NATIONAL SPELEOLOGICAL SOCIETY
CAVE DIVING SECTION

# UNDERWATER SPELEOLOGY

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*Underwater Speleology* is the official newsletter of the
**CAVE DIVING SECTION OF THE**
**NATIONAL SPELEOLOGICAL SOCIETY, INC.**
P.O. Box 950, Branford, Florida 32008-0950





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**THE NSS AND CAVE DIVING.** Founded in 1941, the National Speleological Society joins together thousands of individuals dedicated to the safe study, exploration, and conservation of caves. The first cave-diving information ever published in the U.S. was in a 1947 *NSS Bulletin*. In 1948, NSS divers were responsible for the first cave dives in the U.S. using scuba. Prior to 1973, cave diving within the NSS was on a purely local level. That year saw the creation of the NSS Cave Diving Section to provide a vehicle for information exchange. Today, with over 400 members, the Cave Diving Section promotes safe cave diving through semi-annual workshops; cavern- and cave-diving training programs; warning-sign installation; search, rescue, and recovery through the National Cave Rescue Commission; cave exploration and mapping; several texts and publications on cave diving; and the bi-monthly newsletter-journal, *Underwater Speleology*, that you are presently reading.

**MEMBERSHIP.** The National Speleological Society welcomes the interest of anyone who has a sincere concern in the safe study, exploration, and conservation of caves, wet or dry. You may join the NSS either by writing to the NSS main office directly (National Speleological Society, Inc., Cave Avenue, Huntsville, AL 35810) or to the Cave Diving Section (NSS Cave Diving Section, P.O. Box 950, Branford, FL 32008-0950). Regular NSS Membership is now $25.00 per year, and entitles the member to monthly issues of *NSS News* and a semi-annual technical journal on speleology, voting privileges, and discounts on publications, convention fees, etc.

As a sub-organization or "section" of the NSS, the Cave Diving Section is subject to the by-laws and ethics of the NSS. Membership in the Cave Diving Section is open to anyone who is a member in good standing of the NSS. Regular membership is $5.00 per year, and we also offer a CDS Family Membership for $1.00 for family members (who are also NSS members) of regular CDS members. Membership in the Cave Diving Section includes subscription to our bi-monthly (6 issues/year) newsletter, *Underwater Speleology*, voting privileges, discounts on publications items, workshop registration fees, etc.

**NEWSLETTER SUBSCRIPTION.** If you do not wish to join the Cave Diving Section, but would like to keep current on cave-diving events, exploration, and technology, you are invited to subscribe to *Underwater Speleology* for $15.00 per year.

**WHAT THE NSS-CDS HAS TO OFFER.** The NSS Cave Diving Section sponsors two Safety and Information Exchange Workshops each year, traditionally held in Branford, Florida over the Memorial Day and New Year's Day weekends, although exact dates and formats vary. This year's SPRING WORKSHOP will be held at the Branford High School on May 27-28, 1989. The WINTER WORKSHOP will be conducted on Dec. 30-31, 1989. Information and pre-registration materials are published in the newsletter and can be obtained by writing to the NSS Cave Diving Section (P.O. Box 950, Branford, FL 32008-0950).

Information on cave-diving books, back issues of *Underwater Speleology*, T-shirts, Maps (available only to people with a cave-diving certification from an accredited agency such as NSS-CDS, NACD, YMCA, or NAUI), and free safety brochures may be obtained by writing to NSS-CDS Publications Coordinator (NSS Cave Diving Section, P.O. Box 950, Branford, FL 32008-0950).

Information on cavern- and cave-diving training can be obtained by writing to the NSS-CDS Training Director (NSS Cave Diving Section, P.O. Box 950, Branford, FL 32008-0950).

**CHANGES OF ADDRESS.** Members and subscribers are urged to report any change of address or address corrections in writing immediately to the Secretary-Treasurer in order to insure continuity of newsletter receipt. (The Newsletter Editor does not handle the mailing list, thank God!) Membership/subscription status, applications, and general information may be obtained by writing to the Secretary-Treasurer c/o the Section's permanent address:

Secretary/Treasurer
NSS Cave Diving Section
P.O. Box 950
Branford, FL 32008-0950

**NEWSLETTER SUBMISSIONS.** We welcome all current news items, reports, articles, photographs, negatives, slides, cartoons, notices for gear wanted/for sale (individuals only), letters to the Editor, or other submissions of relevance or potential interest for publication in this newsletter. We can now accept textual information on computer diskette if it is on an IBM-XT-compatible 5-1/4" 360K floppy in standard ASCII text format, WordStar version 3.0 - 5.0, Wordperfect up through 5.0, Multimate, MS-Word, and probably a bunch of other junk I haven't tried yet (no one ever reads this fine print!); however, all computer diskettes must be accompanied by a complete paper printout. For a small fee we can also receive FAX transmissions at the printers [FAX only (813) 484-6665 (8am-5pm M-F)]. All submissions become the property of the NSS-CDS.

All articles and letters to the Editor should include the author's name (even if he wishes to be printed as anonymous), return address, and NSS # (if any). If the subject matter refers to advanced exploration dives or techniques, or controversial topics such as deep diving, solo diving,questionable practices or safety infractions, please also include relevant biographical information such as professional qualifications (e.g., if your job is relevant or you have a doctoral degree - specify field), number of years cave diving, number of cave dives, level of certification, instructor status (if any, and number of students trained), exploration and survey projects participated in, cave-diving or NSS awards, etc. (modesty shall not be tolerated, but approximates are acceptable), so that readers may reflect upon the subject matter in the context of the author's experience or lack thereof. (Newly certified divers or non-divers are more than welcome to express their opinions; however, the advocacy of advanced techniques by unqualified divers—or manifestly unsafe practices by any diver—may be subject to review and/or censure.) All newsletter submissions should be sent in directly to the Editor:

H. V. Grey, Editor, UWS
P.O. Box 575
Venice, FL 34284-0575

## CALENDAR

Sept. 29 - Oct. 1, 1989 - Catalina Hyperbaric Chamber "Chamber Encounter," Santa Catalina Island, California.

Nov. 11-12, 1989 - NACD "Research ' 89," Tallahassee, Florida. See Page 3.

Nov. 17-19, 1989 - NSS-CDS Instructor Institute. For additional information, contact the Training Chairman.

Dec. 30-31, 1989 - NSS-CDS Winter Cave Diving Workshop. Branford High School, Branford, Florida.

## NSS-CDS WINTER WORKSHOP

Start making your travel plans now—because preparations are well under way for the annual NSS-CDS Winter Cave Diving Workshop to be held in Branford, Florida over the weekend of Dec. 30-31, 1989. The Workshop is being co-chaired by NSS-CDS Instructors Kelly Brady and Lt. Henry Nicholson. A special pre-registration form was completed just at press time and has been included as an insert. Please read it carefully and return it promptly. We'll hope to see you at the Workshop!

## NACD SEMINAR - "RESEARCH '89"

*[NACD Press Release]*

During the weekend of Nov. 11-12, 1989, the National Association for Cave Diving (NACD) will be conducting its 21st Annual Seminar, "Research '89." It will be held in Tallahassee, Florida at the beautiful Center of Participant Development facility located next door to the Tallahassee-Leon County Civic Center on Pensacola Ave.

During Saturday, Nov. 11 a variety of speakers will give presentations beginning at 9:00am and ending by 5:00pm. That evening a slide and video festival will take place with presentations by outstanding photographers. On Sunday, a variety of workshops will be held focusing on specialized aspects of diving and cave diving. Also, during Saturday, a selection of booths representing dive stores, manufacturers and individuals will be displaying their products and services. As you can see, "Research '89" should be a tremendous success.

Our 1988 NACD Annual Seminar, "Exploration '89," was our best success to date with an attendance of over 300. Parker Turner and Steve Gerrard, Co-Directors of "Research '89," are looking forward to organizing and conducting a quality seminar that will offer interesting and educational topics focusing on our theme, "Research."

If you have any questions, please do not hesitate to contact either of the "Research '89" Directors:

Parker Turner
2414 Glenshire Ln.
Tallahassee, FL 32308
(904) 668-3427
(904) 644-3450

Steve Gerrard
P.O. Box 20006
Tallahassee, FL 32316-0006
(904) 877-8196

## SUBSCRIBERS REALLY MISSED OUT!

If you are only a subscriber to *Underwater Speleology*, and not a member of the Cave Diving Section—and therefore not a member of our parent organization, the NSS, the National Speleological Society—you would not have received the August, 1989 issue of *NSS News*, which is sent to NSS members on a monthly basis as part of their membership privileges.

What's special about the August issue of *NSS News* is that it features two extremely fine articles by one of our premier cave-diving explorers and photographers, and former NSS Training Chairman, Wesley C. Skiles. The first article, "Close Call in the 'Outback' — Pannikin Plain Cave," contains 7 pages of fascinating text and beautiful photos about the narrowly averted disaster that "nearly" occurred at the end of the large sump-diving and documentary-film expedition in the Nullarbor Plain in Australia, when hurricane waters flooded the cave. The second article, "Wakulla Springs Project — High Tech Deep Cave Diving," gives an exciting 6-page overview of the expedition, with several photos. The full-size front-cover photo is also by Wes, and shows Andrew Wight during a remote (push) dive over two kilometers from the entrance of Pannikin Plain Cave.

Copies of this issue are available for $1.50 and can be obtained by writing to the main office of the National Speleological Society: NSS, Cave Ave., Huntsville, AL 35810. (Doug Rhodes [who, with his wife, Glenda, edits *NSS News*] made a special trip from their home in Albuquerque, New Mexico, to Branford, Florida for our Spring NSS-CDS Cave Diving Workshop at the end of May. Doug said he wanted to meet us and that he hoped to feature more articles about cave diving in future issues of *NSS News*—and he's certainly delivered!! It was great meeting you, Doug. We hope you can visit again sometime. We'll get you cave diving yet!)

## 10TH INTERNATIONAL CONGRESS OF SPELEOLOGY

Dr. Jill Yager writes from the 10th International Congress of Speleology in Budapest, Hungary:

"Cavers from all over the planet are here! And plenty of cave divers, too! (From Tasmania to Namibia!) Budapest could be spectacular, but for the smog and the dirty grime that covers the beautiful old buildings. No emission controls, and plenty of diesel trucks and busses! A good trip . . . many adventures. Will send you a report for the news."

