Issue 5
April
1996

DeepTech

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Shreck Exley

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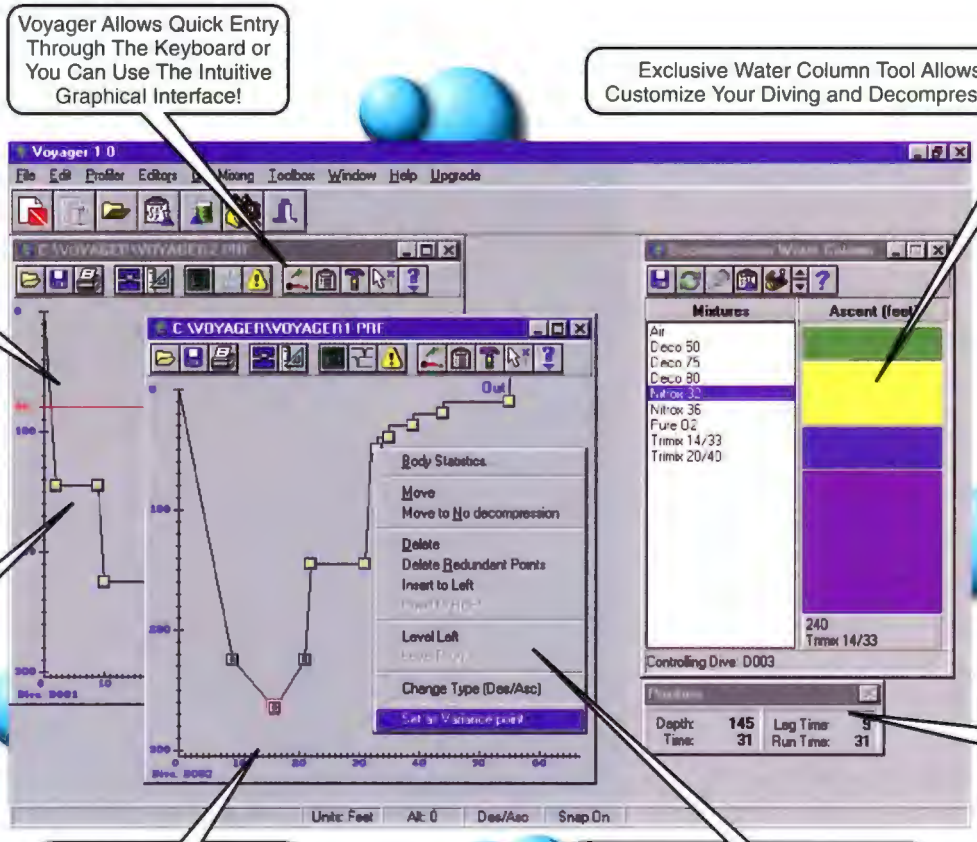
Voyager

Install Voyager For Windows On Your PC And Unlock The Power Of Full Featured Desktop Decompression Software!



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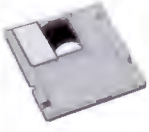

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DeepTech

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DeepTech's Advisory Board provides invaluable technical information, insight and advice. Their generous contributions of time and information are greatly appreciated.

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WARNING:

Diving is a potentially dangerous activity. Neither DeepTech, nor it's contributors accept liability for diving related injuries incurred by our readers. The materials contained within this magazine are for informational purposes only and are not intended as a substitute for dive training.

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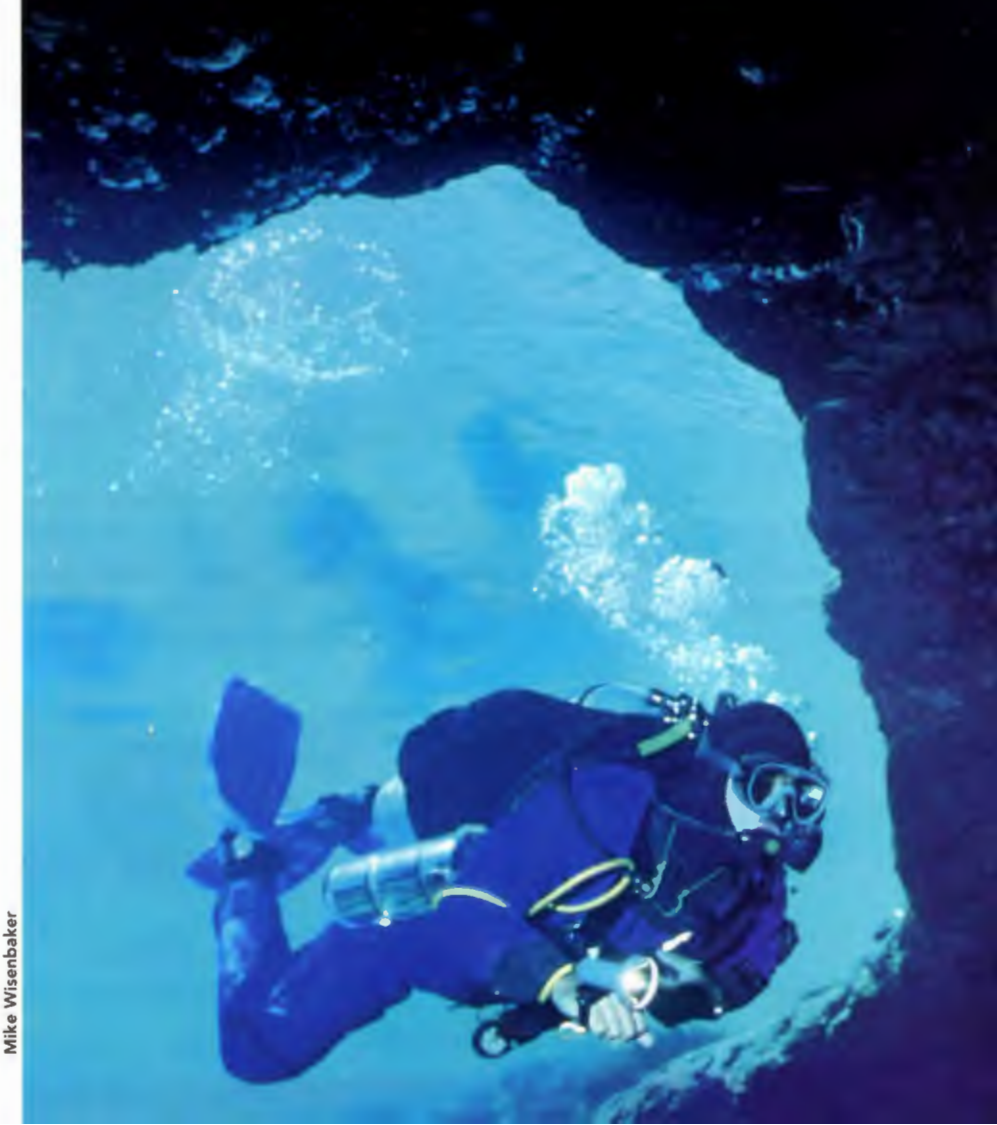
ISSUE 5 • APRIL 1996



Mike Wisenbaker

ON THE COVER: Eric Hutcheson hovers in "Nohoch Nah Chich" for Wes Skiles camera.

Train with

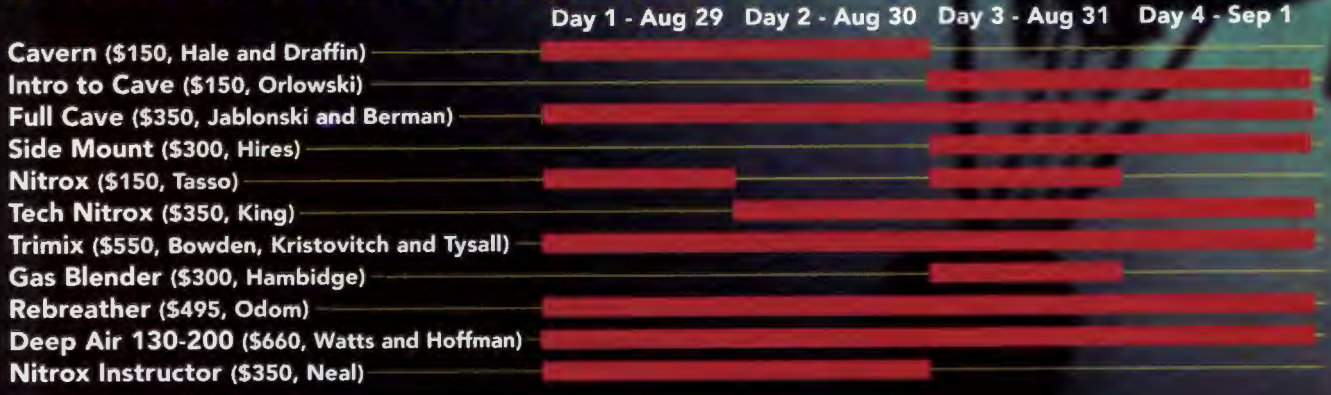
The Dog Days of August

Advanced & Technical Diving Workshop

Are you looking for an in-your-face, hands-on, in-water, training experience, taught by world renowned experts in technical diving? If so, then the Dog Days of August is for you! DeepTech Magazine is proud to sponsor this unique 4-day event, Aug. 29 — Sep. 1, 1996, at the Hilton in beautiful Ocala, Florida. Full certification courses in Trimix, Rebreathers, Cave and Cavern, Deep Air, Nitrox and Technical Nitrox are being offered, plus a unique series of workshops and seminars that guarantee people will be talking about this event for months to come.

DeepTech has gathered together instructors for this event from among the best available from IANTD, TDI, PSA, NSS-CDS, ANDI, and the NACD including Jim Bowden, Joe Odom, Ann Kristovich, Hal Watts, Terrence Tysall, Hugh King, John Orlowski, Lamar Hires, and Jarrod Jablonski among others.

Certification Courses at Dog Days of August:



Workshops at Dog Days of August:

(Note: All Workshops Occur on Saturday & Sunday)

Zacaton and Other Interesting Caves Jim Bowden and Ann Kristovich talk about the next step in exploring the profound Zacaton cave system with a choice selection of slides from their latest trip.

Gear Configuration for Extreme Diving George Irvine and Lamar Hires explain the how-to's of their proven techniques for getting the job done in the most efficient way possible.

The State of Rebreathers Bret Gilliam explains the current state of Rebreather technology and some insights on what to expect in the way of training for users and instructors. For those who want to "give-it-a-try" we will also be offering "Rebreather Experience" sessions (non-certification).

Tech Gear For Tech Heads New and emergent gear is displayed and explained by industry experts from Dive Rite, OMS, Cochran, American Underwater Lighting, ScubaPro, and others!

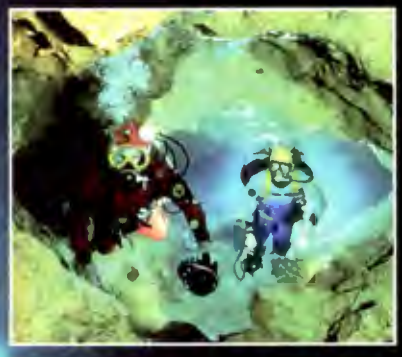
Deep Air Training Pros and Cons An in-your-face live debate between Hal Watts and George Irvine

Saturday Night Pool Party Also featured at the Dog Days of August is a Saturday night pool party with drinks and munchies at the Hyatt followed by an entertaining tongue-in-cheek "roast" of techdiving by Bret Gilliam, Tom Mount, Joe Odom, Jim Bowden, and Hal Watts. This will be a humorous look at techdiving over the past 30 years.

The Elite

Deep Air
(Hal Watts, Steve Hoffman, Bob Hambidge)

Trimix
(Jim Bowden, Terrence Tysall, Ann Kristovich)



Cavern
(David Hale, Jackie Draffin)

Intro to Cave
(John Orlowski, Shelley Orlowski)

Full Cave
(Jarrod Jablonski, Steve Berman)

Side Mount
(Lamar Hires)

Rebreather
(Joe Odom)

Nitrox
(Eric Tasso, Jim Cutway)

Tech Nitrox
(Hugh King)

Nitrox Instructor
(Jan Neal)

Gas Blender
(Bob Hambidge)

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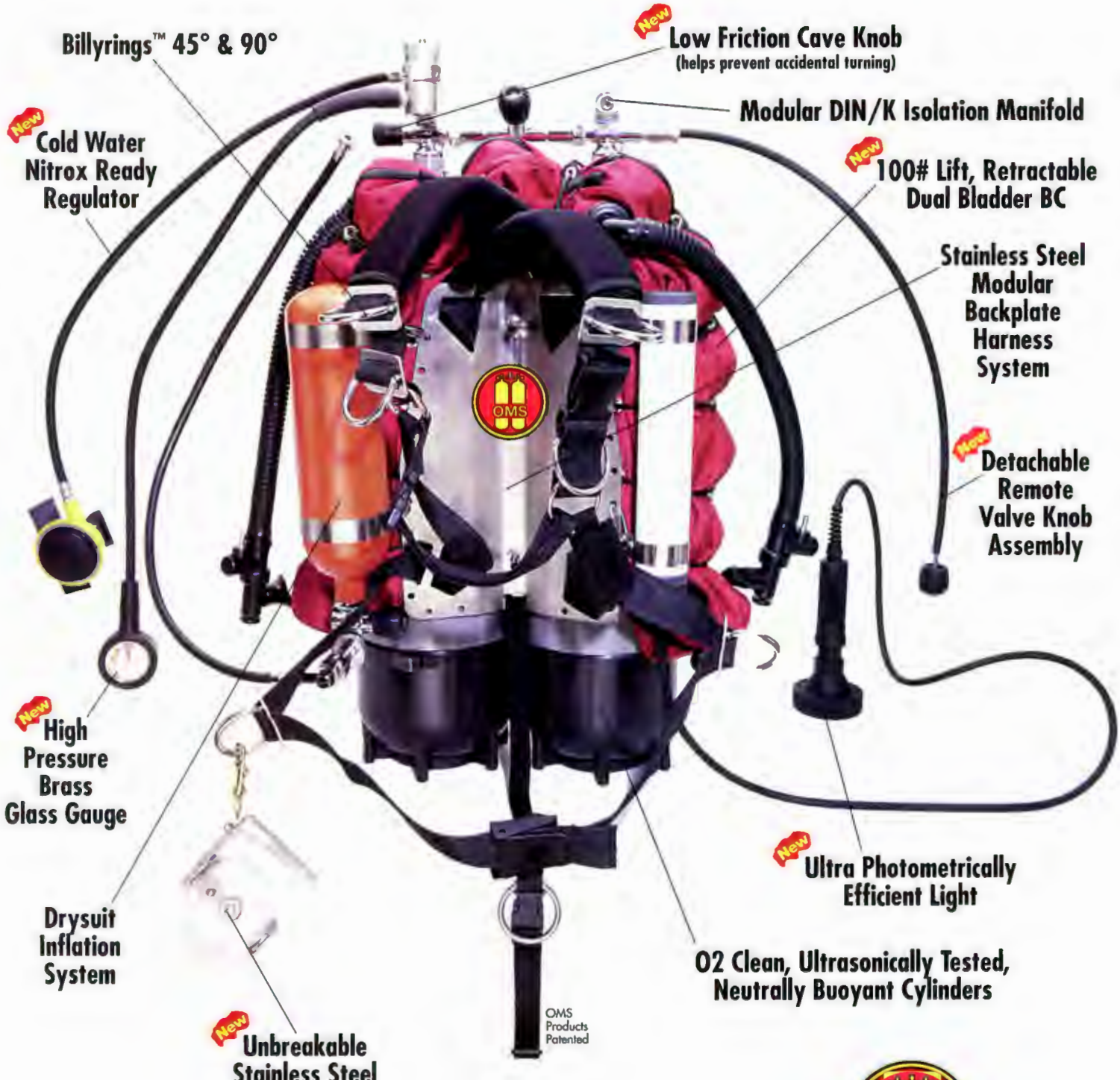

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Pushing the Limits

By WINREMLEY

When Jim Bowden dived to 925 feet in Zacaton, many in the dive industry applauded his accomplishment. However, there were also many who said he was foolish and that he set a bad example for others to follow. When Olivier Islar made his record breaking 4 km cave penetration in the Doux de Coly system in France using homemade rebreathers and a custom built habitat there were those who said he was foolish to spend the tremendous resources he spent just to "swim a little further into a cave." George Irvine and the WKPP are constantly being criticized for there "daredevil" 6,000 ft. cave penetrations into Wakulla at depths below 300 feet. Polly Tapson received similar criticisms for her Lusitania expedition.

Why is it that these explorers devote significant portions of their lives and tremendous resources in underwater exploration only to receive abuse and criticism from the media and some members of the diving community? Do they indeed set a bad example for others to follow? If this were true the dive media would be filled with stories of divers gacking on the Lusitania, and in Wakulla, Zacaton, and Doux de Coly, trying to mimic those accomplishments. It's true that Sheck Exley's untimely death occurred while trying to find the bottom of Zacaton but I know of no one who characterizes Sheck as a copy cat or a follower. He was an explorer of the first class in every respect.

Yes, I read the incident reports in the media of divers drowning. Let's face it – diving can be a dangerous sport. Although I have never read an incident report that said "Another diver buys the farm trying to beat Olivier Islar's record in Doux de Coly." If you want to maximize your chances of dying of old age then you should stay home with your doors locked, eat health food and ride your exercise bike all day. Diving is not the only dangerous sport. I once took hang gliding lessons from an instructor who had an interesting response to the safety issue. He said, "If you want to be safe then never fly higher than you're willing to fall." This is a simple philosophy yet amazingly profound. It could be applied to the sport of diving by saying "If you want to be safe then never dive past the point where you can swim to the surface on one exhale." I doubt, though, that many techdivers would embrace this philosophy.

And what about rock climbing? Now there's a dangerous sport! But among the rock climbing community, climbers who climb the highest are revered as the experts, they are the ones to learn from. And the free-climbers, who climb hundreds of feet without safety ropes or lines, are given almost mystical admiration. This group could be considered the "tech-climbers." They are not foolish. They are the experts. Yes, sometimes they fall and die, but when this happens the climbing community sees their death for what it is—a tragic loss of one of their own. Absent are the criticisms of equipment and technique so pervasive in the diving community.

Let's not forget motorcycle racing, white water rafting, skydiving, downhill skiing, boxing, and luge racing—well, OK, but everyone knows that luge racers are wacko. You have to be wacko to lay flat on your back on a flexible flyer and race feet first down a bobsled run at 90 miles per hour.

The point is that history is filled with people who participated in potentially dangerous activities for no more lofty goal than to have a little fun and get the adrenaline pumping. Today even meeting someone you like and having sex can be a potentially fatal activity. Let's recognize too, that many of the divers who are criticized for their "dangerous activities" are doing so in the name of research and not merely to have fun.

The real question is – why are the critics so vocal? Are they really concerned with the safety of those who might follow down the road of extreme techdiving? To quote Macauly Culkin from the movie *Home Alone* "I don't think so!"

After careful consideration and analysis of the many possibilities I have concluded that it can only be one thing—ENVY! Yes, it's nothing more than one of the seven deadly sins rearing its ugly head. The critics are either not skilled enough to do this type of diving or they are scared to undertake it for themselves. They react by saying that no one should do it because it is foolish and dangerous. They minimize their own inadequacies by finding fault in others. It's a new twist on the old saying, "Those that can do, those that can't become critics."

Kudos to Polly Tapson, George Irvine, Olivier Islar, Jim Bowden and all the other explorers who truly push the limits. Ignore the critics and see them for what they are—*cry-babies!*

Win Remley

Homebrew

First a congratulation on a job well done on giving us another technical magazine in which to share information around the world. Keep up the great work.

With regards your Homebrew article and the subhead Gas Diffusion (DeepTech Issue 3, Sep '95), it is far from "hogwash" that mixes do not instantly homogenize. While blending gas recently for the USS Atlanta expedition in the Solomon Islands we had numerous instances while blending EAN80 where the gas did not diffuse/homogenize until we rolled the cylinder. I know, I know, they say its not possible, but believe me it is not only is it possible, it actually happens!

Interestingly it only occurred to us when making EAN80. At first we thought that we were just messing up on the math somehow. After dumping a few of these "incorrect" mixes, We decided to roll a cylinder that was supposed to be EAN80, but analyzed at EAN54. After rolling for about twenty or thirty seconds and then analyzing again, presto—EAN80. This happened enough for us to realize that it was not a one shot screw up. All of the mixes that did not instantly homogenize first analyzed between EAN45 and EAN55, but after a very short roll came up to EAN80.

So the next time you have an "expert" tell you it's hogwash, you can tell them that although it may not be a "common" occurrence, it does happen. Also I thought that your recommended flow rate of between 2 to 4 cubic feet per minute over an analyzer sensor head was somewhat excessive. Two to four "liters" per minute (or less) is probably more appropriate, no?

Kevin Denlay
Tweed Heads, Australia
altdive@iaccess.com.au

[Thanks for the correction on the analyzer flow rate. We have conducted tests on three separate occasions, trying to mix gas that wasn't homogenized and we just can't do it. By the time we get the analyzer connected it measures the correct percentage. Next time you're in the U.S. please show us your technique—WR]

Whitefish Point

DeepTech is a slick production with quality information—keep up the good work. That was a fascinating article on the wrecks around Whitefish point in DeepTech (Issue 4, Jan '96) Having dived in Lake Superior a few times, I've always wanted to make a trip to Whitefish point, and was wondering if you could supply the name of a shop that conducts charters there?

