

The Sea of Cortez, Baja California, Mexico

—Diving For Shelter At Cabo San Lucas

August, 1982. My first trip to Baja. Lightning illuminates the black sky, turning night into day. Palm trees by our patio at the Solimar hotel are bent a near 90°. The driving rain is nearly horizontal. Wet sand pummels the walls and windows like buckshot. Less than 50 yards away, gigantic 15-20 foot waves, roaring louder than a 747, crash against a vertical sand bank, the last bastion between the hotel and the ocean. This is Hurricane Paul. And I and my companion are watching it live on our giant television screen, the glass sliding doors to our room.

Suddenly I see someone struggling to pick up a large object and carry it away. What could possibly be worth battling a hurricane for? He disappears behind my building, so I stick my head out my leeward door to offer assistance. The man had rescued an adult pelican that had become a victim of the high winds--it had been thrown relentlessly against the building. It is caked with sand. It cannot lift its wings. It looks like a ball of feathers and sand. It cannot survive.

The electrical power fails, and daylight has broken. But the storm continues for two more hours. Yet, I am hungry -- hurricane or not. My companion and I make the short dash to the dining room, barely able to keep our feet. Others are there. Indeed, the kitchen and dining room staff are there, preparing a full breakfast with the aid of an emergency generator. Luis Bulnes, the hotel owner, informs us that Hurricane Paul's Center is only 60 miles away; we could expect to be in the eye within two hours, at noon.

What does one do in the middle of a hurricane? Mainly watch it. But I read a bit, and even play a few hands of gin. I return to my room to find the maids on duty, mopping the sand and water which had blown under my door and stuffing the gap with dry towels. Young men bring large buckets of water to flush the toilets, beds are being made and clean towels are delivered. I'm awestruck. I marvel at these devoted people who have left their homes in the height of the storm--which produced 125 mph winds and three to six feet of rainfall--to carry out their assigned duties.

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At 11:30 am the eye arrives over Cabo San Lucas. Overhead, the sun shines brightly, the sky is blue, and the winds have stopped. We tourists immediately head for the beach with our cameras to record the work of Paul. The surf is magnificent. Waves 15 to 18 feet high crash against giant boulders which previously had been buried by sand. Engrossed in photographing the breakers, I fail to notice the sky darkening. Suddenly I hear the roar of the sea--I am lashed with wet sand and knocked to the ground. I am wearing only my swimming suit, and now must make a downwind dash to the hotel. The pain of the wind-whipped sand is almost unbearable and I find myself screaming in response. I find momentary shelter behind a large boulder, but know I must make that final dash. I feel as if my skin has been ripped from my body. At once, I am up to my chest in water. I grab for a hunk of the boulder. As the surf recedes I am laid flat, as if someone is pulling on both my feet. I am barely able to hold on. As the wave disappears I stand and sprint to the hotel. At last I'm safe and out of the wind. But the sand has actually imbedded itself in my skin. I remove it by scrubbing with a wash cloth. My body is raw.

I watch the rest of the storm from the safety of my room, venturing out only when we are told that lunch is being served: chicken soup, a salad, sirloin tips Mexican style with refried beans, rice, Mexican bread and dessert. Amazing. With this bedraggled crew of tourists and surprisingly fresh staff I feel myself an actor in a B-movie.

Late in the afternoon the wind and rain stop. The once-beautiful palm trees have broken fronds, but their design permits basic survival. The dining room is flooded, the large window smashed. Glass doors to the main entrance are shattered. The roof of the storage building has disappeared. Paint has been sandblasted from the hotel walls. The finish on the windward side of my rental car is bare metal. Heavy metal outdoor furniture is strewn everywhere. The surf now ends 30 yards from the door. The hotel looks like a long-closed, once-luxurious resort. Luis Bulnes is outside inspecting the damage. He tells us he will have the hotel back in the original condition within one week. He is optimistic.

And so is the pelican. He is shedding sand from his feathers. He stands and spreads his wings. He is celebrating his life. Somehow, he survived. And somehow, I did. And somehow, so did Cabo San Lucas.

Diving For Mantas At Adcock's Seamount

I could not let anything so insignificant as my hurricane experience deter me from diving the Sea of Cortez. You see, Cortez has held a special interest for me since I first saw pictures taken there of schooling hammerhead sharks. Being both fascinated and terrified by sharks, the lure of diving with these denizens led me to the Sea last year, but I had barely gotten wet before Paul called on us. Usually as tranquil as an inland lake, its waters are disturbed only by local winds, or by extreme tidal activity centered at the narrow midriff region. Nevertheless, its water and weather conditions can change frequently and abruptly.

