

# undercurrent®

THE PRIVATE, EXCLUSIVE GUIDE FOR SERIOUS DIVERS

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## At The Request Of Our Readers

### -- Personal Favorites And Pacific Pelagics

Dear Reader,

Each month I get letters requesting my personal recommendation for a dive vacation. I don't answer all of them, not only because of time limitations, but also because many writers presume I have the powers of Carnac. Take this one: "My wife and I are experienced divers and go diving every Christmas. We want something new this year. What do you recommend?" (Since the only thing I know about them is that they don't stay home at Christmas, that's about all I could recommend as new). Another wrote: "I went to Cayman two years in a row, but went to Bonaire last year. I'm thinking of returning this year. What do you think?" ("I think you should, I replied, which made about as much sense as the question.)

I would hope that this monthly newsletter gives plenty of good and varied leads each year, especially in conjunction with the readers' updates which we run every 12-18 months. But I do understand how difficult it is to choose between destinations. A Chicago reader, not wanting to make the choice himself, tossed it squarely back to me. "I want to take a dive trip in the next 6 months. I've read Undercurrent for six years and have probably been diving about as much as you. But with all you know about travel, tell me where you would go -- and I'll make my reservations."

Now I had to ponder that. The truth is, I wouldn't know where exactly to go. With so many variables and so many choices, I too get confused. Yes, I've dived in a few dozen overseas spots, but there are scores more I've never been to and I get just as enticed by those features in Skin Diver as anyone else. But I have an added advantage: I read hundreds of comments each year from our readers who can keep me up to date on a number of interesting places so my perception of what's good and bad might be a little better than the next guy. So, if I were to plan my next trip, here's what I would do.

If I wanted to spend big bucks, get big thrills, and dive my butt off, I would sign up on just about any boat trip that See and Sea Travel offers. I

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sometimes presume that diving's biggest boat booking agency might operate like a shuttle service, but aside from a few nitpicky comments we get, they normally stand tall in the crowded field. If I were to hop one of their craft, my destinations of choice would be Papua New Guinea, the Maldives, the Philippines or Fiji. And I'd work holidays to afford their pricey trips.

Closer to home, the Aggressor fleet gets high praise. I'd opt for the Belize Aggressor outside Belize's barrier reef -- too many of the Aggressor's Cayman sites are accessible from the land, and, well, Cayman is a bit of a bore anyway. A bore, I say, only because it has developed into an American suburb -- and looks like it. For my money, Spanish Cove is Cayman's only first rate dive resort, although hotels and dive operations have proliferated ad nauseam. And Cayman dive operators ought to be ashamed of the destruction of the reefs off once lush seven mile beach. If your idea about Caribbean living is dining on Whoppers, being towed around in a parachute, or watching satellite television in your room or the bar, Grand Cayman is your ticket to paradise.

A couple other islands offer the night life, the restaurants, and all the tourist trappings -- along with decent diving: St. Thomas, in the US Virgins, and Barbados. I myself prefer less development and more local color. I like to travel back in time, to when the only destinations for divers were the small and distant fishing lodges. At a moment's notice I would head to any of three little hostels on Little Cayman (Sam McCoy's Lodge, Pirates Point, or the Southern Cross Club) where the tourists and the residents seldom total more than a hundred and the diving is arguably the best in the Caribbean. Just as quickly I'd head to the pristine and primitive Coco View on Roatan, where I could roll off the porch into good diving -- or get the best of both worlds by spending 4 days on their little liveboard. And, I would add to my list the isolated St. George's Lodge in Belize, where the diving is super, the accommodations excellent, and where proprietor Fred Goode continues to push up his prices to make his profit with the fewest possible divers around. And I wouldn't overlook Divi's well-run Tiara Beach Hotel on Cayman Braz, a perennial reader savor, with a first-class Peter Hughes' dive operation.

There's not much left of that pristine underwater wilderness in many other parts of the Caribbean. Saba is one underdived spot, itself unique, the very place I would select for a nonbeach, culturally different vacation. You see, you can wear your flannel nightie year round at the country inn-like Captains' Quarters, which sits about 1500 feet high on this little volcanic island, yet get better-than-decent diving in the sunny Caribbean. Our readers tell me that Sea Saba -- not Saba Deep -- is the shop to do my diving with.

Some winter diving is for the birds -- or even penguins. I find winter in the Bahamas too chilly for my bones, but in the summertime -- unless a hurricane forms -- it can be super (or pretty average, if you don't go to the right place). Two favorites here -- the Riding Rock Inn and Rum Cay, both of which have good accommodations and the best of Bahamas' diving.

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And while you're avoiding Bahamas' winter diving, avoid Hawaii as well -- there's too good a chance that a great storm will pass through from December to February. Other times of the year you can get the most personally guided dives anywhere at Dive Makai on the island of Hawaii. Central Pacific on Maui is less personal, but deserves credit for continuing to please its customers -- especially with its Lanai and Molokai dives. Hawaiian coral isn't much to gawk at, but the fish life can be exotic. And both islands are good for families, tennis buffs, and all the conveniences of home, including Whoppers.

But if you're a serious diver who can get this far, perhaps you had better keep traveling to exceptional diving and an exceptional hotel -- the Palau Pacific. I'd sure want to give this place a go. And I'd like to give the wrecks of Truk Lagoon, where a giant Japanese fleet took its ultimate bath, few days time. Graham Clark at the Blue Lagoon is the choice here.