Eddy Brian
Iowa City, Iowa
BrianE@anesthesia-po.anesth.uiowa.edu

[Try calling Superior Dive Tours at 705-946-3929]

Cenotes

Astounding photos of the Quintana Roo's Cenotes. You guys just keep getting better and better. Okay, let's add some more staff and get this baby published more than four times a year!

Roger Herring
Hawthorne, Florida
afn03632@afn.org

That photo by Charles Bisch on page 26 (DeepTech Issue 4, Jan '96) of Cenote Sac Actun in the Yucatan can't possibly be filled with water. You guys are pulling our leg, right? Is that a rabbit peeking out from behind the stalagmites?

Michael Schultz
Hamburg, Germany
via the internet

[Haven't you heard of cave-bunnies?—WR]

Gilliam Gets Angry

Finally, a magazine [DeepTech] has the guts to stand up to the garbage that has been printed in other publications about the diving practices of dive industry leaders and explorers. I've read with disdain criticisms of people like Polly Tapson, Bret Gilliam, Jim Bowden, Joe Odom and others, and wondered where these self-righteous, self appointed, critics get off telling other people how they should dive. DeepTech provided what amounts to a community service by giving Bret Gilliam a forum to defend himself (Issue 4, Jan '96). How I or any other diver dives is no one's business except our own. I don't endorse unsafe diving—I just don't want anyone else except me to determine what is safe or not safe for me to do. Let's face it—we have enough interference in our lives from the institutions we, as a culture, have established for ourselves. Let's not make it any worse by giving credence to know-nothing writers who sit in their hole and criticize those who are out there living life!

Patricia Belcher
Paris, France

If it wasn't for men like Gilliam, Exley, Bowden and others, divers would never have ventured beyond 130 feet or dared to experiment with advancing technology and diving methods. When was the last time one of those arm chair critics strapped on dive gear and went face to face with the challenges that those men have faced?

It's easy to understand Gilliam's frustration at having to deal with nitwits whose actual diving experience is limited to pounding a computer and posing in diapers while standing next to dive gear that they don't know how to use. Hats off to Gilliam for setting the record straight!

Fred Delois
Natick, Massachusetts

As if we don't have enough acrimony and conflict in our world already with Coke vs. Pepsi, Democrats vs. Republicans, Pro-choice vs. Pro-life, PADI vs. NAUI, etc.—now it appears that a new series of battles have been launched in the form of Tek Wars. Recent material in aquaCorps and DeepTech have pitted Tapson vs. Handelman, Gilliam vs. Menduno, readers vs. Irvine, etc. What is the point of all this? I think aquaCorps and DeepTech are both great publications. I just hope they don't become tit for tat tabloids with who said what about whom and who thinks so and so is a this or that. C'mon folks! Let's keep the big picture in focus. We readers are interested in technical diving and its vast array of related subjects. We appreciate

the wealth of knowledge and experience offered by the legendary figures, gurus, and "big guns" in the field. However, we don't want to see them go at each other's throats! Authors should keep in mind the power of the pen. If you don't have anything constructive to say about somebody, then don't say it. Let's keep the world of technical diving on the high plain where it belongs.

ERIK C. BAKER
STATE COLLEGE, PENNSYLVANIA
cdae1@aol.com

I just read the latest issue of DeepTech and, as with the previous editions, I am very pleased. You deserve applause for your frank reporting of Bret Gilliam's opinions. I am new to the technical aspects of diving and I have learned to give credence to the words of the leaders in the field. I am certified through TDI in nitrox and I will soon take advanced nitrox and deep air training as well. As a result of my experiences with TDI and having read several books and articles written by Bret Gilliam, I believe that he is a credible contributor to your magazine.

DARREN WHITTEN
FT. WORTH, TEXAS
Darren1581@aol.com

You have come a long way in the last year. However, I must express my disappointment in the editorial practices becoming evident. The recent trend to completely uncensored articles does not tend to emphasize the quality of the magazine. I am tired of personal attacks being carried out in public forums like the internet and Compuserve, and the recent trend towards doing this in your magazine is a practice that I disapprove of.

The printing of every word uttered by someone is not necessary. If a word is not commonly used in polite company, it need not be printed verbatim. Remember the aquaCorps revolt brought about by their offensive images. There are many people in technical diving that are not the ex-military drill sergeant types. A bit of etiquette would not hurt the content of your magazine.

STEVE KELSAY
CHARLOTTE, NORTH CAROLINA
kelsays@moodys.com

[Thank You for your comments Steve. We have changed our policy and now edit out profanity from DeepTech—WR]

Decompression Software

After receiving a copy of DeepTech, a much sought after but rare commodity in Europe, I was somewhat dismayed that the article on Decompression Software (Issue 4, Jan '96) by Bill Hamilton and George Irvine carried so many inaccuracies with regard to Proplanner. It would appear that the authors either didn't have a current copy to review or they only have experience with a very early version.

Proplanner was the first available desktop decompression program (1990) and was actually designed because I personally was fed up with paying and having to wait for custom tables from experts around the world. It was designed as a mission oriented package deliberately formulated to run with very low memory overhead, typically 200K, and on almost any PC from an 8086 on up. In fact it is ideally suited for boat use with some of the new palm top computers. Some of the inaccuracies with your article include:

- There are three versions of Proplanner: 1) Air/Nitrox (allows for any deco gas mix); 2) Air/Nitrox/Trimix; and 3) Air/Nitrox/Trimix and both Nitrox and Heliox/Trimix Rebreathers. The rebreather programs having the unique ability to bailout to an open circuit gas at any point on the dive.
- Proplanner is a true multi level decompression planner with full oxygen and nitrogen tracking displayed live as the dive is being built.
- To my knowledge Proplanner is the only package which allows mission sequence building. Saved dives can be appended together with user programmed surface intervals and stored tissue states providing the ability to continually track a weeks diving.
- There is a gas optimization function which within a user specified range of PO2s will predict the best gas switches.
- Proplanner, like Abyss, allows for a recovery half-time from an oxygen exposure and, again, Proplanner was the first to do this.
- Proplanner has a full range of gas management functions allowing the user to predict cylinder fill pressures based on a dive profile.
- Full runtime schedules can be printed from Proplanner.
- To our knowledge Proplanner is the only software which uses some of Buehlmann's latest work on micro bubbles in relation to yo-yo diving and repeat diving. As this work was not published in book form most designers seem to have ignored it. However, as Mr. Irvine correctly points out, this does cater to the commonly accepted procedure of employing deep safety stops on gas dives, something outside the realms of the classic Haldanean model. Proplanner does, however, allow the user to not only force a deep stop but allows selection of the shallowest stop depth to plan for heavy swell ocean diving and oxygen management applications.

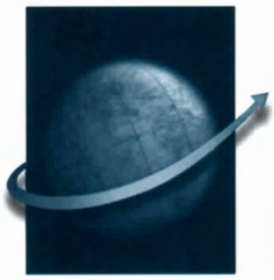
As mentioned, Proplanner has been in existence for over five years and is probably the most used gas program at the international level. Many of the deeper exploratory open water dives have been conducted using Proplanner with no known problems. It is an operational tool with a suitably limited graphics interface.

On a final note and with no malice intended, I would suggest that for the credibility of DeepTech and its contributors, any authors should declare their business associations with any products they review within the article. This will allow us all to balance our appraisals more fairly.

KEVIN GURR
AUTHOR OF PROPLANNER
IANTD UK PRESIDENT

[For the record, neither Bill Hamilton nor George Irvine have any contractual or financial arrangements, agreements, or relationships with any of the decompression software companies whose products were reviewed in their article.]

Please submit correspondence to DeepTech at deeptek@aol.com or fax to 941-955-7446, or mail to P.O. Box 4221, Satasota, Florida, USA 34230-4221.



Diving**News** **Exploration**Updates and**Discoveries**

The Dog Days of August

This Summer will see the first annual Dog Days of August Advanced and Technical Training Conference hosted by DeepTech Magazine. This unique event will bring together the world's best instructors from ANDI, IANTD, PSA, NACD, NSS-CDS, and TDI to provide a hands-on, in-water training experience unlike any other.

Full certification courses are being offered in Nitrox, Technical Nitrox, Trimix, Gas Blending, Cavern, Cave Intro, Full Cave, Side Mount Cave, Deep Air, and Rebreather User.

Instructors for this awesome event include: Jim Bowden, world record holder for deep scuba and renowned sump diver; Hal Watts, president of PSA and former deep-air record holder; Joe Odom, Training Director of TDI; Ann Kristovich, women's world record holder for deep scuba; Terrence Tysall, former Seal and owner of the Orlando Dive Center; Jarrod Jablonski, world renowned cave diver; Lamar Hires, President of Dive Rite Manufacturing; and others.

The Dogs Days of August is scheduled for Thursday through Sunday, August 29 through Sep 1, 1996 in beautiful Ocala, Florida. The Hilton Hotel in Ocala will be the base of operations for the workshop where attendees will stay and receive academic instruction. Special rates are available at the Hilton for this event. In-water instruction will be conducted at 40 Fathom Grotto, Ginnie Springs, and several other locations near Ocala.

On Saturday and Sunday a series of advanced, non-certification, workshops and presentations will also be conducted in a variety of subjects including: gear configuration for extreme diving; rebreathers; Dive Propulsion Vehicle (DPV) diving; new and emergent gear displayed and explained by industry experts from Dive Rite, OMS, Cochran, American Underwater Lighting, Faralon, ScubaPro, and others; and a special presentation by Jim Bowden and Ann Kristovich on Zacaton and other exciting projects. The workshops can be attended separately from the training courses for those who only want to participate on the weekend.

Saturday night there will be a pool party at the Hilton for attendees followed by a humorous "roast" of the technical diving community presented by Bret Gilliam, Jim Bowden, Hal Watts, Joe Odom, and Tom Mount.

The Dog Days of August is an event that people will be talking about for months. For a registration packet, call DeepTech at 800-250-6858.

Wrecks '96,

The Wrecks '96 4th Annual Symposium of the MetroWest Dive Club will be held April 20, 1996 at the Keefe Tech High School in Framingham, Massachuttes. The Wrecks '96 Symposium is billed as the only event of its kind that is hosted by wreck divers for wreck divers.

The event consists of speakers and presentations from 8 am to 1pm with a party for all following the event at Ebenezer's Restaurant nearby. Speakers include Terry Tysall of the Orlando Dive Center, Brett Gilliam, President of TDI, Evelyn Dudas, the first woman to dive the Andrea Doria, and Dan Berg, an explorer, photographer and author.

Displays include wreck artifacts, wreck gear set-ups, and DPVs. Over $2,500 in door prizes will be given away. The cost for the event is $12 for members and $15 for non members. To register or for more information contact John Lyndon at 508-820-3408, jlydon@receptor.mgh.harvard.edu.

Tara Remley, daughter of DeepTech publisher Win Remley, recently earned her first open water certification from NAUI. You go girl!

aquaCorps Ceases Publication

In a press release dated March 28, 1996 aquaCorps magazine announced that they were terminating publication of their popular journal. Citing financial difficulties and lack of operating capital, Michael Menduno, aquaCorps President, stated that they were looking for additional investors or an outright purchaser to take over the magazine. During the second week of March this year, Menduno informed his staff of the decision and laid off the entire company. AquaCorps' lease on their Caroline Street address in Key West, Florida expires at the end of March and Menduno said he was planning to vacate the premises.

Pierce Hoover, editor of Sport Diver Magazine, said in a telephone interview that Sport Diver had recently been approached by Menduno with an offer to sell aquaCorps. Sport Diver declined the offer citing a history of poor financial performance of aquaCorps magazine as the reason.

A contributing reason to the financial difficulties at aquaCorps may have been, according to industry pundits, the poor turnout at this years tek96 conference. There were only an estimated 400 paid attendees at the show and several of the exhibitors present said they would not be back next year.

Walter Comper

The tek96 conference was sparsely attended this year with an estimated 400 paid attendees.

DeepTech Surveys Warm Mineral Springs

NorthPort, Florida is the location of one of the most unique underwater archaeological sites in the Eastern United States—Warm Mineral Springs. Skeletons of humans, saber toothed cats, giant ground sloths, and dozens of other animals have been discovered in the spring that date from as far back as 10,000 BC. Warm Mineral Springs is also one of the few sites in North America that has stalactite formations underwater.

DeepTech is constructing an extensive 3 dimensional survey of the system with diving and survey operations lead by Curt Bowen, Co-Publisher of DeepTech magazine. The sink has a typical hour glass shape with a small active cave located near the bottom at 210 feet. The surface pool is over 200 feet across and narrows to 110 at 70 ffw. The bottom of the sink measures 275 feet in diameter. The sinks walls are being surveyed by using the triangulation method and the cave system with the azimuth and distance method. The water flowing from the cave is geothermally heated to 95° F and cools to 84° F at the surface when it mixes with cooler vents. The water is high in mineral content and low in oxygen. This anaerobic, highly mineralized water preserves animal remains that have fallen in. Working closely with Dr. Robin Brigman, of the Westing-house Savannah River Company's Environmental Science Section, water and bacteria samples are being collected for analysis. Video and still photography is also being used to assist with survey operations.

Robin Gruters

The final survey map will illustrate the sink and cave in 2 and 3 dimensions with photo collages of important sites, and biological, hydrological, and geological information. This information will be submitted to several organizations including the NACD, NSS-CDS and several scientific and dive publications. Look for a comprehensive article in a future issue of DeepTech.

Oceanic Settles Phibian Lawsuit

Oceanic recently settled their lawsuit with Stuart Clough and Jack Kelly, formerly of Carmelian in the UK. Two years ago Clough and Kelly, the original designers of the Phibian rebreather, entered into an agreement with Oceanic for the manufacture and distribution of their advanced technology rebreather. Oceanic formally announced the Phibian and began marketing activities in US and foreign markets. In December of 1995, after considerable technical delays at bringing the Phibian to market, the deal fell apart with both parties threatening litigation. The terms of the recent settlement include Clough and Kelly's new company, Undersea Technologies LC, receiving all rights to manufacture an updated version of the Phibian on their own, with Oceanic precluded from manufacturing any closed circuit rebreather for a period of three years. Undersea Technologies is planning to release three rebreather models at an unspecified date. For more information on the new products contact Undersea Technologies at their Tulsa, Oklahoma office: 918-585-2511.

Weeki Wachee and Twin Dees Exploration

Karst Underwater Research gained access to the coveted Twin Dees and Weeki Wachee Springs in July of 1995 for the purpose of collecting water samples and providing detailed survey data for a geophyisical and hydrologic study of the Weeki Wachee area near Brooksville, Florida. The project is being sponsored by the Southwest Florida Water Management District.

Initial efforts have been concentrated at the Twin Dees spring. Weeki Wachee Spring exploration will follow in the summer when the flow is at its lowest. The flow typically ranges between 170-240 cfs.

Twin Dees is characterized by a spring vent with a two to three foot diameter limestone shaft extending vertically from 10 ffw to 35 ffw. This entrance shaft is typically difficult to enter due to the high flow rate through the narrow shaft. The shaft is followed by 1,200 feet of low horizontal tunnel averaging two feet in height. Beyond this, the cave opens into large subway-sized tunnels with a series of pit rooms.

In the late 1970s, Sheck Exley explored the Weeki Wachee system and followed the largest pit down to a huge dome room that he named the Pleasure Dome. Current Karst Underwater Research exploration activities are being conducted by Dave Miner and Jeff Petersen of the Sarasota/Bradenton area in Florida. Recent exploration of a newly discovered tunnel leading off from one of the pit rooms gave way to a series of large braided tunnels ending in another massive dome room. This room, nicknamed Middle Earth, has an average diameter of 200 feet, 190 feet at the ceiling and 270 feet at the floor, with a 1,000 foot circumference. Exploration activities continue along the floor in search of possible flow sources. KUR would like to thank the following for their support of the project. Contributors and additional sponsors for the exploration and survey efforts include: Dive Rite Manfacturing of Lake City, Florida and Depth Perception Dive Center, of Brandon, Florida. The staff and management of Weeki Wachee also serve as invaluable assets on the project.

ADEC '96

ADEC '96

The Asian Diver Exhibition and Conference (ADEC) is scheduled for May 17-19, 1996 at the World Trade Center in Singapore. The conference consists of dive product and dive service exhibits plus educational seminars and workshops. The conference is being hosted by Asian Diver Magazine and Miller Freeman, plus the following sponsors: PATA, BSAC, NAUI, PADI, SSI, Singapore Airlines, and The Beaufort Hotel. On Friday, May17th admission is limited to dive-trade companies only, with the Saturday and Sunday program open to the general public. For more information call ADEC at (65) 294-3366.

DeepTech 1996 Trade Show Schedule

Beginning in January DeepTech Magazine began attending many of the popular diving related trade shows in the U.S. Trade shows that DeepTech will attend this year include tek96 in New Orleans, DEMA, also in New Orleans, Beneath the Sea in the Meadowlands outside New York City, Our World Underwater in Chicago, the NSS-CDS conference in Branford, Florida, the NACD conference, also in Branford, Florida, and our own workshop: The Dog Days of August. If you are planning to attend any of these shows please stop by the DeepTech booth and introduce yourself to us. It's always nice to meet the people we write for and get feedback on our magazine.

Above: The girls of DeepTech at the tek96 conference in New Orleans (L to R, Tami Doutrich, Linda Ann Davis, Linda Bowen, Melissa Haggar) **Left**: DeepTech staff prepare for the days activities

Diving Medicine & Physiology Symposium

Dr. Jolie Bookspan, author and dive physiology expert, is directing a symposium on Medicine & Physiology of Scuba Diving on November 2, 1996 at the Korman Suites in Philadelphia, Pennsylvania. All presentations shall be conducted "In Plain English", as is customary for Dr. Bookspan's projects.

The tentative schedule includes a Friday evening reception, Saturday breakfast, the symposium, and an IMAX show at the nearby Franklin Institute science museum on Sunday.

The event is open to the public and accredited for AMA Category I CMEs for physicians, Category A-NBDHMT for DMTs and CHTs, and PDUs for NAUI instructors. Featured speakers include Owen O'Neill, M.D., Peter Bennett, Ph.D., John W. Phillis, Ph.D., Michael Casey, Thomas Millington, M.D., Richard Moon, M.D., Steve Thom, M.D., Ph.D. and Special Guest Mike Gernhardt, Ph.D. and NASA Astronaut.

The symposium benefits the Undersea Hyperbaric Medical Society (UHMS). Certification exams for Baromedical Nurses Assoc BNACB certification and Hyperbaric Technology (NBDHMT) will be offered Saturday following the symposium.

Participants can preregister for the exams by contacting Pauline Poletti at the National Board for Diving and Hyperbaric Medical Technicians at 504-366-8871. For more information regarding the symposium contact Dr. Bookspan at 215-557-0165, or jolieb@grip.cis.upenn.edu.

NACD 1996 Conference

The National Association for Cave Divers annual conference is scheduled for November 8-10 in Gainsville, Florida. The conference will feature workshops and presentations by cave divers from the U.S. and several other countries, plus exhibits from equipment manufacturers, associations, and service organizations. The event consists of a Friday night social, workshops and presentations on Saturday, and guided cave dives and educational seminars on Sunday. For more information contact Lloyd Bailey at 352-332-0738.

CHC's EDAM and ERD Course

The Catalina Hyperbaric Chamber (CHC) has scheduled their Emergency Diving Accident Management (EDAM) course on August 4-9, 1996, and their Emergency Response Diver (ERD) course for October 20-25, 1996. The EDAM course is an intensive program offered to all divers interested in accident prevention, recognition, assessment, and treatment of DCI and air embolism victims. The ERD program is a hands-on, workshop dealing boat and beach rescue techniques, effective CPR, and first aid. The cost of each course id $600 and includes housing and meals at the USC Wrigley Institute for Environmental Science. For more information contact Karl Huggins at 213-743-2412, or at huggins@mizar.usc.edu.

NSS-CDS Workshop

The National Speleological Society Cave Diving Section will be holding its annual workshop in Branford, Florida on May 25th to the 27th. Presentations from Jim Bowden on Belize, Wes Skiles on Nahoch, Lamar Hires on cave diving in Japan, Tom Morris on Thunderhole, and many others are scheduled. DeepTech Magazine is presenting a special award and check for excellence in cave exploration at the workshop. Workshops will be offered on cave cartography, gear maintenance, and equipment configuration. Many dive industry businesses will have exhibit booths for those who wish to get a peek at new products. DeepTech subscribers are invited to visit our booth and say hello. For more information on the workshop contact Lamar Hires at 904-755-5913.

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Walter Comper

NAUI gives the big desk to a non-diver.

What does it mean? – Progress, that's what!

