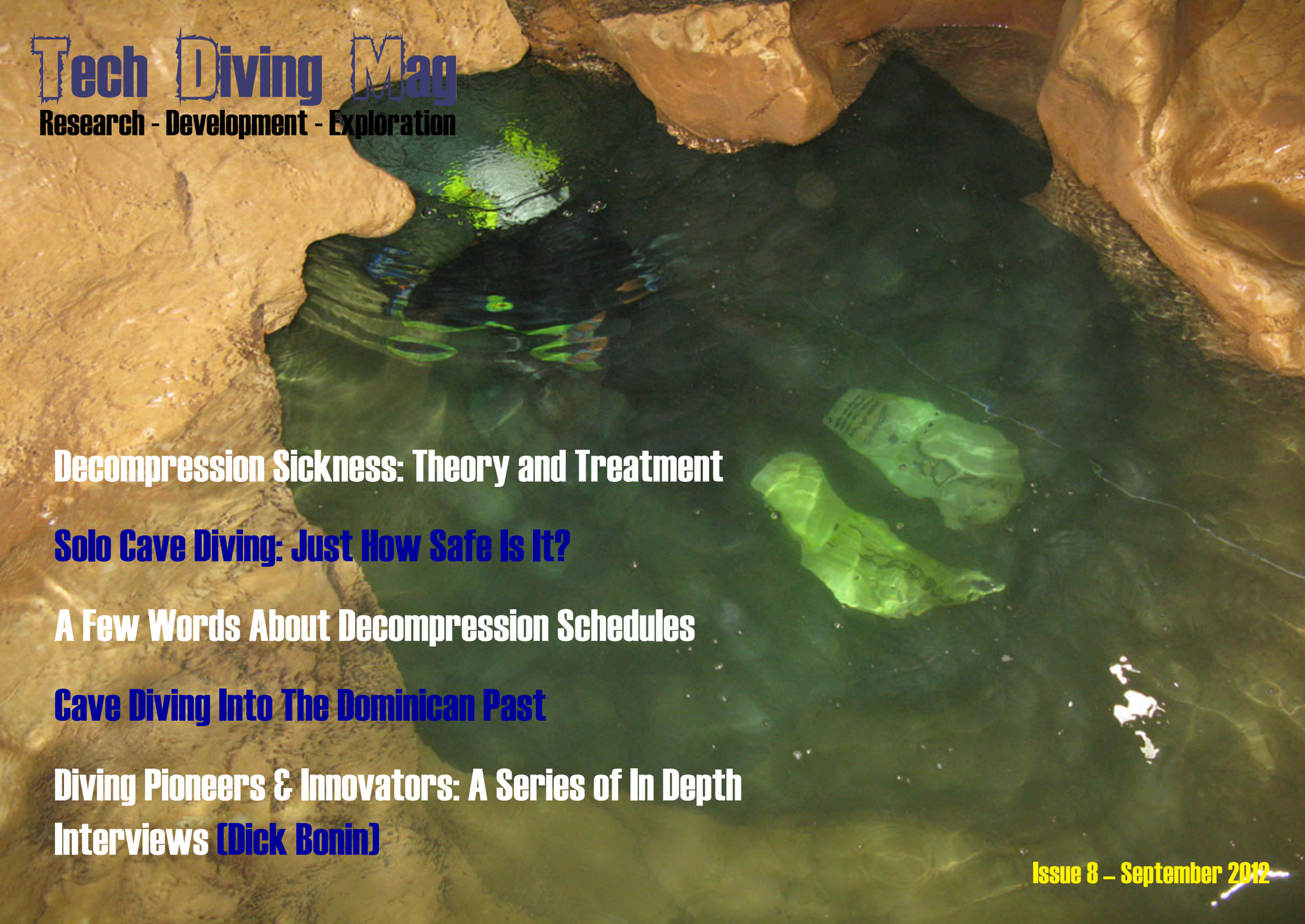

Tech Diving Mag

Research - Development - Exploration

Decompression Sickness: Theory and Treatment

Solo Cave Diving: Just How Safe Is It?

A Few Words About Decompression Schedules

Cave Diving Into The Dominican Past

Diving Pioneers & Innovators: A Series of In Depth Interviews (Dick Bonin)

Issue 8 – September 2012

Contents

Front cover image © Libor Stubna (Slovakia) at Shpella Radavcit cave (Kosovo). Honzo (Poland) from Cave Divers Group Poland starts exploring a new passage.

Editorial

Welcome to the eighth issue of Tech Diving Mag.

In this issue, the contributors have, once more, brought together a wealth of information, along with some distinctive first hand experiences. The contributors for this issue are world renowned industry professional Bret Gilliam, accomplished diver, instructor trainer and book author Steve Lewis, technical diving instructor Peter Buzzacott (PhD) and cave explorer Cristian Pittaro. Get to know more about them and read their bio at www.techdivingmag.com/contributors.html.

As you might know, Tech Diving Mag is based on article contribution from the readership. So you're always welcome to drop me a line if you're interested in volunteering an article. One more much appreciated thing is your photos (even without articles)! For submission guidelines, take a look at www.techdivingmag.com/guidelines.html.