Some of this is too price-y for everyone, so where do you go if you haven't got deep pockets? I suppose Cozumel, where swarms of divers deplane daily. Air fare competition helps keep the cost down, as does the decline of the peso (although food and lodging here is still many times what it would be at nontourist, mainland Mexico). To be honest, as of this writing I don't know where I would hole up or with whom I would dive. Too many conflicting reports from our readers. So, I suppose I'll have give that island a first hand look.

Finally, if I were hell bent on photography, I'd go where I can get repairs, develop my film, and be sure that I won't lose a week if I flood my strobe. To contradict myself from a few paragraphs ago, that would mean anyplace on Cayman, but the photographer's island of choice would probably be Bonaire, where you can get truly professional service from Photo Bonaire. (By the way, a couple readers have reported that the Nikon Photo Seminar has improved immeasurably since our lovingly critical report in February.)

Finally, I would never turn down a chance to dive Australia's Great Barrier Reef. But only by boat. I would not travel half way round the world to stay at Heron or Lizard island, or any of the other resorts there -- that I've learned from the readers who have disappointedly done that before.

There are a few other places I would never dive. Jamaica, for one. There aren't any fish. I wouldn't go to St. Maarten or Aruba. I wouldn't go to

#### Back Issues And Information

You may order back issues on any of the following for \$5 each. More information can be found in our reader updates, the last published Nov/Dec 1986 through May, 1987. We have also listed phone numbers for more information or reservations.

*Australia*, March 1988

call 415/339-2550

*Bonaire*, April, 1986; January 1988

*Cayman Aggressor*, March 1985

415/434-3400

*Cozumel*, September, 1983

*Papua New Guinea*, August, 1987

800/826-0057 (Calif.) or 800/541-4334

*Palau Pacific*, February, 1987

800/247-3483 or 296/441-3483

*Pirates Point*, August, 1982

809/948-4210

*Rum Cay*, November/December 1983

800/272-1492 or 305/761-1492

*Saba*, June, 1984

800/328-5285 or 011-599-4-2246

*St. George's Lodge*, August 1980

800/678-6871 or 011-501-44190

*See and Sea Travel*, 800/DIV XPRT or

415/434-3400

*Southern Cross Club*, Little Cayman,

July 1984; 317/636-9501

*Spanish Cove*, September, 1982

*Tiara Beach Hotel*, May 1986

800/367-3484

*Truk*, Blue Lagoon Dive Shop, tel. 796.

PO B 424, Truk Lagoon,

East Caroline Islands, 96942

Ambergris Caye in Belize in the wintertime, because the wind keeps most people inside the reef and away from the real diving. I wouldn't go to Nassau, which is about as burned out as Key West. I wouldn't go to Loreto, in Baja Mexico, which touts its splendor with full page ads, but has yet to please a single reader of ours. I wouldn't go to Honolulu, unless I was in Hawaii and couldn't get to the other islands. Nor would I go to a Club Med or any similar resort anywhere, unless driven by motivations deeper than diving.

And, if I were after big fish and big excitement, but want to stay in this hemisphere, I think I'd select Cocos Island. It's a damned exotic destination as this month's reviewer reports:

C.C., travel editor

## *Cocos Island; Costa Rica*

I want to tell you about an exciting and thrilling, seldom dived location. As it turned out, the boat I took was not up to snuff, but it is being replaced by a super craft next season. Let me tell you what may be in store for you.

Cocos Island, reputedly the world's largest uninhabited island, lies 300 miles off the Pacific Coast of Costa Rica. It's a beautiful and friendly country, itself worth a few days of excursions into the coffee shops or countryside, replete with rivers and rain forests.

Air fares from Miami run as low as \$300 round trip and from Los Angeles about \$450. Although the waters across the Pacific are reasonably calm in the November to May season, the 30-hour voyage to Cocos is not for landlubbers. But I found at Cocos -- as did a previous reviewer -- a constant parade of pelagic fish guaranteed to shiver your timbers. That means sharks. And plenty of other big fish too. This is a destination only for serious, experienced divers. It's not for those who get their jollies poking around a patch reef.

At Shark Fin Rock I dived a lovely seamount, surrounded by tropical fish so unaware of the difference between divers and fish they never moved away. There were fish in clouds: triggers, butterflies, trumpetfish, and scores of 3 foot white tip reef sharks. I swam under an arch filled with yellowtails and a couple of small cruising white tip sharks, but then, in the distance, four hammerheads began a slow approach. They would come no closer than 30 feet, then disappear back into the blue, only to reappear again and again. I spent much of the dive photographing moray eels and fondling octopus.

This was a typical dive. On others I encountered large schools of shining travellay jack, or mackerel, or bonito. I encountered an enormous snapper which, in our collective wisdom, we estimated at 250 pounds. I'd have been thrilled if it were 50 pounds. And though I had been forewarned the water temperature in January would be in the mid-70's, it never dropped below 82°.

My favorite dives were at Dirty Rocks, where more than once I saw several eagle rays bottom feeding. I always saw at least one manta. Once I encountered a dozen 12 foot ocean white tips, which seemed menacing enough for me never to take my eye off them. Others spotted a mako shark. During virtually every dive, I could hear the whistles of pilot whales which played hundred yards off our boat, but never ventured in close enough for a dive. Where there is colorful

coral; the seamounts are generally rocky peaks, often with innumerable lobster residing in crevices.