We will all look forward to reading it!

## THE MEXICAN CONNECTION: DOS OJOS, REVISITED - by James Coke (NSS #26442) and Lorie Beth Conlin

It was 105° in the shade as I read the fiberglass tape for the 80th time. Not quite 3km to a cenote that I hadn't visited in over 2 years. I was getting pretty excited now as the overgrown terrain looked more and more familiar. The chiclero path was just ahead on the left with another 400'+ of land survey to go; a cool snorkel in the East Ojo will make this trip into the jungle even more worthwhile. Little did we suspect that this was only the beginning to another adventure.

Three years ago an article on Dos Ojos appeared in UWS Vol. 13, No. 5, relating a story of an extended jungle trek to the "Two-Eyed Cenotes." Not being one of the longest or deepest underwater cave systems in Quintana Roo, Mexico, the article had more to do with its being a very unique and beautiful underwater cave. Much unlike the celebrated caves found in the Tulum area, the Dos Ojos expedition was a trip to a rich cenote area discovered in the Xel-Ha drainage area. This cenote was only one of many to be explored; yet as the story unfolded the cave was as intriguing as its remoteness.

Three weeks ago we completed two portions of a land survey that would allow us to position Dos Ojos Cenotes with a nearby underwater cave, Nohoch Nah Chich. With much effort and help, Mike Madden had mapped this cave to more than 34,000' of surveyed passage, and still going. Nohoch presents the same logistical problems as Dos Ojos; it's a long way into the jungle before you can sample the rewards. We had volunteered to help Mike by completing a lengthy survey on land to determine the assumed proximity of Dos Ojos and Nohoch; indications of a possible connection between the two caves on the Nohoch survey did appear feasible. As time permitted we slowly completed our job, celebrating finally in the cool waters of a 3-year-old legend.

"Dos Ojos was put on the back burner when the jeep was, well...lost. Logistics were tough enough hauling gear back and forth to the cenote with the jeep; it would be even harder without Willey." As I said that, we couldn't find my reasoning particularly noteworthy; and not being able to come up with any other good reasons why we shouldn't dive Dos Ojos, plans were started "cenote-side" for a major push dive upstream. Too much unknown territory lay beyond the end of the 1986 line to ignore.

We planned on a 3-day project where we could comfortably move 400 lbs. of equipment into the jungle, perform the dive (fingers crossed!), and leave the site with all equipment intact.

Taking into account the heat and sun, we couldn't wear ourselves out before the dive, so we elected to use some of the local help in portering the gear, making the process easier. We did not realize at the time, though, how entertaining we would be for the porters, and how delightful they would be for us. Crazy gringos swimming into a cave filled with "monsters and serpents" attracted a small crowd of our porters, their friends and everyone's family. On the descent I thought about our topside hosts raffling off the remaining gear if we didn't return at the specified time. That thought vanished the moment we swam into the cavern zone.

Twin singles, stage bottles, and 1800' of braided #24 appeared to be the way to make the push, as plans called for single tanks to be carried into the jungle. The singles were much safer for handling by unknowing hands and would prevent a premature end to our dive should we experience manifold problems. Depths averaged 25' (freshwater) so a long dive was promised as we entered the West Ojo in search of new passage. For me it was like visiting a long lost friend; for Lorie Beth it was making a new acquaintance.

Finding ourselves at the end of the original line initiated the exploration past the Air Pocket Chamber. This chamber is said to be one of the prettiest rooms in Quintana Roo due to its size, decoration, and the large air bubble found on 60% of the cave ceiling. What began as new borehole passage quickly disappointed us as the cave started to wander and pinch. Desperation motivated us to search the last lead, and as the cave ascended it invited us into a dry cave. It was a small room and very pretty, but we still had over 1500' of line and plenty of air left in our stage bottles. In surveying back to the start of our line a decision was made to swim into the Air Pocket Chamber and use the current-blown tree roots hanging from the ceiling as the guide. That unlocked the door to a new passage in Dos Ojos, the Dry Eye Section, or Tikim Wich in Mayan.

Interestingly enough, the cave passage from there on was almost predictable, and spectacular. Long runs in wide open bedding plane at depth would suddenly wall off, exposing a large breakdown-formed crack on the ceiling that forced exploration to ascend into a huge chamber. Tree roots bent under by the current were the guide to further cave, yet each chamber had more than one inviting lead. Air pockets and immense and fragile speleothems enriched each chamber as the methodical spinning of the reel handle grew more rapid. At the "end" of each chamber a breakdown crack beckoned with a sound spring flow leading into deeper white bedding-plane passage.

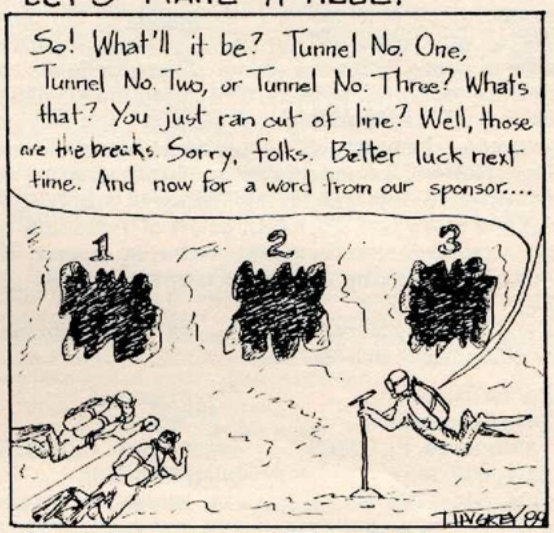
Having emptied all but the last reel, a distinctly large air pocket located on the edge of a large room drew our curiosity. Surfacing with a hand over my helmet at first brought alien sounds to my water-filled ears. Faint echoes interspersed with tiny squeaks dominated the indistinct view; taking off my mask improved the dim scene. We had surfaced in a sump within what appeared to be a sizeable dry cave. Bats flew overhead while squeaking their protests to our intrusion. Lorie Beth slapped a mosquito on her hand just before it could deliver the final coup de grace. The sump had to be fairly close to the dry cave's entrance, yet this was not the time to get out of the water to investigate further. Still had a bit of line left on the reel that was destined for a place to stay. As the final bowline appeared on the reel I glanced at my pressure gauge, as Lorie did hers. It was agreed that a lot of air remained for the survey out; too bad about the lack of nylon.

Completing the double-slate survey and on our way out, I had more thoughts about our Mayan friends on the surface. We had told them that our dive would take almost 3 hours, and had expected them to go home, eat, and relax out of the sun and bugs. Our eventual appearance in the West Ojo brought a murmur from the same crowd we had left behind; although they were passing around the last water bottle we had brought and smoking the last of the cigarettes. Historically, the Maya have always smoked a "chamal" or cigarette to celebrate an occasion. We certainly didn't want to put a damper on their party as a lot of equipment needed to be carried out of the jungle that afternoon!

The next day saw all the tanks at the road head and a small party ensuing. Stories about the dive and jokes were traded. Some of the Mayans remained adamant that monsters did live deep in the cave, and we were just lucky not to have been eaten. Again, a few asked the same question, "What are you really looking for in that cave?"

Using a SMAPS 4.2 computer program gave us some quick information on the exploration that we had just completed. Nohoch will soon be on this program and a definitive line survey should show us how close these two cave systems really are. Return trips are being planned for the near future, with more line being added to the gear inventory. We hope to find a lot more cave passage in Dos Ojos; we'll let our friends provide the monsters and serpents.

"LET'S MAKE A REEL!"




COURTESY OF DUSTIN CLESI

## STYGOBIONT: A Sporadic Column by a Seeker of the Dark
### - by Dennis Williams (NSS #18261)

**The Old-Fashioned Way—She Earned It.** During the afternoon of the 21st day of June, a Wednesday, Jill Yager successfully defended her Ph.D. thesis and became one of the very few (if not the first) Doctors of cave diving. Her area of study was Remipedia, the little crustacean that she discovered 10 years ago in Lucayan Caverns, on Grand Bahama. All of her field work was in the special kind of water-filled cave where Remipedia are found. This type of cave is known as anchialine and contains marine water covered by fresh or brackish water. If you want to know how to pronounce anchialine, here's some help.

There are four syllables, ANCH-I-A-LINE.

1. ANCH is the same as the first syllable in anchor and rhymes with yank.
2. the "I" is pronounced as an "e" and rhymes with he.
3. the "A" is a long "a" as in say.
4. LINE is the same as in fishing line.

This name was coined by a biologist in Europe (Lipke Holthuis) and translates as "near the sea." It has become

noteworthy to American cave divers because it describes most of the water-filled, inland caves in the Bahamas, the Yucatan, and the Caribbean.

The full title of Jill's doctoral dissertation is "THE REMIPEDIA: A STUDY OF THEIR REPRODUCTION AND ECOLOGY." During five years of field study Jill spent less than the equivalent of two days underwater. Most Ph.D. researchers in ecology would have the luxury of hundreds of days in the field. However, when the environment that is being studied demands ritual attention to life-support equipment, is beneath one hundred feet of water and is hundreds of feet horizontal from air, is in perpetual darkness, and requires a healthy waiting period before you can safely return to the surface of the earth, the word luxury is seldom heard.

Most of us cave divers are content to complete a dive with little more than a few memories. Jill returned from her dives with enough information to teach us about the animals that swim in the anchialine night and to get herself a Ph.D. Congratulations are in order from all cave divers to Jill Yager. If you want to contact Jill you can find her at:

Jill Yager, Ph.D.
Biology Department
Antioch College
Yellow Springs, OH 45387
513-767-7331

Oh, by the way, June 21st is the longest day of the year.

**Uncommon Caver.** I called Steve Maegerlein the other day. I had some technical questions and I knew that Steve would have the answers. In the old days I would get a chance to meet with him several times a year, at the workshops and during the NSS national conventions (he was Treasurer of the CDS for several years). After he graciously gave me the answers to my questions (have you noticed that not everyone will share their dive notes?), I asked him how often he was cave diving. I got the feeling that he would like to be wet more than he is, so if you live near southern Indiana and want to dive with one of the master craftsmen of cave diving, give him a call. I didn't ask him if it was okay to tell you guys this and he may say no to your offer. But, if you get a chance to dive with him, don't miss it.