When I decided to return in August of 1983, I considered several live-aboard dive boats operating from La Paz, although I deplore "boat fever" and prefer land-based

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operations. But one cannot reach the best of Cortez from land. I first considered joining a charter with filmmaker Jack McKinney aboard the Baja Explorador; too often, however, paying guests on these kinds of trips get the short end of diving since the priority is to get good commercial footage. So, I joined a charter organized by the Santa Monica Blue Fins on the Marisla ("Sea Island"), a converted and modified U.S. Coast Guard Buoy Tender (formerly the Columbia). Powered by a diesel engine driving a generator which powers an electric motor to turn the single large screw (rumor has it that this combination attracts Manta Rays); she is 121 feet long, with eight double staterooms on the upper deck. Each has a double and single bunk, a salt water head, reading lights and a fan. The fantail serves as a lounge, with three small tables, several chairs, and a bar with plenty of ice. Two roomy hot water showers are on the main deck. The Marisla has a large air compressor and a nice bank of storage tanks for unlimited filtered air. My tank was refilled almost before I had doffed my diving gear. But, I'm ahead of myself. Let me tell of this trip as it unfolded. My own personal diary is the best source.

DAY 1: Rendezvoused at L.A. AeroMexico Airlines ticket counter; met personable dive master Roger Bilyeu and his wife Miriam. Less than two hours' flight to La Paz. Immigration was quick; Roger had prepared visas for us. Customs a snap; no bags had to be opened. Taxis were waiting from the Los Arcos Hotel, home for the night. Nice, clean hotel on the waterfront. Supposed to have had a big Mexican buffet dinner, complete with Mariachis, but arrived too late. Good dinner; hotel water safe to drink.



THE MARISLA

DAY 2: Departed hotel at 11:15; boarded Marisla 15 minutes later. Dive gear had been taken to the ship directly from the airport. Under way by 12:30 then sat down to tacos, refries, guacamole and melon. At 2:30 pm anchored over the wreck of the Salvatierra, a ferry which sank in 1976 in 70 feet. Not always divable because of the strong surface currents, but we arrived at slack tide so current minimal. Abounds with life; overgrown with gorgonia, fans and colonial cup coral, especially inside some of the compartments. Can be safely and easily penetrated in many places. In his pre-trip letters Roger recommended that full body protection be worn on all dives. I now know why: I am nursing several jellyfish stings on the exposed part of my face; nothing bad, just irritating, but impossible to avoid since they come even from invisible pieces of tentacles. Two bald divers needed bathing caps. Full 1/8 inch wet suit too warm--early September water temperature is 87° to 90°. Switched to a long-sleeved turtleneck and panty hose. (I resisted this venture into the domain of the transvestite, but the panty hose indeed provides excellent protection; easy to get on and off, dries quickly, even warm at times in 75° water.) By 4:15 pm under way for Isla Partida. Anchored before sunset by scenic rock formation (Los Islotes), a reddish-brown rock decorated with large patches of white; looks like icing on a cake, but actually pelican and booby droppings. Wonderful clear air provided a night sky of more stars than I remember existed. Even the barking of sea lions on the rocks only a few yards away could not keep me from a good night's sleep--so sound I was unaware that we had moved in the middle of the night to a protected anchorage. Captain Richard Adcock had become concerned with the sudden appearance of rather intense lightning and an increase in the wind velocity. Moving this large vessel so precisely in the very dark of the night with no buoys or lights indeed impressed me. Richard, an American, has been in Mexico since 1956. His knowledge of the Sea of Cortez, its marine life, its weather characteristics, his intense interest in making each trip "special," seem exceptional. Enjoy listening to him reminisce about the Sea before it was "discovered." His wife, Mary

Lou, is the first and only Mexican female to obtain a Captain's license. She oversees the food preparation, along with three young Mexican girls.

DAY 3: Clear and bright. In the water at 7:52 am. Bottom near Los Islotes consisted of countless large boulders. Around the islands the walls are vertical. No large coral heads, only small stands of stony coral; abundance of sea fans, sulphur sponge and gorgonia. Crown of thorns starfish adorned many boulders, and changed from red to green as I moved my gloved hand lightly across their backs. Triggerfish watched to see if I would provide a meal of sea urchins. Looking up from the bottom at 50 feet, I was impressed by the numbers of colorful fish: Cortez angelfish, King angels, large schools of green jacks, threebanded, scythe and long nose butterflyfish, bumphead parrot fish, cornetfish, the beautiful gafftopsail pompano, and schools of yellowtail surgeonfish eating algae from the boulders. Under boulders I discovered lobsters, green morays, and many giant hawkfish. Damselfish attacked me for invading their territory; I am thankful that the giant damselfish (up to 1 foot) were not so aggressive; they have rather substantial teeth. Found several large caves. One contained three Moorish idols. Colonial cup corals almost covering the walls and ceiling. King angels swam upside down, feeding on the ceiling. Dead barnacles on the boulders housed small blennies, many gobies, many varieties of blennies, including the large, panoramic fanged blenny. Plenty of Murex shells. Visibility 80 feet.