I booked my trip through Ocean Voyages, a Sausalito agency specializing sailing trips. They booked me on the 120 foot Albert, indeed a roomy craft. But the Albert was up for sale and the owner wanted out of the business, so concerns were given short shrift. It was undercrewed, so it was difficult to get tanks filled. The divemaster complained of too much work and at times didn't get us into the water. The Albert remained unnecessarily anchored in one bay, requiring divers to make trips in small boats of up to two hours to certain sites. And these boats frequently broke down -- once we missed an entire day of diving. Prior to the trip, I was personally assured that unlimited diving was the rule, but two or three tanks was the norm.

I was at first hesitant to recommend another trip to Cocos sponsored by Ocean Voyages, but my editor insists that I show patience. You see, he called the owner of Ocean Voyages, Mary Crowley, who acknowledged problems with the Albert and its owner and says she will atone with a superior boat this year the air-conditioned 120 foot Okeanos, built in 1972, converted to a classy boat in 1982, and recently purchased by a wealthy Costa Rican. Holding a maximum of 20 divers, the craft has cabins with beds, including doubles, will carry a crew of six, and four skiffs should offer the transportation needed for diving on Cocos. This summer Crowley will try out three different people on private runs to select a divemaster. Because skiffs have to be used to get many sites, she told our editor that four dives per day should be the rule. Until mid-April, the Okeanos was being booked by Baja Expeditions: Ocean Voyages apparently won over the owner of the Okeanos and now has exclusive booking rights. An 11-day trip, with 7+ days of diving, will go for \$1695, plus air.

It's not easy getting to Cocos, but the diving is such an experience that I would give it another go with the personal assurances of Crowley that this year the Okeanos will make it different. Anyone remaining skeptical can follow the recommendation of our 1984 reviewer who endorsed the spacious, comfortable, non-airconditioned 82-foot sloop Victoria. She is still making 12-15 day trips, normally under power, with her long time Swedish crew, offering three tanks a day, good food and good vibes. The April, 1988 Cousteau Society Calypso Log reports on a trip to Cocos aboard the Victoria by a Cousteau team (they noted that warm waters from El Nino in 1982-83 were responsible for much of the coral death; they found great schools of hammerheads, but also noted that illegal hookah diving is eliminating the lobsters and illegal fishing is affecting the hammerhead population; Costa Rica has no one available to enforce the regulations). For information on the Victoria write OTEC, Apdo 323, Paseo los Estudiantes, San Jose, 1002 Costa Rica, tel. 22-08-66 or Fax 332321. Mario Vargas, a PADI and NAUI instructor, offers trips that include sleeping out on the island: PO Box 425-2010, Zapote, San Jose, Costa Rica, tel. 24-00-33.

Costa Rica is a beautiful and friendly country, well removed from the neighboring wars. Many Americans travel there to visit the rain forests, the rivers and the cities. But for diving, only seaworthy adventurers need apply. Thirty hours across the sea is tough enough. Seven days with hammerheads, sharks, and all those other pelagics is for the serious diver. If you pass you're in for quite a trip. Ocean Voyages: 1709 Bridgeway, Sausalito, CA 94965 (415/332-4681). If you're interested in sailing trips write for their super catalogue describing scores of trips worldwide. PS: The asking price for the Albert is \$525,000; she's up for lease for \$49,000 a season. Contact Bill Bolling, 305/743-0443.

# Neurological Dangers Of Diving

## -- More Evidence ... And Readers' Responses

In the twelve years we have been publishing *Undercurrent*, no article has stimulated a greater response than October's "Potential Neurological Damage in Divers," by William Schane, M.D., a staff physician and diving officer of the National Oceanographic and Atmospheric Administration.

In his article, Dr. Schane arrives at three conclusions, based upon several medical sources:

"Many divers are bent and many of those exhibit serious spinal cord diseases, even if they do not violate currently accepted tables.

"If you are bent, even with minor limb pain with only minor transient tingling or weakness after a dive, you may be left with permanent spinal cord damage.

"If you dive frequently, you may be developing permanent brain and/or spinal cord damage even if you do not clinically bend.

"Therefore, I find it paradoxical that at the very time when those of us who treat injured divers are trying to encourage more caution, shallower dives and shorter bottom times, the sport diving community and decompression meter manufacturers and advocates are saying that technology will allow us to dive deeper and stay longer. The meters are no better than the models upon which they are based, and wearing a meter on your arm in no way changes how your body handles culprit gases."

After Schane's article appeared, we received an article from *Lancet*, the British Health Journal, in which I.M. Calder and others performed autopsies on 8 professional and 3 amateur divers, none of whom had been treated for DCS or exhibited documented neurological abnormalities. The authors write that:

"Our results document important tract degeneration in the spinal cord of some professional divers. . . . Could the lesions that we describe have arisen from causes other than diving, such as alcohol toxicity, subacute degeneration of the cord, or multiple sclerosis? . . . [It is unlikely]. . . . The possibility arises that the lesions may have contributed to the patients' difficulties in their final diving accidents. The tract degeneration may have been detectable had a full neurological examination been carried out before their final dives. Our results also indicate that some professional divers appear to be unwittingly working with tract degeneration in their spinal cord."