**Earth's Most Buried Man.** Floyd Collins' casket and tombstone were removed from their long-time resting place inside Crystal Cave on Flint Ridge and placed in a small cemetery in Mammoth Cave National Park. This took place in March at the request of his remaining family members, and the grave-side service was limited to family and a few park officials. If you have just landed and are unaware of Floyd then you have missed one of the best caving stories of all time. Get a hold of a copy of the book, *Trapped*. The NSS Bookstore will sell you one if your friends are also new here.

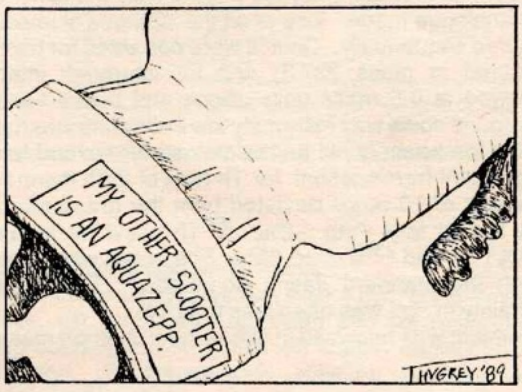
**Continuing Education.** In June, Alex Penn and I spent a week dry caving in Flint Ridge. We took the Speleology course sponsored by Western Kentucky University, and taught by Roger Brucker. The first day we caved for nearly 10 hours, gaining access to this underground playground by way of the Austin Entrance. This was not my first time in Mammoth cave. I crawled around in there during the early 80's looking for the Kentucky Blind Shrimp with Terry Leitheuser. This was Alex's first time in a dry cave, and she would have been thrilled with just an hour or so of caving. However, Roger took the class to Argo Junction and back with several side trips. It occurred to me sometime after the seventh hour, having just worked my way 80' down Brucker Breakdown, that pain can result from caving with an unlimited supply of breathing air. It took my old muscles three days to get well. Fortunately my head is still messed up. Since I first caved there, part of me has always lived somewhere just inside the Austin Entrance.

Roger has taught this course for the past ten years and it may be taken for undergraduate or graduate credit. There is no doubt that one of the neatest things about this course is that you get to cave in Mammoth Cave National Park with Roger Brucker. He teaches with, what I assume is, the same enthusiasm he employed to lead trip after trip into Flint Ridge, helping to make it the longest known cave in the world (300+ miles). If you want to learn more about caves, to understand their geology and biology, their history and future, how to survey and photograph them, and you want to learn from someone who loves them, you should consider taking this course.

—Stalactites do it a drip at a time.

## MALARIA DANGER IN TROPICS

Training Chairman Joe Prosser sent in a copy of an article from the June, 1989 issue of *In Depth* which reported on two open-water divers who contracted Malaria while visiting Honduras. The article stated that the Foreign Travel Division of the Center for Disease Control considers the risk of Malaria in Honduras low, but recommends that all travelers take weekly prophylactic doses of Chloroquine before and during their visits. If you are planning any cave diving or open-water diving in tropical and subtropical rural areas of the Philippines, New Guinea, Indonesia, Vanatu, Africa, South America, Honduras, etc., you may want to contact the Center for Disease Control in Atlanta. Foreign Travel Division: (404) 639-2572.




## DENNIS WILLIAMS COAUTHORS ARTICLE ON URANIUM DATING OF CAVE DEPOSITS

**High-Precision Mass-Spectrometric Uranium-Series Dating of Cave Deposits and Implications for Paleoclimate Studies - by W.-X. Li, J. Lundberg, A.P. Dickin, D.C. Ford, H.P. Schwarcz, R. McNutt, and D. Williams**

*[Originally printed in* Nature, *Vol. 339, 15, June 1989.]*

ABSTRACT: Calcite deposits in caves, known as speleothem, can provide valuable palaeoenvironmental information.[1-4] In particular, because speleothem are deposited only in air-filled caves, gaps in deposition in coastal caves record high-stands of sealevel. Here we report the use of isotope-dilution mass spectrometry to date speleothem by the uranium-series method. The use of mass spectrometry in uranium-series dating was first applied to corals,[5] and has greatly improved the precision of this dating method. The speleothem dated here—a flowstone from 15m below modern sealevel in a Bahamian cave—records changes in sealevel over the past 280,000 years. The dated hiatuses in deposition indicate high sealevel stands that are in general agreement with data from deep-sea oxygen-isotope stratigraphy[6] and other

estimates for the timing of high-stands and glacial minimum.[1-3,7]

Corals record only the highest sea stand; speleothem complement the coral record in that they record a much larger fraction of the total range of sealevel. Coral has the advantages of high U content (3 ppm), easy recognition of alteration of the primary aragonite to calcite, and negligible incorporation of common (detrital) $^{230}Th$. Although generally having lower U content (ppm), speleothem is typically precipitated as coarsely crystalline calcite which inhibits recrystallization or chemical migration of isotopes. Most speleothem from the deep interiors of caves contain negligible amounts of common $^{230}Th$.

Clear calcite crystals were dissolved in 7M $HNO_3$. A $^{229}Th/^{236}U$ tracer (calibrated against uraninite in secular equilibrium) was added. The solution was dried, redissolved in 7M $HNO_3$ and loaded on a pre-cleaned and conditioned 12-ml nitrate-form anion-exchange column. Major-element ions were eluted with 7M $HNO_3$. U and Th were eluted with $H_2O$ and 1M HBr and purified further through two sets of 0.25-ml columns. The final stage involved separation of Th (eluted with 6M HCl) from U (eluted with 1M HBr). The dried U fraction was loaded onto a tantalum-rhenium double-filament bead. The Th fraction was loaded onto the V-shaped side filament of a rhenium triple-filament bead, because this yielded the best $Th^+$ ion emission. All filaments were of zone-refined metal. Filament beads were outgassed under vacuum before loading. Blanks showed no U or Th counts higher than the background level.

Isotope ratios were measured on a VG354 solid-source mass spectrometer with a 27-cm radius and 90° magnet sector. Uranium and thorium analyses used a Daly multiplier detector in the analogue mode. Ions of all the isotopes of interest were measured sequentially. Counts were corrected for background (measured at mass 227.3) and for interpeak interference (measured at 0.5 mass units above and below each peak). Background noise was extremely low and tailing was negligible. A stable ion beam could be maintained for several hours with no significant fractionation: for Th runs of 2-3h means of each of the sets of 10 ratios deviated from the grand mean of the whole run by less than 0.2%. $^{230}Th$ could be measured to ±0.13% (1σ) and $^{234}U$ to ±0.05%. The errors were propagated through the standard dating equations.[8] The resulting 1σ uncertainty in age was often less than 1%.

Uranium was analysed in two stages: isotope masses 235, 236 and 238 over 60 cycles and then masses 234, 235 and 236 over 100 cycles. Each run was monitored and adjusted to keep the $^{234}U$ ion beam high and the Ta filament current at the optimum for U ionization, between 2.0 and 2.3 A. This single-spike, two-stage method for $^{234}U$ measurement differs from the double-spike, single-stage method of Edwards *et al.*[5]

Thorium was normally run in one stage over 100 cycles (masses 229, 230 and 232) but if detrital Th content was high, interference from the high $^{232}Th$ necessitated a two-stage run (masses 229, 232, and then 229, 230). The center-filament Re current was kept at ~5 A to give a $Re^4$ ion-beam current of 1.5 x $10^{11}$ A. Each run was monitored to yield a stable and long-lived $^{230}Th$ beam with current ~5 x $10^{17}$ A, while keeping the side-filament Re current between 2.2 and 2.6 A.

The measured ratios must be corrected for mass discrimination by the Daly detector and for mass fractionation

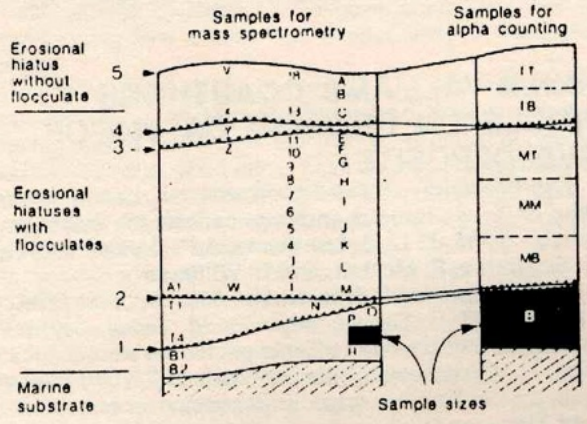



Fig. 1. Sampling diagram for Bahamas flowstone DWBAH. The dashed lines show the four erosional hiatuses with FeO(OH) flocculate. The uppermost erosional surface has no flocculate because sealevel remains above it. Shaded areas compare sample sizes for the two dating methods. Sample size is a function of U content and age for the DWBAH speleothem (with a U content of 0.15 ppm), samples of 3-5g sufficed for mass-spectrometric analysis, shown in black on the left, whereas alpha-spectrometric analysis, on the right, would require ~40g of sample.

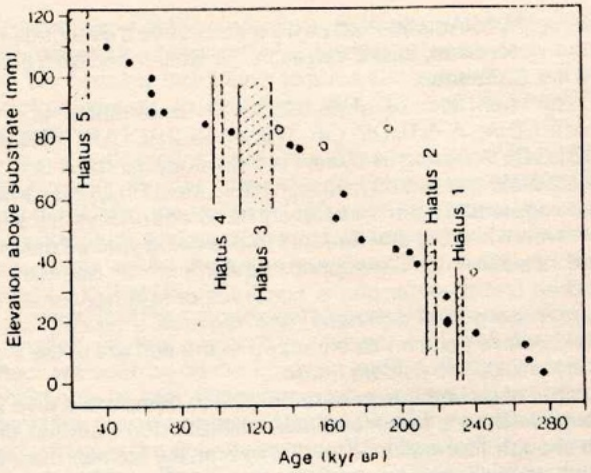



Fig. 2. Mass-spectrometric dates for Bahamas flowstone sample DWBAH from -15m in a submerged cave. Dates are shown by solid circles with 1σ error bars. Where no error bar is apparent it is smaller than the size of the symbol. Open circles indicate samples on hiatuses that show unexpectedly high ages as a result of U leaching. Vertical solid lines show the date of sealevel fall. Vertical dashed lines show the approximate date of sealevel rise. The crosshatched areas show periods of non-deposition during high sea stands.