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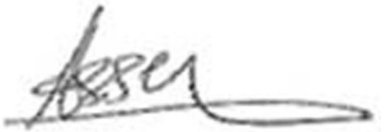


Asser Salama
Editor, Tech Diving Mag

Decompression Sickness: Theory and Treatment

By Bret Gilliam

The "bends" is an occupational hazard of diving. It matters little whether the stricken diver was engaged in commercial, military or simply recreational pursuits. He's just as bent and same rules apply. The mixed gas diver and other high tech participants have to deal with another anomaly of diving: the fact that if you in trouble, it's generally your responsibility to get out of it without standard medical assistance.

Dick Clarke, founder of the National Association of Diver Medical Technicians, has provided this observation: "Decompression accidents are unique in that, with few exceptions, it is the layman who is responsible for patient assessment, diagnosis, early therapeutic intervention and, in some cases, even definitive care."

That's right folks; if you get bent on a dive trip the chances of having immediate medical help are slim to none. It is vital that divers, especially those involved in tech diving activities, have a clear and thorough understanding of decompression sickness (DCS) symptoms and predisposing conditions. (Recently the term decompression illness or DCI has come into use and describes the same condition, sometimes in more detail.) Early recognition of DCS signs and symptoms and appropriate first responder care are key to the stricken diver's successful recovery.

DCS is a statistical inevitability and must be accepted as an assumed risk of any diver. You can do everything exactly by the book and still get bent; hopefully this is not news to anyone. In my study (1989-90) of sport divers covering the customers of a large liveaboard dive/cruise ship, 71.4% of DCS cases he treated in the vessel's recompression chamber were diving within the limits of their diving tables. There is no guarantee that any table or computer is infallible.

CAUSES OF DCS

In a nutshell, improper decompression resulting in occlusive inert gas bubble formation is probably our major our culprit in decompression sickness. Although some would argue to the contrary, most experts generally agree that *all* dives are decompression dives. Even ones without stage decompression obligations have ascent rates factored into their model as a means of decompression. Hopefully divers are now routinely practicing slow ascents in the last two atmospheres, 66 fsw (20 m) to the surface in conjunction with a recommended 5 minute "safety stop" around the 10-15 fsw (3.03-4.5 m) level.

CONTRIBUTORY FACTORS TO DCS

Primary Direct Effects of Physics: Depth, time, rate of release (dive profile).

Secondary Effects, Inherent: Physical fitness and overall health condition, age, body fat level (obesity or extreme lean condition), height, muscular makeup, old injuries that may affect circulation etc., theories of male versus female susceptibility.

Secondary Effects, External: Thermal conditions (cold water or excessively hot conditions), physical exertion during and after dive (elevated PCO_2 levels), constrictive equipment factors (tight wet suit, binding straps etc.), improper hydration, smoking, alcohol use, drugs.

Equipment Factors: Breathing regulators with excessive resistance, inaccuracies of depth gauges or watch, failure of dive computers; inappropriate dive tables.

Decompression Models: Use of unvalidated tables, improper manipulation of tables for averaging or extrapolation etc., failure to compute repetitive dives correctly, improper decompression stops,

compromised model or table through improper ascent rates, high altitude diving, use of extreme exposure tables, flying after diving.

Stress: Time pressure and task-loading.

There are many excellent reference texts that can provide a detailed subject treatment of the pathophysiology of decompression sickness and so only a brief review is offered in this section. We are more concerned with divers being able to recognize symptomotology effectively and react accordingly. Divers with a desire to delve deeper into the mechanisms of DCS are encouraged to access these separate materials.

At the surface, we are basically saturated with nitrogen at one atmosphere. As we descend breathing air (or other gases) in our scuba systems, pressure increases and the inert gas (nitrogen or other gases such as helium) is dissolved and absorbed by the body's tissues and blood. The deeper we go, the more inert gas is "loaded". Theoretically, after a period of time (based upon the longest half-time utilized in the model) at any given depth, be it 60 fsw (18.2 m) or 600 fsw (181.8 m), we are saturated with all the inert gas we can hold and no further decompression obligation would be incurred no matter how long we stayed down. This is the basis of "saturation diving" theory where aquanauts are placed underwater in a bell or habitat to work for as much as a week or more and then decompressed when the project is finished.

As untethered free swimming-divers we do not have the luxury of saturation support equipment and we must come back to the surface. Herein lies the problem with the pesky inert gas we have absorbed (in-gassed or loaded) during our brief, by comparison, sojourn into the deep.

Remembering our diving history, we will recall that Haldane originally postulated his theory that our body could tolerate inert gas pressure up to twice that found normally at the surface. This 2:1 ratio became the basis of the earliest dive tables and accounted for the presumption that we could have unlimited bottom times at 33 fsw (10 m). However, as more research study was accomplished it became evident that his ratio theory was flawed and has since been modified to be expressed as approximately 1.5:1, a significant difference. In fact, authenticated DCS cases have been observed in divers at 18 fsw (5.5 m) after extended time periods.

Haldane offered other valuable principles of decompression that included the theory of exponential inert gas uptake that provided the basis of tissue half-times and compartment M values. We are now overwhelmed with new decompression models or algorithms that stem from Haldane's early work and go considerably farther in scope. U.S. Navy tables were developed assuming a 120-minute tissue/compartment as the slowest; we now see use of models that incorporate compartments with 689 minute half-times in dive computers and far longer in custom tables!