The results from Calder lend further credence to Schane's point that "more than likely there are long-term consequences to diving that we are only now beginning to appreciate."

More than 150 *Undercurrent* readers wrote for

copies of the Schane bibliography. Several wrote letters. These are what a few readers had to say:

"No doubt longer, deeper dives are being made with the computers. My own experience has been that a growing minority of individual divers and dive guides are relying upon computers to lengthen bottom times well beyond those permitted by the U.S. Navy Tables.

### Dive Tables Under Attack

On March 23, Sarasota, Florida diver Michael Bean was awarded \$175,000 in a suit filed against PADI. The nonbinding ruling was made by a three-lawyer arbitration board. PADI is expected to appeal the decision and defend it in court.

Bean, who had been certified for four months, had made a dive to 100 feet about 40 miles off the west coast of Florida. He alleged that he followed the US Navy Tables, as published by PADI, and subsequently suffered a severe case of the bends. His attorney, Clyde Wilson, a PADI assistant instructor, told *Undercurrent* that Bean was on crutches when he came into their office, but thanks to physical therapy he no longer needs crutches. He walks with a limp and claims to no longer be able to work from a ladder in his wall papering business.

Wilson said that "Nowhere on the tables does it warn the user that even if followed exactly there is still a possibility of decompression sickness. Nowhere in the text material used in the entry level PADI course is there any mention of the fact that different people are or may be affected differently by decompression. Nor is there any mention of the evidence which indicates that about 5% of those following the Navy Tables exactly may experience some sort of decompression problem."

This unique argument -- based on the notion that the PADI Dive tables are a product and therefore subject to the strict liability rules established by product liability law, persuaded a panel of federal arbitrators. The panel determined that Bean was damaged in the sum of \$350,000, but was himself responsible for half that sum because he had accumulated some experience, having been diving nearly every weekend since his certification.

"That computers are more conservative than the Navy Tables is true only in certain instances and the statement that computers make diving safer is an exaggeration. . . . Computers make an interesting contribution to diving, but to state that they make it safer is at least premature and is likely giving a false impression of the safety of relying upon dive computers to limit the risk of decompression sickness."

*Jeffrey D. Hubbard, M.D., San Francisco*

"Although we in Quebec face diving conditions quite different from those in the southern States, most people (including myself) know little about diving medicine or decompression theory other than what we learned during the basic diving course. . . . Reading your article, I might have found the explanation to a mysterious knee problem I had after a summer of doing work at 100 to 150 feet, a problem that no doctor could identify positively.

*Richard Larocque, St. Jean-sur-Richelieu, Quebec*

"I just finished reading Dr. Schane's article. That is pretty scary stuff. I've been diving since 1979, a total of 230 dives. My short-term memory, which a few years ago seemed about the same as anybody else's, isn't worth a damn. It never occurred to me that diving could be a factor. I am 48 and have never been bent.

"It would be interested to hear from your readership whether there are others who have noticed a significant change in their memories or brain function. Why don't you ask them?

"If you should happen to use any part of letter, please do not mention my name. I don't want to announce my balminess to the whole world.

*A Pennsylvania subscriber*

"After 18 years of continuous diving in the Caribbean -- I stopped logging at 5,000 dives about 1972 -- he makes me wonder just a tiny bit about the cause of my arthritic joint problems. It has always been my feeling that 10 years of organized football and joints without strong muscle and tendon attachments -- resulting in injuries and reinjuries -- were at the root of my problems.

"Now, at age 62, I can still ski, walk, and dive with the best of them, but my pain and deformation is located in the areas of reoccurring injuries. I wonder if Dr. Schane is right, or is there a contribution factor of heavy contact sports and the resulting injuries. Perhaps it may be a combination?"

*David Woodward, Steamboat Springs, CO*

"Bravo to Dr. Schane and *Undercurrent* for speaking out. The enthusiasm which greeted the

various decompression computers infected me as well, and I used one uneventfully for three years -- then I got a serious hit as a result of two 40 minute (total) 87' (maximum) depth dives, which were dived quite conservatively as far as the meter readings were concerned.

"What amazes me is that since then, every physician who talks to me about the hit expresses surprise that an experienced diver like myself would trust one of the computers -- but not one hyperbaric expert said anything against the meters to me personally or in any thing I read before I bought that meter.

"Here's what I've learned since my hit after talking to a lot of well-informed hyperbaric physicians and physiologists: the more the diving medicine people research the effects of compressed gasses on divers (or goats, or whatever) the less they are able to draw conclusions. So while the sport scuba diving industry tells us we can dive more often and deeper and longer with safety, the hyperbaric experts warn us that we must dive less often and shallower and for shorter periods of time.

"Each of us makes our own individual decision about how conservatively we dive, but it's critical that we get informed when we make that decision. My thanks again to *Undercurrent* and Dr. Schane for providing the information."

*Dee Scarr, Bonaire*

"In the past 2½ years, I have made approximately 135 dives, most of which have been repetitive dives on boat trips. Since I am 53 years old, I can sometimes ascribe my slips of memory and sore joints to 'getting on in years.' But when my 36-year-old spouse, who dives just as much as I do, has some of the same 'slowing down experiences,' I begin to wonder. To say the least, Dr. Schane's provocative article has more than piqued my curiosity.