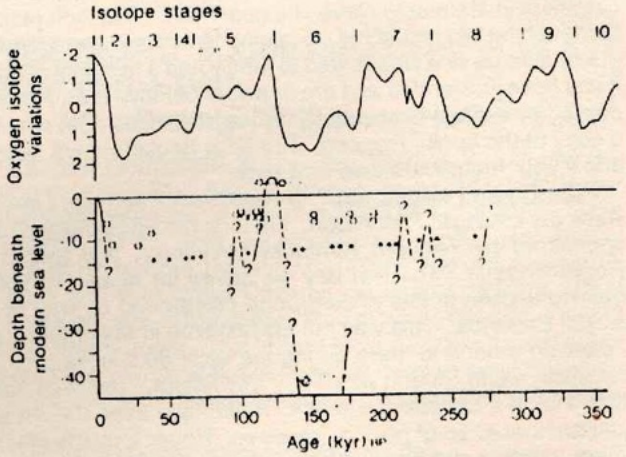



Fig. 3. Pleistocene sealevel curve for Bahamas from speleothem dates, correlated with the oxygen isotope record.[6,14] The slope on which the speleothem dates are plotted is the maximum estimated tectonic subsidence rate[2] of 1m per 50kyr. The mass-spectrometric dates from this study are shown as solid circles, alpha-counted dates from Gascoyne *et al.*[2] as open diamonds and those from Harmon *et al.*[1-3,7] as open squares.

TABLE 1

*(a) Tests of standards*

NBS005a*

| | $^{234}U/^{238}U$ | $2\sigma$ |
|---|---|---|
| NBS value | $3.417 \times 10^{-5}$ | $0.070 \times 10^{-5}$ |
| McMaster value† (mean of 6) | $3.416 \times 10^{-5}$ | $0.003 \times 10^{-5}$ |

McMaster standard speleothem 76001‡

| Technique | N | Age (kyr) Mean | $1\sigma$ | Low age | High age |
|---|---|---|---|---|---|
| Alpha count | 29 | 47.35 | 2.85 | 44.50 | 50.20 |
| Mass spectrometry | 12 | 47.58 | 1.17 | 46.40 | 48.75 |

*(b) Comparison of alpha-counted ages and some mass-spectrometric ages for equivalent samples of the DWBAH speleothem*

| Sample | | Alpha-count dates Age (kyr) | $1\sigma$ error | | Mass-spectrometric dates Sample | Age | $1\sigma$ error | |
|---|---|---|---|---|---|---|---|---|
| 2DWBAH | BHB | >350 | | | B2 | 274 | +4.7 | -4.7 |
| | B | >350 | | | P | 241 | +3.5 | -3.5 |
| | 2B | >350 | | | | | | |
| | | Hiatuses 1 and 2 | | | | | | |
| | MB | 170 | +69 | -42 | A1 | 209 | +11.0 | -14.0 |
| | MBR | 307 | +64 | -119 | 1 | 197 | +3.5 | -3.5 |
| | MM | 203 | +121 | -55 | 6 | 168 | +2.0 | -2.0 |
| | MT | 139 | +54 | -39 | 10a | 144 | +5.2 | -4.6 |
| | | | | | 10b | 139 | +4.8 | -5.3 |
| | | Hiatuses 3 and 4 | | | | | | |
| | TB | 66 | +11 | -10 | 14 | 71 | +2.0 | -2.0 |
| | TBR | 60 | +6 | -6 | 15 | 64 | +0.5 | -0.5 |
| | TT | 76 | +8 | -7 | 18 | 39 | +0.7 | -0.7 |

* Uranium isotopic standard NBS005a (National Bureau of Standards, USA). Our measured ratios were well within the error of the NBS figures.

† Mass-spectrometric value

‡ The McMaster standard speleothem 76001 has been dated many times by alpha-counting[1-3]. The mass-spectrometic dates were well within the error of the alpha-counting dates.

during ionization at the filament. Ideally both are corrected by normalizing a measured isotopic ratio to an accurately known constant value. For the first stage of U analyses the naturally occurring, constant $^{235}U/^{236}U$ ratio of 0.0072526 was used. The corrected $^{235}U/^{236}U$ ratio then became the normalizing ratio for the second stage.

Normalization of Th was done as follows. Measurements of NBS U500 standard on the Faraday detector (which shows no mass discrimination) indicated that fractionation at the filament was only -0.007% per mass unit, whereas Daly measurements on NBS U500 showed that fractionation plus mass discrimination was up to 0.5% per mass unit. We assumed that Th behaves in a similar fashion to U, that fractionation is also negligible compared to mass discrimination at the detector, and that the measured ratios can be adequately corrected with the mass discrimination factor of $(m_1/m_2)^{1/2}$.

Analyses of two standards demonstrated the precision of this method (Table 1a). We then dated the submerged flowstone from the Bahamas (Table 1b), where the growth record helps to constrain eustatic changes in sealevel. Previous alpha-spectrometric studies[1-3,7] showed how dates on drowned speleothem can set limits on times of high sea stands on Bermuda and the Bahamas. The sample chosen was of high purity (low detrital Th); also, its low U content (0.15 ppm) provided an extreme test of the method.

The sample (Fig. 1) from 15m (±0.75m) below sealevel in Lucayan Caverns, Grand Bahama Island, shows three prominent, and two lesser, growth layers. Each is terminated by an erosional hiatus. Upon each hiatus, except the final one, is a thin layer of goethite (FeO(OH)) flocculate. This pattern is found to be the predominant flowstone sequence to depths of -20m in caves of the Bahamas Banks.

The sequence of (1) flowstone deposition, (2) dissolution of its surface, (3) flocculate deposition and (4) resumption of flowstone deposition represents (1) calcite deposition in the vadose zone, (2) subaqueous solution, probably at the fresh/saltwater interface, (3) saltwater flocculation of iron compounds and (4) return to vadose conditions. The hiatuses are products of sealevel rise. The flowstone immediately above each goethite layer dates sealevel fall through -15m or a little more (to allow for a shallow freshwater lens); however, the date of each sealevel rise cannot be pinpointed so confidently because an unknown amount of flowstone is lost by dissolution during inundation and submergence of the cave.

Figure 2 shows the mass spectrometric dates and Table 1b illustrates their much greater precision and reproducibility compared with alpha counting. Except for samples on the hiatuses (which probably experience U leaching during ensuing dissolution events), all the dates are in chronological order within the error bars. Bearing in mind tectonic subsidence of the Bahamas Banks (estimated[2] at ~1+m per 50kyr) and the difficulty of determining sealevel rise because of the erosion, the hiatuses indicate periods of sealevel high than -10 to -15m at >280kyr, 235-230kyr, 220-212kyr, 133-110kyr, 100-97kyr and <39kyr (Fig. 3).

The four rather short-lived peaks, at around 230, 215, 125 and 100kyr BP, are generally in agreement with the high-sea-stand chronology inferred from oxygen isotope stratigraphy of oceanic foraminiferal cores[6] and do not support the recent suggestion[9] that the chronology of the marine foraminiferal record is questionable. However, the isotope variations in foraminifera are affected by other factors in addition

to ice volume; sealevel changes follow the timing and general pattern of the foraminiferal isotopic variations but the magnitude of variations need not be directly comparable[10].

The Bahamas flowstone DWBAH sample shows no record of the expected (that is, to -15m) sealevel rise in isotope stages 5a and 7a, although deeper speleothem may record rises to lower levels at these times. This sample also shows no evidence of the rise at -40kyr reported by Mylroie and Carew,[11] but any part of it younger than 39kyr has been lost to erosion. Further mass-spectrometric dating of submerged speleothem from various depths in the Bahamas and elsewhere should permit the construction of palaeo-sealevel curves of much greater prevision than any that exist at present.

This study has shown that isotope-dilution mass-spectrometric U-series dating of speleothem is possible to at least 400kyr BP on samples with U content as low as 0.08 ppm Speleothem with high U content (3 ppm) should permit dating approaching 600kyr BP. Where $^{234}U/^{238}U$ ratios can be shown to have remained constant, mass spectrometry will also give higher-precision age estimates beyond 600kyr (ref. 12). As in alpha counting, the presences of detrital Th creates the problem associated with common $^{230}Th$. For the samples analysed here, however, with $^{230}Th/^{232}Th$ activity ratios greater than 100:1, this problem was negligible.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COURTESY OF RICKY CZAK

## CAVE DIVING IN THE NORTHEAST, PART 3: UNUSUAL GUIDELINE TECHNIQUES

### - by John Schweyen (NSS # 24848)

*[Editor's Note: Sump diving—scuba diving in flooded portions of otherwise dry caves—is one of the most advanced and technically demanding specialties of cave diving, and as such, is well beyond the scope of most recreational sport cave divers. It is best attempted only after tutelage under experienced and acknowledged sump-diving experts.]*

*ABOUT THE AUTHOR: John Schweyen has made over 500 cave dives, 400 of which have been sump dives, primarily in the inhospitable cave conditions of the northeastern United States. He has made exploratory sump dives in 47 different sumps and has "cracked" 29 of them. He is currently heading the NSS-CDS's Sump Diving Project, has frequently lectured at NSS-CDS Cave Diving Workshops, and has written numerous technical articles on sump-diving techniques and equipment for* Underwater Speleology. *The following is the third in a series of articles discussing the particular problems of sump diving in the cold northeast caves.]*

I mean unusual in that some of them are not covered during cave-diving instruction in this country, and some are applicable only in exceptional, life-threatening situations. These are a few techniques that will make life easier, will keep you from getting into trouble, or if you prefer to dive on the edge, might get you out of trouble. In most cases, they are just variations of standard procedures that are familiar to experienced sump divers.

