	Oct 2, 1901	55	Storm
Sagamore	308 ft. Whaleback Barge	1,601	Unknown	1892	Jul 29, 1901	72	Collision/N. Queen
Samuel Mather	246 ft. Wooden Steamer	1,576	Wheat	1887	Nov 22, 1891	195	Collision/Brazil

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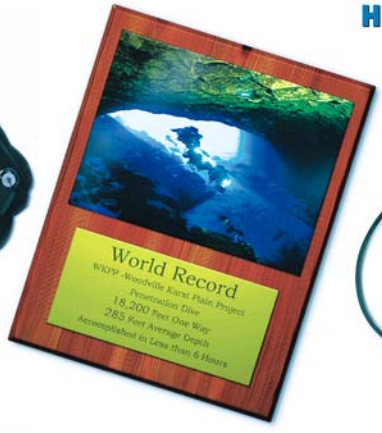

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ARTIFACT PRESERVATION

IRON

By: Andrew White

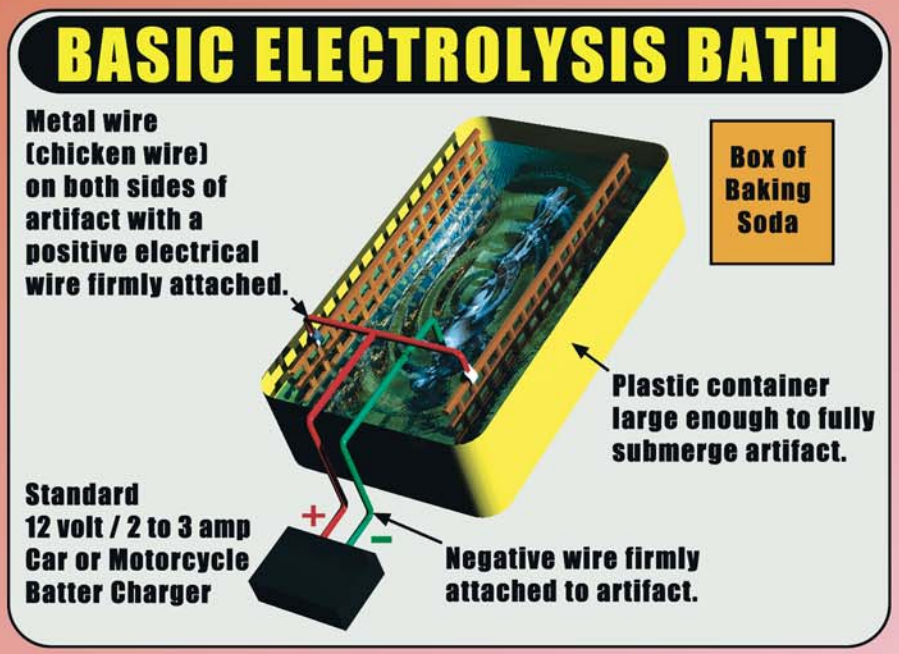
Iron has been used by man for centuries as a building material. It is one of the most plentiful metals found on the earth. Iron artifacts recovered by divers include portholes, knives, flintlock pistols, running light frames, and a wide array of other interesting items. However, when left in a saltwater environment for long periods of time iron is vulnerable to oxidation, where acids and chlorides create an electrical charge that corrodes the metal compound. In older artifacts, oxidation has caused a level of marine biological growth to encapsulate the object. This growth, called a concretion creates a highly acidic layer on the artifact that greatly increases corrosion.

Iron artifacts removed from sea water should be immediately placed in a fresh water solution. If allowed to dry, the concretions surrounding the object become very hard and cling to the artifact with much more intensity. Regular tap water works for storage, but rain water and distilled water have a higher ph level that allows them to inhibit corrosion much more efficiently.

Removal of the concretion level depends upon the size and general condition of the metal. For large amounts of concretion, a hammer blow can generally remove most of the outer layer. For smaller and more brittle objects, a dental pick, or brush can be used. Remember to always keep the artifact wet when removing concretions.

Laboratories use a technique called glass bead blasting to rid artifacts of the concretion layer. This is similar to sandblasting but the soft glass beads are far less abrasive than sand. The normal intensity of blasting ranges from 25 to 80 pounds while being mindful of keeping the nozzle at least 6 to 10 inches from the item. Each artifact should be carefully examined before this process and with more brittle objects, air pressure should be decreased.

The most effective method for restoring iron artifacts is electrolytic reduction. This process reduces concretions to a more stable form where they can be removed with less stress on the metal. The artifact is completely submerged in tap water with a 2% solution of sodium carbonate (baking soda). It is then subjected to 3 amps of electricity for two to three days.



It is recommended that this be done under laboratory conditions but electrolytic reduction is fairly easy to set up on your own. A water tank must be on hand that can completely cover the artifact when filled. Then the appropriate amount of sodium carbonate must be added (measure weight to volume). Two steel anodes are placed inside the tank next to the artifact. It is important not to let the anodes touch the artifact as this will cause a short. The anodes should be connected to the positive terminal of your power source. The negative terminal is attached to the artifact. The power source should be placed on 6 volts and, in a short while, should start producing bubbles of hydrogen. The artifact can be manually cleaned and picked during this procedure, but special care needs to be taken. Only soft, sensitive brushes should be used when cleaning an artifact after the concretions have been removed. It is important to have adequate ventilation when using electrolytic reduction as potentially explosive hydrogen gas is given off during the process.

Once all concretions are removed, the artifact should be placed in boiling, distilled water for an hour to provide deep cleaning. After boiling, allow the water to cool and replace it with fresh distilled water. Repeat the cycle three to four times. Larger artifacts may require more boiling cycles. Once the boiling cycle is complete the object should be rinsed and soaked in distilled water. The artifact is now ready to dry. For complete dehydration you can preheat an oven to 350 degrees Fahrenheit and allow the artifact to sit in the heat for 24 to 48 hours. Dehydration times vary according to the surface texture of the item. As a general rule, the rougher the surface of the artifact, the longer it will take to dehydrate.

Once fully dehydrated, Tannic acid can be applied to the exterior of the artifact. This solution inhibits corrosion and restores a more aesthetically pleasing black color to the object. Dip or brush the artifact in the tannic acid solution for up to four coats. Be sure to wear waterproof gloves when carrying out this step, if not the tannic acid will stain your skin black.

The final step is to provide a protectant from moisture using conservation wax. Dip the artifact in melted wax for approximately 30 seconds, then allow to dry. The wax not only keeps moisture out but also provides a self-sealing layer that prevents scratches.

Our continuing coverage of artifact preservation will continue in future issues. Upcoming articles will contain valuable information on preserving wood, silver, and paper.