"If Schane's hypothesis is true -- that there may be a cumulative effect from diving that may cause permanent neurological damage, even though the tables are not exceeded and the recognized symptoms of decompression sickness are not experienced -- it will cast a most frightening shadow over the entire sport. Whether true or not, however, the mere possibility of its being true certainly warrants increased study and exposure."

*Arthur Silberman, Sausalito, CA*

"As a director of the USAF Hyperbaric Medicine Division, I take issue with the statements of Dr. Schane. He is wrong.

*William J. Ehler, D.V.M.*

*As more information is developed by Dr. Schane and others, we will continue to report it.*

If you wish to receive a bibliography listing the sources Schane used in developing his article, please send a self-addressed stamped envelope

to Undercurrent, PO Box 1658, Sausalito, CA 94966. You may order a copy of the October issue for \$5.

## Bendomatic Decompression Computers

### -- A Challenge And A Response

Everyone, it seems, extols the virtues of the Edge decompression computer. But not Australia's Dr. Carl Edmonds, of Diving Medical Centre, Cremorne, Sydney. The following piece, which has appeared in different forms in *Pressure*, the newsletter of the Undersea Hyperbaric Medical Society, and *Scuba Diver*, an Australian magazine, reports the ill-fated history of decompression meters and computers and challenges the safety of the Edge meter. *Undercurrent*, which has included material from the full study of the Edge issued by Edmonds, takes all responsibility for editing.

To answer Edmonds, we have included a piece which was also published in the two other journals, by Craig Barshinger, a consultant to Orca, the company which manufactures the Edge.

★ ★ ★ ★ ★

Over the years, decompression meters and computers have demonstrated some unique characteristics:

- ★ Enormous quantities are sold. The SOS Scuba Pro meter was said to have sold 300,000 meters by 1977;
- ★ Everyone who uses one is an immediate "expert," by definition;
- ★ Comprehensive testing of the meters' capabilities is not required;
- ★ Support for their use has been based on such scientific statements as "I did not get bent, therefore the meter must be good;"
- ★ The rationale of the principles underlying them need only be given in vague terms, as specific details only confuse the issue; they are all extremely safe and ultra conservative, some offering to only double the allowable bottom time;
- ★ Unlike decompression tables, they work in all circumstances, and all temperatures and all altitudes, and are not influenced by such factors as hard work, cold water, intercurrent illness, diver limitations, etc.;
- ★ They make some people a lot of money, and make other people go broke;
- ★ Academics stay well away from testing these devices, presumably because of a fear of litigation or not wishing to antagonize the

commercial world; commercial entrepreneurs presumably overlook information that could be disruptive to their well-organized advertising and sales campaigns.

#### The SOS Meter

The first decompression meter used by sport divers in the United States was the SOS meter, developed in Italy in the 1960's and later marketed in the U.S.

The Royal Australian Navy School of Underwater Medicine first became interested in decompression meters in the 1970's. In 1971, the first six divers requiring treatment in the School chamber had ascended according to an SOS meter. As the chief observed: "There is nothing wrong with the meters, Doc, it's the divers who get bent."

The SOS meter relies on the flow of air through a restrictive substance. A study of this meter showed that it indicated shorter decompression times than required by the U.S. Navy decompression tables when used for repetitive dives, and for dives in excess of 60 feet. In addition, the SOS meter was dogged by many mechanical problems, with questionable durability.

In 1974 I arranged for a series of tests of the SOS, with the following results:

- ★ There was a great variation between the individual meters;
- ★ The meters gave inadequate decompression for combined dives, compared to the USN tables;
- ★ For single no-decompression dives, the meters became more unsafe as the depth increased beyond 60 feet.

Thus, the SOS meters were not advised for dives greater than 60 feet or for repetitive dives.

Some other test results -- although not published in U.S. periodicals of general circulation until an *Undercurrent* article in 1976 -- began getting some attention in the United States.

Creative divers have found many innovative ways of extending the "allowable" time underwater with the SOS meter. One technique is to complete the dive and then to bring the pointer down faster (and therefore allow further diving), by leaving the meter on top of the compressor, so that it is both heated and shaken by the compressor movements. This is presumed to be very effective in "degassing" the

meter prior to the next dive.

Another technique is to use two separate meters, one on each dive. This allows the diver to remain out of the conventional repetitive situation. A variant on this is not to use the meter on alternative dives. This ensures that decompression requirements are avoided on these alternative dives.

Another variant is to wait until the meter approaches decompression, and send it up in a goody bag with the abalone.

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*"A reading of the Edge instruction manual uncovers many misleading items, but the one with which I would have no argument is the disclaimer of responsibility."*

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[Undercurrent comments: Although tests show that the data provided by the meter has no basis in science and decompression theory, thousands of American divers treat it like a rabbit's foot, relying on it for diving. It is still available in many diving shops, although Scubapro no longer markets it.]

The only meter that has been genuinely tested according to acceptable standards with scientific merit before being marketed, to my knowledge, has been the DCIEM. Even now, this is not available in a commercial format in Australia and I would be reluctant to support it until all the results are presented.

### The Orca Edge

The Orca Edge is the most popular decompression computer today. A reading of the Edge instruction manual uncovers many misleading items, but the one with which I would have no argument is the disclaimer of responsibility.