But all this was to serve the purpose of preventing bubble formation in the blood as pressure was decreased upon ascent. Haldane and other pioneers in DCS originally thought that no bubbles would form if their decompression models were followed. Through the use of modern Doppler devices it is now known that bubbles may exist on every dive. Such scanning is frequently employed to monitor divers during test criteria for new table development and as a benchmark of decompression stress. "Bubble trouble" as a term was first popularized by Rutkowski as a convenient catch-all for DCS and embolism manifestations. In our discussion, we are concerned with inert gas bubbles, of course, not air bubbles as would be the problem in lung

Decompression doesn't have to be boring or tedious: following the contour of the bottom as you ascend from a drop-off wall can provide great entertainment at your stop depths. Peter Meyer enjoys a school of bigeye jacks at his 30-foot deco stop in Papua New Guinea.

overexpansion accidents typical of breath-holding ascents. Where these bubbles are located and their size will dictate the presentation of DCS symptoms.

SIGNS AND SYMPTOMS

Many texts distinguish DCS symptomotology into type I (pain only) or type II (serious symptoms, central nervous system involvement). To the layman or diver in the field, this distinction is not of great importance and requires special training in many instances to classify presentations. Most importantly, we want our readers to be able to recognize any symptoms or signs of DCS and leave diagnosis and treatment selection to trained chamber staff or medical consultants. But what you do for the patient and the observations you can record and pass along to treatment personnel will be of significant aid to his ultimate hope of recovery.

Type I (pain only, mild symptoms):

"Skin bends"- skin blotching or mottling of the skin producing a red or purplish-blue tinge.
Itching similar to fiberglass irritation.
Fatigue
Indifference, personality or mood swings, irritable behavior, diver unaware of surroundings.
Pain usually associated in or near a joint such as shoulder or knee. Onset may be gradual and may be transient (niggle).

Type II (Central Nervous System involvement, etc.):

CNS spinal and cranial abnormalities usually gradual in onset with initial subtle symptoms often masked by pain distractions.
Cardiopulmonary symptoms are typically manifested by "chokes", a dry persistent non-productive cough. Cerebral symptoms may follow; all effects in this group should be considered life threatening.
Unusual fatigue
Dizziness or "staggers", vertigo
Numbness, paralysis, progressive loss of feeling in skin patches.
Shortness of breath
Unconsciousness, collapse, syncope
Loss of bladder and bowel control, inability to urinate.
Muscular weakness, poor grip, poor resistance to restraint of motion.
Visual disturbances, inability to hear fingers rubbed close to ears etc.
Headache
Abdominal encircling pain or lower back pain precursor of overt spinal symptoms. Frequently this presentation is misdiagnosed as less serious Type I DCS.
Convulsions
Any symptoms developing while still underwater.

The alert diver will recognize that many of these symptoms are nearly identical to those of embolic event presentations. Since treatment and first aid are essentially the same, don't worry about the distinction. This table illustrates symptoms as categorized by Type I and Type II but consider all symptoms serious in the field.

One of the most frustrating aspects of sport divers and DCS is their stubborn denial of symptoms and failure to accept early treatment. This has historically led to the majority of sport diver accidents being unnecessarily delayed for treatment. Even divers that knew beyond a doubt that they were at risk from their profile and were presenting early symptoms have refused oxygen when readily available due to some perceived ego threat or for fear that fellow divers would think less of them. Others refuse to accept the possibility that DCS could be involved since ""I can't be bent, I was within the limits of the tables".

Early recognition, reporting and treatment of DCS problems dramatically improves patient resolution prognosis. Bends can happen to anyone, it is no one's fault and should involve no "loss of face". Indeed, the prudent diver and his dive group should overtly encourage prompt relation of any ailment that even remotely resembles the symptoms list. Many divers may mistake DCS symptoms as muscle strains or limb numbness caused by sitting on it etc.

ALWAYS ERR ON THE SIDE OF CAUTION. If you are suffering from DCS it is only going to get worse as symptoms are progressive. Don't wait to seek qualified help!

FIRST AID IN THE FIELD

Immediately give the patient oxygen for surface breathing. Incredibly, many divers do not realize the importance of 100% O2 administration and this can only be accomplished via a system incorporating a demand valve/mask (or by use of an oxygen-clean scuba system regulator connected to an oxygen cylinder). This seal should be tight fitting to insure the maximum level of O2 delivered to the patient. Air leaks around the mask will dilute the percentage of O2 (FO2) inspired. Care must be taken to insure the integrity of the mask seal especially in male patients with beards or mustaches or any patient with facial wrinkles etc. As a rule of thumb, you want the mask seal to be good enough for the patient to breathe on his back underwater. Free flow oxygen systems, although still widely in use, are not recommended. Most free flow devices usually will not deliver 100% O2 and are extremely wasteful of the gas.