**Turning the Dive in Low Vis.** You're nearing the turnaround point after pushing some difficult passage and you're over 200' from the last good belay. You look around for a natural tie-off, but there's nothing in sight. The vis is closing down and you can't spend all day back here. Should you start reeling up line and cut it at that last belay? You can, but you'll become a frustrated diver if you have to do it often. There are two things you might try to avoid derigging fresh booty. One is to just dump the reel and pick it up the next time. If it's not empty, and you expect to be back soon, this may be most efficient. However, if you won't be back till next year, you risk losing your reel or finding that it doesn't work as well as before. The other option is to tie a loop in the line, weight it with a small piece of lead, and cut the reel off.

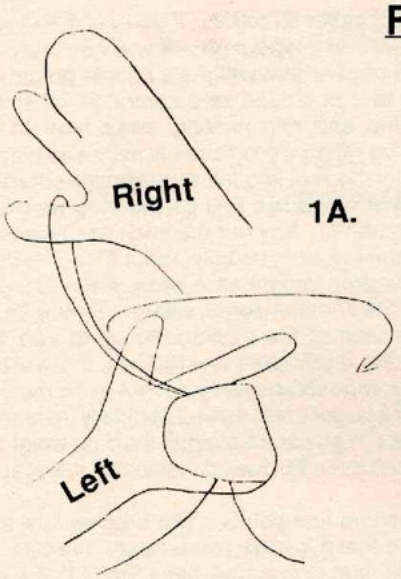
Small drop weights are one of the most useful items in the sump diver's inventory. They are really just portable tie-offs that are used when there are no natural tie-offs and a bombproof belay is not required. For quick placement and removal, it's useful to attach a clip. On a push dive, I usually carry two or three bullet weights for belaying the line in addition to the one I always have for lost line emergencies.

Let's go back to the turnaround problem. You put a loop in the line, clip a drop weight into it, and cut the reel. (If you cut the reel off first and subsequently lose the line before weighting it, you may have to chase the end around, an exciting prospect in low vis. If you are on uneven floor, think about locking the reel so it doesn't roll away.) On the next push, a fresh reel is tied into the loop, the drop weight is unclipped—unless the clip is jammed with mud—and the dive proceeds.

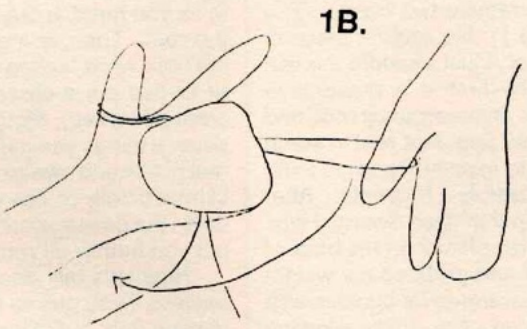
When loading the reel, you should always tie loops at the beginning and end of the line. This will save you the trouble of tying knots underwater when you happen to turn the dive at the end of a reel or when you switch reels.

Now let's make things a little more challenging: no natural tie-offs, 40° water, and instead of low vis, we have zero vis. This doesn't happen very often, but it's good to know what to do. You still have the option of ditching the reel, but if this is unacceptable, you're left with the problem of tying a loop with

# FIGURE 1 - TYING A FIGURE-8 KNOT WITH MITTENS




1A.



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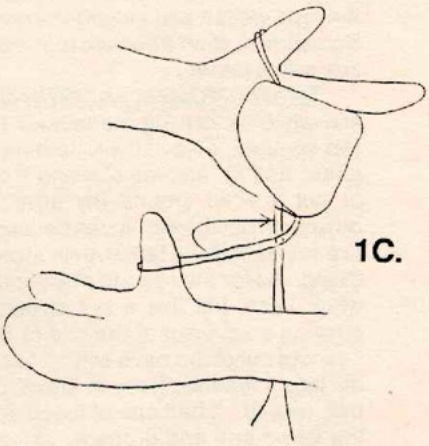
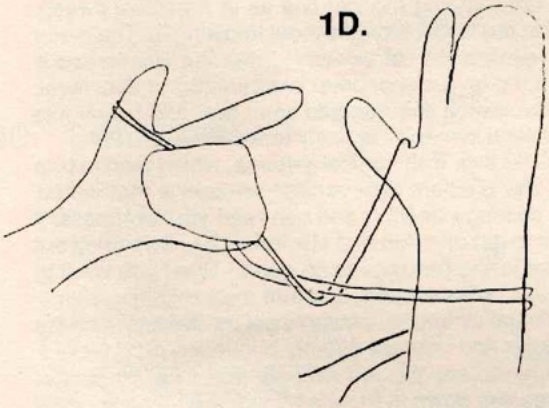
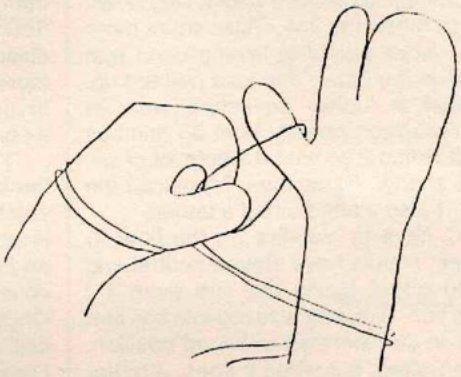


1C.

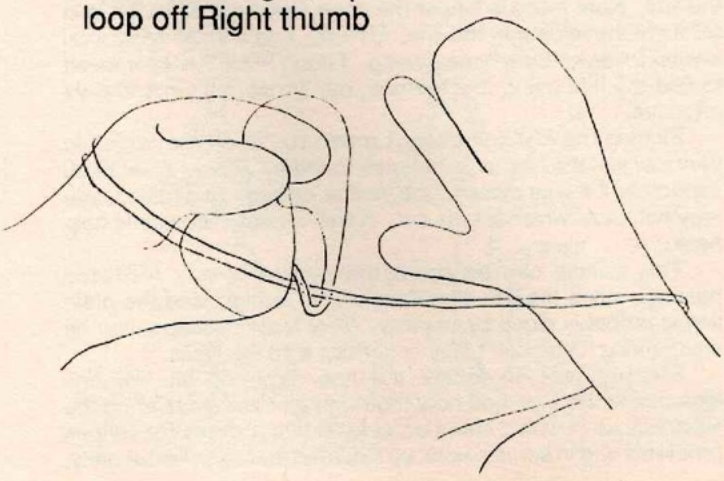


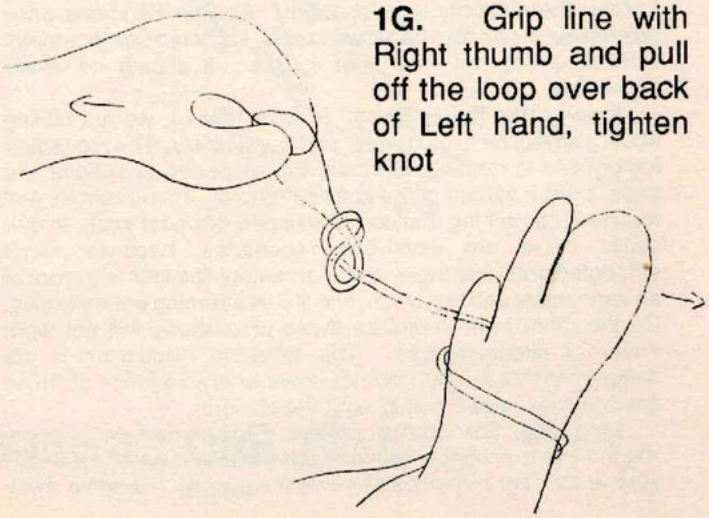
1D.



**1-E.** Form the "OK" sign with Left thumb and forefinger through loop on Right thumb, then release line held by last 3 fingers of Left hand

**1F.** With Left thumb and forefinger, pull loop off Right thumb





**1G.** Grip line with Right thumb and pull off the loop over back of Left hand, tighten knot

gloved hands and without the convenience of eyesight. The technique I've been using is illustrated in Figure 1. This is just a method for tying a figure-8 loop with three-fingered mitts on and eyes closed. Given the constraints, this is the only knot that I've been able to tie. If you can master the knot, clipping in the drop weight and cutting the reel off shouldn't be a problem. Sometimes, at an awkward turnaround, it's useful to clip into the line with a tether . . . .

**Tethers.** A tether is used in low vis to clip yourself into the line while performing maneuvers that require two hands. The two common objections to tethers are 1) "It's another piece of gear," and 2) "Instead of using a tether, I just straddle the line or put a wrap around my arm." The first is a reasonable objection, but the same can be said for an emergency reel, and I've found that the tether gets more use than that reel in sump diving. As for the second objection, I do exactly the same thing when I can, but this is not always possible. Example: After pushing a squeeze at the end of Sump 2 in Arch Spring, I was heading out of the cave when I felt a slab of rock on the back of my leg. I reached back to knock it off and grabbed my weight belt instead. It had one of those open-water-diver buckles with the flared end and probably came loose when I was wiggling through the restriction. So, I had my weight belt in one hand, the line in the other, and I was on the long, steep side of the silt mound in very low vis. If I let go of the weight belt, I would probably go to Never-Never Land, since the ceiling height in this area was unknown. I dumped some air, straddled the line to work with both hands and proceeded to slide backwards down the slope—not a safe way to follow the line. After some more farting around, I decided to move ahead to level ground with weight belt in one hand, line in the other, and toes pointed up. I was very unhappy. After a further adventure with an entanglement and a decompression penalty from 35 minutes additional bottom time, I left Sump 2 without a whole lot of air. Fortunately, Sump 1 was a shorty. Since then, I replaced the buckle with double D-rings. I also started using a tether.

With a tether, you don't have to stabilize on the floor to straddle the line. In my case, I could have stayed neutral and clipped in without worrying about losing the line even if I unintentionally changed position. You can also clip into line that is up too high to straddle or in an otherwise awkward position. Granted this doesn't happen often, but when it does, a tether can save your butt.

The few tethers that I've seen all have a clip or carabiner at each end, which allows for flexibility in placement. One end is clipped to a convenient point of attachment on the diver, and the other is clipped to the line. The tether that I use is just an 8" piece of surgical tubing with a non-locking carabiner on one end and a large boat hook on the other. The 'biner goes to the line. The surgical tubing will certainly not hold much weight, but I prefer the elasticity over strength. As Ron Simmons once pointed out, it can also be stowed under slight tension to prevent it from spilling out when not in use. It should be easily accessible.