The manual states that the Edge is not a guarantee for avoiding the bends. It is claimed that the experience from thousands of dives indicates that the Edge is a better bet than the U.S. Navy tables. The manufacturers suggest that sport divers add extra safety factors, e.g., not getting closer than 5 to 10 minutes to no-decompression limits. This would presumably exclude all no-decompression dives in excess of 120 feet, although the manufacturers do not draw this conclusion from their advice.

The brochure stresses the importance of dive planning, wearing back-up depth and time measuring devices and regularly confirming the calibrations. There is a very clear disclaimer, without limitation, exonerating both the seller and the manufacturer from any liability for personal injury resulting from the use of Edge.

I teamed up with two colleagues to perform in a chamber a series of no-decompression dives according to the Edge computer and to compare these with USN tables. My desire to test the Edge came after one of my old diving buddies got bent diving the

wreck of the *Yongala* in 1986. I tested the device she was using, along with other models, at the Royal Australian Navy School of Underwater Medicine.

My friend had made two dives to 87 feet, after which she developed decompression sickness. It appeared that the computer had allowed a dive combination that would not be permitted by the U.S. Navy tables. There were several possible explanations of this decompression incident: a chance occurrence because of the fallibility of the decompression tables, a misreading of the computer, a fault within the computer itself, or the computer program permitted an unsafe diving profile.

As a measuring device showing the depths, maximum depth, durations, surface intervals, temperature, the Edge was very reliable and accurate.

For single dives to a fixed depth, sometimes it was safer than the Navy tables, other times it was not. I would agree with the manufacturers' doubts about using it at great depths. I would set 120 feet as the maximum for the Edge -- and only for a single dive.

For multi-level diving there is no adequate comparison to make -- as there has been no satisfactory trial performed to test these concepts. Karl Huggins, (who developed much of the theory on which the Edge is based) in his oft-quoted report on multi-level diving tested eight schedules, most of which would be incapable of producing the bends in anyone, and did not find evidence of bends.

In the two schedules which he tested and which were slightly questionable, he produced either bubbles or bends. This does not reassure me in any way about the safety on multiple-level diving protocols.

However, if the unproven multi-level dive theories are correct, then the Edge computer may be of value for a single multi-level dive, with certain qualifications. Basic diving principles should be applied, i.e., the deepest part of the dive should be performed first and the diver should ascend throughout the dive. If the reverse holds true and the diver performs his maximum depth at one stage during or towards the end of the dive, I believe the computer would be unacceptable.

The area in which the computer is certainly not of value is in repetitive dives of any nature. When we performed 19 repetitive dive protocols, including 69 dives in various combinations, the computer came out far less safe than the U.S. Navy tables. It often omitted up to many hours of decompression with some of the repetitive dives (the computer said no decompression was needed!).

As one glaring example, one could dive to 141 feet for eight minutes, with surface intervals of one hour without decompression, throughout the day. When one considers that Pearson and Leech in their open water trials stopped at the second of such dives because of concern regarding the bends incidents, and the omitted decompression according to the U.S. Navy tables after the eighth dive is calculated as between four and five hours, one gets some idea of how

radical the Edge computer is.

I would doubt that any sensible researcher would be courageous enough to test many of the repetitive dives which are acceptable, no-decompression dives according to the Edge, on a diver.

A typical dive which the Edge allowed, without incurring a decompression requirement, was:

49 feet, duration 75 minutes, surface interval three hours;

82 feet, duration 25 minutes, surface interval two hours;

115 feet, duration 10 minutes, surface interval one hour;

148 feet, duration eight minutes.

I would challenge the manufacturer to go, together with their families and friends, into a chamber and perform such a repetitive dive schedule, and see what sort of pretzel comes out at the end.

### Safety Factors with Established Tables

With the Navy tables, there is no possibility of an encompassing the vast combinations of depths and duration available with the Edge. The tables use increments of water depth and time segments, thereby compelling the diver to "pigeon hole" his dive into one of the established depth/duration "boxes."

One of the most obvious safety factors is the "rounding up" of the depth and duration so as to decompress according to a greater depth and greater duration. Thus, if a diver descends to a depth of 56 feet for a period of 62 minutes, he will decompress as if he has been to 60 feet for 70 minutes.

This rounding up results in a safety factor in favor of the established tables. As one approaches the designated depths and durations, the less safe the dive will be, as more inert gas is absorbed into the tissues for the same decompression obligation.

This safety factor contributes to the relatively acceptable results when divers use these tables. Attempts to use the maximum depth/duration to approach the no-decompression limits have resulted in unacceptable incidences of decompression sickness. As it calculates decompression requirements for the precise depth and time, this safety factor is omitted with the Edge.

Although the slower recommended ascent rate (20

feet/minute from 0-60 feet, and 40 feet/minute from 60-120 feet) with the Edge may be of benefit in reducing the danger of pulmonary overload with venous gas emboli, it will also add to the nitrogen load in the tissues, when performing repetitive dives.

### Conclusion

The Edge, despite its sophistication, reliability and ingenuity in design, has followed other computers that have been commercially released and marketed as "safe" before being adequately tested.

Any diver using the computer should take five or ten minutes off his bottom time (this virtually prevents any deep diving), and also should dive well within the decompression limits proposed by the computer. Even these two qualifications do not make the computer safe for repetitive dives.