The National Association of Underwater Instructors (NAUI) was one of the first training associations. When I took my first NAUI scuba course 24 years ago, at the age of 16, NAUI had already been certifying divers for 12 years. Back then courses were typically taught by gruff, ex-military divers with little patience for those who had difficulty with either the academic concepts or the in-water skills. Only about half of our class of ten students was certified in that course – unfortunately I was not one of them. However, I was given a deep appreciation for the hazards of diving and the skills required to dive safely. I, of course, did ultimately get certified and as a NAUI instructor today, diving is a significant part of my life. NAUI is a very different organization thanthe one that first taught me to dive. After all, this is the nineties and we are just five short years from the twenty-first century. NAUI has evolved into a progressive organization with high-tech training materials like interactive CD-ROM teaching aids and a Web site for planet wide information dissemination and promotion.

Most students taking a NAUI course today are certified but not because the courses have become easier. In fact, NAUI continues to place more emphasis on academic principals and

By WIN**REMLEY**

An exclusive DeepTech interview with Jim Bram, the new Executive Director of NAUI, and Jed Livingston, NAUI's Director of Training.

Photography by Walter Comper

Jim Bram

Position: Executive Director of NAUI

Age: 44

Education: MBA, University of Nebrasksa

Work Experience:

- Vice President—Marketing, Philip Crosby Associates
- Vice President, American Society for Quality Control
- Sales and Marketing, Hilton Hotels

Diving Experience: Non-Diver. Dived one supervised "Resort Dive" several years ago in Cozumel with his wife.

in-water skills than any other recreational association. This is due mostly to therigorous standards that NAUI sets for their instructors.

NAUI has not been without controversy though. There has been tension between those who would see the NAUI organization grow more quickly and those who hold steadfastly to their founding principals of excellence in dive training. When Sam Jackson, the former Executive Director of NAUI, recently left the organization to join DEMA. The NAUI Board of Directors selected Jim Bram to replace Jackson. Surprisingly, Jim Bram is not a diver. He does not have a certification card of any kind. What he does have, however, is a very strong business and marketing background in U.S. and international markets. Industry pundits say that this move signals a change in the NAUI direction towards more commercial success.

What direction NAUI is taking, and what plans NAUI has to address the technical diving community are questions we had in mind when DeepTech recently interviewed Jim Bram, Executive Director of NAUI, and Jed Livingston, NAUI's Director of Training.

DT: There have been rumors surrounding the circumstances of Sam Jackson stepping down as head of NAUI and moving over to DEMA. Rumors that maybe it was with the blessing of the NAUI board. What really happened there?

BRAM: I think Sam simply took an opportunity to work for DEMA. There are always rumors when the head of an organization moves on, particularly in the dive industry. It's something that doesn't really concern me because I wasn't around at the time.

DT: What do you bring to the NAUI corporate table that maybe has been lacking in past executive directors?

BRAM: I bring a strong corporate background to the table with a lot of marketing and business development experience. I think my background is the main reason the board selected me. I have worldwide marketing experience. I've done business development in Europe, Asia, the U.S., and Canada. I also have a non-profit association background so I understand boards and how they work. I understand the non-profit corporation. If you take a look at my background you'll see a synergism between me and what the board was looking for, which is more of a professional business approach.

DT: Is that indicative of a move on the part of the NAUI Board to achieve more commercial success?

BRAM: I think that NAUI's board is trying to accomplish a more professionally run business. NAUI has grown up with mostly a club mentality for years. They're too big to continue doing it that way. We can't accomplish our business goals running the organization like that so we are taking a very businesslike approach.

DT: You're not a certified diver. How can a non-diver run a dive training organization?

BRAM: NAUI is like any other business, we are a distribution business and we are a service organization. We provide products and services to our members worldwide. Although I'm not a diver, I still bring the business skills to the table that are required to run this type of organization.

DT: In your position as executive director you will be directing the future course of NAUI. Not being a diver yourself, it could be argued that you don't understand the needs of divers as well as a Director who is a diver. How would you respond to that?

BRAM: I can understand that point of view. I think the beauty about a non-profit association, is that you have a Board of Directors and a lot of other good people to rely on to make sure that you correctly influence the needs of the industry. That's one reason why I have Jed Livingston. I can understand those concerns but I don't see it hindering NAUI whatsoever.

Although I'm not a diver, I still bring the business skills to the table that are required to run this type of organization.

DT: You recently wrote an article in Sources Magazine (Feb 96) where you state a four step process to improving the quality of NAUI HQ activities That implies that there is a problem with quality at NAUI.

BRAM: How to improve quality is a problem that almost all organizations in corporate America have been going through for the last 15 years. They're trying to understand how they can get zero defects in any of the processes they have. This is true regardless if you're talking about service organizations or manufacturing organizations. When I wrote that article you mentioned, I was talking about focusing the staff, on zero defects, on looking at old systems and looking at new ways to look at old systems. I was talking about new thinking on how we actually do our business, and on how we move our products and services. It is a continuing process improvement.

DT: How do you see the need for quality improvements in the training activities of NAUI?

LIVINGSTON: Training is NAUI's core. It is the one thing we really have to sell. Our ability to deliver training can always improve and that's what we are focusing on now. We have a shortage of NAUI instructors right now which naturally restricts our ability to deliver training. We need to revisit our ability to train and continue to meet the demand for good NAUI instructors. This is not unexpected given the industry has been flat since the end of the 80's. That's why we need to go back and take a hard look at how we can adjust to the fact that the pool from which we can draw is smaller.

DT: The focus at NAUI seems to be shifting to a more international market, is that because NAUI has not been very effective at penetrating foreign markets?

BRAM: It has a lot to do with natural business expansion. Our focus is on international right now because our customers are demanding us to be there. Our international partners have grown substantially over the past year and will continue to grow this year.

DT: PADI was founded after NAUI, yet PADI has enjoyed tremendous commercial success. NAUI's success, relatively speaking, pales in comparison to the numbers from PADI. How do you account for this?

Training is NAUI's core. It is the one thing we really have to sell. Our ability to deliver training can always improve and that's what we are focusing on now.

BRAM: First of all, PADI does a marvelous job, they have attacked an industry with a very commercial philosophy and they do a very good job at it. NAUI, on the other hand, has spent a lot of years with the main focus on the quality and safety side of the industry. Our corporate philosophy has been different from PADI's. Our philosophy is to be the best at what we do.

LIVINGSTON: And we are the best at what we do. I think divers discover that for themselves. When divers start to talk to other divers it doesn't take long for them to go through the list and realize that one of them is better trained. One of them will say "Gee, I didn't learn that in my course. Where'd you take your course? Who taught you that?" I think also that NAUI embraces the strength of the individual and the uniqueness of education in a needs-based process.

DT: So what you are saying, correct me if I am wrong, is that you think that the overall skill and knowledge of a diver coming out of a NAUI course is better than that from PADI or any of the other recreational training associations.

LIVINGSTON: Yeah, I'd make that claim. You betcha!

DT: What did you mean by "education in a needs-based process?"

LIVINGSTON: What I mean is, that PADI's philosophy was to create a cookie cutter program. Everyone is taught the same thing at the same time and in the same way. In PADI's video-driven curriculum, the instructor becomes more of a facilitator. In a needs based education system, you have to analyze the students as individuals. Each student's learning style is unique. The best way to meet those individual needs is human interaction. NAUI's strength is in our ability to embrace the individual student's needs through a dynamic, flexible curriculum. That takes more personal attention, more time, and a more sophisticated instructor.

BRAM: For a NAUI student, the training experience is going to be better and the effort is going to be more rewarding, more self-satisfying.

DT: How do you reconcile that philosophy with NAUI's new CD-ROM based instruction?

LIVINGSTON: It is a very effective component in the educational structural process.

DT: It is a non-human interactive environment.

LIVINGSTON: True, but it is still interactive, allowing the student to proceed at their own pace and spending more time on topics of particular interest to the individual. Diving is both an academic subject and a physical sport. The academics are essential but people learn to dive in the water not in the classroom. Our CD-ROM interactive products blend well with our needs based philosophy. The academics represent only about a third of dive training. Where you really turn people into divers is underwater and that is where NAUI instructors have the reputation for being the best.

DT: Technical training organizations, like TDI, IANTD, PSA, ANDI, NACD, and the NSS-CDS all have enjoyed tremendous growth and success over the last two to five years. What plans does NAUI have to address this market?

BRAM: The technical associations have paved the way for a segment of the industry that was non-existent three years ago. They have taken the scolding that everybody gave them like "you'll never exist," and "this won't happen," and made it into a niche market within the dive industry They've done an excellent job with it.

LIVINGSTON: NAUI took a real hard look at nitrox when it first gained momemtum in the techdiving community. We saw it for what it was, a safer gas at recreational depths. It's not an evil, gas and it isn't going to undermine scuba diving. In 1991 or 1992 the Board adopted a policy that approved it as a breathing gas for a specialty dive course. At that time tech organizations took the lead and also took the brunt of trying to create a market where one didn't exist. They did a good job of that even in the face of staunch opposition from many folks. This year we also incorporated a mainstreaming of nitrox by embracing a minimum standard of training coming into line with what has been established as a standard training experience, namely one class and two nitrox dives as a certification package. Typically, when NAUI encounters things that are not within our core experience base, we identify people who are experts in that field to help us establish policies and standards. The first was the cave diving community. We recognized the NACD and the NSS-CDS as being the best sources for cave training because it wasn't really our bailiwick. We embraced their standards and included their standards as the baseline measurement in our own standards. Today, if someone wants to teach a NAUI cave course they have to be an instructor with the NACD or NSS-CDS. We use the same philosophy in techdiving.

DT: By adopting the standards of other technical associations, you seem to be placing NAUI in the role of follower rather than leader in dive training.

LIVINGSTON: I don't think so. We are an association of educators. To be opposed to education would be contrary to our nature and our philosophy. When we identify an aspect of dive training that is not within our frame of expertise, we look to the experts in that area, who as often as not are also NAUI members. for help. We have done this for the last 36 years.

DT: The evidence proves, I think, beyond anyone's doubts that nitrox is a physiologically superior gas for recreational diving. Do you foresee the day when nitrox will be the gas that is used and taught in beginner open water courses?

LIVINGSTON: Actually, our standards have been revised to accommodate that scenario now. As I said, the academic component that prepares someone to be a nitrox diver can be incorporated in beginning scuba diver courses, so that someone may, in fact, only be a nitrox diver and that's the only card they will ever earn. If they wanted to buy air they would be qualified to do that too, of course. Divers will continue to have the choice between air and nitrox.

DT: Actually, I meant more than giving beginning divers a choice. Do you see the day when an instructor will say "Welcome to your first scuba course, this is nitrox, the gas you breath underwater."

As dive techniques become mainstream, we bring them into the fold because it makes good sense. This does't mean though that we are going to be the ones that push the envelope on the extremes of training and experience.

LIVINGSTON: I think that is a question of the infrastructure. I anticipate always seeing a premium and regular option. When you go to a gas station you can always buy high test if you need it, but if you prefer to use regular and it meets your needs, it's there for those who want it.

DT: What about super high test–trimix?

LIVINGSTON: Trimix is currently in a place where nitrox was four or five years ago.

DT: Does that mean that four or five years from now NAUI will adopt a

trimix training standard and teach mixed-gas for deeper diving?

LIVINGSTON: Never say never. Frankly, I don't know if we will ever see trimix come inside our rectangle. As dive techniques become mains ream, we bring them into the fold because it makes good sense. This doesn't mean though that we are going to be the ones that push the envelope on the extremes of training and experience. However, we won't stand in the way or call it evil. Again it's education–pursuit of knowledge. Education is never a bad thing as long as it is done safely and with consideration for consequences.

DT: The training progression of most technical divers seems to be open water, then advanced, then a couple of specialties, and then they switch from the recreational training associations to the technical associations for further training. That implies that there are deficiencies in the more advanced certifications offered by the likes of NAUI and PADI, etc. Are you comfortable with your position as a recre-ational training association or do you wish to embrace the technical diving community from a training viewpoint as well?

LIVINGSTON: I think the really technical diving appeals to an even smaller market segment than what nitrox originally appealed to. I don't see the real technical market segment growing to the size the nitrox market did.

DT: Can you quantify what you mean by real technical.

LIVINGSTON: Right now it is the trimix 300-400 foot multi-stage decompression diving. That type of diving has a small market field because it takes a lot more work to be involved in it. NAUI's expertise is in the every-day diver and will be for sometime to come. Will that market segment ever be large enough to be looked at in more a mainstream context? That remains to be seen.

DT: What is the latest on the not-for-profit vs. for-profit issue?

Where you really turn people into divers is underwater and that is where NAUI instructors have the reputation for being the best.

BRAM: That's an issue that has been discussed around NAUI for years. Fundamentally, it's just a matter of how many dollars you want to pay in taxes. We are a not-for-profit corporation. We are going to stay a not-for-profit corporation, however, our focus is going to be on providing a year-end surplus.

DT: How do you see NAUI's growth over the next five to ten years?

BRAM: I think our U.S. growth in the next couple years will be flat to moderate. Our international growth, however, is going to be up substantially over the next three years. I am optimistic about the overall forecast for NAUI in general, probably in the 5% to 7% over the next couple of years. I think the dive industry market itself is flat and will probably continue to be that way for a couple of years.

DT: What do you believe is the cause of that?

BRAM: I think the cause of that is probably the industry itself. I don't really know. You have a certain amount of people that come into the industry every year, with a certain amount going out every year. The dive industry growth followed the baby boomers to some extent and as the baby boomers get older the dive industry seems to get flatter.

DT: The baby boomers have kids that have been labeled Generation X. Generation X is now of diving age. Why aren't they learning to dive like their parents?

LIVINGSTON: They don't have enough money.

DT: Jim, now that you have the big desk at NAUI, I suspect that you won't remain a non-diver for long.

BRAM: My wife and I are trying figure out which of the many offers to teach us we are going to accept. Everyone has been very generous in this respect. We are looking forward to it actually. We dived once a long time ago in one of those resort dives in Cozumel. We enjoyed it a lot. I definitely want to get certified—by a NAUI instructor of course.

DeepTech congratulates Jim Bram on his new post and wishes him and NAUI the best of luck in their continued quest of "safety through education."

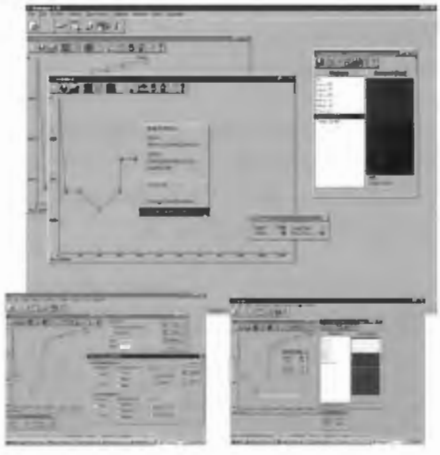
TechGearFor TheTech-Head

By WALTERCOMPER

January was definitely the trade show month for the dive industry with four shows occurring within 20 days of each other. In New Orleans DeepTech attended DEMA, tek96, and Underwater Intervention, and we were at BOOT in Düsseldorf/Germany. We saw a great many new and emergent products by manufacturers from all over the planet. Below is some of the Cool Stuff that caught our eye.

Voyager–The Software, Not the Starship

Though scheduled for release in March of 96, DeepTech was given a



sneak preview of Voyager, a new desktop decompression software program developed by Dale Harrod and Jim Sposato of Diverse Technologies. Voyager is a true Windows Multiple Document Interface (MDI) application that makes extensive use of Windows95 features like drag and drop, and an intuitive, graphical user interface similar in feel to Abyss.

Voyager supports all of the features commonly available in other decompression software packages such as altitude diving, repetitive diving, oxtox tracking, and gas mixing, etc. It also offers a table generator similar to that included in the new version of DECOM. Voyager's table generator will provide a range of tables with varying bottom times and varying bottom depths, giving the diver a matrix of tables ready to dive with. Also, a graphical representation of the water column allows the user to create very complex dives with a minimum of effort, and then modify them just as easily.

A Macintosh version is also under development, although no release date has been set. Voyager should be shipping for Windows95 and Windows 3.x platforms by the time you read this. Costs for Voyager vary depending on diver experience and skill level. The least expensive is the recreational version ($79.95), and the most expensive is the breathe-anything-you-want, dive-as-deep-as-you-want techdiver version ($349.95). For more information contact: Diverse Technologies at 954-984-0432 or at: http://www.DiveVoyager.com.

Lambert's Frog may soon leap!

Environmental Support Systems will soon release a closed-circuit, computerized rebreather based on the technology Barnum Lambert developed for firefighter rebreathers.

It features a scrubber unit housed inside the chest mounted counterlung for better performance in cold water. Interestingly, the counterlung/scrubber unit is disposable. After the scrubber has been expended, the counterlung/scrubber assembly is simply discarded and replaced with a new one. The unit is compact and ideal for the traveling diver. The unit's weight is 24 to 28 lbs., depending on the size of the tanks used. For a four hour duration dive two tanks of 13 cu. ft. each are attached to the BC. A computer constantly monitors the percentage of oxygen plus the performance of the scrubber and the oxygen sensor. There are audible warnings for low gas, scrubber life, changes in the PO_2, and scrubber failure. According to Barnum Lambert the unit will be available by the fall 1996 for about $8,500. For more information contact Environmental Support Systems, Barnum Lambert,. (408) 227-0743.

DNAx™— Nitrox Without Oxygen

Undersea Breathing Systems' (UBS) new nitrox gas blender avoids the hazards of pure oxygen handling by using a new air separation technology based on the different permeability rates of nitrogen and oxygen through hollow fiber membranes. The final product isn't a blend of oxygen and air, but rather denitrogenated air (DNAx™). The absence of pure oxygen in any stage of production vastly reduces liability. "We are in the business of NOT blowing up peoples shops," says Bill Delp of UBS. The new system can also be effectively used to blend virtually any combination of trimix by first partially filling the cylinder with helium, and then topping off with the correct blend of DNAx. Prices vary from $8,900 for

the 8cfm unit, to $17,900 for th 17cfm unit. For more information contact Undersea Breathing Systems at 407-588-7698.

ScubaPro Becomes Common European Norm (CEN) Compatible

ScubaPro is catching up with the engineering demands of the soon to come European nitrox market. One of the new, so called CEN caveats is that all gas-mixtures containing more than 23.5% must be used in cylinders that have dedicated valve connectors and are to be used only with oxygen cleaned equipment. The wisdom behind this rule is highly questionable but it seems to be inevitable. At DEMA and tek96 ScubaPro introduced their new dedicated EAN connection, a DIN-like valve and first stage assembly that prohibits the use of conventional regulators with EANx cylinders and vice versa. To achieve this, the male and female parts of the valve and first stage are switched. Despite the lack of similar regulations in the US, ScubaPro will be selling the CEN compatible nitrox equipment along with their other line of nitrox compatible equipment in this country as well. For more information, contact ScubaPro at 800-GO-SCUBA.

Lund's Do It Yourself Rebreather Kit

Tracy Robinette, designer of the Shadow Pack, a fully closed, mixed gas rebreather, is currently not only manufacturing full-face masks but also initiating the " Lund-Club" together with J.R. Hott that will offer members an oxygen rebreather in kit form. Club members pay an annual membership fee of $50 and receive mentoring in rebreather technology and use from more experienced members. After members have received the appropriate training and instruction they become entitled to purchase the rebreather kit for approximately $1,500. Selling the rebreathers as a kit keeps the club's liability low since the Lund-Club is not considered the manufacturer of the complete unit. In legal terms, the end user, who assembles the rebreather himself, is the manufacturer. For more information contact Tracy Robinette at Divematics at: 714-773-5909, or at http://divenet.com

Bulk-Up your Camera

SeaMag, Inc. may improve your bottom time with a new ProMag film back. If you're an underwater photographer who is tired of having to resurface after shooting 36 images, ProMag may be the solution to your problems. The ProMag film back is a bulk film back with a maximum pressure rating of 160 feet (the housing itself is pressure tested to 320 feet). The ProMag has a capacity of 260 frames of 35mm film. It uses a dedicated adapter ring to attach to Nikonos V and Sea & Sea Motor Marine cameras among others. Preloaded film cassettes are available as well as film processing from SeaMag at approximately 32¢ per frame, including developing. A nice feature is that the film can be removed partially from the camera in the event the whole roll is not used. The ProMag was initially developed for the military and is constructed from hard anodized aluminum. It comes with an electronic leak detector, an end-of-film-alert, a frame counter, and a low battery warning. The ProMag cost is $1,295. For more information contact SeaMag at 714-858-5466.

The ProMag Film Back

The Range Rover of DPVs

The new Farallon Mk-8 Diver Propulsion Vehicle DPV has a rugged 6061-T6 aluminum hull, a run time of 60-115 minutes, and a range of approx. 3.5 miles. It's one of the few DPVs designed for the demands of extreme techdiving. The Mk-8 DPV has a maximum speed of 3.3 mph and a maximum operating depth of 400 fsw which should cover almost everyone. A digital speed control provides precise speed tuning, while the digital battery status display provides the safe feeling of always knowing how much power is left. A dedicated "intelligent" charger, available as an option, extends the life of the battery by monitoring the battery's temperature during charging, and provides a 7 hour quick charge without damage. This charger can also be used to recharge batteries from other DPVs as well enhancing it's utility. Other optional accessories include a dolly for easy transportation of the 120 lb. scooter, and a platform for mounting gauges or a video camera. With optional silver zinc batteries instead of the standard sealed, lead acid, the range is extended from 3.5 miles to approximately 10.5 miles. However, this feature may also extend you financially by adding about $12,000 to the cost and reducing the number of recharge cycles. Except for rare applications in commercial, military and extreme cave diving applications the practicality of silver-zinc batteries is questionable. The base price of the MK-8 is $3,995. For more information contact Farallon at 800-743-3483.