**Emergency Procedures.** In what follows, we are talking about a solo diver in cold water and low visibility. The procedure for lost line is nothing new, and the response to serious line traps is just a variant of the lost line routine. The entanglement routine is something that was developed this past year. In one sense these are worst-case scenarios, because minor entanglements, line traps, and momentary line loss are more of an annoyance and rarely turn into life-threatening emergencies. On the other hand, I'm sure these procedures will not work under all circumstances. The following discussion is not comprehensive in that I do not cover every variation of these emergencies, and I usually omit the obvious.

**Lost Line.** Standard procedure: Stop immediately. In low vis, the line is probably within reach—sweep around for it with your arms. Try not to lose orientation and do not move away more than a couple feet in either direction. If you can't find it, go to your emergency reel and drop weight. If you don't have a drop weight, any piece of gear that weighs a couple pounds should suffice. If you try to look around for a natural tie-off you are wasting valuable time and risk moving away from the guideline. In addition, tying off on a projection is risky and time consuming in low vis. Clip the reel into the drop weight—there should be a clip on the end of the line and on the drop weight so that this is a quick maneuver. Lay out as much line as you think you need to reach the lost line, usually about 6', and lock the reel. Then, using the drop weight as a base, swim along the floor while feeling for the line (horizontal sweep), Figure 2a, or sweep out a cross section of the passage to try to trap it (vertical sweep), Figure 2b. If you can't find the line, there are several things you can try: repeat the sweep, let out a few more feet of line and sweep out a larger area, sweep vertically instead of horizontally or vice versa. You can also move the drop weight down the passage and start over, but keep in mind that this may put you further off route.

Now let's talk about some fine points. The drop weight is useless if you pull so hard that it follows you around. I've been using a 2-lb. bullet weight, and in practice, have found that it's not difficult to judge the proper amount of tension. However, a stressed diver is more likely to ignore this. Jamming the weight into the silt helps prevent movement.

During horizontal sweeps in zero vis, it is important to keep one hand in contact with the floor to avoid missing the line. Even then, you are not trapping the lost line as in a vertical sweep. You may just be pushing it along without knowing it. The major disadvantage with horizontal sweeps is that the search line is more likely to snag on rocks or other irregularities at floor level. In one case, my search line dug into sand bar, and I went into a spiral. Horizontal sweeps are likely to screw up the vis.

I've had better luck with vertical sweeps, which tend to trap the lost line. The problem with vertical sweeps is that unless you know the passage bearing and can read your compass, it is more difficult to get oriented and stay oriented. Sweeping out an area parallel to the passage is no good. What you want to do is sweep out a cross section, and that means finding a wall. Once you begin the sweep, it is easy to get turned around if the ceiling is irregular and you are directly above the drop weight. I saw this happen to one person who got into a ceiling pocket during a drill session down in Florida. If you are trying to cover the entire perimeter, and the vis is zippo, one hand should always be in contact with the side of the passage to avoid missing the line. You may have to run out some additional line from the gap reel to stay in contact with the walls.

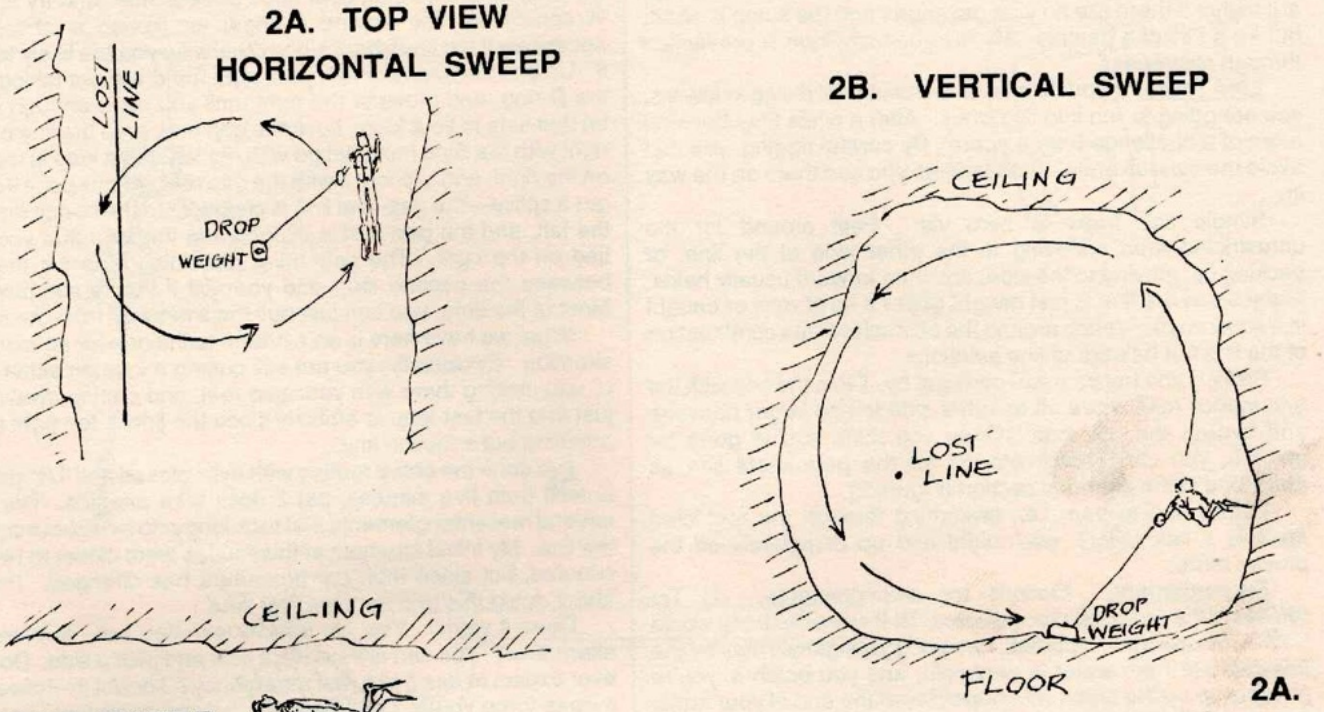
I've had more success with sweeping out a cone. This is really just a vertical sweep that is done some distance away from the drop weight, Figure 2c. The advantage here is that you don't get disoriented at the ceiling, and you are still trapping the line. Note that the longer the cone, the more difficult it is to tell if you have caught the line. Usually, I do a small horizontal sweep followed by a cone sweep. I don't think I've ever failed to find the line using this method, but I'm sure it's not always effective.

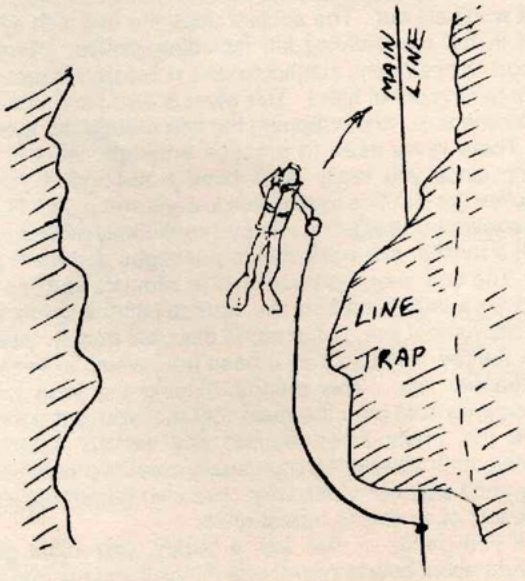
Finding the lost line doesn't mean you're off the hook. In very low vis, the line is sometimes found by getting entangled, especially if it was close to the wall or ceiling. In addition, you may not know which way is out. A well-marked line would help here.

This routine can be counterproductive in very restricted passage since the risk of entanglement is high, and the main line is probably close by anyway. Very large passage may be disorienting if you can't stay in contact with the walls.

Elapsed time to locate the line depends on visibility, distance to the line, and how thorough you are at covering the search area. I would count on at least five minutes for serious problems and in some cases, up to fifteen minutes. Fortunately,

## FIGURE 2 - LOST LINE PROCEDURES




## FIGURE 3 - LINE TRAP

TOP VIEW

I've never had to do this in a real emergency.

It is stupid to run search patterns unsuccessfully until you are out of air. If things get desperate, you can take your best shot and start heading for the surface. If you are familiar with the area, a compass will be useful. Your chances of success are higher if there are no side passages and the sump is short, but it's a hell of a gamble. My favorite technique is prevention through awareness.

**Line Traps.** If you do a lot of explorational diving in low vis, you are going to run into line traps. After a while they become more of a challenge than a scare. By careful rigging, you can avoid the serious ones . . . as long as you see them on the way in.

Simple line traps in zero vis: Feel around for the unrestricted area. Moving to the other side of the line, or backing up, moving to the side, and then forward usually helps. Many times the line is just caught under a lip of rock or caught in a small crack—reach around the obstacle for the continuation of the line but beware of line junctions.

Serious line traps: If you can't get by, T into the line with the emergency reel, move off to either side to find larger passage and bypass the line trap. Once you think you've gone far enough, you can search around for the permanent line as described in the previous section (Figure 3).

Forcing a line trap, i.e., swimming through the restricted area, is a last resort—you might end up completely off the proven route.

**Entanglement.** Options for entanglements: 1) Try removing the snagged piece of gear. 2) If more dexterity would help in disentangling yourself, removing your gloves may be the answer; but if the water is very cold, and you botch it, you're going to be up the creek with popsicles at the end of your arms. I've never dared to try this since my hands get cold easily. 3) If you know which way is out, cutting the line while holding onto the good end is usually the quickest way to disengage yourself. It's also a good way to kill yourself if you're not careful. I've only slashed the line twice, mainly to save on decompression time after a deep dive. I was very happy with the results. Don't hesitate to perform surgery if time is critical and nothing else is working. And if you do a lot of low-vis diving, think about carrying at least two knives.