As I came around a large boulder I was momentarily frightened by a large dark creature rapidly approaching just at the edge of visibility--a large sea lion followed by others. Was curious but wouldn't allow me close. Gave up hope of getting pictures, but a small fellow came right up, looped, rolled and hung upside down looking at me. Wonderful. Shocked to see "JDP" carved in the seal's back; heard that drunken fishermen had done this to a group of seal pups, but didn't believe it. God, how cruel. Surfaced for ham and eggs, pancakes and hot Mexican coffee. After breakfast discovered a beautiful underwater tunnel that led to other side of island. Cruised to seamount (El Bajo) miles from land; top of the seamount, at 60 feet. After lunch dropped up current to drift to the seamount hoping to see hammerheads and mantas. No luck. All the fish of Los Islotes here, plus guineafowl pufferfish, porcupine fish, chocolate chip starfish, large spiny oysters, soapfish, large schools of jacks, panama graysby leatherbass, large snappers, scorpionfish, barberfish flagpin majarra, colorful wrasse (Cortez, rainbow, and sunset), Mexican hogfish. Captain Adcock headed for Isla San Francisco. Dived Bonith and Judith Rocks. Interesting, not exciting; sea lions posed for many pictures. Cruised to overnight anchorage and dinner of baked chicken breasts, salad, rice and corn, and a bottle of wine.

DAY 4: Another beauty. Cruised to Isla San Diego Reef for pre-breakfast dive. Visibility 80 to 100 feet. Vertical walls of small reef covered with robust, bumpy orange, yellow, and red sea fans. Many long, large caves covered with colonial cup corals. Maximum depth 40 feet. Found an entire colony of the beautiful red-tipped Dorid nudibranches. Great place for macro. Murex shells, a great range of starfish and crowns of thorns. Jeweled, zebra and green moray eels peeped from among the many boulders. Breakfast of scrambled eggs and Mexican sausage was followed by another dive, then we moved to Isla San Diego for two afternoon dives. Saw my first Cortez Manta Ray, took a short siesta, then dined on hearty roast pork. We returned to the reef for excellent night dive. Open colonial cup corals were magnificent. Littering the bottom were synapted sea cucumbers, looking like

**THE SEA OF CORTEZ
BAJA CALIFORNIA, MEXICO**

Diving for Experienced Divers	★ ★ ★ ★ ★
Diving for Beginners	(go elsewhere)
Ship	★ ★ ★ ★ ½
Ambience	★ ★ ★ ★ ★
Food	★ ★ ★ ★ ★
Tour Leadership	★ ★ ★ ★ ★
Moneysworth	★ ★ ★ ★ ★

★ poor. ★★ fair. ★★★ average. ★★★★ good. ★★★★★ excellent

Abandoned Diver Swims For 19 Hours

Alone in the Gulf of Mexico, 10 miles off the Florida Coast, 38-year-old Wayne Allan Brown watched the search party depart as the sun began to set.

"Hmmm..." the abandoned diver told himself, "looks like I've got to swim."

And so he did. For the next 19 hours, through four late-summer thunderstorms and a number of conversations with the Almighty, Brown swam on. He was finally rescued by a boater about 300 feet off Anclote Key near Tarpon Springs.

According to a report by Beverley Keneagy of the *St. Petersburg Times*, the incident began at 6 a.m. when Brown and three friends left the Tarpon Springs Anclote Marina on a fishing and diving trip in Brown's 23-foot power boat "Improvise!" They spent the morning at two fishing and diving locations, and about one o'clock decided to try one more site before heading back to shore. They dropped anchor about 10 miles northwest of Anclote Key on a live coral reef in about 25 to 30 feet of water. Brown dove into the water and his buddy, Mark Gable, was supposed to follow. Gable didn't show. Brown learned later that Gable had problems with his diving equipment and stayed in the boat.

Brown, who has been a diver for 20 years, went to work spearfishing, and about 15 to 20 minutes later he had a string of hogfish. He decided to come back up to the surface to see what had happened to Gable. His buddies were nowhere in sight: "I came up to the marker buoy and it [the boat] was gone," Brown said. "I said, 'Oh my God, it's gone, it's sunk.' But I didn't see any debris floating around in the water." He finally sighted his boat on the horizon about three miles northwest of him. Brown's friends later discovered that the anchor had slipped out of the rocks and that the boat had drifted.

Brown let go of the string of hogfish so he wouldn't attract sharks and inflated his BC. He drifted around in the water until dusk and watched rescue workers search for him. He saw his boat with his buddies in it, the Coast Guard, several helicopters and about 15 other volunteer boats search for him about five or six miles from where he was drifting. "Three times I could read the letters on the side of my boat," Brown said. "I kept saying, 'Come on, keep coming.'"

"I was screaming, 'Hey, I'm over here,' " he said, and he waved his arms and his spear gun in the air. But no one saw him. Darkness soon fell, and he watched the search party leave. Brown decided his best option was to swim toward Anclote Key. He began swimming on his back, trying to maintain a straight course with the help of constellations overhead.

Then rain started to fall, quickly joined by hail, water spouts, lightning and thunder. The waves were about seven feet high. "Lightning struck the water a couple of times and it tingled my skin," Brown said.

"I've got to admit, I talked to the man upstairs," he said. "I said, 'Here I am swimming my brains out. Don't hit me with a bolt of lightning.'"

"Every time I started to doubt I'd make it I'd see a new landmark on shore that showed I was making progress and put some new juice into me," Brown said. At dawn he was sighted near Anclote Key by a boater who picked him up and took him back to the marina where, Brown said, he "drank about nine gallons of water."