Can't Reach Your Knobs?

OMS has a new gizmo called the Remote Valve Shutoff (RVS) solving a problem that may occur when a hard to reach valve needs to be closed in order to prevent a free-flowing regulator from dumping all your breathing gas. It's designed for divers who can't reach their valve knobs while diving, such as cold water divers (dry suit and insulation too bulky), or cave divers in tight restrictions. A free-flowing high performance regulator can dump a scary amount of gas in a short period of time. If using doubles, the Remote Valve Shutdown can either be used to close the isolator valve or to shut down a specific cylinder valve. The RVS attaches to the valve via a cable and runs under your arm so it can be

clipped to your chest for streamlining. It's an interesting safety feature. For more information call OMS at 800-667-9149.

Barsky on "Our Secret Dream"

Are you wondering how to make money with diving instead of always spending it? Steve Barsky may have the answer for you. His book, *Careers in diving,* authored by Steven M. Barsky, Kristine C. Barsky, and Ronnie Lynn Damico, gives you ideas that range from the mainstream to some that are off the beaten track. Originally published in 1993, this book seemingly never received the attention it deserved. Until recently, it wasn't even listed in the Best Publishing's Catalog, so it will probably be news to most everyone.

Working in the dive industry is a dream for many, a nightmare some, and a pretty average job for those who manage to find a niche for themselves in this small but growing industry. If you're considering a profession in the dive industry, this book is a must. It's hard to think of a job in the dive industry that's not mentioned by Barsky. The recreational careers from instructor to wholesale/retail sales and manufacturing are well covered. Also covered are some unusual jobs like abalone divers, sea urchin divers, aquarium divers, and tropical fish collecting for public aquariums.

Careers in Diving is more of a reference book than anything else. Barsky takes advantage of his extensive knowledge of the industry and features some interesting biographies as well.

The one shortcoming in *Careers in Diving* is that Barsky often stays close to the surface (pun intended)—meaning that he doesn't offer tips for further reading for those who want to go deeper into a subject. *Careers in Diving* is $18.95. For more information or to order contact Best Publishing at 602-527-1055.

continued from pg.15

Crystal Beach Spring Exploration

Brett Hemphill, Rudy Sturm, Sherry Garman and Michael Garman have been working with scientists from the Florida Museum of Natural History to unlock the secrets of the unique ecosystem hiding within the Crystal Beach Spring cave system near Brooksville, FL. The Spring, which may be the only fresh water spring discharging to a salt water body with cave passage accessible to a diver in Florida, guards its secrets closely. There are three major restrictions in the first two hundred feet of passage and the entrance is usually obscured by a halocline. The discharge from the Spring is tidally dependent. The flow can rip your mask off at low tide or turn into a siphon creating low visibility during extremely high tides.

At the present time, six unusual organisms have been discovered in the cave system: a troglodytic crayfish; a fresh water bryozoan; a false mussel; a true mussel; a hydrobiid snail; and an orange "jellyball" with cellular structure that has not been identified. The crayfish have been observed feeding on the "jellyballs" and the "jellyballs" have been observed stuck in the branches of the bryozoa. Experts are still in the process of determining the species of the organisms; however, one of the mussels has been tentatively identified as a new specie.

Sediment core samples collected from the floor of the cave at three locations to date have shown a consistent three layer stratification: a top layer of reddish sandy silt; a middle layer of blue clay; and a bottom layer of green, anaerobic clay. Tests to determine the clay minerals present are in progress.

The floor of the cave in several locations is covered with partially fossilized vertebrate bones. Bones from two locations in the cave were collected and sent to the Florida Museum of Natural History for identification and dating. Both sets of bones were from 40 to 50 pound jewfish. Dating tests have not been completed at this time but it is possible that the bones are over 10,000 years old.

It is possible that the organisms exist in a chemotrophic ecosystem based on hydrogen sulfide. Initial water quality samples have been collected and more will be known when the analyses are complete. Future work, including types of samples, collection locations, and preservation techniques, is presently being coordinated with Richard Franz and Dan Cordier of the Florida Museum of Natural History. Arnold Jackson of American Underwater Lighting has agreed to produce a video documenting the cave's ecosystem. The dive team is continuing to explore and survey new passage in this extensive system. Look for more updates in DeepTech in the near future.

Submit diving news, information, press releases, and exploration updates to DeepTech at deeptek@aol.com, or fax to 941-955-7446, or mail to P.O. Box 4221, Sarasota, Florida, USA 34230-4221.

Documenting wrecks and caves in an effort to give others an appreciation for their often solemn beauty is an activity that has been common among divers from the very beginning. Wes Skiles and Terry Begnoche, for example, have developed an almost mystical ability to capture the personality of caves and wrecks in still photography. Underwater photographers, videographers and cartographers, over the years, have produced photos, drawings and videos that give the viewer detailed images of what sunken vessels, reefs and cave systems look like. No one, however, has acquired the unique blend of art and science found in Eric Hutcheson. Eric's style of artistic creativity combined with the hundreds of hours he spends collecting detailed survey and measurement data, have produced some of the most astounding, technically accurate renderings ever produced of wrecks and cave systems. Eric's drawings of underground aquifer systems are routinely used by archeologists and geologists in the study of their respective sciences.

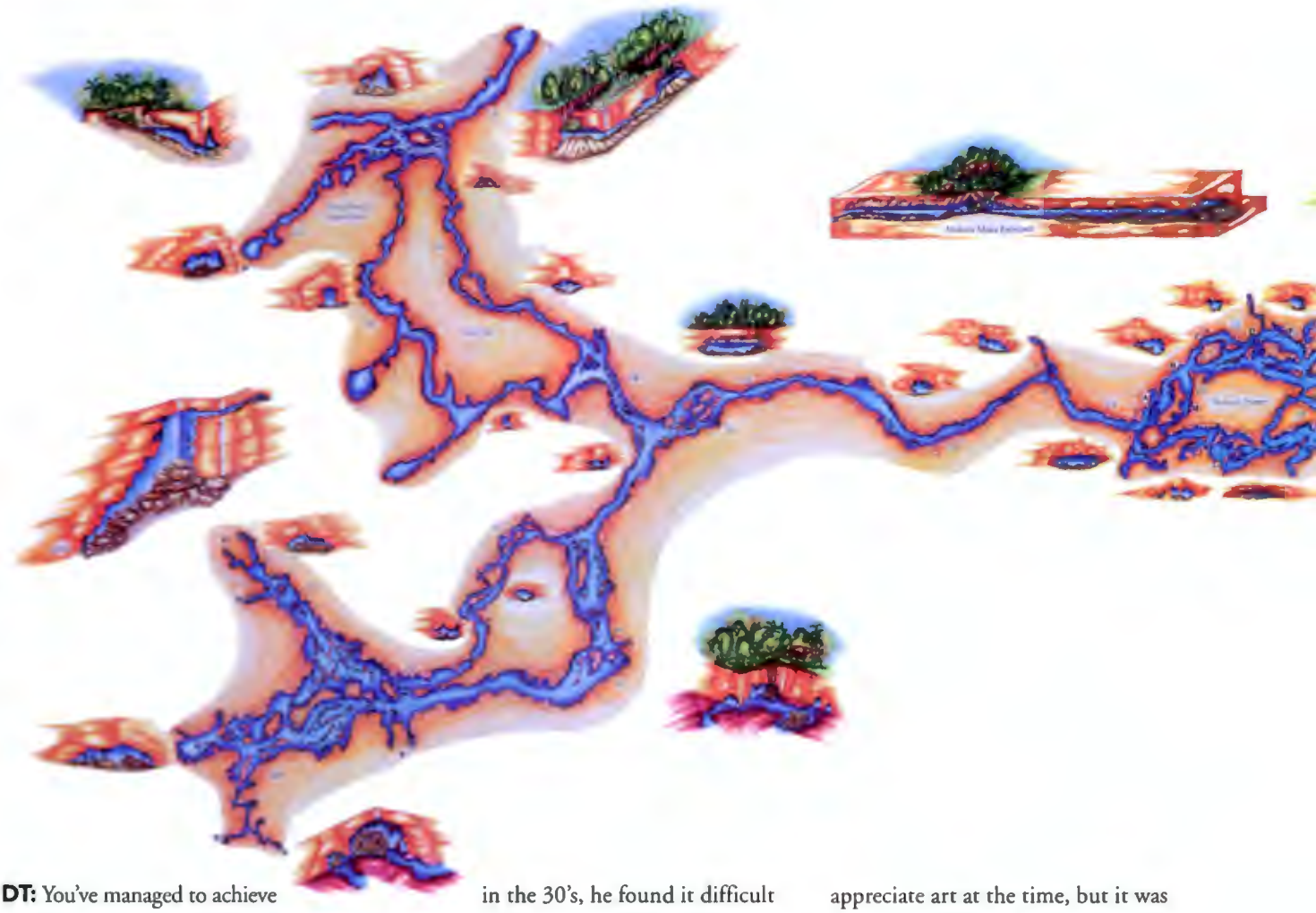
The Cartography of Eric Hutcheson

By WINREMLEY

Eric is 34 years old and lives in beautiful Ocala, Florida with his charming wife Sharon and seven year old daughter Erika. With his long blonde hair and colorful personality, he looks and acts every bit the part of an artist. For those who are unfamiliar with Ocala, it's horse country. Virtually all of the country roads are lined with sprawling, grass-covered horse ranches and natural forest areas. To the West and North of Ocala is the cave diving holy land of North-Central Florida. This is the area where Eric's art first began to flourish.

Eric's art studio is an unusual combination of drafting tables, large drawings laying everywhere, and dive gear (lots of dive gear), arranged around the walls of the studio. There's a stereo and a large pair of speakers in his studio as well, which Eric listens to while he produces his artwork. Next to the stereo is a stack of LP albums (remember those large black vinyl discs) with titles from Edgar Winter, Pink Floyd, Ted Nugent, Led Zeppelin, Johnny Winter, the Allman Bros. and Dixie Dregs. It was here in his studio that I first met Eric. He has an energetic, colorful personality and he quickly endears himself with the people that he meets. Eric graciously agreed to do the following interview with DeepTech and supplied us with copies of his artwork.

Wes Skiles



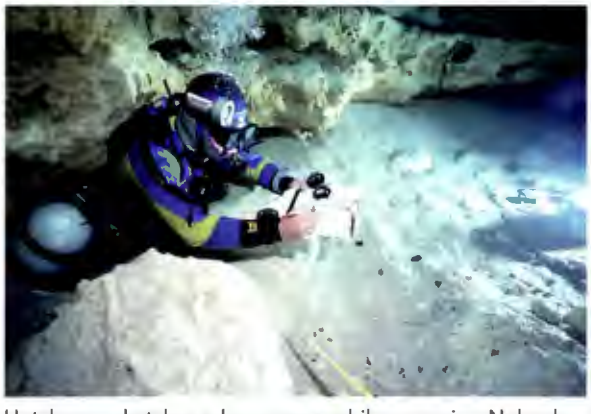
DT: You've managed to achieve a rather unique blend of creative art and cartography Eric, how did that come to be?

HUTCHESON: That's an interesting question. It's one that many people ask me. The best answer is that I just fell into it. There were three or four chance experiences from my past that set me up for this career. I'm grateful for the opportunity to make artistic, historical documentation of the explorations that I've had the pleasure to be involved with.

DT: Do you have formal art training?

HUTCHESON: No, I don't. I was fortunate that my grandfather was a skilled and talented artist. He decided that of all his grandchildren, I should be the one to carry on with this talent. He loved art, but as an artist in Miami in the 30's, he found it difficult to earn a living selling his paintings and drawings, so he took a job doing architectural engineering. Many of the art-deco buildings and bridges built during that time were based on his concepts. A lot of those structures have since been torn down, so his drawings are now historical documents.

He was the one who first inspired me to start drawing. He would sit me down, and hand me the tools, and show me how to do it. I didn't really appreciate art at the time, but it was kind of fun. It's not really what a ten year old kid in Miami wants to spend his time on. I mean I was living in a tropical paradise. I wanted to go surfing, go fishing, and play with the girls.



Wes Skiles

Hutcheson sketches a large room while surveying Nohoch.

DT: Did you get into diving while you were still in Miami?

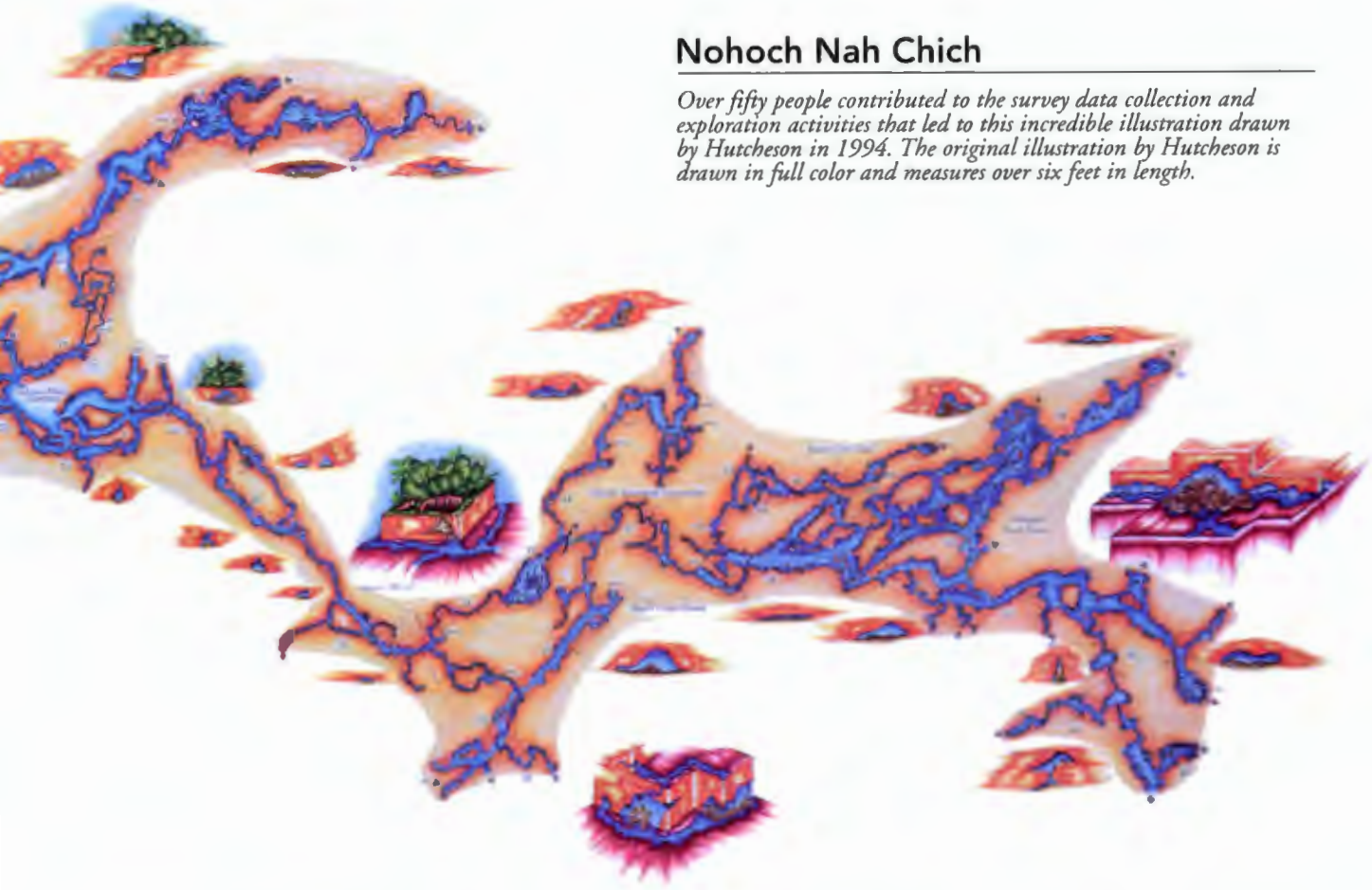
HUTCHESON: Well, I dabbled in it. Diving wasn't really big back then. There were a few TV shows being made around Miami that had to do with diving. I remember seeing the sets for Flipper and The Creature From the Black Lagoon, they were pretty neat. Some of my friends and I got started in diving by coming across a scuba tank and trying it out.

DT: How did you come across a tank at the age of 10 in Miami?

HUTCHESON: You're going to drag it out of me aren't you? Well, to build the roads, expressways, and bridges in Miami, they dug these huge rock pits

Nohoch Nah Chich

Over fifty people contributed to the survey data collection and exploration activities that led to this incredible illustration drawn by Hutcheson in 1994. The original illustration by Hutcheson is drawn in full color and measures over six feet in length.



mining raw materials. They dug them so that they could eventually be used as lakes and canals later on when housing communities were built. After the houses were built and the rock pits were turned into canals and lakes, the homeowners all bought boats to keep in the water. One of the things that we like to do late at night was to sneak onto these boats and swipe the fire extinguishers so we could have fire extinguisher fights and spray that white foam stuff all over each other. Usually the guy who found the largest fire extinguisher won the fight. One night I found the largest fire extinguisher I'd ever seen, except that it had a strange hose and funny nozzle on the end of it and it would only spray air—no foam. One guy said "hey, that's a scuba tank like on Sea Hunt."

DT: So you swiped a scuba tank thinking it was a fire extinguisher.

HUTCHESON: Yea. The next day we played with it a little. You could obviously see where to put it in your mouth so we tried it and jumped in the lake—no mask, no fins, no nothing, just a pair of shorts and a scuba tank under your arm. It was my first experience with "no-mounting". We thought it was unbelievably cool. We played with that scuba tank for a day or so, and when it was out of air, we threw it into the woods and that was that.

DT: When did you really get into diving, aside from jumping into rock pits with "fire extinguishers?"

HUTCHESON: I was always into water sports, snorkeling and breath hold diving. We used to help salvage companies pull ditched cars from the bottom of the rock pits doing breath hold dives with hundred pound chains. We wrapped the chains around the axle of the car, and these big cranes would pull the car from the bottom. They would sell them for scrap metal. I made a little money showing these guys where the cars were and wrapping the chains around the axles for them. Then my sister put an end to it.

Tom Morris

Clay layer in Silver Spring near Ocala, FL

DT: How did she do that?

HUTCHESON: I was standing on the bank of this rock pit with the guy that owns the crane. I had a 100 lb. chain and I was getting ready to jump off the side to hook up a car when my sister showed up and cussed this guy up and down. She basically called him a dirt bag for hiring a kid to jump into the water with 100 lb. of chain around his shoulder. He probably wasn't the greatest type of guy anyway. She scared him, and that was the end of my paying gig for pulling out these cars. He wouldn't hire me

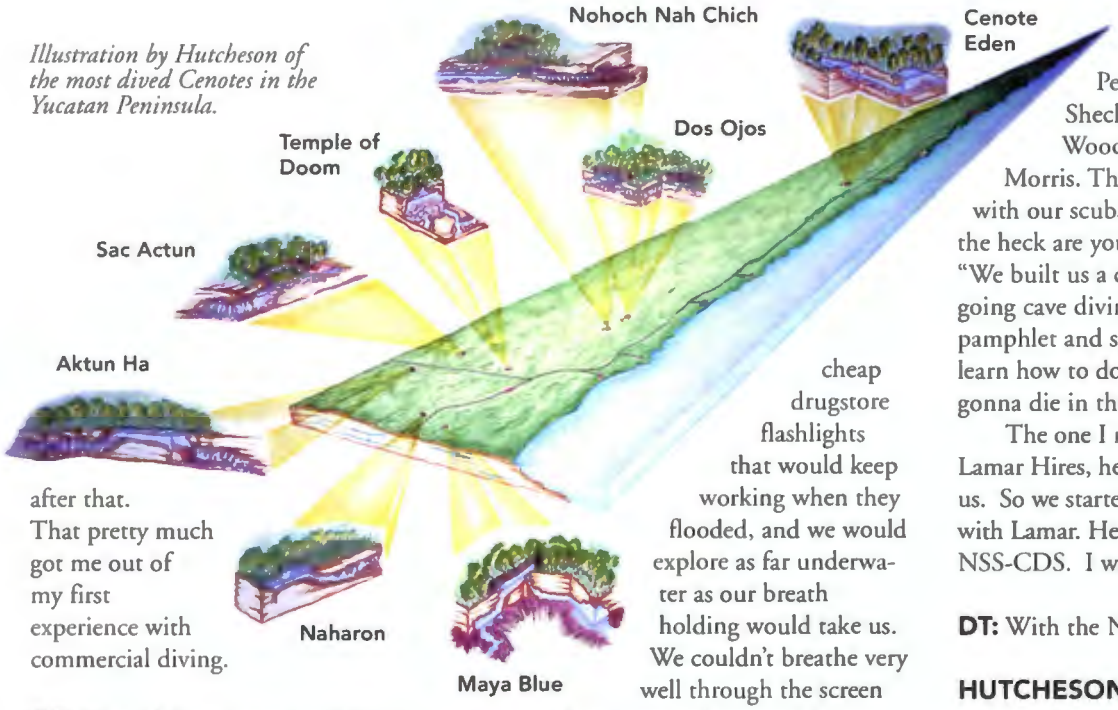


Illustration by Hutcheson of the most dived Cenotes in the Yucatan Peninsula.

after that. That pretty much got me out of my first experience with commercial diving.