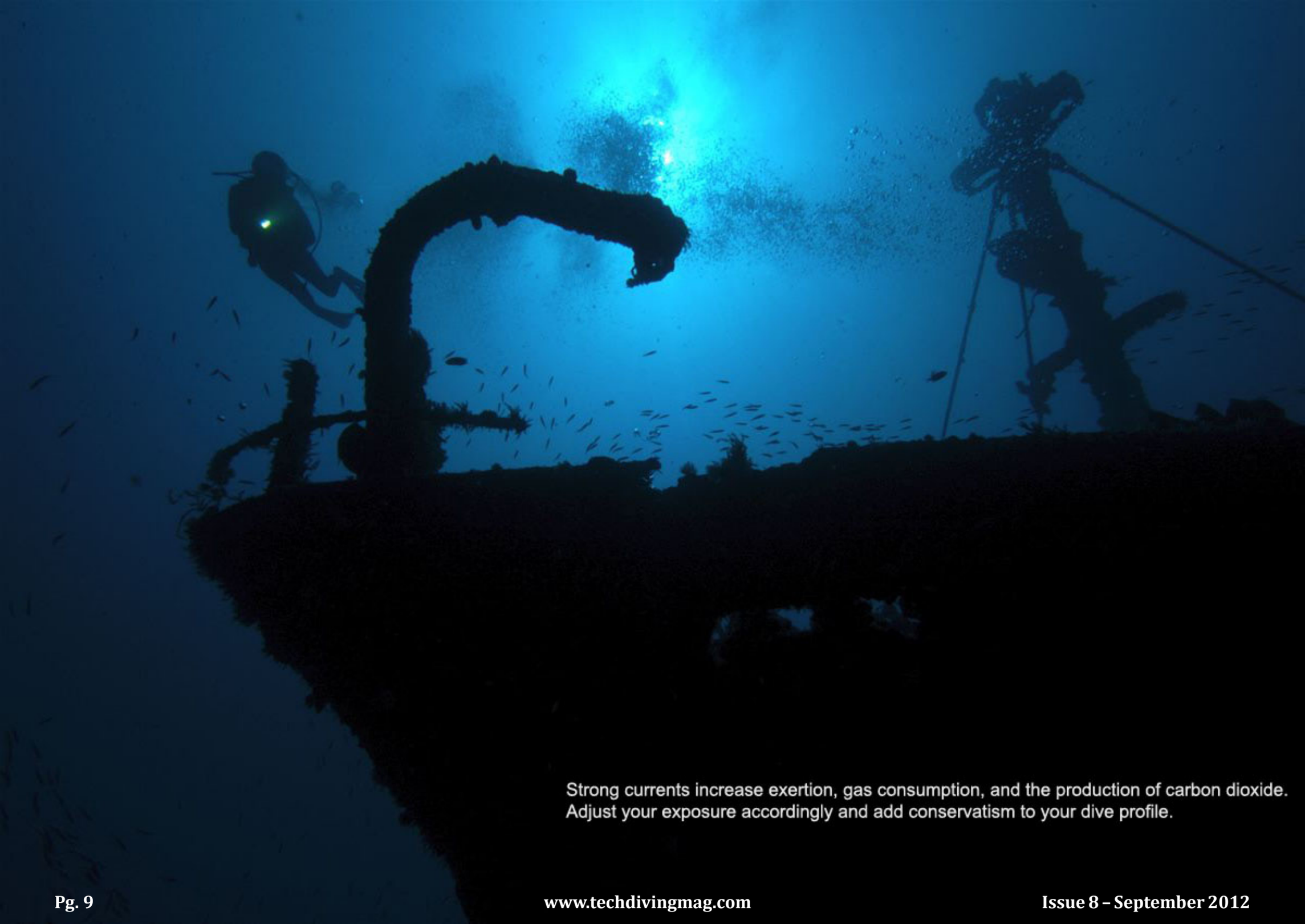
Oxygen is administered primarily to help eliminate inert gas and reduce bubble size to some extent. By breathing pure O2 at the surface, the blood's oxygen partial pressure is elevated dramatically. This provides a breathing media totally absent of the harmful inert gas, and establishes a steeper gradient across the tissue-bubble interface. This allows more efficient out-gassing of the occlusive nitrogen and also contributes to better oxygenation of the tissues where the bubble insult has occurred. Key to the outcome of this therapy is sufficient PO2 (best accomplished by a 100% O2 demand valve system) and adequate flow for delivery.

Many patients will relieve of symptoms simply by proper and immediate oxygen first aid techniques. Davis was a leading advocate of O2 role in field resolution and the author's experience (1989-90) recorded 12 cases of symptomatic DCS that were completely spontaneously relieved by 100% O2 administration during transit of the patient to his chamber facility.

Until recently patient management included positioning the diver in either Trendelenberg (head down, legs bent at knees, left side tilted down) or Scoltetus (head down, legs straight). Recommendations from various sources since 1990 have modified this traditional advice to suggest use of simple supine positioning (patient lays flat on his back). Trendelenberg proved to be of little benefit except in the first 10-15 minutes of surfacing primarily in arterial gas embolism (AGE) cases, and the difficulty of maintaining this posture was not felt to be significantly beneficial.

Removal of the diver's wet suit etc. is desirable but ensure that he is kept warm and comfortable. Cover with blankets, towels or dry clothing. Observe for any "skin bends" symptoms. Continue administration of oxygen until delivered to medical care or supply is exhausted.

Oral fluids should be given if the patient is conscious. Regular drinking water or unsweetened apple juice in amounts of 12 to 16



Strong currents increase exertion, gas consumption, and the production of carbon dioxide. Adjust your exposure accordingly and add conservatism to your dive profile.

ounces every 30 minutes will help keep the patient properly hydrated. This amount may require urination if transit is prolonged. This is a good sign and should be accommodated in the supine position. Inability to urinate may indicate more serious Type II manifestation. Such urinary retention will ultimately become quite painful. If the patient is unable to pass water within a reasonable time period, back off on continued administration of fluids.

Do not administer pain drugs other than aspirin initially (aspirin has been suggested to effect a decrease in platelet aggregation in the blood). Painkillers may mask other symptom development.

Be prepared to initiate CPR and rescue breathing if patient condition deteriorates. Technical diving activities should automatically infer that the dive team as well as the surface support crew is well trained and well experienced in CPR techniques.