Brown estimates that he swam about 16 miles as a result of the tide having pulled his body in different directions.

long pieces of intestine. Never seen so many pufferfish. Quickly tired of catching them and watching them inflate. At the end of the dive, the well-lit Marisla was easy to find. Dive master Roger Bilyeu, a knowledgeable and helpful fellow, is making everything run smoothly. His seventh trip on the Marisla. His pre-trip newsletters and information on the ship, the itinerary, what to bring, and a complete set of detailed maps of the dive areas is making this trip work well.

DAY 5: Diving by 7:30 am. During potato pancakes breakfast, cruised to Isla Santa Cruz to dive a virgin reef. Boulders were silt covered; few fish, visibility 15 to 30 feet. Depth only 40 feet. Headed for a lonely looking rock several miles out from any other island, Los Animos. Dived twice to 50 feet. Visibility 100 feet. Marine life abundant--nearly everything in the fish book. Sea lions frolicked around me; large turtles swam by; 200-foot underwater vertical walls were spectacular. An enormous sea hare spewed out a reddish substance when I moved him for a better picture angle. Large groupers and snappers hid around the many large boulders. Saw my first golden grouper--what a beautiful fish! Boarded to hear that Hurricane Kiko was heading toward Baja with 115-knot winds; could be here tomorrow morning.

Captain Adcock decided to head for shelter: after a five-hour cruise we anchored in the beautiful and well-sheltered Eclipse Bay. Surely, fate would not deal me two hurricanes in two trips! August through October is the best time of year to dive the Sea of Cortez; too bad it is hurricane season as well.

DAY 6: Broken clouds from Hurricane Kiko; she had turned out to sea. Made three dives at Isla Los Islotes. Though I dived it previously, enjoyed it tremendously, especially playful sea lions. Many lovely nudibranches, including a deep purple one with gold spots that no one could identify. Mary Ann found a spiral shark egg case with the young shark moving around; brought up for inspection and then returned it to the deep. Made night dive at Eclipse Bay after fried chicken, corn-on-the-cob dinner.

DAY 7: Strong easterly winds kept us in sheltered bays all day. Made four dives, including a night dive, in Cross Bay, Isla La Partida Bay, and a northern bay of Isla Espiritu Santo. Visibility 30 feet to 50 feet. Spent the majority of each dive concentrating on and studying some form of marine life. Lunch of chicken salad, tuna pate, salad, homemade bread. After night dive we gathered in the stern lounge area and watched four large sharks and schools of green jacks swimming in the lighted water aft of the ship. No moon and a million stars. Wonderful way to end an exciting day of diving.

DAY 8: Moved just offshore from an inland lake fed by high tide through a channel 150 yards long, and three to four feet wide and one to three feet deep. Donned flippers, mask and snorkel and rode the rapids into the lake. Did it three times. Great fun. The channel is filled with the snap, crackle and pop of pistol shrimp. Cruised (while having banana pancakes, ham and eggs) to the north side of Isla Ballena. This seamount known only to Richard Adcock. The dive I had been waiting for! Large schools of jacks, pompano, mullets and yellow tail snappers everywhere. The sea was alive with fish. At 90 to 100 feet were large growths of yellow coral full of tiny bright blue fish (they called it juvenile black coral), fans, gorgonia and sponges. Large cabrilla, snapper and grouper were under the ledges. Large Manta Rays allowed us to swim with them, ride them and photograph them; 15 to 18 feet in span with a white pattern on the underside. Bottom time ended much too soon. Lunch of fried red snapper, fruit, salad, homemade bread. Spent surface interval snorkeling around the north side of Ballena, entering many large caves by free diving; plenty of good air once inside the large chambers. Afternoon dive was the same--wonderful. Water temperature was 87° down to 75 feet; strong thermocline dropped the temperature to 76°. Other dive boats had failed to find Manta Rays, so maybe Marisla's engine noise does attract them. Dinner: steak and lobster, broccoli and cauliflower and a bottle of wine.

DAY 9: Last diving day. Elected to stay at Isla Ballena and dive hidden seamount again. Mantas still around; Willie rode one starting at our anchorage in only 30 feet of water! Terrific! After the dive, headed reluctantly for La Paz. Spent the time eating, resting, packing, settling our bar bills, reminiscing about our great eight days of diving.

Now that I'm home finishing this story, trying to have as critical an eye as I can, I recall sitting on the fantail with several other companions trying to come up with something we didn't like about the trip. None could conjure up a complaint. But I am disappointed in not having seen hammerheads, which school there in great numbers. Some believe "El Nino" had warmed the waters beyond the hammerheads' liking. And I wasn't pleased with one greedy lady who spent every dive filling her goody bag with live shells. If everyone took as many as she did, shells would soon be as rare as they are in the Caribbean. Richard ought to place some limits. Spearfishing of game fish is allowed, but only enough for meals. Spearfishers are dropped away from the dive sites.