Surely technology is now available to parallel our knowledge of diving physiology, so perhaps the next Edge model will take some of these factors into account. In a future computer, the program should at least incorporate:

1. A safety margin in the model equivalent to the "rounding up of depths and durations to those designated in the established tables -- e.g., a 64 foot depth should be read by the computer as 70 feet. This would ensure that the computer does not exceed the durations allowed by the tables, and thereby increase the likelihood of decompression sickness.
2. In repetitive diving, the meters should be at least as restrictive as the U.S. Navy Tables
3. Once descent has been complete in the multi-level dives, no subsequent descents should be permitted from that or any other plateau depth, until multi-level diving is better researched.

In conclusion, the Edge seems suitable for measuring and recording various dive parameters, such as depth, times, temperature, etc. It seems suitable for some single fixed-depth dives and some single multi-level dives, if sufficient care is taken to ensure a sensible dive plan. Its use in any repetitive dive situation, with either fixed or multi-level dives, should be discouraged.

## *Orca Industries Stands by its Edge*

Dr. Edmonds has thrown down the gauntlet, but rather than get drawn into a brawl, we want a clean fight! We will tell you about how and why the Edge works, without having to kick around in the mud.

The Edge is an electronic computer which measures depth and time every three seconds. From this information, it calculates the amount of nitrogen that has been picked up (or lost) from body tissues.

The data is shown graphically on a large dot-matrix LCD, along with the permitted limit for each tissue.

There are 12 tissues shown. Lung tissue is a fast tissue, muscle and viscera are intermediate tissues, and fat and bone are slow tissues. There are actually no clear-cut distinctions between tissues; they blend together in a spectrum like the colors in a rainbow. What differentiates these tissues is the speed with

which they take-on or give-off nitrogen when the applied pressure (i.e., depth) changes. This speed is expressed as "half-time."

The Edge calculates "tissues" with half-times from 5 to 480 minutes. If you are at 100 feet, it would take the five minute "tissue" only five minutes to reach 50 feet. It would take the 480 minute "tissue" a full 480 minutes, or 8 hours, to reach 50 feet.

You are in a no-decompression status as long as each bar representing a tissue remains above the limit-line. If any bar gets too close, you can actually pull it away by ascending! While the Edge dot matrix graph only simulates what is happening in the body, it produces long but safe dive profiles, which is what we are striving for. It is the state-of-the-art in decompression science.

While it is advantageous to be able to visualize and control nitrogen levels, it is equally important to

know your remaining no-decompression time at any point in the dive. This is continuously recalculated and displayed, with a "+" sign showing you still have remaining time (a "-" sign indicates decompression debt during a decompression dive).

The tissue calculations in the Edge are essentially the same as those used by Haldane in his pioneering decompression research, and by generations of subsequent decompression researchers. But there are two important differences.

Before the Edge came on the scene in 1983, it was not believed possible to make a computer so simple as the Edge, yet so safe. It appeared that, like the tables, a decompression computer would need to have many "fudge factors" to adjust the calculation procedure on repetitive dives, or deep dives, or in any number of "extenuating" circumstances.

We departed from past practices. By tracking the

## A Portable Recompression Chamber For Liveboards?

If a diver surfaces and starts to have any symptoms of decompression sickness, the faster he can get into a recompression chamber, the more likely those symptoms will disappear forever.

That's all well and good for a US Navy diver who has a recompression chamber on board his ship, but for someone aboard a dive boat in Belize, he may have no chance whatsoever of reaching a chamber in fewer than 12 hours. Where the Navy diver is cured and diving again, the Belize diver is hobbled for life. There is no \$100,000 recompression chamber aboard his boat or, for that matter, in the country of Belize. For treatment, the sport diver must be flown to Panama or to Guantanamo Base in Cuba.

This may change soon, thanks to the Gamow Bag, created by Dr. Igor Gamow (pronounced Gam-off) an engineering professor at the University of Colorado. His goal: to deal with altitude sickness suffered by mountain climbers.

You see, the Gamow Bag is a portable recompression chamber, capable of being pumped up by foot to a pressure equivalent to a depth of nine feet and by a compressor to a depth equivalent of 20 feet or more. Although there are other portable recompression chambers, this one differs in that it is a ten foot-long air tight nylon bag that can fit into a back pack and weighs only ten pounds. Patented by the U.S. Government and approved by the U.S. Food and Drug Administration as a medical device, it should be on the market this fall. The price, which has yet to be established, will be between \$1000 and \$2000.

The Gamow Bag would only be used as an interim chamber until an injured diver can be transported to a chamber run by a qualified physi-

cian who can assess the dive profile of the bent diver and create the right decompression profile -- which may require several depths and several hours -- or even days. However, until the diver can get to the chamber, bag recompression can reduce the chance of long term disability. And because the bag is soft and tough, the diver may remain in it -- even on a commercial plane -- on his way to a chamber -- as long as a compressor accompanies it. It may not be usable, however, for a seriously injured person who may need other medical attention, although when the bag is fully inflated a second person can be inside.

Although a number of questions need to be answered about the applicability to diving, Gamow realizes the potential of the bag for the diving industry and will modify the device for potential use in diving.

For example, used in conjunction with oxygen, its decompression potential might increase dramatically for divers. Connecting devices for oxygen tanks, scuba tanks, and compressors will have to be developed to take into account all the possibilities. Developing clear instructions for using the bag for bent divers might be a complicated task, given the infinite number of diving profiles possible, and the numerous tables required to treat victims diving those infinite profiles.