TRANSPORTATION

If you are shore diving, ensure initial patient care and make sure victim is attended at all times. Hopefully, a properly planned dive will include a contingency list of medical professionals and the nearest recompression chamber facility. Call the chamber or hospital and advise them of the incoming patient. If they direct you to wait for an ambulance team, do so. Otherwise transport patient to the facility they designate and by their proscribed method, either vehicle or aircraft.

If at sea, call the Coast Guard via VHF radio or cellular phone. It may be necessary to relay messages through another vessel if sufficiently offshore that your radio cannot reach the mainland. Make certain that the Coast Guard knows that this emergency involves a diving accident victim and requires transportation to a recompression facility. At this point, they may direct you to proceed with your vessel to a designated port where assistance can meet you or they may decide to send an evacuation helicopter to intercept your vessel and extract the diver for faster transport.

It is incumbent upon divers to know what facilities are available to them in an emergency. This becomes particularly important if your trip is remotely located or out of the United States. Prior to leaving on that long-awaited dive vacation to the south Pacific or Caribbean inquire as to the availability of medical staff, chamber locations and medivac flights if required. You should also determine if the resort or liveaboard has 100% demand mask O2 available on their boats; insist on it. If enough divers demand proper equipment it will finally be made standard practice.

Call DAN to confirm chamber locations and readiness with listings of local addresses and phone numbers. Now is an excellent time to join DAN's diving insurance program that can cover your costs if treatment or medivac "life flight" is required. Costs of air ambulance, chamber time and medical staff can easily exceed $30,000 from a remote location. DAN's insurance is an inexpensive hedge against such a financial burden.

RECOMPRESSION CHAMBERS

Many divers have seen a chamber either in photographs or in real life, but very few have ever had occasion to be in one unless they were being treated. As a result a certain mystique has developed about chambers and many divers regard them as hostile and menacing environments. Briefly, we would like to acquaint our readers with the realities of these important devices. Generally, chambers are divided into two categories:

recompression chambers (used for the treatment of diving related injuries and other ailments) and **decompression chambers** (used for surface or deck decompression facilities so the working diver can be removed from the water and complete decom obligation in a dry and controlled situation).

Both of these units are also properly referred to as "hyperbaric chambers", meaning that the pressure inside will be higher than normal atmospheric pressure. These elevated pressures are usually expressed in feet of seawater (fsw) just as if we were diving in the ocean. Air pressure is introduced to the chamber to raise its internal pressure and begin the "dive". We can then use these chambers to treat DCS or AGE cases, conduct "dry" surface decompression schedules, or simulate dives for research purposes.

In hospital situations, the role of hyperbaric medicine has been recognized as a specialty wherein victims of such injuries as crush wounds, burns, skin grafts, gangrene and carbon monoxide poisoning are treated with oxygen in large climate- controlled chambers. These typically are able to accommodate as many as 18 patients at once, have hatches shaped and sized like conventional doors, are equipped with air conditioning and humidity controls and even piped-in music or television.

In the field, things are just a little bit different. Forget the creature comforts and get prepared for close quarters. Although a well set up field chamber can provide the same therapeutic benefits to a stricken diver, they are substantially smaller in most cases.

Field chambers range in size typically from 48 inches in diameter to 72 inches and are usually made of steel. In the past, monoplace chambers were in common use in commercial diving theaters and were designed to pressurize one patient in a single cylinder. This did not allow an inside tender to attend the patient and therefore he was pretty much on his own once treatment was initiated. Rarely will these chambers be encountered today. Most will be variations on the multi-place (more than one patient or tender) multi-lock (two or more pressure compartments with sealing hatches). These allow several divers to be treated at once with an inside tender to monitor their condition. Medical equipment or relief staff can be "locked" into or out of the chamber by use of the outer lock that can be pressurized to equal the treatment inner lock and subsequently depressurized to travel back to the surface pressure.

From the outside of the chamber, the supervisor can control the depth of the dive or treatment schedule and choose what gases will be supplied to the occupants. Pressurization is accomplished with standard air but most modern treatments call for oxygen therapy beginning at 60 fsw (18.2 m and 2.8 ATA). Nitrox mixes of 50/50 (N2/O2) or 60/40 (N2/O2) are commonly used deeper than 60 fsw instead of air to lessen narcosis and safely keep the O2 partial pressures within tolerance ranges. Both O2 and nitrox therapy gases are delivered to the patient or tender via BIBS (built-in-breathing-system) masks similar to aviator oxygen masks.

The chamber supervisor monitors his gauges that are calibrated to display pressure in fsw graduations. He also has an oxygen analyzer plumbed into the chamber to monitor the inside environment's O2 percentage. Due to fire hazards, this percentage of O2 (FO2) will not be allowed to exceed 25%. Most BIBS are set up with "overboard dumps" that exhaust the expired oxygen outside the chamber to prevent the rapid rise of the FO2. However, it is common to have some leakage of masks due to improper fit etc. and O2 will be leaking into the chamber from this source. As the supervisor sees the FO2

If you drop your stage cylinders at your ascent point on a wreck, be precise in your navigation, penetration, and exploration to ensure a safe and timely return to your deco gases. Far too many divers have gotten lost on wrecks and been forced to make emergency ascents leading to DCS. If you have any doubts about your ability to return to a site area, keep your cylinders with you on all phases of the dive. Joe Giacinto explores the cargo hold of a Japanese shipwreck from WWII in the south Pacific.

approach the 25% level he will institute a chamber "vent" where the inner lock is flushed with air by inputting pressure and simultaneously exhausting the incoming air from an outflow valve. This scrubs the chamber of excess O2 and also cools and refreshes the atmosphere.