DT: When did you move to Ocala?

HUTCHESON: I moved to Ocala in 1976 when my family relocated here. I was about 14 years old at the time. I was devastated. Here I was a surfer from Miami stuck in the sticks with nothing to do. No beaches, no girls, and rednecks everywhere.

DT: Did you start diving then?

HUTCHESON: Eventually. I met Ken Peakman who was about my same age. We began exploring the dry caves around the area with wax candles and kite string to find our way out. Ken would blow out the candles, laugh and say, "Now find your way out!" I hit my head on the wall 400 times.

DT: These were all dry caves?

HUTCHESON: Yes, the ones we explored were. They were dry until you descended down through the fractures and eventually hit the water table. You could travel at the water table where the passages would be half dry and half wet. It was almost as much fun as fire extinguisher fights.

Occasionally we would get to where the water table cage stopped and it would completely submerge. We brought snorkels with us with screens rubber-banded to the opening to keep rocks and dirt from falling into the snorkel and choking us. We also used cheap drugstore flashlights that would keep working when they flooded, and we would explore as far underwater as our breath holding would take us. We couldn't breathe very well through the screen covered snorkels and we would hyperventilate and almost pass out. We were lucky we didn't kill ourselves.

My mother was worried about us so anytime she would see a newspaper article about cave diving or cave exploring, she would cut it out and show me that there were people doing this on a legitimate basis. She suggested we call them and get involved. It was mostly the Florida Speleology Society. We overheard a group of excited explorers talking one time about surveying a cave system and finding old candles and string left there by early explorers a long time ago. Kenny and I didn't have the heart to tell them it was us. At that time we didn't want to map the caves—we just wanted to take girls down in there.

Eventually I did get an open water scuba certification though. It was about 1983. Mostly so we could have fun exploring the wet caves farther than we could by breath holding.

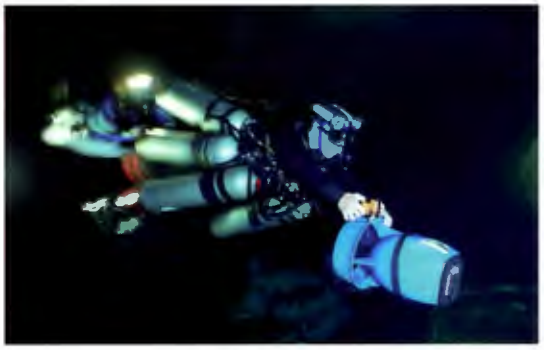
DT: So after you took your first open water scuba course, you started diving the sumps and the caves immediately?

HUTCHESON: Yes, we did. We went to places like Devils Den when it was still a cow field and Peacock Springs also. There were people there diving on a professional level. People like Wes Skiles, Sheck Exley, Lamar Hires, Woody Jasper, and Tom Morris. They would run into us with our scuba gear and say "What the heck are you kids doing?" We said, "We built us a cave diving rig and we're going cave diving." They handed us a pamphlet and said, "You really need to learn how to do this right or your gonna die in there kid."

The one I remember the most is Lamar Hires, he really grabbed a hold of us. So we started taking these courses with Lamar. He introduced us to the NSS-CDS. I was really impressed.

DT: With the NSS-CDS?

HUTCHESON: Yes. I was really impressed with their professionalism and with the NACD also. These guys were going out and diving and exploring with detailed plans of exactly what they were doing and why, and bringing back useful information.



Wes Skiles

Eric Hutcheson with Mike Madden "drafting" behind to minimalize drag while pushing Nohoch.

DT: When did you first start drawing pictures of the systems you were diving in?

HUTCHESON: It was shortly after I started working with Lamar Hires. I saw the maps that he, Sheck Exley, and Wes Skiles were producing. Then it hit me, like "Hey, I love these caves. I bet I could draw one of these maps."

DT: Which was your first map that you drew?

HUTCHESON: The first one that I published was Silver Glen Springs. A whole group of explorers and I worked

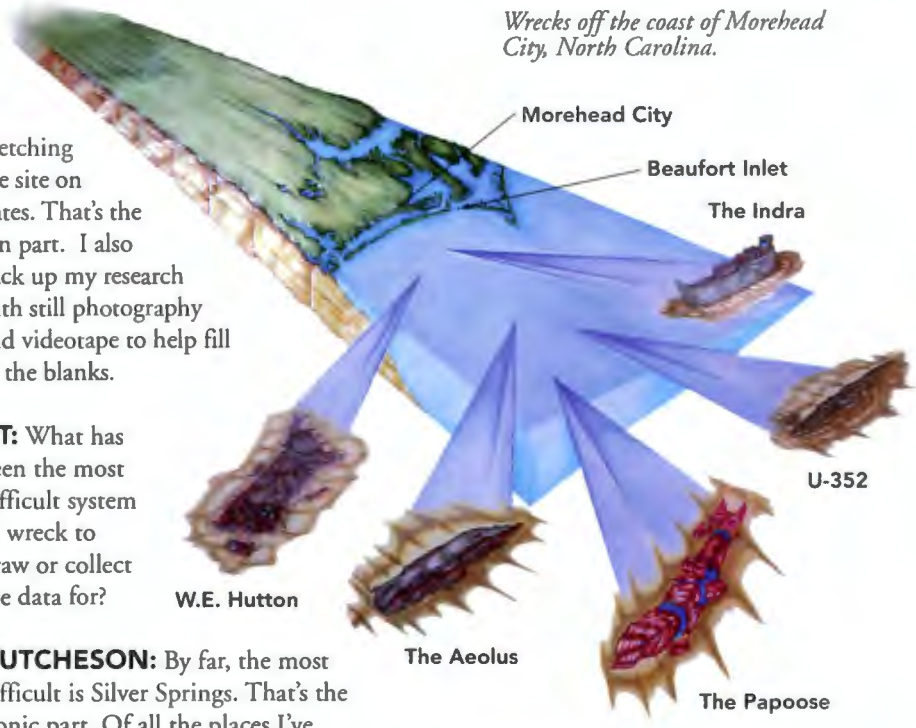
for 8 or 9 months between 1989 and 1990 exploring that system. It was mostly side-mount, hard-core diving. I produced a map and published it. It was pretty well received. I used many of the techniques my Grandfather taught me and created kind of an "artsy" drawing of the system. I wanted to produce a map that someone who doesn't know what a cave looks like could look at and say "This is cool, yeah this is where it goes up, and this is where it goes down, and this is where the water flows!"

DT: You wanted to give people a sense of what it was like to experience the cave?

HUTCHESON: Exactly, I really wanted to show everyone what gets my motor running while diving the caves, and I wanted to do it the way my Grandfather drew the old buildings and bridges in South Miami, with artistic style and lots of accurate technical detail.

DT: You've also documented wrecks with your art. When did you start that?

HUTCHESON: That came a couple years after I started drawing caves. I've always loved the ocean. Diving wrecks and documenting them with art was a natural. Caves, wrecks, reefs, it's all the same to me. The problem is finding the time for wrecks. Every time, it seems, that I make plans to do a wreck, a cave project comes up and I'm off and running for months at a time.



Wrecks off the coast of Morehead City, North Carolina.

sketching the site on slates. That's the fun part. I also back up my research with still photography and videotape to help fill in the blanks.

DT: What has been the most difficult system or wreck to draw or collect the data for?

HUTCHESON: By far, the most difficult is Silver Springs. That's the ironic part. Of all the places I've surveyed and drawn, the hardest was one of the first that I attempted.

DT: What makes Silver Springs so difficult?

HUTCHESON: It's the restrictions and complexity. Silver Springs is a diversion maze created by a single, large underground spring that somehow became obstructed. The water needed a place to go so it flowed up through another layer of geology in dozens or maybe even hundreds of smaller tunnels that seem to intertwine and branch off everywhere. We are still looking for a connection to the main line. It's a bizarre, twisty, tight system, with tunnels running everywhere. The problem is that most of it is no-mount diving. You have to push your tank through ahead of you and wiggle your way through small, drainage-pipe sized tunnels. Plus much of it is unstable and crumbly. Rocks and stuff are always falling on your head in there. And I'm talking rocks, not little pebbles.

Bill Foote

Eric Hutcheson squeezing through the Silver Springs system using his "no-mount" technique.

DT: How do you actually go about collecting the data for your drawings?

HUTCHESON: It's a combination of survey techniques, measurements, and

DT: There is a lot of hype in the media about rebreathers, is this a tool that you anticipate using at some point to continue your work?

HUTCHESON: Oh, sure. I look forward to the day when I have regular access to some really good equipment like that. How could it get any better? The number one restraint is time and air. Rebreathers are the answer to that. Plus, if I could find a way to use one in Silver Spring, then there would be no bubbles to knock the rocks loose that fall on my head.

DT: What projects do you have in the works?

HUTCHESON: I've got several neat projects in the works, I don't like to talk about them until I'm at the drawing stage though. I just want to do what my grandfather did. He inspired me and left me a lot of material to work with. Someday, I'd like to go back to Miami, and spend a year at the various dive sites there and create a show at a museum displaying my work. It's sort of a way for me to honor the gift that my Grandfather gave me.

Mike Wisenbaker

The Caves That DREAMS Are Made Of

Story and Photography
By MIKE**WISENBAKER**

The Woodville Karst Plain is a huge network of some of the most awesome caves into which divers have ever ventured. How they were formed and how they are interconnected is a mystery that only God and the divers exploring the system can truly appreciate.

Millions of years ago limestone formed when ancient seas covering the coastal plain, retreated, stranding marine animals and plants. Over time, the debris from the ocean floors fused into bedrock. Rain picked up carbon dioxide as it fell through the earth's atmosphere, creating carbonic acid. Once on the ground, the water became even more acidic as it soaked through a thin cover of soils, roots and decaying vegetation. These acidic waters slowly began dissolving the limestone underlying the region, forming caves and sinkholes. The term "karst" refers to the limestone surfaces that have been shaped by thousands of years of chemical and hydrologic erosion. A good example of this erosion occurs at Silver Springs near Ocala, Florida. This fountain delivers 530 million gallons of water a day carrying a load of 540 tons of dissolved rock!

Acidic waters continue to etch new cavities into the 20-36 million years old rocks that shoulder what geologists have labeled the Woodville Karst Plain. This karst plain covers more than 450 square miles in Leon, Jefferson and Wakulla counties in Florida's Big Bend south of Tallahassee. The plain runs from west of Highway 319 to just east of the Wacissa River, and south a few miles into the Gulf of Mexico. The northern border of the karst plain is a break called the Cody Scarp that slices across the landscape near the Tallahassee fairgrounds. It separates the Red Hills to the north from the Woodville Karst Plain. The scarp developed when Gulf waves lapped ashore about 100,000 years ago during a warm phase of the last Ice Age.

Caves, lost rivers, springs, sinkholes and windows represent the most noticeable examples of karst features. Karst windows (called spring-siphons by divers) form when the roof of an underground stream collapses. This leaves a gap where water from a cave spring reaches the earth's surface. The water flows for a short way through an open channel before vanishing into a swirling gyre known as a siphon. All of these geologic marvels form due to the voids in the rocks below them.

As for the hundreds of sinkholes found here, many remain dry depressions, others hold dark surface water and those opening into aquifers contain pure groundwater. The depressions that dip into groundwater, though, often catch surface runoff or may be topped by warm algae blooms. Temperatures, as well as color, give clues that reveal if water in sinks is groundwater or surface water. Groundwater sinks in this area read 69 degrees throughout the year and are generally clear in times of drought, whereas surface water temperatures vary with the changing of seasons.

Underwater cavities in the karst plain range in size from a gallery named the Black Abyss—large enough to hold a small skyscraper—to minuscule fissures. While most caves here lack stalactites found in the cenotes of Mexico or the blue holes in the Bahamas, many possess striking bands and formations of minerals like chert and goethite. The lack of dripstone suggests the grottos have been filled with water for most of their existence.

The Woodville Karst Plain holds more than a quarter of Florida's 27 first magnitude "springs." These include: Spring Creek Springs, St. Marks Spring, Wakulla Springs, Wacissa Springs Group, Kini Spring, River Sink Spring and Natural Bridge Spring. Four of these seven karst features, however, are not true artesian springs. St. Marks Spring represents a river rise, while Kini Spring (a.k.a. Upper River Sink), River Sinks Spring (a.k.a. Lower River Sink) and Natural Bridge Spring are karst windows. Despite what we call them, they comprise an impressive list of hydrologic marvels. More than 64.6 million gallons of water issue through each of these "springs" every day.

In the 1830s, French naturalist Comte de Castelnau believed that water from Tallahassee's Lake Jackson, which occasionally vanished mysteriously, rose at Wakulla. Similarly, E.H. Sellards, the first person to head the Florida Geological Survey, predicted more than 80 years ago that water whirling underground at river sinks fed Wakulla. For the past 25 years or so, dedicated cave diving explorers seem to be proving Sellards' theory. They've charted more than 11 miles of cave passages in the Leon Sinks Cave System (LSCS) in North-central Florida, which currently is the longest surveyed underwater cave in the U.S.. The water in this cave system passes through 26 karst widows. It probably furnishes about half the 252 million gallons of water that daily gush from Wakulla Springs, the crown jewel of the karst plain.

A WKPP diver uses side mounted tanks allowing him to crawl through the jaws of this siphon at a remote sink southeast of Tallahassee.

The sink and spring openings in the karst plain host a wide array of flora and fauna that favor their cool waters and rocky walls. Above exposed cliff faces trees such as southern magnolia, laurel, live oak, gum, dogwood, redbud and hickory hug the slopes. Wax myrtle, sparkle berry, beauty berry, wild grape, Virginia creeper and the infamous poison ivy fill the understory. These plants often create oases in drier areas of the plain such as the sandhills portion of the Leon Sinks Geological Area in the Apalachicola National Forest. Lush growths of mosses, liverworts and ferns, including the endangered Venus-hair fern, cling to the stony bluffs of sinks, grottos and nearby outcrops. In sink basins and twilight zones of aquatic caves, divers may spot bass, bream and pickerels. Farther into the caves, several species of globally imperiled crayfish and other rare troglobites abound. The typically blind, albino organisms spend their entire life cycles underground. They have unique adaptations enabling them to survive in total darkness. Divers' bright lights often reveal fleeting glimpses of the tiny trolls that call the stygian reaches home. At other times, errant eels and bullheads—not used to masked monsters blundering through their territory—may crash into unsuspecting divers.

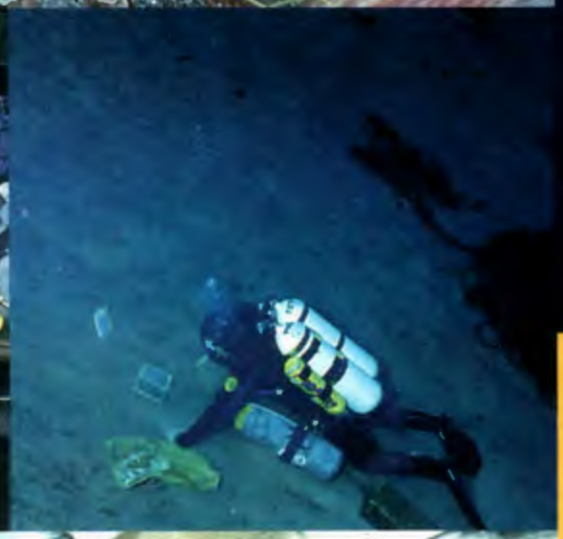
The caves in the Woodville Karst Plain also hold evidence of life-forms long since extinct. For example, the waters of Wakulla Springs have harbored many Ice Age giants, including almost three entire mastodon skeletons, one of which is on display at the Museum of Florida History in Tallahassee. A mastodon tooth also turned up at 45 feet beneath the surface just inside the downstream cave of Venture Sink, one of more than two dozen openings into the LSCS. Project cartographer Steve Irving recently reported and gathered samples of dugong bones about 1,200 feet into the cave at Indian Springs. The remains represent an ancestor of the manatee that thrived in prehistoric oceans. According to paleontologists at the Florida Museum of Natural History, this aquatic mammal lived more than 30 million years ago.

The WKPP has gained access to practically all caves in the region including Big Dismal Sink in the Apalachicola National Forest.

Serious cave exploration of these natural treasutres caught on in the late 70s when explorers began using scooters to extend their range. Multiple staging, using appropriate gases for various depths, wearing dry suits and riding custom-made super scooters have allowed them to go even deeper and farther into the caves. They even inflate their dry suits with argon to cut down on the loss of body heat in the chilled aquifer during their lengthy decompression stops.

In their explorations of the karst plain, these aquanauts face an environ-

Upper River Sink (a.k.a. Kini Spring) is one of the largest karst windows in the Leon Sinks Cave System.



From top to bottom:

Top right: *A diver peeks into the upstream cave with the surface of Emerald Sink in the background. Vehicle access was recently closed here because an imbecile ditched a stolen car in the sink.*

Top left: *Tim Norkus (left) and Steve Irving (right) hold slave strobes to help illuminate the small dry corridar of Cal's Cave in Wakulla County. Unlike most caves in the region, it's only one of three partially dry caves in the karst plain.*

Cave diving explorer Bill Gavin makes ready for a dive into Cheryl Sink. His exploration reel holds hundreds of feet of line. Note the small yellow cylinder, which holds argon, used for inflating his dry suit.

WKPP director George Irvine passes the time reading as he degases for nine hours after a long deep dive into the "A" tunnel of Wakulla Springs.

Tom Payne eases his way out of a cul-de-sac in Osgood Sink near Woodville, Florida.

Barry "the rat" Miller, laden with stage bottles, rides one of the super scooters, developed by Bill Gavin and George Irvine, into Indian Springs.

ment perhaps more hostile than deep space. They meet with limited gas supplies, currents, bone-chilling cold from long immersions and task loading that would tax an air traffic controller at Atlanta's Hartsfield airport. One big difference from dry caving, other than having to carry something to breathe, stems from the possibility of a careless fin stroke reducing visibility from a hundred feet to less than an inch in a matter of seconds. Even with flawless propulsion techniques, problems may arise from exhaust bubbles causing particles to rain from cave roofs. On the other hand, unlike their terrestrial counterparts, these cavers don't have to worry about vertical skills when they encounter pits and shafts. A thin guideline to the surface, rigorous training, specialized gear, Hogarthian configurations and nerves of androids enable them safely to negotiate the mazes.

If the linear trend of the Leon Sinks Cave System continues, it may one day become one of the world's longest underwater caves. Should nearby cave systems such as Big Dismal Sink, Pipeline (Chip's), Indian, Wakulla and Sally Ward be tied into this network, the system would possess more than 25 miles of passages. In contrast to the shallower clear conduits in the Yucatan peninsula, which presently hold the world's longest water-filled caves, the deep dark passages in the LSCS can only be dived a few months each year—if that long. For the past two years, visibility has been generally poor. Explorers must wait for droughts to allow tea-colored surface runoff to be flushed out of the system.

The exploration of upstream Sullivan Sink eventually led cave divers to work with scientists for the first time to study the Woodville Karst Plain. Parker Turner later advanced this effort in 1990 by founding and heading the Woodville Karst Plain Project (WKPP). Tragically, Turner died in 1991 in a caving accident at Indian Springs resulting from a freak underwater avalanche that buried his safety line. His dream, though, to link and map the vast network of underwater caves and sinks in the Woodville Karst Plain lives on. Several years ago, the WKPP became an official project of the National Speleo-

Upper Left: ***WKPP support divers hustle to keep track of stage bottles of various gas mixes and scooters in Wakulla Springs.***
Right: ***WKPP support divers busy themselves with the tasks of getting explorers ready for dives that carry them to depths in excess of 300 feet and distances of more than one mile.***

Left: *Dan Cring, a professor of anthropology at the University of Southwestern Louisiana, hangs over a lime-stone crack near the head of the Wacissa River in Jefferson County. Hydrologists believe the Wacissa springs may be fed by a siphon originating at Bird Sink on the northeastern fringe of the Woodville Karst Plain.*

logical Society—the nation's premier caving fraternity.

WKPP divers, under the direction of Parker Turner, Bill Gavin and George Irvine have performed some remarkable feats in the Leon Sinks Cave System. After making scores of set-up dives, four explorers entered Sullivan Sink and cruised downstream through places over 200 feet deep. Following a precarious 1.5 mile journey, they reached their goal by surfacing at Cheryl Sink. During this mission they sailed through a giant chamber, mentioned earlier, dubbed the Black Abyss by earlier explorers.