Each diver is on his own and responsible for keeping his own bottom time-- which is not easy, when making four to five dives per day. I diagramed each of my dives, the only sure way to accurately keep up one's dive category. The nearest recompression chamber is in San Diego, 1,000 miles and a day away.

Besides sunning, reading, and resting aboard there was water skiing, fishing, beachcombing, boat touring, watching TV (cassettes), and snorkeling. Every morning between 6 and 7 am, a group snorkeled for about 45 minutes. Anchorages were very scenic; cactus of many varieties, some in bloom, dotted the shoreline. We saw marlin, pods of whales and porpoises from the boat. Swimming suits are OK at all times of the day. A T-shirt is desired on the last night for dinner--dress-up night. Take insect spray. When the wind is calm, the flies appear from nowhere. Weights, tanks and backpacks are furnished. Bring your other equipment plus any spare parts you think you might need. Bring your own dive light for night dives (Chemlites are mandatory).

The package I purchased from the Santa Monica Blue Fins was \$1195 for the 10 day excursion, which included: round-trip airfare between Los Angeles and La Paz, two nights in the Los Arcos Hotel and the full boat trip. Of the seventeen people on my trip, only 5 of us were first-timers; the others had made as many as 8 trips on the Marisla! For more information on Marisla trips contact: Beverly International Travel, Inc., 9465 Wilshire Boulevard, Suite 832, Beverly Hills, California 90212, or call (213) 271-4116.

I'll be back next year. To see the schooling hammerheads. I hope you join me.

Cold Water Regulator Freeze-Up

—A Serious Problem In Water Below 45° F

With winter upon us, a few hearty souls will be diving in cold water inland lakes—or even under ice. This creates special problems not normally encountered by most divers. One of the more serious problems is regulator icing.

Regulator icing is caused when moisture freezes somewhere in the air delivery system; it can occur in fresh water in temperatures as high as 45 degrees, or in sea water around 35 degrees.

Two distinct problems arise when a regulator ices: free-flow of air caused by icing in the first stage of the regulator; and freeze-up or "lock-up" of the second stage, which can cut off the air supply. "Lock-up" is the more serious problem.

First stage icing is caused by water in or around the first stage. Ice builds up in the spring mechanism, preventing a tight seal. Subsequently the air will free-flow. Many regulators have a means to protect first stage icing, using a cap which can be filled with anti-freeze, or a first stage cover filled with silicon grease to prevent water from getting in or around the mechanism, or a positive air pressure feature which keeps water out of the first stage.

While it is possible to inject silicon grease into the first stage of most regulators for icing protection, the orifices are too large to restrict the silicon, so it may

be forced out leaving no protection at all.

Second stage "lock-up" has two possible causes. The least likely is that there is a leak somewhere in the second stage, either in the hose or the connectors, which allows water to enter the second stage. The more likely cause is that there is either water inside the tank—or there is too much moisture in the air pumped into the tank. This moisture can freeze, forming ice in the first stage. The air pressure can push these shards down to the second stage, usually to the point where the second stage connects to the hose.

If you have ever "bled" a tank dry and touched the valve on the tank while bleeding it, you no doubt have noticed that the valve felt cold. This refrigeration is caused by the extreme pressure drop. That pressure drop also occurs inside a regulator.

For example: a tank filled to 3000 psi feeds into a first stage which then delivers to the second stage an intermediate pressure between 125 psi to 150 psi to the second stage. This causes a drop in pressure of between 24:1 and 20:1. Then, when the diver breathes, a vacuum is created to activate the delivery mechanism which gives the diver his air at ambient pressure. Thus there are two separate pressure drops within a split second. Since the air in the tank is cold,

due to the surrounding water, these subsequent drops in temperature can create icing if there is any moisture in the tank or in the air.

These freeze-up problems can be minimized if you:

- *visually inspect your tank occasionally to make sure it is dry inside;
- *have your dive shop check your second stage for any leaks;
- *make sure you get a dry fill.

The dry fill is very important. Some folks who fill tanks believe that a little moisture in the air prevents divers from feeling dryness in their throats and mouths. They intentionally provide damp air to make breathing more comfortable. That's fine for nearly all diving—but not if the temperature is under 45°.

Multi-Level Dive Procedure

—How It's Used And Why It's Not Taught

For many years, some divers have been using a so-called "multi-level dive procedure" that seems to have no base in the literature presented to sport divers. In fact, any diver who spends much time diving at resorts will find himself being taken on an occasional dive that runs smack up against all the rules of the U.S. Navy. I've been on guided tours to 200 feet at the crater of Molokini (near Maui)—so deep, in fact, that my rented camera imploded—and to 170 feet over the wall at Small Hope Bay in the Bahamas. In these and other dives we followed procedures that violated the Navy tables—but procedures that had been used day-in and day-out, without problem (so we were told) for many years. The word was that we were burning off nitrogen at shallower depths while progressively ascending to work our way out of the water. Although the U.S. Navy tables would have us decompress, we did not. In June 1980, we carried an article entitled "How Hawaiian Divers Beat the Tables" which explained how techniques there seem to be employed—and why they might work.