The supervisor is assisted by an outside operator and a record/time keeper, who logs all stages of the treatment. They can communicate with the inner occupants via a low voltage radio or sound-powered phone handset to discuss patient status or to confer on treatment procedures.

Inside the chamber, the patient will either lie in a supine position or sit up with the legs outstretched while leaning back against the chamber wall. A fire retardant mattress is usually provided or bunks may be hung from the chamber sides. Medical equipment, or fluids etc. may be passed inside via a medical lock (small hatch door compartment usually about 12 inches in diameter) or through the same outer lock that accommodates staff transfers. A patient is cleaned of all oils such as sun tan lotions or chap sticks and he is given fire retardant clothing to wear. This further reduces the chance of fire.

CHAMBER DIVES

As the chamber is pressurized with air, the occupants will immediately sense the pressure change in their ears and equalization techniques will be necessary. Usually the outside operator will observe through signal from the inside tender that all occupants are clearing comfortably. If problems occur and someone is slow to clear, descent is stopped until rectified. Remember that our patient needs to get down to 60 fsw as quickly as possible to begin treatment so in many cases the dive is conducted as fast as the occupants can equalize. In cases where severe DCS symptoms are present and the patient cannot clear, the eardrum may be punctured by the inside tender to allow the dive to continue (a ruptured ear drum will heal, DCS may not).

During the dive it gets quite noisy inside as air pressure is introduced and protective earmuffs are provided for occupants. It also gets hot! Compression of the air atmosphere rapidly raises the temperature inside the inner lock to 100+ degrees F. in tropical locations. Newcomers will be surprised to notice the high-pitched speech caused by the increased air density. This becomes more pronounced and distracting as depth increases.

In deep treatments, as in Table 6A at 165 fsw, speech even between staff members is discouraged if the chamber environment is air. The altered voice effects can stimulate narcosis in less experienced tenders or ones with less adaptive time at chamber depths. Once reaching treatment depth the chamber will be aggressively vented to flush out the stale, hot, humid air and replace it with fresh. The patient will be breathing O2 via BIBS mask in 20-minute intervals with five-minute "air breaks" where the mask is removed and chamber air is breathed.

Air breaks are provided for the patient's comfort and to allow him recovery time from breathing pure oxygen for prolonged periods. At any time during treatment if symptoms of chronic or CNS O2 toxicity are noted, the tender will suspend BIBS mask breathing and provide a 15 minute air break. This time is not counted as part of the treatment table. After this rest, the schedule is resumed on BIBS O2. Standard treatment Table 5 is two hours and 15 minutes long and Table 6 is four hours and 45 minutes long. Extensions may be added to Tables at the supervisor's discretion.

Table 5 has historically been reserved for the less serious, pain-only bends while Table 6 is used for more serious DCS involvement and pain-only bends that is not relieved in the first ten minutes of O2

breathing at 60 fsw. Most chamber supervisors will now go directly to Table 6 in treating sport divers. This is due to the fact that upon close neurological examination of patients it has been found that pain only symptoms frequently masked or distracted from the more severe but less compelling (in the patient's mind) Type II symptoms of numbness etc.

The more immediate treatment is instituted, the better the chances of complete recovery.

During treatment, the ascent phases will be marked by the chamber dramatically cooling as the pressure is reduced. In many instances, the air will become so humid that a dense mist is formed, almost like being in a cloud. The mist can be irritating to the throat if inhaled and cause coughing or choking so breathing is always done through the nose. If coughing etc. develops, the ascent will be stopped to avoid the hazard of embolism.

QUALIFICATION OF DCS

When a patient is presented to a chamber facility, the diver medical technician (DMT) or chamber supervisor will want to perform a gross physical and neurological examination to list the diver victim's symptoms. There is a protocol for rapid neurological exams that can be done in five minutes. In severe cases, the exam will be done in the chamber if the patient's condition precludes further delay. The DMT will note the patient's deficits and observe that many of them may fall in our symptom list. However, that alone does not qualify our patient as a confirmed DCS case.

Confirmation or qualification of DCS is accomplished by a Test of Pressure. The patient is recompressed to a depth of 60 fsw (2.8 ATA) and put on O2 via BIBS mask for a twenty minute breathing period. If pain, paralysis, weakness etc. is relieved or improved during this test of pressure breathing period it is presumed that DCS exists and is the source of the patient's problems. Similarly, if no relief is noted then DCS is not considered a factor in the patient's ailment.

This distinction is important since divers can manifest symptoms that would be very similar to DCS from other problems including muscle strains from lifting gear or an idiosyncratic reaction to medication. This test of pressure confirms whether further recompression therapy would benefit the patient. Applying this test has proven to be nearly 100% reliable.

During the period of the test of pressure a determination will be made as to what the appropriate Treatment Table applies. This is determined by the time factor involved for the relief of symptoms and the seriousness of symptom presentation. Patients resolving in ten minutes or less have historically been treated on Table 5. If resolution takes longer or if any Type II symptoms were initially presented, a Table 6 is chosen. This is a judgment call and the current trend is more towards committing to a Table 6 regardless of time factor resolution.

You may then ask: what about the patient that manifests symptoms, reports promptly and relieves after O2 administration during transit? Opinion is divided on this issue. If the patient is asymptomatic and a test of pressure does not confirm DCS at that time, can they be considered a bends case?