In 1987, Bill Stone's U.S. Deep Caving Team surveyed over two miles of caves in Wakulla Springs. They found that the main passageway heads southwest from the spring entrance. Several hundred feet back in a chamber called the Grand Junction Depot, the cave splits into six smaller passages known as tunnels A, B, C, D, F and G. The water quality in one of the four larger tunnels differs from the others. While tunnels B, C and D carry air-clear water, tunnel A often bears a charge laced with tannic acid. The fluid in this tunnel seems to match that in the LSCS and affects the general clarity of the spring.

In recent months, WKPP divers have added about 2,500 feet of line to the B tunnel. In January of 1994, they also pushed 6,129 feet from the cave mouth at Wakulla at depths averaging just under 300 feet into A tunnel. During the 1993 drought, the team discovered a channel emptying into the natural pipeline between Sullivan and Cheryl sinks. This uncharted artery passes through another enormous room called the White Abyss as it trends northeast toward Big Dismal Sink (with its 12,000 feet of mapped passages). Presently, the missing link between the two systems covers only about 400 feet. When joined with Big Dismal, the LSCS will comprise almost 15 miles of underwater cave! Thus, with each

season, we move closer to solving the riddle of the sinks in the Woodville Karst Plain.

Some might question why cave diving explorers engage in the high risk activity of probing these uncharted labyrinths in the Woodville Karst Plain. It can't be denied, though, that explorers supply crucial information about the origins and paths of our drinking water. Sometimes ignorant individuals dump fetid garbage, rotting animal carcasses, car batteries and other toxic wastes in

Gar hover over the huge spring vent at Wakulla Springs.

sinkholes. Sheriff's divers once recovered more than a half dozen VW beetles from Gully Sink just west of Woodville. Knowing that the Floridan aquifer supplies most of that state's potable water, the sinks and springs that pock this reservoir demand more respect.

Karst areas such as this also are subject to wide array of other human misuses. Merely walking up and down the banks of steep-sided sinks can create gullies, damaging fragile plants. Submerged parts of sinks may be marred by witless divers who carve graffiti on beautiful rock formations or scar caves by their poor swimming skills. The most flagrant damage occurs when divers attempt to remove fossils, artifacts or mineral formations from these underwater jewels.

The imposing sinks and conduits in this and other karst plains deserve our continuous stewardship. Countless treks by cave diving explorers such as WKPP divers have shown that these complex systems play a critical role in supplying potable water to the nation's fourth most populous state. They also provide field laboratories in which scientists can study karst and the unique creatures living there. Lastly, the alluring windows into the aquifer exhibit some of nature's finest artistry.

CAVE

The story of Olivier Islar's record push into Doux de Coly

By WIN**REMLEY**

OBSESSION

There are cave divers, and then there are cave explorers. Olivier Islar is a cave explorer in the first degree. Few cave divers, regardless of their skill level and experience would dare to undertake the ambitious exploration of the Doux de Coly cave system, which lies in the Dordogne region of France.

Win Remley

Olivier Islar

Islar, in an obsessive quest to push the Doux de Coly system past the practical limits of conventional scuba, designed and built a triple redundant, semi-closed, mixed gas rebreather and a custom decompression habitat to lay 13,300 feet of line at an average depth of 150 feet.

The multinational team of explorers included divers from France, Switzerland, Belgium, and the UK. Dr. Bill Hamilton of Hamilton Research, designed the custom tables used by Islar. The team recognized that they had a difficult task ahead of them. Of his project Islar said, "Diving far into a cave with a homemade rebreather is like flying into a cyclone to test the sturdiness of a jet."

The System

Doux de Coly is a large system with passages of varying shape from 30 ft. wide by 6 ft. tall to 10 ft. wide by 20 ft. tall. It is divided into three main sections: the entrance zone; the shaft; and the deep zone.

The entrance zone is fairly shallow averaging 20 ft. in depth and extends about 1,000 ft. to where the shaft begins. The shaft is a vertical tunnel that descends to the beginning of the deep zone at a depth of about 145 ft. The shaft is where the habitat was installed for extended decompressions. The deep zone ranges in depth from 145 to 190 feet and has been explored by Islar to 13,300 ft., (more than 4 kilometers).

There's only one significant restriction caused by a boulder fall that narrows to 60 in. wide by 30 in. tall. This was tight for Islar considering the size of his apparatus. Flow in the system is light with an average rate of 1 cu. m./sec. The water temperature is approximately 60°F.

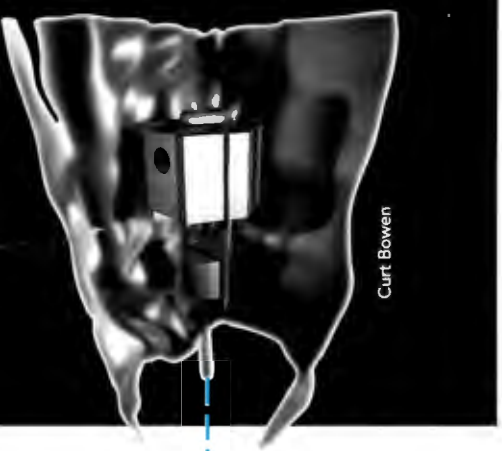
Open Circuit Explorations

Doux de Coly was first explored by Islar in 1981 to 5,700 ft. using conventional scuba. In 1983 and 1984 additional penetrations were made to a maximum of 10,170 ft. using set up dives to place stage cylinders at 1,900 ft., 3,600 ft., and 4,900 ft. into the cave. Islar's custom scuba rig consisted of five back mounted cylinders pressurized to 3,675 psi for a total of 882 cu. ft. of gas. He began breathing from his quintet at 6,200 ft. into the cave where he dropped his last stage. He used the rule of thirds on all cylinders (one-third in, one-third out, one-third reserved for emergency). Although Islar had become obsessed

Top: *Islars chest mounted redundant RI 2000 rebreather.*

Middle: *The RI 2000's "snap-fit" couplings enabled Islar to switch the cylinders from one rebreather to another while underwater.*

Below: *Artist rendering of the habitat Islar built and installed in the "shaft" for decompression.*



with exploring Doux de Coly, he felt he had reached the practical limit of open circuit scuba in exploring this system

The RI 2000 Rebreather

Frustrated at not being able to push Doux de Coly further on conventional scuba, Islar and his exploration partner, Alain Ronjat, began looking into the use of a rebreather to continue the project. They closely examined units available from Dräger, and Cis-Lunar and decided that they were unsuitable for their particular mission. They instead began designing a home made rebreather, the Rl 2000, that ultimately was used in Doux de Coly. The RI 2000 is a semi-closed rebreather, or rather two, fully independent, semi-closed rebreathers in a single back mounted case. A third independent semi-closed rebreather was also built as a thin streamlined unit to be chest mounted providing triple redundancy. Islar designed his rebreathers to all share the same set of cylinders via a unique snap-fit coupling that enables the cylinders to be connected to any of the three rebreather circuits while underwater.

"Diving far into a cave with a homemade rebreather is like flying into a cyclone to test the sturdiness of a jet."

The 1989 Expedition

In 1989, Islar made his first attempt to push Doux de Coly using his home made rebreather. From an exploratory point of view, the mission was a failure. He only managed to get to about 5,000 ft. The Rl 2000 leaked at the snap-fit connectors due to the silt in the water. The scooters also broke down making further exploration impossible. It became obvious that a habitat would be required to manage the lengthy decompression which was expected to be more than ten hours.

The Habitat

Islar and his team decided to construct a habitat and install it in the vertical shaft that begins about 1,000 ft. from the entrance. They considered a design consisting of a metal frame covered with a flexible sheet similar to that constructed for the Wakulla I expedition but rejected that design as too fragile for transport and installation into Doux de Coly. They instead created the habitat as a rigid housing constructed with aluminum and stainless steel. The habitat was transported to the shaft in three parts and assembled in place. The ballast weight for the habitat totaling 1,433 pounds was transported 26 pounds at a time by support divers. This activity took almost six days to complete.

Once the habitat was completed it was tested for functionality. The plan was for Islar to remove the bulk of his cylinders with the help of support divers at the bottom of the shaft. He then climbed into the habitat housing and sat in an armchair style seat. Islar was dry from the waist up and wet from the waist down due to the design and small size of the habitat. The habitat could be raised using a simple rope and pulley. While inside the habitat Islar continued breathing from the rebreather. Several cylinders were attached to the inside of the habitat to supply breathing gas during decompression. He changed cylinders and breathing gases via the snap-fit connectors.

Support divers could communicate with Islar by briefly sticking their heads into the air space inside the habitat. Once comfortable inside the habitat Islar could relax and rehydrate by drinking fluids.

The Record Dive

Still smarting from the failure of the 1989 expedition Islar and his team left nothing to chance. Every detail of the exploration was scrutinized. On July 29, 1991 he made his first attempt. He successfully pushed the system to 12,600 ft. without incident. The newly redesigned scooters and improved snap-fit couplings worked perfectly.

The record dive occurred six days later on August 4, 1991. Islar broke the 4 kilometer barrier by pushing Doux de Coly to 4055 meters or 13,303 ft. At about 13,250 ft. a large room opens up with at least two passages continuing on. Unfortunately the one Islar followed along the left side ended at 13,303 ft. which is where he turned his dive.

On the return, the injector on one of the dorsal counterlungs developed a leak, probably caused by silt in the water. This wasn't viewed as critical since the faulty rebreather circuit was still operating at about 50% capacity making it still usable. The more critical incident was caused by an over-zealous support diver who accidentally drowned one of the C02 scrubbers. However, due to the triple redundancy, Islar was able to complete decompression without further incident. After exiting the habitat at the top of the shaft, the swim to the entrance was completed on pure oxygen from 115'.

The Future

Islar believes that rebreathers are the only way to make extreme pushes into cave systems. He acknowledges that this is increased risk exploration. He sees systems like Wakulla and Cathedral Canyon as an ideal opportunity for this type of technology. Islar and Ronjat currently have no plans for commercial production of the RI 2000. They see it more as a prototype that is still too heavy and clumsy to have commercial value. Islar would prefer that history simply record the RI 2000 and his explorations as valuable research and experience to be used to further future dive techniques.

Top: *Islars custom Decompression Habitat.*

Middle: *Islar rides his custom "Double-Scooter" into Doux deColy.*

Below: *Islar pauses briefly for a photo in the entrance tunnel with one of the local inhabitants.*

Drift Diving and DECOMPRESSION

By CURTBOWEN

Currents can be caused by many factors including wind, gravity, tides, the rotation of the Earth, and the orbit of the moon. Some of the most exciting and challenging technical dives are in locations where currents exist. Offshore deep wrecks, channels, bay inlets, and global currents like the gulfstream, offer experienced divers a great dive and the opportunity to explore rare dive sites, however the ascent becomes a critical component of the dive plan. Any one who has ever tried to ascend on an anchor line in a stiff current during a decompression dive is acutely aware of how tiring and muscle-numbing the experience can be. Additionally, if you get blown off the anchor line you may not be able to swim back to it if the current is stronger than two or three knots. Drifting with the current while ascending from a decompression dive is a much more relaxing way to tick off the hours, but it adds complexity to the logistics and planning of the dive.

Special gear is required on drift decompression dives including float balls, rope or line, lift bags, reels, jon lines, and additional clips to name just a few items. The specific plan for a drift decompression dive depends on the characteristics of the dive site itself. No rules or guidelines can apply to all dive sites. Divers must first analyze the site, develop their specific drift decompression plan, identify everything that might go wrong, and make a contingency plan for it.

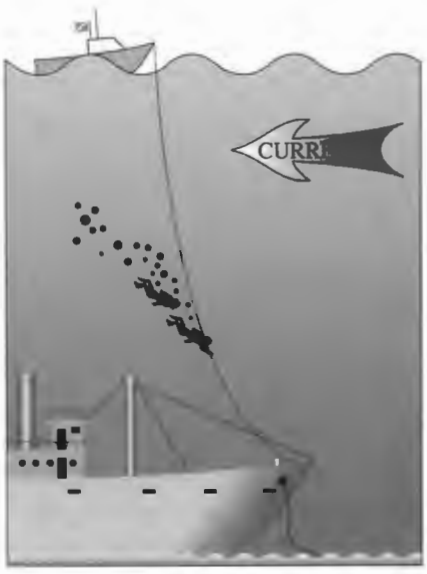
When analyzing the dive site remember to consider such things as the speed of the current, the chance of it changing direction, the seas, the possibility of drifting through shipping channels or into shallow water, hazardous marine life, and the experience level of the divers.

A drift decompression plan should be detailed, and all divers should understand it thoroughly. It should provide for adequate gas supplies plus a reserve for each mixture being used. Every diver should carry their own gear and gas supplies due to the possibility of becoming separated.

An exhaustive "what if" session with the dive team is helpful in identifying everything that can go wrong. For each incident scenario, a contingency plan should be developed and all divers should be capable of reacting appropriately. Remember to consider things like equipment failure, separated divers, boat traffic, entanglements, knotted lines, and mechanical difficulties on the boat that prevent the captain from following the float balls.

On the next few pages some helpful hints and tricks are illustrated that we at DeepTech have learned and used successfully over the years. Ours are not the only methods, indeed for each dive site there exists several possibilities for a drift decompression plan. The point is that drift decompression diving is unique in its planning and execution. There is never just one way to do it. When developing your plan design something that will work well for you and your team under the specific conditions of the day. Ask others in your area for their suggestions.

The Descent – 3 Scenarios



Standard Descent

Boat anchors into the wreck.
Current: Slow enough to allow the divers to pull themselves down the anchor line.

Buoy Line Descent

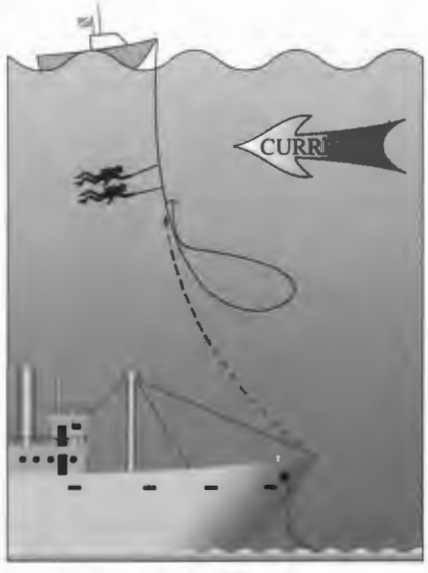
Boat drops divers upstream from the site.
Current: Slow to moderate
Divers: Descend quickly holding the end of the buoy line. Upon reaching the wreck the divers clip the line to the wreck.

Curt Bowen

Free Descent

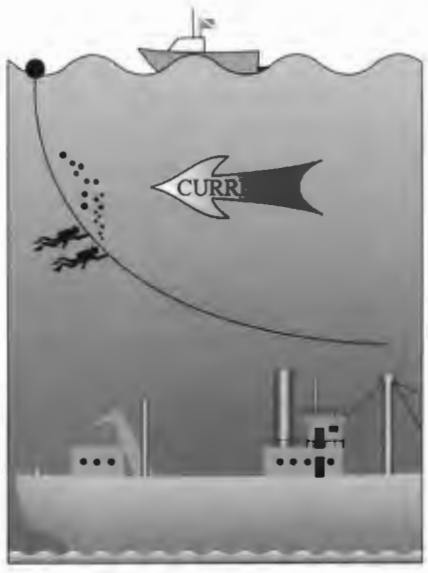
Boat drops divers upstream from the site.
Current: Slow to High
Divers: Descend quickly, Upon reaching the wreck the divers tuck behind out of the current.

The Ascent – 3 Scenarios



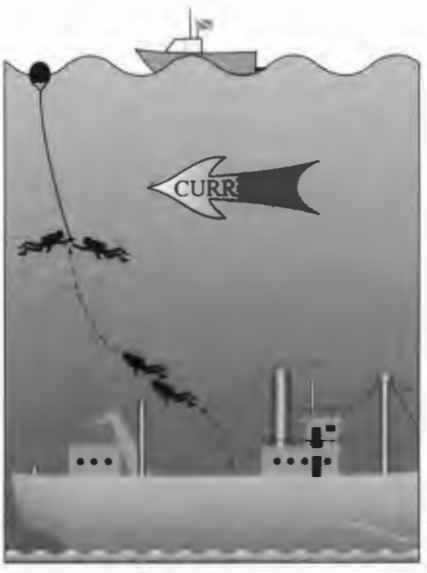
Standard Drift Ascent

Anchor is pulled from the wreck and brought partialy up the line and clipped in.
Divers: Ascend up the line to the first stop, deploy jon lines if needed.
Caution: The boat may be affected by winds, high seas, and shipping traffic.



Float Line Ascent

Line is pulled from the wreck and brought partially up the line and either clipped in or allowed to drift freely up off the bottom.
Divers: Ascend up the line to the first stop, deploy jon lines if needed.
Boat: The captain follows the buoy.

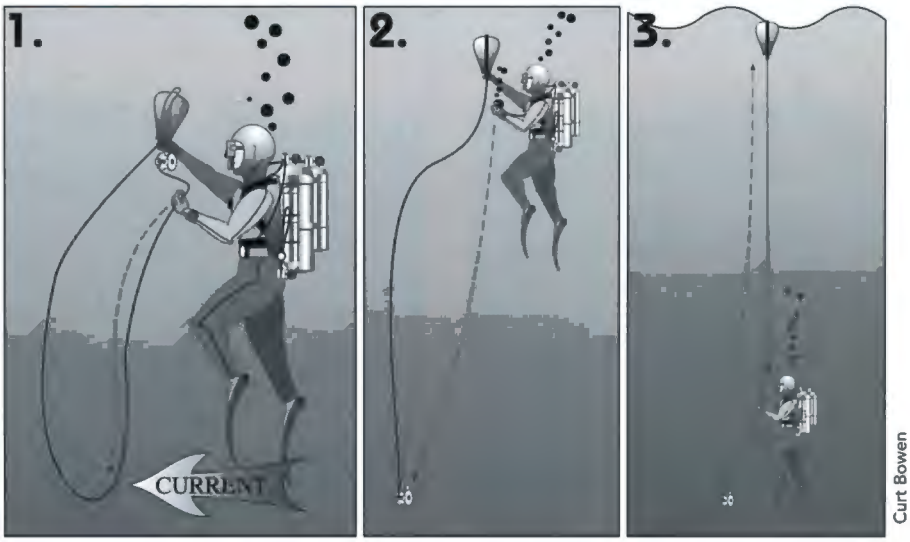


Curt Bowen

Free Ascent

No lines are used
Divers: Ascend in open water to the first required decompression stop and deploy lift bags.
Boat: The captain is required to monitor his position over the wreck keeping a constant watch for deployed lift bags.

Deploying the Lift Bag



Curt Bowen

1. Upon ascending to the first decompression stop the diver prepares the lift bag and reel. Stopping 10 feet below the first required stop the diver holds the empty lift bag and reel in one hand. The diver ties the reel line to the lift bag and slowly belays off enough line for the bag to reach the surface.

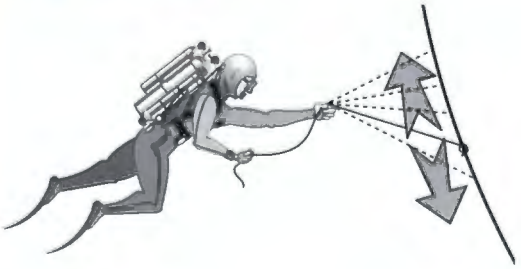
2. As the line is belayed off, it is allowed to sink slowly preventing entanglement. Once enough line has been belayed the diver tightens down the lock bolt on the reel and drops the reel, maintaining a hold on the lift bag.

3. Once the reel has tightened the line with it's weight the diver inspects the line to make sure he is not entangled, he then pumps air into the bag and lets it shoot to the surface. The line is OKed through his/her other hand and the reel is retrieved after the bag has reached the surface.

Line Tubes

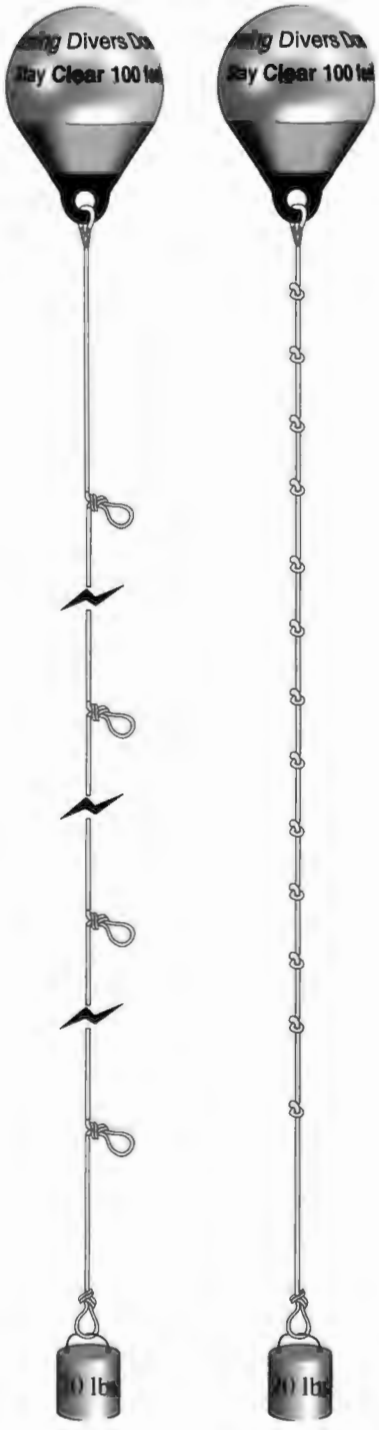
An easy alternative to a reel, a lift bag tub can be made from a piece of 3" or smaller diameter PVC tube and two end caps. A hole is drilled through the bottoms of the caps. The line is fed through each end and a knot is tied on the out side. Several feet of line can be neatly coiled into the tub prior to the days diving. This type of deployment is very fast, reliable, and easy to carry. A rope bag can also be used in the same manner.