For some time, we have been following Dennis Graver's work with the multi-level diving tables. Graver (past national Director of Training for PADI) has taken the experience and work of others and developed multi-level dive techniques for sport divers. He dives by these tables, as do many other people in the industry. Nonetheless, the technique receives no official recognition, nor is it officially discussed. The procedure deserves greater consideration, so we have asked Graver to prepare for *Undercurrent* this article on the history and application of the multi-level tables.

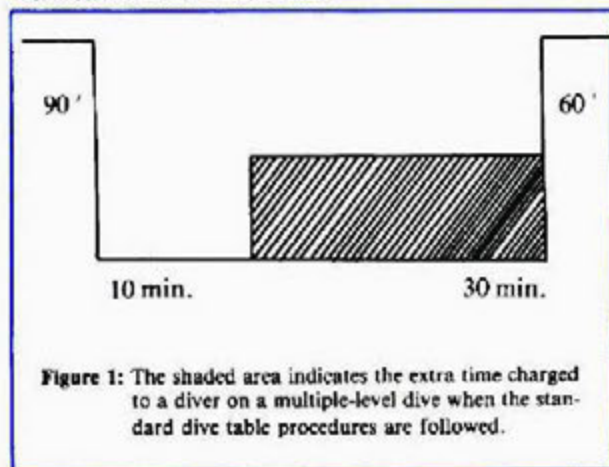
Ben Davison

To prevent problems, ask the person filling the tank to bleed off the water separator before filling your tank. You can also get a "quick and dirty" check on moisture by putting a tissue in the yoke of the fitting used to fill your tank, turning on the unit and then checking the tissue for signs of moisture.

If you use an octopus, you should have some form of environmental protector for the first stage. The rapid drop in pressure common in normal use is further compounded when two people draw air from one first stage. The potential for icing is increased.

Cold water diving can be a fun and exciting winter-time activity. But it is a speciality. Don't undertake it without special instruction, experienced buddies—and proper attention to your air fills and regulator.

Recreational divers are penalized unfairly when following the U.S. Navy dive tables for multiple levels during a dive. It is common to dive at more than one depth during single dives. The rule that the total bottom time of a dive and the deepest depth attained are to be used for determining the repetitive group imposes the same limitations as if the diver had spent the entire dive at the deepest depth. Reason suggests that one must have less nitrogen if part of the dive is spent at less than the deepest depth, but how can this be calculated?



According to the tables, the dive profile in Figure 1 results (at 90 feet for ten minutes and 60 feet for 30 minutes) in a schedule of 90/40 (90 feet for 40 minutes), which requires seven minutes of decompression and ends with a Group J Designation. Wouldn't it be great to know this same dive profile can be made safely without decompression and with a final group designation of H?

Well, hold onto your hoods, because multi-level dive computations such as the one just described are quite feasible.

History Of The Multi-Level Procedure

A dive table procedure is available to permit divers to calculate multiple depth dives without the "deepest depth" penalty. The technique has been around for many years, having been introduced to the recreational diving community in 1975, after I read an article by C.L. Smith, an engineer and diving instructor. Smith addressed the problems associated with the use of the standard dive tables when diving at multiple depths. His notions germinated a number of ideas for me.

By applying a procedure of converting time at one depth to equivalent bottom time for another depth, I developed a method of calculating multi-level dives with the standard dive tables. I had learned during an instructor training course the equivalent bottom time technique as a means of determining residual nitrogen time for repetitive dives shallower than 40 feet.

I shared my concept with C.L., who tested the procedure by calculating the tissue pressures for various tissues at various depths. He concluded that the technique was valid except near the no-decompression limits of the tables. I became excited about the possibilities of the procedure.

At the eighth International Conference on Underwater Education (ICUE) in the fall of 1975, San Diego, I presented a paper on the multi-level procedure. The purpose of the presentation was to call attention to the technique and to request information to prove it valid or invalid. No sooner had I concluded my talk, than several members of the audience, especially Bruce Bassett, informed me that my procedure was not new, but one used commonly in the commercial diving industry. This news was even more exciting than the results of Smith's computer calculations.

For months following ICUE 8, I pursued information on multi-level diving. Bassett sent me a copy of a letter by Dr. Robert Workman of Taylor Diving and Salvage. The letter clearly outlines the procedure. I also found the technique described in the Diving Operations Manual for the Marine Technology program at Santa Barbara City College. Additionally, I received from numerous sources a great deal of information and calculations to support the multi-level approach.

Once I knew the technique had been and was being used successfully, I began using it myself. Armed with support and experience, I presented a second paper on the topic at OUR WORLD UNDERWATER in Chicago in May 1976. By this time, word of the technique had spread. The room where I spoke was packed. I was bombarded with questions

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throughout the weekend, and challenged by many well-meaning people who were completely faithful to the traditional use of the tables. It was an incredibly interesting weekend, and I learned even more about the dive tables.

Support For The Concept

As time passed after OUR WORLD in '76, I kept hearing from people who were using the technique regularly and without incident. Resort operators in Hawaii and the Caribbean found it to be exactly what they needed for their short, deep dives which are concluded with long, shallow exposures.