After Roberta Swicegood's accident, an interesting question was asked during a discussion on guideline surgery. How do you cut your way out of an entanglement without violating the continuous guideline rule if you don't know which end to hold onto? Here's the deal: Gloved hands, no vis, no buddy. You're wrapped up tight, you don't know which way is out (disorientation after finding a lost line), and you have to cut the line. I agree, it'll probably never happen, but if you can get out of this one, all the others will be cake—well, almost all.

Obviously, the cut line must be spliced to keep it continuous. If you have oodles of slack, just tie loops in the line on either side of you, link the two loops with your gap reel, and cut yourself away from between loops. Unfortunately, you rarely have enough slack to tie knots.

The following routine will work with very tight line: Unlock your gap reel, pull out a short amount of line, lock it, and clip it into a chest D-ring on the side you expect to cut the line (let's assume this is the left side), Figure 4a. Pull out your tether, clip the 'biner to the permanent line on the left at arm's length, and twist it around about 5 or 6 times (Figure 4b). Then, holding onto the snap-hook end, twist the carabiner around so that you have about 5 wraps of bungy around the line (Figure 4c). (During some early work, we found that these bungy wraps are critical to holding the line.) Attach the snap hook to the 'biner (Figure 4d). This prevents the 'biner from twisting back, and forms a loop in the bungy. Without unlocking the gap reel, clip its line into the bungy loop (Figure 4e). If the line hanging out of the gap reel is long enough, you shouldn't have to unclip the reel from the D-ring at the risk of dropping it. Get a couple wraps of the main line around the thumb or forefinger of your left hand, and cut it midway between this and the bungy attachment. (If you cut the gap reel line by mistake, you'll have to put a loop in the end, attach it to the boat hook or carabiner, and try again.) Wrapping the line around a finger for friction is absolutely necessary if the line is taut since otherwise you are likely to lose it. Unlock the gap reel with your right hand without taking it off the D-ring, and move to the right until you have enough slack on that side to tie a loop. Lock the gap reel, grab the line on the right with the right hand, let go with the left, put a loop in the line on the right, and clip into it with the gap reel. At this point you've got a splice—the gap-reel line is clipped into the bungy loop on the left, and the gap reel is clipped into the loop that you just tied on the right. The only thing remaining is to cut the line between the second loop and yourself if you're still tangled. Most of the time, you can just pull the line away from the snag.

What we have here is an extreme technique for an extreme situation. Essentially, you are still putting a loop on either side of you, linking them with your gap reel, and cutting away. It's just that the first loop is artificial since the line is too tight to tie anything but a friction knot.

I've done the entire routine with eyes closed and 1/4" gloves in less than five minutes, but it does take practice. I've had several real entanglements that took longer to fix without cutting the line. My initial attempts at this routine were closer to twenty minutes, but since then the procedure has changed. Forget about doing this one right the first time.

Does it work? Yes. Is it tedious? You bet. Is there an alternative? You can always flip a coin and pick a side. Do you ever expect to use it in a real emergency? I doubt it—however, it does force you to practice skills that are commonly used in low-vis sump diving.

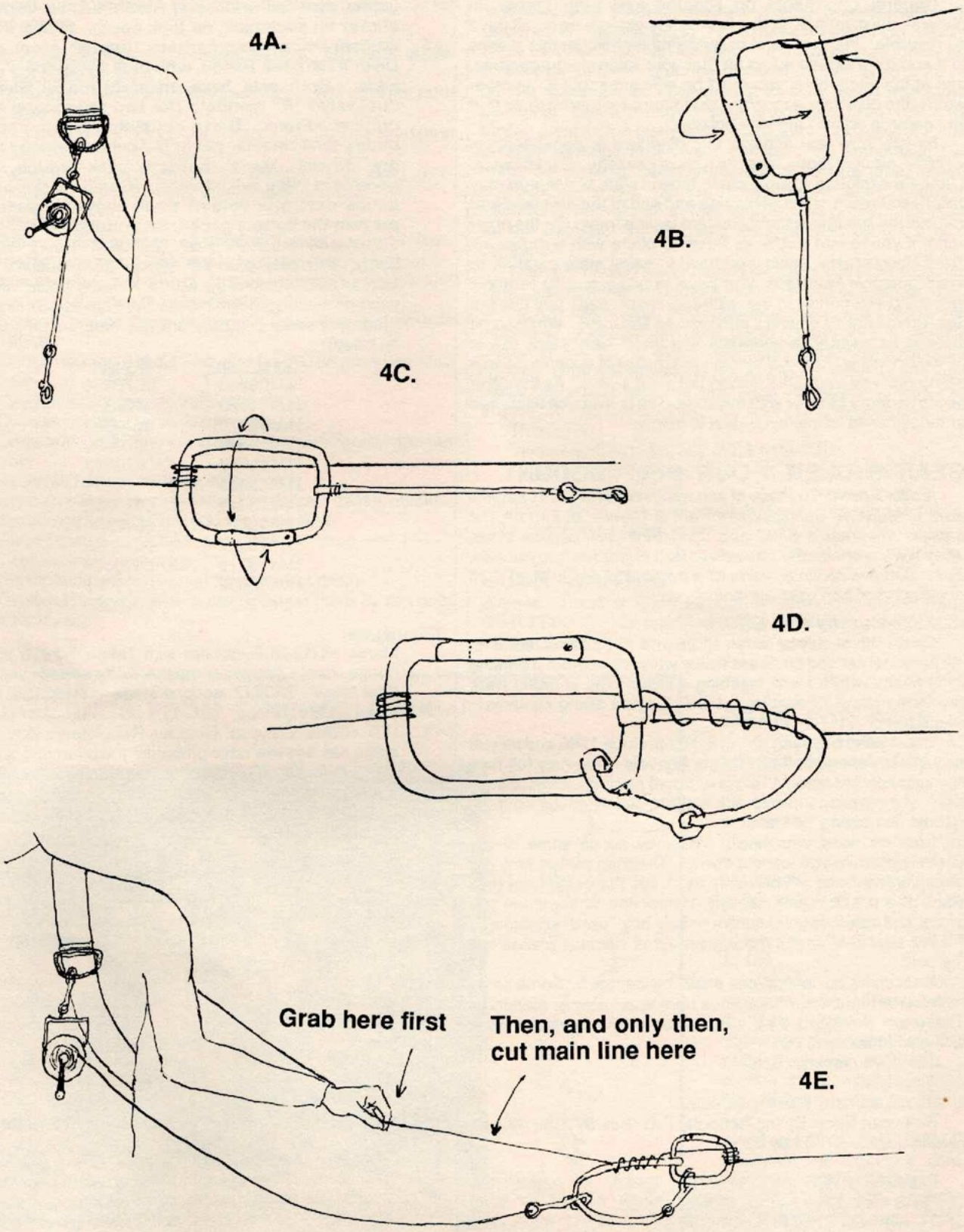
**Drill work.** A lot of divers pay lip service to the concept of practicing emergency procedures and don't do anything about it. Cave divers who expose themselves to low visibility should develop some kind of response to these scenarios and practice that response under simulated conditions. The first thing that they'll find is that the fix can be difficult—so difficult that the chance of doing it right the first time in a real emergency is very slim without practice. The psychological and time pressures would be overwhelming. They will also find that they are more cautious since they really won't want to resort to these procedures in an emergency. At the same time, however, they will probably be more comfortable in the water. Finally, they will discover that I failed to mention all the subtle details.

The safest way to practice this stuff is in a warm, clear cave that won't silt out. The subject does the drill with eyes closed and in full sump-diving kit, including gloves. Another diver keeps an eye on the subject to take notes and to prevent things from getting out of hand. This diver is also useful for setting up good line traps and wrapping the line around the subject.

There is no need to practice entanglements in a low-vis sump since you really don't need a ceiling. If you have to practice the lost-line routine in a low-vis sump, DO NOT violate the continuous guideline rule by intentionally getting off the line. Pick a familiar site without side passages and don't go in very far. The only way I've been able to simulate lost line in low vis is to run another line from the surface into the sump, parallel to the permanent line, but at some distance from it. About 50' in, lock the reel and use it as a base from which to search for the permanent line. This means clipping the drop weight and emergency reel onto the main reel that you just dumped. I've done this many times without any serious entanglements. Having other divers with you usually creates problems because they can't stay out of the way. I've also found that it's good to have lots of air during repeat drills.

If you prefer to dive with a buddy, you might give some thought about how to coordinate things if you run into a line trap

# FIGURE 4 - ENTANGLEMENT PROCEDURES



or the two of you get off the line at the same time. Obviously, having another person around can be a complicating factor. And don't ask me what to do if the person ahead of you gets entangled in a restriction and you can't reach to help—oh, the knives . . . oh, the horror!

**General Comments on Rigging and Line Traps.** In general, the diver's objective is to safely explore as much cave as possible. In the context of guideline technique, this means that you must rig the sump so that your return is guaranteed, and at the same time, you must be efficient about it. In other words, the objective is to return along the exact same route that you came in on with minimal belays.

Exactly how you achieve this objective is dependent on visibility, silt conditions, and the type of passage. For instance, if you are exploring a large, clean tube in clear water, you may only need belays at the beginning and end of the dive, and you can pull the line taut without concern for line traps. On the other hand, if you're into a low-vis bedding plane with a dense silt cloud biting at your heels, you have to belay more carefully to avoid potential line traps, you have to belay quickly to avoid becoming enveloped in the siltout, and you can't pull the line taut without risk of driving it into unseen line traps. While some slack is necessary to negotiate line traps, very slack line is difficult to follow. Optimal tension is a matter of experience with hitting real line traps and finding out what works. As the diver becomes more familiar with the sump, the line can be tightened or repositioned to make it easier to follow.

## GEAR STOLEN - OUR HELP SOUGHT

*[Editor's note: To those of you who have dived the beautiful cave in Manatee Springs State Park at Chiefland, Florida, the names "Friedman's Sink" and "Sue Sink" are familiar ones. They were named after cave diver Bob Friedman and his wife, Sue. Bob has recently suffered a tragic and devastating theft of diving gear and asks our help.]*

Dear Friends of the NSS-CDS,

On the 4th of July between 11:25 and 11:35 in the morning, my personal car and business trailer were stolen from a parking lot in Miami where I was teaching a class. The vehicles were recovered about 3 hours later, but ALL of the diving equipment was stolen.