The Jon Line



A jon line can be a essential piece of equipment for decompression in rough sea's. Normally made from a 6 to 10 foot piece of 3/8 inch rope it helps the diver stay at one depth while the line fluctuates up and down with the boat or float. It is also used to separate divers decompressing on the same line and same depth preventing over-crowding.

Float Lines



The above illustrates two types of float down lines. The left drop line has a loop tied at 5 to 10 foot intervals. The float down line on the right, a 3/8 inch line has knots tied every 2 feet. These loops or knots are used to hang stage tanks, clip surface support regs, etc...The down line should be weighted with 20 pounds to prevent the diver from pulling the line upwards if he or the cylinders become bouyant.

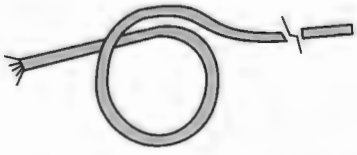
Down Lines

With the increased chance of divers becoming separated during the dive, the boat can carry preset down lines and added tanks for decompression.

Curt Bowen

Rope Tricks

A little rope trick can be used to help prevent a line from becoming a big ball of knots. This trick can shorten the line by two-thirds and allow simple deployment when needed. After pre-tying, the line can be balled up and placed into a pocket. When needed it can be removed and unraveled with ease by just pulling on one end.

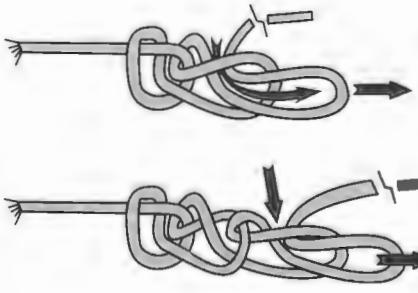


1. Make a loop on one end of the rope

2. Pull the running end of the rope through the loop.

3. Pull the loop snug

4. Tighten the short end of the line



5. Pull the running end of the line through the new loop creating another loop, tighten old loop and repeat until all the line has been tied. When completed, the line can be untied by simply pulling on the end of the line you finished with.

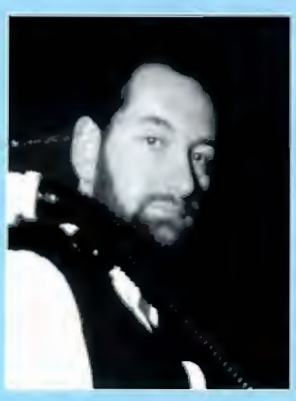
Rebreather Roundtable

Alan Krasberg

Alan Krasberg is founder and former owner of General Diving Systems in Aberdeen, Scotland, which he sold in 1989. Krasberg started diving O2 rebreathers in 1947 at the age of 13, and one year later built his own rebreather. He ran the first commercial saturation diving operations for Westinghouse in1965 and provided mixed-gas diving tables for several companies. In 1962 he built his first Closed-Circuit mixed-gas rebreather. He designed his first semi-closed rebreathers, with topside PO2 readout, used on the Westinghouse diving operations in 1965. The Westinghouse divers logged a total of 6,000 diving hours using his design. He designed and built the first surface-loop, closed-circuit system for commercial diving, a technology still in use today. Krasberg still dives an O2 rebreather in his off-time.

Bret Gilliam

Bret Gilliam is the President and Founder of TDI, and a 25 year veteran of the professional diving industry with over 14,000 logged dives since 1958. His first experience with rebreathers was on Navy projects in 1971 and includes both mixed gas and oxygen closed-circuit military models, as well as civilian market semi-closed circuit models. He and others within TDI were asked to coordinate training curriculum for the Drager/Uwatec Atlantis I semi-closed nitrox rebreather in January of 1995. A generic diver and instructor program was developed by Gilliam and others at TDI, with manuals, instructor support materials, and unit-specific operating guidelines. Over 100 rebreather instructors have been trained by TDI to date, with several hundred rebreather divers trained and certified as well.



Peter Readey

Peter Readey is a Marine Engineering Officer and a highly experienced commercial and research diver. He has been using closed-circuit rebreathers throughout most of his diving career. Readey is founder and former director of Prism Life Support Systems. He also served as a consultant with Carmellan Research. He recently joined forces with Cochran Undersea Technology to further develop the Prism rebreather. During the development and testing phase of the Prism I Readey has conducted introductory rebreather experience dives for about 1,500 divers worldwide.

Rebreather safety and training standards are topics not often talked about amidst the hype and hoopla of press releases and product announcements. Questions like "How deep can I go?", and "When can I get one?" always seem to get more attention from the media.

Until now, DeepTech hasn't published editorial articles on rebreathers—mainly because we didn't wish to add to melee. Nevertheless, DeepTech, in our commitment to advanced and technical diving safety, recently polled several rebreather and training experts in an attempt to arrive at a consensus on which segment of the dive market rebreathers are really designed for, the safety issues associated with diving rebreathers, and training standards for both rebreather divers and instructors.

DT: What are the major safety issues regarding rebreather diving, and what is the weakest part or element in a rebreather system?

Gilliam: For semi-closed units primary considerations include accurate prediction of the actual breathing bag mix, and proper user maintenance and preparation. Probably, the hypoxic issue is foremost in my mind. But even then there are only a few scenarios where the risk exists and it's entirely predictable. To get into trouble on a semi-closed, mechanical, nitrox rebreather you have to basically be three kinds of stupid: 1) try to run air as the supply gas and pass out in shallow water, 2) forget to turn the supply gas on in the first place

DeepTech and seven industry experts take a hard look at rebreather safety issues and training standards.

By WALTER**COMPER** and WIN**REMLEY**

Clark Presswood

Clark Presswood is a former U. S. Navy Seal, retired with the rank of Commander. He was heavily involved in scientific research at Duke University conducting experimental dives on the Navy's MK-15, closed-circuit, mixed-gas rebreather. He served 3 years at the Navy Experimental Diving Unit, and 2 years at the SEAL Delivery Vehicle (SDV) Team ONE. Presswood was the Advanced Training Officer at the Naval Special Warfare Center and employed rebreathers throughout the Pacific, Indian Ocean, and Persian Gulf in various capacities during his career.

and pass out because the breathing loop doesn't inject fresh nitrox into the counter-lung, or, 3) you can simply run the supply bottle out of gas and then pass out. So unless we get a lot of Forrest Gump candidates, I think the average diver with opposable thumbs and an IQ above room temperature will be okay.

In closed circuit rebreathers you've got a few other little twists like relying on electric circuitry and solenoids that are subject to failure in salt water environments. Or the oxygen sensor can crap-out on you. Cis-Lunar deals with these contingencies by building redundancy into their units and I like what I see from those guys. Realistically, the carbon dioxide scrubbers for short duration (less than six hours) use are really not a problem and the semi-closed units are well-configured with modern state of the art absorbents doing an excellent job.

Jack Kellon

Jack Kellon is President of The Rebreather Company (RBC). He is a saturation diver, and dive director for saturation systems. He was trained on the MK-6 and Emerson rebreathers in the early sixties. Kellon has more than 30 years of subsequent experience on open circuit, closed and semi-closed rebreathers, with considerable time spent on electronically controlled, mixed-gas units. He also has experience with surface supplied salvage and construction diving. Over the past 30 years Kellon has designed many rebreather components, plus complete helmet and rebreather systems.

Gurr: Training, training, training and a safe design. The weakest parts are O2 sensors and the flow set of semi-closed systems.

Kevin Gurr

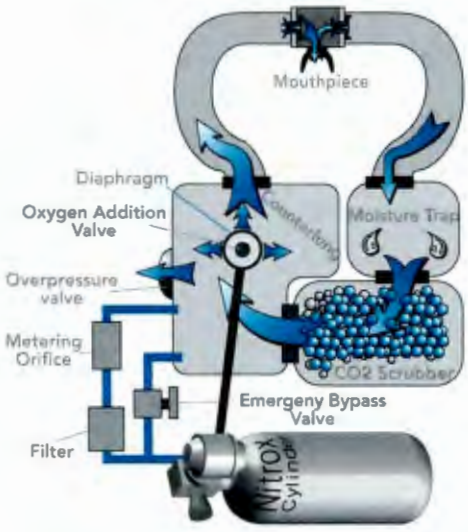
Kevin Gurr is President of the International Association of Nitrox and Technical Divers (IANTD) in the UK and a member of the Cis-Lunar Research and Development Team. Gurr is responsible for the Cis-Lunar training activities in Europe plus he is the author of the popular Pro Planner decompression software.

Readey: There are three safety issues: 1) reliable PO2 monitoring of breathing gas; 2) CO2 detection; and 3) training. The weakest part of the system is the diver. When properly maintained and dived within their system parameters most rebreathers can be reliable. We've had people approach us and ask "When is the deep set coming out? I think I'll wait for that." But to dive deep you first need to build up time in the shallow range. A rebreather is a completely different animal. You must be able to control your unit in shallow water before you consider going beyond recreational limits. For that reason the Prism II, for example, will initially be a Nitrox unit and the upgrade to a deeper unit will only be sold to people who can provide proof of Nitrox range rebreather dives and experiences, and are demonstrating a responsible approach to their diving.

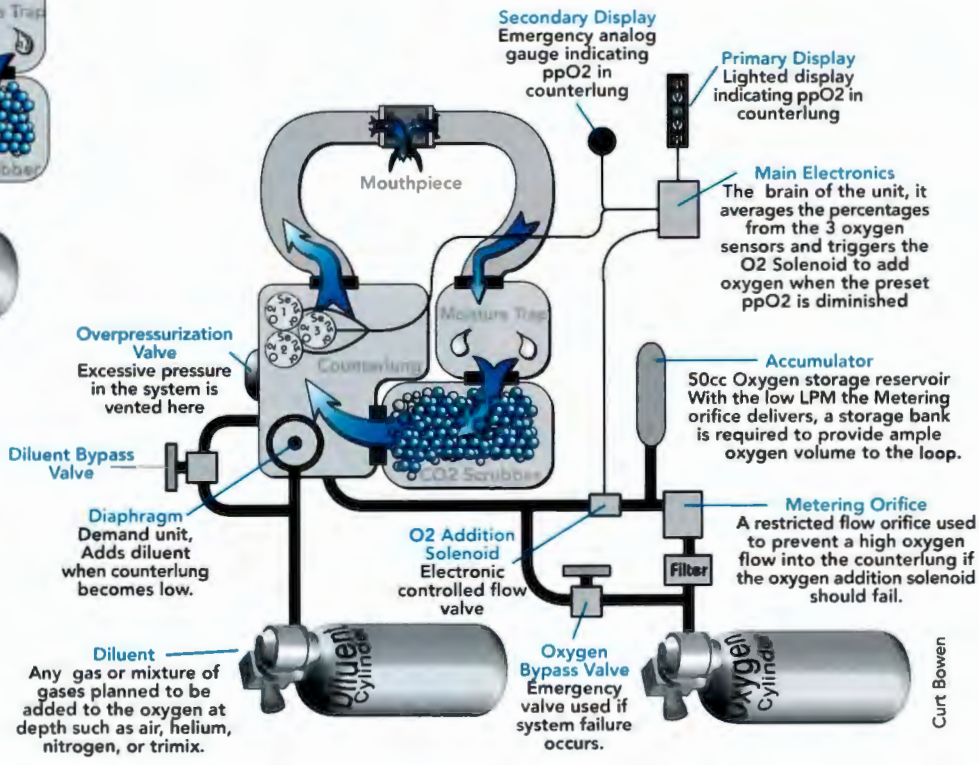
Rich Pyle

Rich Pyle works at the Bishop Museum in Honolulu while he completes his PhD at the University of Hawaii. He has been diving since 1980 and he routinely makes deep, mixed-gas, and rebreather dives in his research. Rich is a certified rebreather diver with 160 rebreather dives logged for a total of 175 hours. He has dived to a maximum depth of 420 fsw on his Cis-Lunar MK-4, plus 15 trimix rebreather dives in the range of 250-400 fsw. Rich is a respected member of the technical diving community with extensive knowledge on a wide range of diving topics. His dives a rebreather almost exclusively for the purpose of discovering new species of marine organisms in the "twilight zone" (i.e., coral reefs in the range of 150-450 fsw).

Anatomy of Semi-Closed vs. Closed Circuit Rebreathers



Semi-closed circuit rebreathers (above) recycle your exhaled gas while scrubbing out the CO2 via a CO2 absorbent. Periodically the exhaled gas is expelled into the water to "freshen" the gas. In a closed circuit system (right), the breathing gas is never expelled to freshen the mix. This requires a more rigorous measurement and control system to assure proper partial pressures of the constituent gasses in the mixture.



Presswood: Preventing hypoxia, hypercapnia, and rebreather flood-out are the main safety issues. Any possible water leakage point is a potentially weak part. Oxygen sensors, power supply systems and the respective housings for these systems have proven to be weak points on certain rebreathers.

> **You don't just slap it on and jump in; and if you do you get punished**
>
> *- Alan Krasberg*

Kellon: The weakest part is the diver. It falls upon the diver to make a rational decision on what action should be taken if a component fails. In addition, the diver is capable of making bad operating decisions that can endanger his life even if NONE of the other components fail. There is a tendency in the sport diving community to view rebreathers as just another specialty course. Even extensive open circuit experience doesn't necessarily instill the attitudes or skills necessary to become a safe rebreather instructor. Rebreather diving shouldn't be promoted to the sport diving community for activities that do not justify the additional risk.

Krasberg: The four major safety issues are: 1) lack of training; 2) lack of proper instructors; 3) lack of rigid and foolproof maintenance and setup procedures; and 4) improper equipment design enabling unnecessary diver error. The weakest part from my own point of view, is the need for rigid maintenance, procedures, and pre-dive checks. You don't just slap it on and jump in; and if you do, you get punished. I've been punished lots of times, and all but once it was due to my own lack of pre-dive diligence.

Pyle: The major safety issue is discipline. My fear is that experienced divers will become comfortable on a rebreather in a short period of time, and will want to pick up doing the same dives they were doing on open circuit right away. It's very easy to allow one's confidence to exceed one's abilities early on in rebreather diving. As with all scuba, the consequences of this are extraordinarily dangerous.

DT: Is rebreather diving for everyone? Or, put another way, do you feel comfortable recommending rebreather diving to your family and friends, and do you feel as safe while diving a rebreather as you do while diving open circuit scuba?

Gilliam: Certainly, semi-closed circuit mechanical gas injection rebreathers can be easily taught to any diver with the willingness to accept the more involved training. A certain amount of diver "maturity" is necessary, but basically you could say anyone can dive

rebreathers. Personally, I feel safer with a rebreather. They're smaller, more compact, and have intrinsic advantages based on breathing a warm humidified oxygen enriched gas supply.

Gurr: Different types of rebreathers are suited to different applications and can be applicable to a wide spectrum of divers.

Readey: Rebreathers can be for everyone. The physics and gas laws remain the same, it's just the method of delivery that's different. Open circuit will always have a place, but I feel there is a possibility, in say five to ten years, of people entering the sport as rebreather divers and learning about open circuit as an emergency option but never really diving in that style. I actually feel safer on a rebreather because I typically have more time to cope with malfunctions.

Mark Mader

Rich Pyle stares down an eel while diving on his Cis-Lunar rebreather.

Presswood: At the current state of the technology and development, rebreather diving is not for everyone.

Kellon: Rebreathers are definitely not for everyone. As with any activity, some people are better at it than others due to attitude and natural skills. You need to have a genuine need for the capabilities rebreathers provide and be prepared through adequate training to deal with it. I have actually become more at home with rebreathers than open-circuit simply because I pay more attention.

Krasberg: Even with good training, I expect the fatality rate of rebreather diving to settle out higher than that of hang gliding or sky diving. If you actually NEED the equipment for silent operation, or a decompression advantage, or duration at depth, use it. Otherwise, why put up with the hassle?

Pyle: Rebreather diving is not for everyone—but neither is open-circuit diving. There are many people doing open-circuit diving who shouldn't be, and there will be many people doing rebreather dives who probably shouldn't. These aren't the only types who will die, but I think they're at a disproportionally greater risk. Rebreathers require non-water-related skills like a cool head and more than an average amount of intelligence. Above all, they require discipline. It's easier to survive scuba dives with insufficient discipline than it is to survive rebreather dives with insufficient discipline. I have told many of my friends that they would be better off with a rebreather. There are other diving friends, however, whom I would never recommend a rebreather to.

DT: What should the prerequisites be for divers taking a rebreather course and how much training should be required to become a rebreather diver?

Gilliam: With constant flow semi-closed units, we have found that the average diver with reasonable experience (100 hours or so) can be trained fairly quickly and with excellent retention. Again, there are certain learning curves to rebreathers that are only solved through direct, hands-on diving experience. Once those initial hurdles are crossed, it's pretty routine. We've found that a three to four day course with about six or eight dives produces a comfortable diver who can be expected to function independently without supervision. Obviously, the more time you get on the unit, the more proficient the diver becomes. Closed circuit is a different ball of wax and will require mixed gas training and more time in contingency situations. But again, I see those units as a tiny market right now. Cis-Lunar is really the only player and their customers are highly motivated explorers for the most part with a corresponding technical background.

All this is fairly easily defined and ordered in an instructional program but emphasis must be placed on relearning certain skills and reflexes that differ from open-circuit.

Fundamentally, if you understand the physiology and the math involved, there's really no big mystery to rebreathers in the semi-closed mode of operation. And that's the type of units we're most likely to see in the hands of the average diver this year. Closed circuit is available in limited editions and require more specialized attention to operations and initial training disciplines.

Gurr: See the IANTD standards. They pretty much cover the bases on the topic of training.

Readey: This is a hard question to answer since people tend to progress at individual rates and it's unlikely that the recreational market would pay for the kind of extended in-water supervision currently employed by the military. Certainly a working knowledge of nitrox would be useful, but then this is something that could be taught with the rebreather. It should be possible to teach an average diver how to set up and dive a basic rebreather configuration within recreational limits in about four to six days, depending on the commitment and drive of the individual concerned.

The weakest part of the system is the diver. When properly maintained and dived within their system parameters most rebreathers can be reliable.

- Peter Readey


Bret Gilliam

A diver explores a wreck while on a training dive in a TDI rebreather certification course recently held in the Bahamas

This would qualify them to the lowest level of competence, and they would then need to build up their personal experience and skill levels.

Presswood: Prerequisites should include open-circuit scuba qualification for at least one year and at least 25 open water dives . Additionally, satisfactory completion of a nitrox course should be required, unless incorporated in the rebreather course. This should normally take 2 to 3 days academic instruction plus one to two days of diving.

Kellon: The two most important prerequisites are common sense and the absence of a macho attitude. Beyond that unit specific training and a well rounded academic instruction in rebreather physics and physiology are required.

Krasberg: Get rid of the people who panic. Mental makeup is more important than physical strength. Perhaps a 4-week basic course with lots of controlled condition, simulated black-water flood-outs, and some exposure to O2 hits, hypoxia, and hypercapnia. Instruction on how to avoid hypoxia, recovering from flooding, and recovering from O2 hits are also required. After the basic course, a one-week to two-week course, depending on complexity, on the specific apparatus under consideration should be required.

Pyle: Prerequisites should be basic scuba skills, a moderate number of open-circuit dives (say, at least 50), a relatively high level of comfort underwater, a good grasp of gas physics and physiology, and above all, discipline! (not necessarily in that order).

My personal opinion is that a new rebreather diver should not exceed about 30 feet of depth without close supervision until at they reach at least about 50 hours of in-water time on a rebreather. Unfortunately, this is an unreasonable requirement for a training course. Therefore, training courses should concentrate on providing the students with an understanding of the rebreather design, physics, and physiology, as well as hammering in the discipline thing. The students should implement their own in-water, self-training protocol while maintaining a large margin for error to offset the overconfidence factor.

Different types of rebreathers are suited to different applications and can be applicable to a wide spectrum of divers.

- Kevin Gurr

DT: What should the prerequisites be for rebreather instructors and how much training should be required to become an instructor?

Gilliam: Most existing nitrox instructors are capable of handling rebreathers from the standpoint of academics. Instructors for semi-closed units can be brought up to speed in about 4 days but require more dive time on the units. Operations and maintenance training is more rigorous. Note that I'm

taking about this amount of time per unit since each will have its own peculiarities and special needs. At TDI, we issue credentials based on a specific unit. If the instructor wants to teach another unit, he would need to go through additional training and familiarization.

Closed circuit, as previously discussed, is a steeper learning curve. I'd like to see instructors rack up a hundred hours or so on mechanical semi-closed units before making the jump to closed. It's really a much different technology and more complicated to assimilate without prior experience.