Unquestionably, patients have had DCS and been relieved by O2 breathing. This only confirms the importance and validity of aggressive O2 use in first aid. If transportation from a remote site involving significant financial cost is a consideration, we recommend close observation and suspension of diving activities. However, if a

field chamber is readily available and the diver's profile would seem to have put them at risk, we recommend treatment to be administered at least to the extent of Table 5. It can't hurt the patient, and may provide a safety net for recurrent symptoms.

An interesting observation is offered here for the reader's consideration. Can you get bent free-diving (breath hold diving)? Most divers would answer no. But there is no requirement that you breathe compressed air from a scuba tank to manifest DCS. The malady is dependent on time and depth primarily and therefore expert breath hold divers can, in exceptional diving circumstances, place themselves within a window of vulnerability.

Competitive spear fishermen, South Pacific native working free-divers and Japanese Ama divers are most at risk. Typically, these divers can attain relatively deep depths (80 to 130 fsw) for up to three minutes bottom time. Their profiles reflect an average to rapid ascent followed by a "working" period at depth. Ascents are rapid, sometimes assisted by buoyant apparatus. Considerable exertion may be expended on the dive if the diver must struggle to land a large fish or to swim objects off the bottom.

Originally, little serious consideration was given to the prospects of free-divers falling victim to bends hits, but with Bob Croft's dramatic 240 fsw breath hold dive in 1968 some discussions were prompted. Dives exceeding four minutes had already been recorded and anecdotal accounts of longer breath hold dives were in circulation. A 1962 National Geographic article recounts the diving style of a South Pacific diver: "A man from the Tuamotos who at 59 years old went to 100 feet as many as 50 times a day summed up his attitude toward this skill, 'It is nothing...I have big lungs and a strong body. It is my work.' Two minutes, three, four...a long time if your are holding your breath, but what if you are trying to follow a fish?"

A fixed ascent line for decompression is the most effective way to ensure depth, time, and the location of any contingency equipment.

Surprisingly, no correlation between deep breath hold dives and symptomatic DCS was made in many cases. In National Geographic's 1980 book, *Exploring the Deep Frontier*, the authors relate rather naively, "Oxygen deprivation much longer (than four minutes)...can be damaging or fatal. In the Tuamotos, those who make successive, lengthy dives to great depths, risk a condition they call *taravana,* a sickness that includes vertigo, nausea, partial or complete paralysis, and unconsciousness." Don't these symptoms have something of familiar ring to them? A quick glance through the DCS symptom list should provide some easy match-ups.

Competitive free-diving spear fishermen in the Virgin Islands in the early seventies experimented with wearing the old SCUBAPRO/SOS decom meter during prolonged diving days with interesting results. Many were able to advance the analog needle almost into the "red zone", indicating required decompression, while diving in 100+ fsw depths.

During this same era, in St. Croix commercial lobster diver Sam Espinosa presented himself to me for evaluation after suffering from numbness, exceptional fatigue and joint stiffness following his diving day. I did a neurological examination on him and confirmed that his symptoms were progressively worsening. I was convinced he was bent. He told me that he had been diving since sunrise between 90 and 110 feet deep and stopped just before dark. It was only after I started to record his actual dive profiles and surface intervals, that I realized he was free-diving!

Espinosa responded well to a thirty-minute breathing period on pure oxygen from a demand regulator and declined recompression treatment. When questioned further, he said several of his fellow lobster divers had similar episodes.

Admittedly, it takes an exceptional diver to get bent holding his breath but it obviously does happen. Readers are cautioned about deep breath hold diving following aggressive scuba diving activities. Dive instructor Scott Valerga of Virgin Gorda had made repetitive scuba dives in 1978 while taking tourist divers on scuba tours. When he was unable to free his anchor following the last dive, he made several dives to 90 feet holding his breath to break out the anchor. Within minutes after getting back on board, he was symptomatic of DCS. His previous diving schedule was within the limits of the U.S. Navy tables but with little safety margin. He was treated in the St. Croix recompression chamber operated by NOAA's HYDROLAB facility with full recovery.

DEALING WITH DENIAL

Decompression sickness (DCS) or "bends" is a statistical inevitability in diving. It has no conscience and rarely abides by any set rules. Although we can identify certain predisposing factors to DCS in divers generically, it is still impossible to explain the exact mechanisms of physiology that allows one diver to be bent while his partner escapes unscathed. It is best that divers, particularly those in the technical community, accept that DCS hits will eventually occur and take steps to deal with treatment responsibly.

What concerns many of us in the business of treating divers is the unfortunate mindset that somehow has developed with the sport diving population that consistently denies the possibility of DCS. Indeed, a certain stigma to reporting symptoms has developed and this trend flies in the face of all common sense and logic. Why would any intelligent adult ignore symptoms with the knowledge that DCS manifestations are progressive in nature...they get worse with time. Further, any delays in reporting symptoms and seeking treatment only contribute to a poorer prognosis for recovery.

Historically, denial of symptoms and treatment delays are the rule in sport diver DCS injuries rather than the exception. The technical diver community has been pivotal in reversing this "head in the sand" mentality. We have to remove the stigma of "blame" so improperly associated with DCS reporting. It is no one's fault that they got bent; a diver can play everything in his dive plan precisely by the book and still get hit. Likewise, a deliberately high-risk dive profile may not produce symptoms. The point here is diving leaders have to stop pointing fingers and using antiquated analogies ("he screwed up and he got bent, the idiot!") or continued reluctance to report symptoms will prevail.