"Total bottom time for this dive is typically an hour, and though the diver goes to 120 feet, the dive is made without decompression."

As an example, Alan Baskin of Baskin in the Sun in Haiti, had for years been taking divers to see the World's Largest Sponge (WLS) at a depth of 120 feet. After eight minutes at that depth, the divers use the remainder of their air in coral gardens at a depth of 30 feet. Total bottom time for this dive is typically an hour, and though the diver goes to 120 feet, the dive is made without decompression. According to Alan, not one of his divers has ever been bent on this dive profile. Yet, see what the Navy tables say about

a dive to 120 feet for 60 minutes with no decompression.

The multi-level procedure is not perfect, but close to it. Karl Huggins, co-developer of the new ORCA decompression meter, stated in a paper on the topic that the technique is only 96% accurate. However, the anomalies occur near the no-decompression limits at depths greater than 40 feet. By following the recommendation to keep *at least* one group designation back from the limit for a given depth, divers should be able to avoid decompression sickness.

Recent developments in multi-level diving include articles in *Skin Diver* magazine by Dr. Fred Bove, empirical testing in a recompression chamber by Dr. William Fife, and the development and testing of the ORCA meter. It seems that multi-level diving, calculated manually or by the ORCA computer, is rather widely accepted today and that it is allowing divers to safely extend their total time under water.

How The Multi-Level Theory Works

I am frequently asked to explain my procedure, which differs slightly from the one used commercially. *I first point out that one must be proficient in the use of the dive tables for standard calculations, then outline the multi-level technique as follows:*

Time accumulated at one depth may be converted to an equivalent time at a shallower depth by deter-

(Continued on next page)

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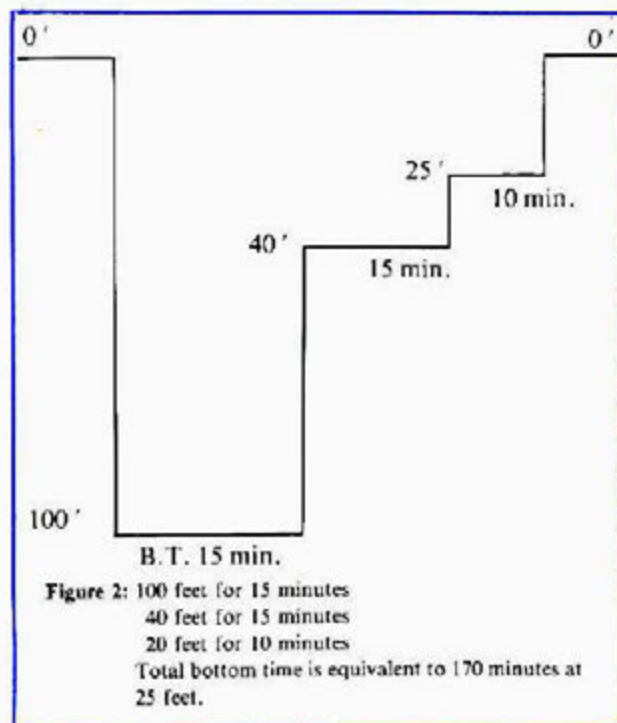
mining the repetitive group designator for the first depth and referencing the bottom time required to obtain that group designator at the shallower depth.

Refer to a set of dive tables. Note that spending 12 minutes at 90 feet is equivalent to spending 25 minutes at 50 feet (or 30 minutes at 40 feet). This equivalency is valid because the repetitive group designations for the dive tables are based on the degree of saturation of a single tissue. Whether one spends a short time at deeper depths, or a longer time at shallower depths, the amount of nitrogen absorbed by just one tissue determines the repetitive group. Equivalent bottom time involves following a particular repetitive group through the tables to the desired depths. A repetitive group E example:

40' for 30 minutes
 50' for 25 minutes
 60' for 20 minutes
 70' for 15 minutes
 80' for 15 minutes
 90' for 12 minutes
 100' for 10 minutes
 110' for 10 minutes
 120' for 10 minutes

Once the concept of equivalent bottom time is understood and can be accurately applied, calculating multi-level dives is simple. One needs to know and apply a few safety rules, but the application of the technique is easy with some practice.

As an example of a multi-level dive, let's calculate the following (see Figure 2):



100 feet for 15 minutes.
 Ascending to 40 feet for 15 minutes.
 Finishing the dive at 25 feet for 10 minutes.
 Upon reaching the 40-foot depth, I determine my equivalent bottom time, which is 40 minutes

THE MULTIPLE-LEVEL DIVING PROCEDURE

Dennis Graver has prepared a more detailed paper, with additional examples, on his multiple level diving procedure. Available for \$2, plus a stamped (37¢) self-addressed business-sized envelope from: Dennis Graver, 4676 Admiralty Way, Marina del Rey, California 90292.

(100'/15 = Group E, and obtaining Group E at 40 feet requires 40 minutes of bottom time.)

After an additional 15 minutes at 40 feet (total bottom time = 55 minutes) and after reaching the 25-foot depth, I again determine the equivalent bottom time, which is 160 minutes (40'/55 = Group G, and Group G at 25 feet = 160 minutes of bottom time.)