I'm speaking from a pretty good body of practical training experience. Mitch Skaggs, Joe Odom, Rob Palmer and I probably have more hands-on time with production level, commercial rebreathers than anyone else in the world at this stage. Some people have seemed to want to needlessly inflate the complexity of semi-closed circuit rebreathers as a way of "profiteering" on training costs. The facts are that these types of units are remarkably simple and easy to train professional instructors on.

To get into trouble on a semi-closed, mechanical, nitrox rebreather you have to basically be three kinds of stupid.

- Bret Gilliam

Gurr: Again, the IANTD standards pretty much cover the bases on instructor training.

Readey: It is important that people have experience on several different rebreathers and have built up enough time with the unit for it to be second nature to them. An instructor should also be able to recognize how a student's set-up may be affecting their diving, and be able to make adjustments, even while in the water, to make the student more comfortable. These instructor skills only come with experience, and it's important that, should an emergency arise, instructors are capable of assisting the student without having to concentrate or worry about their own equipment.

Presswood: Instructors should be qualified by a significant level of diving experience, including in-depth experience with rebreathers and perhaps some training in instructional techniques, or by successful accomplishment of a rebreather instructor course provided by a reputable organization.

Kellon: Initially, there should be few instructors because there aren't many people out there with genuine rebreather experience. I am totally opposed to the one week courses that have been taking place that make instructors out of individuals with no prior rebreather experience.

The Japanese Fieno was designed from the ground up for the sport diving community.

Krasberg: Instructor training should be about the same as user training, except more on the specific apparatus. One group who happen to have copious amounts of time on closed and semi-closed gear to start with are the military divers. Ideally, they could train the instructors, but first they would have to learn the specific equipment. They've been through it, and know first-hand the importance of proper procedures.

Pyle: Instructors only need a thorough understanding of the specific rig design, and a good working knowledge of rebreather practice. The most important skills for rebreather diving are the kind that are learned—not the kind that are taught. The qualifications of the instructor are probably not as important as the qualifications of the student. When it comes to rebreather training, it's easier for a good student to learn from a bad instructor, than it is for a good instructor to adequately teach a bad student.

DT: Which is better, semi-closed-circuit, or closed-circuit rebreathers, and why?

Gilliam: From an efficiency stand point only, closed-circuit is clearly superior. But from a simplicity, cost, and ease of operation perspective, semi-closed wins hands down. The reality is that semi-closed is what the market is currently offering in production models at anything approaching affordable prices. Even then, prices are going to have to come down to attract much consumer interest for the general diving public. I think a retail price in the $3,000 range is about where people will be tempted to open their wallets for a semi-closed circuit unit.

Gurr: That depends on application and user experience. My view is that closed-circuit rebreathers offer less operational hassle and provide greater benefits.

Readey: It depends on a variety of factors. That's why we've designed the Prism II to be multi-mode, and operate as either. Applications such as overhead environments will probably be run closed-circuit to maximize efficiency in gas consumption and decompression management. The semi-closed mode will function as the bail-out option with open-circuit as added redundancy. This way divers will also be able to use the particular gases that are available on site. Photographers will probably also choose closed-circuit for its silence. Most recreational divers however may decide they prefer semi-closed, where that regular exhaust maintains diver awareness that the system is functioning. If a semi-closed unit is fitted with a diffuser it makes little difference to most marine life.

Prism II

Price: $5,000 - $7,000
Type of Unit: Semi-closed and closed circuit modes
Electronics: O2 analyzer, decompression meter, CO2 detector,
Gas mixes: Nitrox (Trimix upgrade)
Maximum Depth: 150 ft
Canister Duration: 4 hrs.
Targeted Release Date: Dec 1996
Special Features: "Lifeguard" independent sensor/dive computer; warning indicators; gas time remaining display

Cochran Undersea Technology
Richardson, Texas
800-856-3483

The Frog

Price: $3,600
Type of Unit: Closed circuit
Electronics: Digital monitoring system; audio warnings for various system failures
Gas mixes: Nitrox (programmable w/O2&air)
Maximum Depth: 220 ft.
Canister Duration: 2-3 hrs.
Targeted Release Date: Fall 1996
Special Features: scrubber canister located inside chest mounted counterlung; scrubber cartridges and counterlungs are disposable

Environmental Support Systems
San Jose, California
408-227-0743.

Cis-Lunar MK-5P

Price: $15,000
Type of Unit: Closed circuit with integrated open circuit bail-out option
Electronics: Oxygen and depth sensors
Gas mixes: Nitrox, Heliox
Maximum Depth: 375 ft.
Canister Duration: 6-10 hrs. at rest; 4-6 hrs when swimming at 60ft/min.
Targeted Release Date: Aug 1996
Special Features: Integrated system redundancy (3 oxygen sensors, 2 depth sensors, 3 microprocessors, multiple power sources, 3 display options); manual operation override in case of electronic system failure; backup PO2 system in case of system or power failure;

Cis-Lunar
South Lancaster, Massachussetts
508-368-0771

Presswood: I personally prefer the semi-closed rebreather concept due to the constant flow of gas, however this is a rig-dependent issue. Closed-circuit technology may evolve into very safe, reliable means of diving in time. Ideally both semi-closed and closed systems would provide redundant oxygen monitoring systems.

Gert DeCouet

A diver examines a reef while diving a Cis-Lunar rebreather. The shark is probably wondering where the bubbles are.

Kellon: Each type of equipment has its strengths and weaknesses because every design involves some sort of compromise. Generally speaking, the simplest rebreather possible that safely meets the requirements of the intended dive is the one that should be used.

Krasberg: They both have their place. Electronic, closed-circuit units have that much more to go wrong but also give you more in the feature and function column. If you need it, that's what you go with. Personally, I like the simplicity and size of an O2 rebreather. Semi-closed is enough for nearly everybody, and there are semi-closed rigs now that sound like they'd be pretty good. At least they "talk-the-talk." Fully-closed mixed-gas was my baby for a long time, but to be honest only the really hairy-chested diving requires it.

Pyle: This question is analogous to: "Which fruit is better, apples or oranges, and why?". 'Nuff said!

DT: What kind of redundancy do you recommend for open-water and overhead environment rebreather diving?

Gilliam: I'm comfortable with a simple bail-out pony bottle of sufficient volume to bring you back from the maximum planned depth. In overhead situations however, I've always liked the "rule of thirds" so you either have triple redundancy or you carry sufficient bail-out gas to provide that margin.

Gurr: A minimum of open-circuit bailout, plus more complex options for deco diving are required. In an overhead environment, depending on the mission, staged bail-out or a spare rebreather should be adequate.

Readey: We should at least match the redundancy level of present open-circuit diving. However with

Odyssey

Price: $ 8,500
Type of Unit: Passive Semi-Closed
Electronics: None
Gas mixes: Any used by open circuit divers
Maximum Depth: 400 ft
Canister Duration: 4-6 hrs.
Targeted Release Date: June 1996
Special Features: New model will be manufactured by an existing major dive equipment manufacturer

RBC
Singer Island, Florida
407-844-5100

Fieno

Price: $ 3,000
Type of Unit: Semi-Closed
Electronics: None
Gas mixes: Nitrox (EAN40)
Maximum Depth: 98 ft
Canister Duration: 110 min. (40 min. gas supply limited by cylinder volume)
Targeted Release Date: Available now in Japan only
Special Features: Disposable scrubber canister required for each dive; disposable air bag (counterlung) required every 50 dives; depth warning indicator activates at 98 ft.

Grand Bleu, Inc.
Tokyo, Japan
(03) 3796-1541

Atlantis I

Price: $6,000
Type of Unit: Semi-closed with constant mass flow and additional lung demand gas supply
Electronics: none
Gas mixes: Nitrox
Maximum Depth: 147 feet
Canister Duration: 2-4 hours
Targeted Release Date: Available now
Special Features: Comes with buoyancy compensator with integrated weight system

Dräger/Uwatec
Greenville. South Carolina
800-804-3483

rebreathers there are far more options available to the diver. Nothing happens quickly on a rebreather. There is a breathing loop with gas volume for the diver to breathe from that gives the diver time to appraise the situation and take appropriate action. Again, this comes with training and experience. No doubt, some rethinking will be needed for guidelines on how to take a rebreather into an overhead environment. The rule of thirds will apply to which section—the closed-circuit mode or the semi-closed bail-out option? Personally, if it was an extreme dive, I would probably carry a second system, perhaps on the scooter. Redundancy is a personal risk assessment that the individual has to make. Divers have to settle for something that is workable and comfortable for themselves.

Presswood: In all environments you need access to an open-circuit breathing option. A redundant oxygen monitoring system and back-up power supply for rebreathers which rely on such a system should also be used.

Kellon: As much redundancy as required to eliminate the possibility of injury due to single point failures should be used. It becomes particularly important in galvanic sensor arrays and also in electronic controls, alarms and batteries. The components of the breathing loop itself are difficult to make redundant without creating size problems. Here, an open circuit bail-out can provide redundancy. In an overhead situation I'd go for all the above plus more open-circuit bailout.

Krasberg: An open-circuit source that will get you out of trouble. On my first rig (1962), I used a semi-closed backup to the electronics plus an open-circuit regulator. In an overhead environment you need LOTS of redundancy—enough to get you home.

Pyle: Unless the rebreather is fully redundant, including at least two independent breathing loops with independent CO2 absorbent canisters, there should be enough open-circuit gas supply to safely return to the surface. For open-water dives without required decompression, this means enough to allow a controlled ascent to the surface. For decompression dives it gets trickier, and depends entirely on the particular dive parameters. Fully closed systems should have at least three oxygen sensors.

The most important skills for rebreather diving are the kind that are learned—not the kind that are taught.
- Richard Pyle

In overhead environments, at the very least, there should either be a completely independent backup rebreather, or enough open circuit gas to get back to the surface including decompression. The difficult part for long, deep decompression dives, is figuring out how much open-circuit gas to carry with you, and how to ensure that

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you can get back to staged cylinders or the surface.

DT: What type of monitoring system should be employed to measure dive profiles and/or gas quality in rebreather diving?

Gilliam: I'd really like to see an integrated active dive computer with all units that's capable of monitoring both actual counterlung oxygen partial pressure and inert gas partial pressure. Then you've really got an efficient responsive tool that's supplying the diver with all he needs to know to make intelligent decisions underwater—on the fly. Sure, it costs more money. Yeah, you can get along without it by performing manual computations, but I like removing the guess work for predicting gas contents in the breathing loop. It gives the diver more freedom and more confidence. In semi-closed rebreathers it doesn't have to give you constant oxygen partial pressure through the depth ranges by controlling the mix, it just needs to monitor partial pressure at any stage of the dive and display the information and incorporate the inert gas loading as a computer function.

Even extensive open circuit experience doesn't necessarily instill the attitudes and skills necessary to become a safe rebreather instructor.

- Jack Kellon

Gurr: Standard digital data logging—depth, time, PO2 etc. In my opinion PO2 monitoring should be employed in both closed and semi-closed systems.

Readey: I recommend that everyone diving a rebreather with inert gases has some form of PO2 monitoring—if the constant flow of a semi-closed system is restricted or disturbed by anything, then the O2 percentage will change. The Prism II has PO2 monitoring that transmits to a wrist unit and gives your decompression on the gas and the PO2 you are actually breathing.

Presswood: Redundant oxygen monitoring systems, CO2 monitoring when such technology becomes available, plus decompression computers with a high reliability algorithm.

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4164 18th Ave NW,
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Glossary Of Terminology

Ambient Pressure - Surrounding pressure
ANDI - American Nitrox Divers, Inc
ATA - Atmospheres Absolute
atm - Atmosphere
Bottom Mix - A breathing mixture used at the deepest portion of the dive.
CCBA - Closed Circuit Breathing Apparatus
Ceiling - The shallowest depth to which a diver may ascend within the limits of decompression requirements.
CO2 - Carbon Dioxide
CNS - Central Nervous System
DAN - Divers Alert Network
DCIEM - Defense and Civil Institute of Environmental Medicine
DCI - Decompression Illness
Decompression Stop—A series of stops at planned depths to allow elimination of excess nitrogen to prevent decompression sickness
DPV - Diver Propulsion vehicle
EAD - Equivalent Air Depth
EAN - Enriched Air Nitrox
END - Equivalent Narcosis Depth
EPA - Environmental Protection Agency
ffw - Feet of fresh water
fsw - Feet of sea water
ft/min - Feet per minute
Habitat - A underwater dwelling for divers in saturation or decompression
Hang Time - Decompression time
HE - Helium
Heliar - A mixed gas created by blending helium and air
Heliox - A mixed gas containing helium and oxygen
HPNS - High Pressure Nervous Syndrome
HUD - Heads Up Display
Hypercapnia - Carbon dioxide build-up caused by improper breathing or incomplete scrubbing of breathing gases in rebreathers.
Hypoxia - Low oxygen partial pressure in a breathing mixture.
IANTD - Internation Association of Nitrox & Technical Divers
Inert Gas Narcosis - The intoxicating effects of an inert gas such as nitrogen
ITC - Instructor Training Course
N2 - Nitrogen
NACD - National Association for Cave Divers
NAUI - National Association of Underwater Instructors
Nitrox - Any mixture of nitrogen and oxygen from 21% to 99% oxygen
NOAA - National Oceanic and Atmospheric Administration
Normoxic - Normal atmospheric percentage 20.9% oxygen
NSS-CDS—National Speleological Society-Cave Diving Section
O2 - Oxygen
OTU - Oxygen tolerance unit
Oxygen Toxicity - Physiological effects of elevated ppO2
PADI - Professional Association of Diving Instructors
ppN2 - Partial Pressure of Nitrogen
ppO2 - Partial Pressure of Oxygen
PSA - Professional Scuba Association
psi - Pounds per square inch
TDI - Technical Divers International
Trimix - Any mixture of Oxygen, Nitrogen, and Helium

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What If It HAPPENED To You?

By SHECK**EXLEY**

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Mary Ellen Eckoff

Before the Dive, What If...

The gas company put the wrong gas in the cylinder you fill from?
The wrong grade of helium is in them?
There are impurities in the gas?
You miscalculate your mixtures and have too much oxygen?
Too little oxygen?
Too much Nitrogen?
Too much helium?
The gauge for mixing is wrong?
The filling temperatures are different?
The dive shop filling your tanks allows the gas to bleed back into their bank system?
Your cylinders contain flammable materials and you put in pure oxygen?
The dive shop tops your deep tanks with bad air?
A pinhole leak allows the helium to leak but other gases remain?
You get the cylinders mixed up while filling?

On the Descent, What If...

You don't have enough oxygen when you submerge?
Your depth gauge reads shallow?
A tank you thought had trimix was really nitrox, etc.?
You overbreathe your regulator?
You have a delay before ascending?
You have a delay on the way down?
You have to exert a lot on the bottom?
You have a five minute line entanglement, etc., on the bottom?
You lose your dive partner on the bottom?
You get blown from the dive site?
You lose your mask?

During Decompression, What If...

The decompression tables you have don't work?
You lose your decompression tables?
You lose your watch?
You lose your depth gauge?
You run out of decompression gas?
You drop one of your decompression cylinders?
Someone steals your decompression cylinders?
Your decompression cylinders have leaked?
You are delayed at a decompression stop?
Danger from hazardous marine life keeps you from completing your decompression?
Your dry suit floods?
You get hypothermia?
You get the bends?

Mary Ellen Eckoff

Sheck Exley decompressing after his 863 ffw dive into Bushmansgat, South Africa

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—Sheck Exley

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The Importance of Deep Safety Stops:

Rethinking Ascent Patterns From Decompression Dives.

By RICHARDPYLE

Before I begin, let's get something perfectly clear: I am a fish-nerd (i.e., an ichthyologist), which means that I am not an expert in decompression physiology. You would be well advised to remember this as you read this humble commentary.

In the old days, before techdiving, I made more dives to 180-220 fsw than I care to remember. I noticed patterns in how I would feel after those dives. Frequently, I would feel fatigue or malaise. Interestingly, these symptoms were not consistent. Sometimes I hardly felt any symptoms at all. At other times I would be so sleepy after a dive that I could hardly stay awake. I tried to correlate the severity of symptoms with a wide variety of factors including the magnitude of the exposure, the strength of the current, the clarity of the water, water temperature, how much sleep I had the night before, dehydration, etc. But none of these factors seemed to have anything to do with it. Finally I figured out what it was - the fish! Yup, that's right! On dives when I collected fish, I had almost no post-dive fatigue. On dives when I did not catch anything, the symptoms would tend to be quite strong.

The problem, though, was that it didn't make any sense. I would expect more severe symptoms after fish-collecting dives because my level of exertion tended to be greater (fish swim fast-people swim slow). Then the answer struck me. Most fishes have a gas-filled internal organ called a "swimbladder," kind of a fish buoyancy compensator. If a fish is brought straight to the surface from 200 fsw, its swimbladder would expand and crush the other organs. Because I wanted to keep the fishes I collected alive, I would stop at some point during the ascent and insert a hypodermic needle into their swimbladders to vent off the excess gas.

Typically, the depth I did this was much deeper than my first required decompression stop. So, whenever I collected fish, my ascent profile would include an extra 2-3 minute stop much deeper than my first "required" stop. Unfortunately, this didn't make any sense either.

When you think only in terms of dissolved gas tensions in blood and tissues, as virtually all decompression algorithms in use today do, you would expect more gas loading with deep stops because more time is spent at a greater depth. As someone who tends to have more faith in what actually happens in the real world than what should happen according to the theoretical world, I decided to start including deep stops on all of my decompression dives, whether or not I collected fish. Guess what? My symptoms of post-dive fatigue virtually disappeared!

I started telling people about my amazing discovery but was usually met with skepticism, and sometimes stern lectures from "experts" about how this must be wrong. "Obviously," they would tell me, "you should get out of deep water as quickly as possible to minimize additional gas loading."

Not being a person who enjoys confrontation, I kept quiet about my practice of including these deep stops. As a scientist I was always bothered by the apparent paradox of my deep stops. Then I saw a presentation by Dr. David Yount, a professor of physics at the University of Hawaii, on the "Varying-Permeability Model" (VPM) of decompression calculation. This model takes into account the presence of "micronuclei" (gas-phase bubbles in blood and tissues) and factors that cause these bubbles to grow or shrink during decompression. The upshot is that the VPM calls for initial decompression stops that are much deeper than those suggested by Haldanian (compartment-based) decompression models. It finally started to make sense to me.

Since you already know I am not a physiology expert, let me explain what is going on in my own simple terms. First, intravascular bubbles can be detected after almost all dives. The bubbles are there, they just don't necessarily lead to DCI symptoms. Most deep decompression dives conducted by techdivers have relatively short bottom-times followed by a relatively long initial ascent to the first decompression stop. The shorter the bottom time, the longer the initial ascent. Conventional thinking holds that you should "get out of deep water" as quickly as possible to minimize gas loading. The point is that divers are routinely making ascents with dramatic drops in ambient pressure in a short period of time—just so they can "get out of deep water" fast.

This, I believe, is the problem. Maybe it has to do with the time required for blood to pass all the way through a typical diver's circulatory system. Perhaps it has to do with tiny bubbles being formed as blood passes through valves in the heart, and growing large due to gas diffusion from the surrounding blood. Whatever the physiological basis, I believe that bubbles are being formed and/or are encouraged to grow in size during the initial non-stop ascent from depth. I'm content to leave the details to the likes of Drs. Yount, Hamilton and Wienke.

DCI is an extraordinarily complex phenomenon. The unfortunate thing is that we will not likely understand it fully for some time to come. In the meantime we can probably reduce the chances of getting bent if we alter the way we make our initial ascent from depth.

Are you still skeptical? Let me ask you this: Do you believe that so-called "safety-stops" after recreational "no-stop"dives are useful in reducing probability of DCI? If so, then you are already doing "deep stops" on your no-decompression dives. If it makes you feel better, call the deep stops "deep safety stops" which you do before you ascend to your first "required" decompression stop.

Some of you may now be thinking "But he said he's not an expert in diving physiology—why should I believe him?" If you are thinking this, then good—that's exactly what I want you to think. By not blindly following the conventional thinking, I stumbled onto deep stops and the apparent advantage of reduced post-dive fatigue and reduced risk of DCI. I encourage you as intelligent, free-thinking, technical divers (well, most of you anyway), to question the methods and techniques you've been taught, and maybe even do a little research of your own to advance the state of diving.

One final point. If you get bent after a dive on which you have included deep safety stops by my suggestion, then it was your own fault for being stupid enough to listen to decompression advice from a fish nerd!

Richard Pyle works in the Ichthyology collection of the Bishop Museum in Honolulu, and is presently working on his Ph.D. in the Zoology Department of the University of Hawaii.

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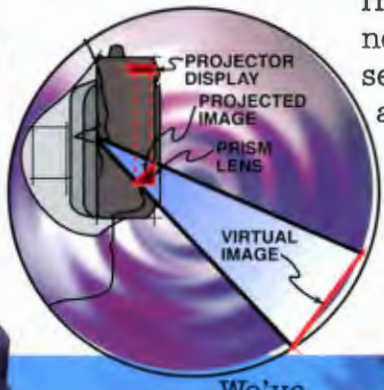

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