I have been teaching diving in Miami since 1966 and as you may know, American Sport Diving Schools is the only full-time diving school in Miami. We sell and rent nothing. It has always been our intention to teach the highest quality scuba courses without competing for sales.

Now we need your help. You may notice some of our equipment while you are out diving. The thieves that may put us out of business will probably try to sell the equipment they stole. It is possible that they will contact you, or someone you know, and ask if you would like to buy any "used" equipment. Please say "yes," and if the equipment is suspect, please call the police.

Most of the equipment can easily be identified. Some items have serial numbers, others have unique coloring or markings. These are explained on the two sides of the enclosed page listing what was stolen.

Thank you for your help.

Sincerely,

Bob Friedman, Training Director

American Sport Diving Schools, P.O. Box 570282, Miami, Florida 33257, (305) 253-5353.

PLEASE KEEP YOUR EYES OPEN IF SOMEONE OFFERS TO SELL YOU SOME USED GEAR. IF YOU SPOT ANY OF THE FOLLOWING EQUIPMENT, please call the Police (Miami Case #1851466-N) and Bob Friedman: 305-253-5353.

**Tanks:** ***NOTE CAVE-DIVING ITEMS!***

2 **Sets of 2400psi Double 100 c.f. galvanized early Nemrod Steel Tanks, with no decals except for one (white with red and blue) Austin's Dive Center VIP sticker on each tank, no tank boots. With a wide red custom-made strap harness through a set of U.S. Diver's Harness Bands, with blue neoprene shoulder pads. Both sets have an early model Sherwood dual-valve "K" manifold (for two regulators) and an original Frank Martz custom-made, anodized, buddy-tank retainer pin in the center (which I use for my 12-cell Martz battery pack—which, thank goodness, was not stolen!). Glued to the harness bands were four sets of small neoprene padding to prevent the battery pack from shifting.**

12 Galvanized Steel 71.2 c.f. (2250psi) Tanks with blue boots, with only one VIP sticker from Austin's Diving Center (white/blue/red), with a K-valve (most with blue valve protector); all tanks and valves are listed numerically (therefore serial numbers are not matched tank-to-valve as listed):

| Steel Tank | K-Valve |
|---|---|
| HJ409940 | 0670326 |
| HJ411123 | 0670331 |
| HJ413278 | 0670333 |
| HJ413549 | 0670339 |
| HJ413557 | 0670343 |
| HJ413606 | 0670351 |
| HJ413611 | 0670353 |
| HJ413620 | 0670360 |
| HJ413622 | 0670363 |
| HJ4137?5 | 0670364 |
| HJ413802 | 0670386 |
| HJ413823 | 0670393 |

**Regulators:**

1 Mares MR12-III Regulator with Tekna T-2850 pressure gauge, depth gauge, compass, knife sheath in console (first stage - 860277; second stage - 03193155; second stage - 03301302)

11 U.S. Divers "Calypso" Octopus Regulators. One second stage has a yellow hose protector, the other has blue. The two other hose protectors are black. There are 4 Scubapro octopus second stages (listed separately). All serial numbers are listed numerically (therefore, they may not match as listed):

| 1st Stage | 2nd Stage | 2nd Stage | SPG | Scubapro 2nd |
|---|---|---|---|---|
| 735047 | 77-13100 | 77-19931 | 197605 | 83222 |
| 736110 | 77-48206 | 77-26122 | 197804 | 931131 |
| 741407 | 77-54240 | 77-28967 | 197920 | 960304* |
| 742857 | 77-54455 | 77-40056 | 197938 | 960388* |
| 743015 | 77-54719 | 77-47349 | 197964 | |
| 744450 | 77-56577 | 77-63303 | 198202 | |
| 745124 | 77-58566 | 82-26791 | 198225 | |
| 745173 | 77-72469 | | 198598 | |
| 745884 | 81-56501 | | 198868 | |
| 748559 | 82-37651 | | 198998 | |
| 749541 | | | 199347 | |

*(adjustable)

**Buoyancy Jackets with Back-Packs (all have white Dacor whistles on hose):**

2 U.S. Divers Advisory Staff "Calypso" - black ("U.S. Divers Advisory Staff" embossed in red on flap of pocket)

3 Small (size) Seaquest "ADV-S1" - blue buoyancy jackets (the letter "S" is inked onto both yellow shoulder pads)

3 Medium (size) Seaquest "ADV-S1" - blue buoyancy jackets (the letter "M" is inked onto both yellow shoulder

pads)
1 Large (size) Seaquest "ADV-S1" - blue buoyancy jackets (the letter "L" is inked onto both yellow shoulder pads)
1 U.S. Divers "Pro-line" - blue and yellow
1 Seaquest "ADV" - black
12 SeaTech "Catalina" - blue and gray (some being used for parts)

**Horse-Collar Buoyancy Compensators (all have white Dacor whistles on hose):**
1 Scubapro - black with blue seam tape, two pockets (oral inflator)
11 Seaquest "Resort" - yellow, no pockets, $CO_2$ plugged (oral inflator)
12 Seaquest "Rough Water" - orange, with $CO_2$ (oral inflators, except 2; some being used for parts)

**Miscellaneous:**
1 Brown carrying case containing Kodak Carousel Slide Project with zoom lens, spare bulb, extension cord, spare remote wire, and set of custom-designed physics and physiology slides (tray labeled)
2 Scuba Caddies (may be carrying the two sets of **double 100's**)
1 Complete First-Aid Kit - labeled (in plastic green and tan box)
1 Oxygen bottle - green (refillable, "D")
3 Oxygen bottles - white (disposable)
1 Complete Tool Box - not labeled (in plastic green and tan box)
- Assorted hoses and other spare parts
1 Scubapro Gear Box - blue, with instructor decals outside, containing assorted masks, snorkels, fins
1 Diver-Down Flag - attached to an innertube
1 Tank rack - four-section
1 Plastic Kiddie Pool - small (to carry wet gear)
1 Garden Hose - custom-made, 5-ended (for washing gear after dives)

## LETTER TO THE SECTION

August 7, 1989

Dear Sirs:

It's time for me to rejoin the Cave Diving Section. I first joined the Section during the 1973 NSS Convention. I did some cave diving in 1976 and wrote a long two-part article for *Underwater Speleology* in '77. This led to my being asked to serve as Vice Chairman for 1980. I must apologize for my lack of work of the Section during that term. I had been without a partner since '76, and my interest in cave diving was rapidly declining. Sump diving in Iowa is not much fun, and I was having great luck in pushing air-filled caves (finding over 2 miles of virgin passage in a 2-year period). The summer of 1980 found me working, going to summer school full time, moving, and getting married. Consequently, I wasn't able to attend the 1980 NSS Convention in Minneapolis and perform my duties for the Section. In '82 I sold my gear and bought a home computer.

I thought I would never cave dive again, so I left the Section. Then, last summer I suddenly had a rebirth of interest. Cave diving was once again taking place in Iowa, and I found that I missed it. I bought my gear back, modernized it, retrained myself for solo diving and did a couple of easy cave dives. This summer finds me reworking my whole rig, constructing some additional equipment and preparing for some serious cave diving. So sign me back up. My address is listed below.

Thank you.

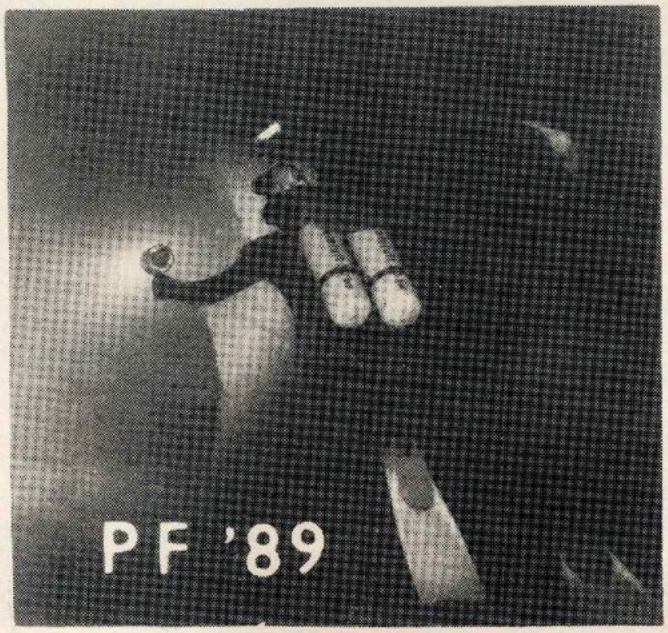
Sincerely, Greg McCarty (NSS #13673)
P.O. Box 396, Fayette, IA 52142, (319) 425-3592

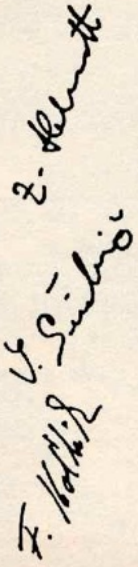
*[Welcome back, Greg! We look forward to hearing about your cave-diving exploration in Iowa.]*

## GEAR WANTED

Wanted - Dead or Alive: ScubaPro manifolds. Call Jarrod at (904) 371-3990. Or call Ginnie Springs at (904) 454-2202 and ask for Jarrod.

## GREETINGS FROM CZECHOSLOVAKIA!



## GEAR FOR SALE

1 Viking Pro-Surveyor, size 01 with wrist rings installed, with a pair of extra wrist seals, repair kit, inflator hose, full Viking underwear, pair of 5-finger gloves, and a large Viking equipment/gear bag. The warranty is good, and I've never taken it out of the bag except when I first received it. I'ts under a year old. I'd like to sell it for $1100.

4 Luxfer 80's, and a pelican rack for them, 1 Sherwood twin manifold (never used), 1 equalizer hose/manifold, 1 $O_2$ bottle (not tank) and valve. All hydros are no more than a year old. I'd like (need) to get $400 for that.

I have all the receipts for this equipment if someone should request a copy. Contact:

Jerry Furman
557 Milwaukee
Denver, CO 80206
(303 399-2877.

# CAVERN AND CAVE MAPS
# P.O. Box 950, Branford, FL 32008-0950

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