After 10 additional minutes at 25 feet, my total bottom time is 170 minutes (160 minutes equivalent time plus 10 minutes actual bottom time = 170), and I surface with a Group H designation without decompression.

Had I calculated the dive using the total actual bottom time and the deepest depth, the schedule would be 100'/40, which would require 15 minutes of decompression and result in a Group K designation!

My procedure differs from the commercial one in that I make all calculations on the no-decompression limits tables. The commercial procedure figures the change in depth as a repetitive dive: that is, the dive profile for the first depth is used in conjunction with the residual nitrogen table to obtain a repetitive group designation for the shallower depth. This approach is more conservative than mine, and can certainly be used, but I feel that my procedure is easier to use and less subject to error because all calculations are performed on a single table.

Conditions For Use:

When making multi-level dives, the following safety recommendations should be observed:

- ★ The initial depth must be 130 feet or less.
- ★ The procedure applies only to exposures within the no-decompression limits. You must also keep at least one group back from the limits.
- ★ The dive profile must always be progressively shallower.
- ★ The time spent at a depth should include the ascent time to the shallower depth, i.e., convert bottom time only after reaching the shallower depth.

- ★ Make a safety decompression stop for several minutes at 10 feet at the end of each dive and add the time of the stop to the bottom time of the final depth of the multi-level dive.

The following recommendations have been made by others who have studied the multi-level procedure. I do not know all of the reasons for these suggestions, but I feel they provide an added safety factor, therefore, I support them.

- ★ Do not exceed an "O" group designation on the tables.
- ★ Do not use the multi-level procedure for cold or arduous dives.
- ★ Ascend 30 feet or more between levels.

I do not tell people to use the procedure, but I do tell them I use it, that commercial divers have been using it for years, that many others have used it safely, and that it is as safe as the tables themselves because it is based on the exposure limits of the tables. Anyone who wishes to take the risk, although it is a well-calculated and documented one, may certainly feel free to apply the procedures. I believe it is a good way to safely increase the amount of time I can spend underwater and thereby increase my enjoyment. I think that is what diving is all about . . .

* * * * *

If these tables are as logical as Graver seems to make them, why are the agencies not teaching the multi-level procedure? The answer is quite simple: the logic has yet to be supported with conclusive data and evidence.

Alex Brylske, the Education and Professional Development Director of PADI, told *Undercurrent* that "we're not teaching the procedure because it has not been documented in a scientific way. Until it's substantiated, we can't permit it to be taught in a basic class."

At NAUI, Walt Hendricks has similar reasons. "Some authorities claim it is dangerous," he said. "Since we have no hard data proving it is safe, we don't teach it."

Bob Clark of SSI told *Undercurrent* that "the multi-level procedure confuses the issue. Our major concern is if the student is taught one procedure, it is difficult to use another. So we stick with the Navy."

Ken Kizer, M.D. and former Navy Diving Officer, said that he can't get too excited about the tables until he sees tested data. "The Navy tables were built

and then tested for a theory which would support them."

The training agencies no doubt recognize the complexity of computing the multi-level procedures during a dive and, furthermore, see the potential liability connected with teaching a procedure that doesn't have the full force of the U.S. Navy behind it. Nonetheless, many of the people we spoke to while preparing this article themselves use the multi-level procedure. Of course, unlike most sport divers, they are true students of diving and have great facility with the Navy tables, thereby making more complex applications of the tables not a problem.

None of this, of course, is a surprise to Graver. He told *Undercurrent* that "this information is appropriate only at the level of Divemaster or higher if it is to be taught at all. During my eight years as Director of Training at PADI I made no attempt to integrate this technique into any level of certification. I believe the procedure is valid, but if it were implemented as an alternate procedure it would confuse the vast majority of divers who cannot even make regular dive table computations accurately."

Perhaps the best application of the procedure will be at resorts, where a fixed multi-level profile can be established for individual sites. That's what Dr. Bruce Bassett suggested to us, because he sees the need to avoid having sport divers compute the procedure for each and every individual dive.

It seems to us, then, that the Graver multi-level procedure will take a long time—if ever—to get any sort of official recognition. It seems to work for those skilled divers who employ it, but the complexity of computation seems to make it a prohibitive procedure for all but the most serious and frequent divers. Someone who travels to the tropics once a year should forget about using the technique.

Furthermore, it's unlikely that it will ever be taught, because by the time the theory and mathematics are developed (if ever), computer technology should be so advanced that one will have a foolproof monitoring device. (Whether the ORCA or other devices are foolproof has yet to be determined.)

In the meantime, divers who are employing the procedure successfully are a step ahead of science. Although hard-nosed scientists may say there is no proof the procedure works, those who are using the tables claim that they are the proof. It may be the task of science, then, to tell us why it works—not whether it works.

Undercurrent correspondents are located strategically in the major diving areas of the world as well as on all coasts and major inland waters of the continental United States.

The editors welcome comments, suggestions and manuscripts from the readers of *Undercurrent*.

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