Although Gamow already has lined up a manufacturer, he encourages inquiries from people who might have an interest in his bag. There may be a number of obstacles in the way of adapting the bag to diving, and Gamow would like to learn how to overcome them. He can be reached Canyon Park, Boulder, Colorado 80302, or call him at 303/443-4938.

longer tissue half-times, which the U.S. Navy had omitted, and by backing off from the Navy table limits, the Edge could retain the simplicity of time-tested Haldanian formulae, yet it would never produce unsafe profiles. It would be totally free of dependence on maximum depth or total bottom time!

The Edge limits were derived from studies with an Ultrasonic bubble-detector, and were designed to *prevent the formation of detectable silent bubbles.*

Studies had shown that divers surfacing from a dive to the exact limits of the U.S. Navy tables often exhibited significant "silent" bubbles. "Silent" bubbles, though present in a diver's circulatory system, do not cause apparent harm. Many researchers felt silent bubbles were quite acceptable. The U.S. Navy tables were established simply with an eye toward avoiding bends. The repetitive tables had to be empirically adjusted quite a bit -- since, as calculated, they produced unacceptable bends incidence. No one knew why at the time. Ultrasonic bubble-detectors were unavailable then, and no one understood the significance of the bubbles anyway. Could it be that the presence of silent bubbles was somehow interfering with the off-gassing of nitrogen during the surface interval?

Dr. Merrill Spencer determined that by cutting back from the Navy limits slightly, divers could surface with no detectable bubbles. Karl Huggins hence created new tissue-saturation values, which form the position of the limit-line on the Edge.

By avoiding silent bubbles, the nitrogen would flow in and out in a simple, predictable fashion. Once bubbles grow to a size where they can block capillary blood flow and initiate blood-clotting, the simplicity is lost, and the inherent biological variability between individual divers becomes significant. We wanted to avoid the sub-clinical physiological insult to the body which U.S. Navy tables permit. All it would cost us was a reduction in the dive time for the square (single depth) dive profiles.

In return, what did we get? For one, the ability to get multi-level credit. You can start a dive at 140 feet and work your way up, always staying in a no-decompression state. Your dive time can be over an hour! It is equally possible to start shallow and go progressively deeper, although this would yield less no-decompression time -- approximately 20 minutes.

Dr. Edmonds cannot abide the idea that multi-level can be performed from shallow to deep. I hope that he will include profiles like this in his challenge!

The second benefit from no-bubble limits is less surface interval time. The U.S. Navy repetitive tables are tough. They have to be, because the nitrogen cannot escape easily once silent bubbles have formed. With the Edge, the nitrogen leaves quickly and smoothly, without damage. Your body is in better shape and can go back in to the water sooner.

Aside from the no-bubble limits, the other key to the Edge's safety is the inclusion of very slow tissues. The U.S. Navy tables stop at 120 minutes half time,

whereas the Edge goes to 480 minutes. According to the 120 minutes Navy-method, all nitrogen is essentially gone after only 12 hours, and you can dive as if it is your first dive. This is unsafe.

Multi-day diving can produce significant bends, especially with 20-40 foot dives which pack the slow tissues like fat and bone with nitrogen! You are not "clean" after 12 hours. The Edge will often show residual nitrogen even 24 hours or more after the last dive. It can thus safely track and protect your slow tissues over periods of days or weeks.

Because of the ability to track even the *slowest* body tissues, and to factor in *all* tissues for repetitive calculations, the Edge excels for repetitive dives. I find it astonishing, therefore, when Dr. Edmonds states categorically: "The area in which [the Edge] is certainly not of value is in repetitive dives."

Although Orca Industries was a young company with almost no money, we conducted a study of the Edge, prior to its release, consisting of 119 man-dives under controlled conditions in a hyperbaric chamber. (We had hoped that the Navy or other official body would conduct it, but from every direction came the cry that it was too risky, it wouldn't work!)

The tests were conducted at the University of Southern California. Our subjects, men and women aged 21-61 years, pedalled a bicycle ergometer in the chamber to simulate exertion underwater. At the end of each dive they were checked with a doppler sensor placed over the heart. The profiles were rigorous, pegging every tissue of the Edge to the limit-line at some point during the series. The dives were way off the tables, but they were just at the limits of the Edge. And they were safe. No bends occurred.

One case of silent bubbles occurred, the lowest detectable level. The results were splendid.

Although the number of test dives was much smaller than we desired, it was our best effort. For me, it confirmed the hunch that simplicity and abundant multi-level credit was possible by remaining in a no-bubble state. We released the Edge for shipment in August 1983 and have consistently had excellent safety, and satisfied customers, with only nine cases of bends in 400,000+ dives.

Dr. Edmonds' remarks concerning our multi-level study are enigmatic. Did he actually read it? He reports the results incorrectly and, furthermore, states that the dives "would be incapable of producing bends in anyone." We agree, but why doesn't he notice that the profiles are way off the "sacred" U.S. Navy tables?

We do agree strongly with Dr. Edmonds that decompression computers are not a "panacea," and that they are only a tool for safer, more enjoyable diving. Divers must never throw away their training and blindly trust an instrument to keep them out of trouble. They must thoroughly understand their equipment, their environment, and their abilities.

And now, Dr. Edmonds, will that be your chamber or mine ...?