Almost all of us know individuals who have surfaced after a dive and variously exhibited DCS symptoms but steadfastly refused further evaluation or even basic first aid such as surface oxygen by demand valve/mask. It's not macho to attempt to "tough-out" shoulder pain or progressive numbness: it's just plain stupid.

In the working and commercial diver ranks an entirely different attitude prevails. Divers are trained to report symptoms as soon as possible and the attitude of diving supervisors is one of accident "containment" not accident "crisis" as in many sport diving situations. Bends is regarded as an occupational hazard that will occasionally take place and commercial operators and the more progressive sport diving facilities regard DCS as a manageable scenario. For the best outcome, divers and chamber supervisors work in a partnership of honest reporting of even slight symptoms with prompt evaluation and treatment.

Until recently, there were few operational recompression chambers in remote resort sites and divers who manifested DCS symptoms were faced with expensive medivac transportation and significant delays even in the best of circumstances. Possibly as a result of this, many so-called "experts" were prone to overly broad condemnations of sport divers who got bent and this attitude only contributed to diver denial. Negative peer pressure and professional loss of face proved to be powerful influences on divers to ignore DCS symptoms in the mistaken hope that they would somehow get better without treatment. Rarely was this the case, however.

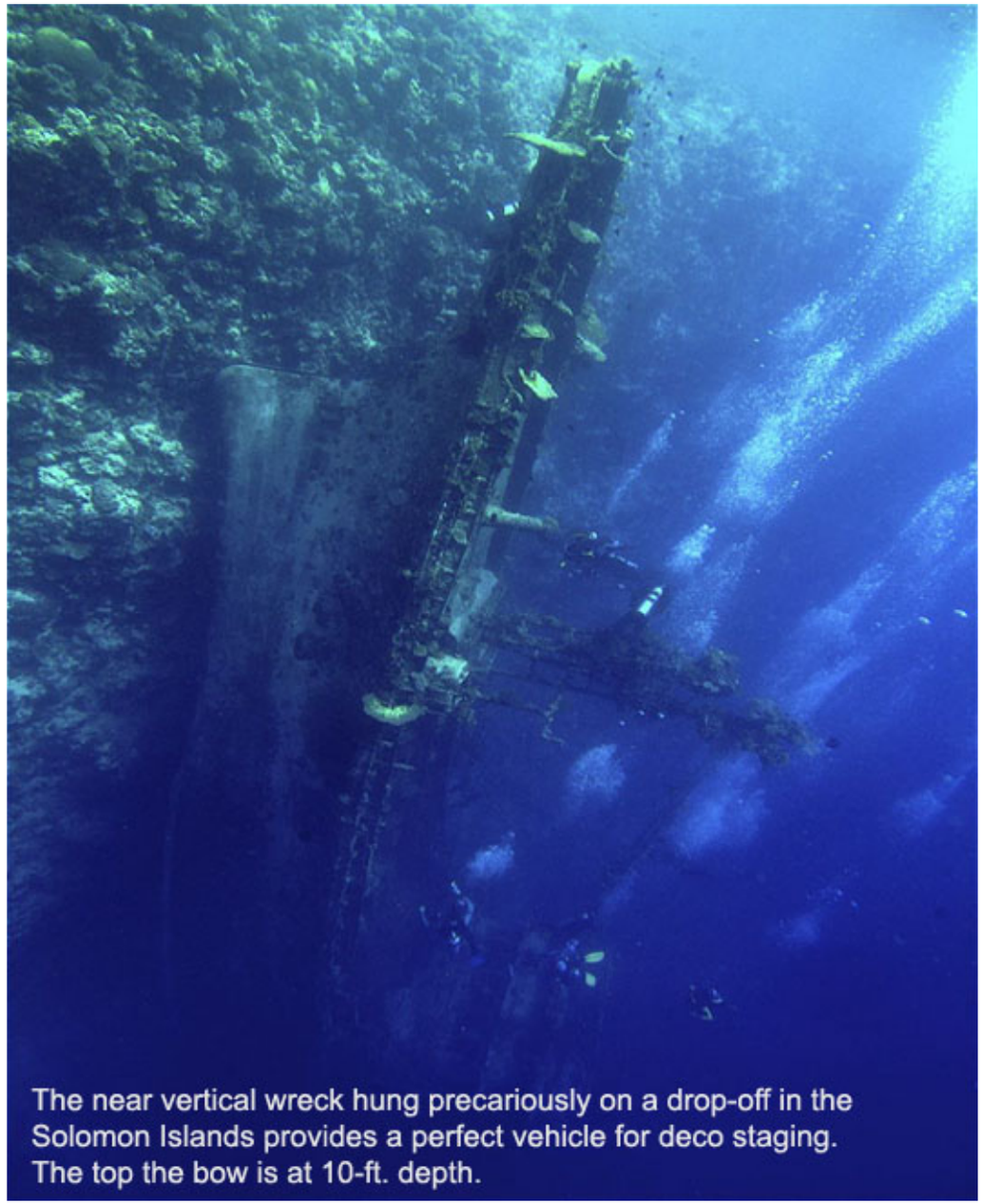
Most chamber supervisors that I have known in my career feel that if DCS is promptly reported and evaluated with ensuing on-site treatment, then the prognosis for complete resolution is excellent. The attitude of many commercial diver medics and chamber operators is "No matter what the problem, if reported and treated quickly, we can clean the diver up". Type I DCS (mild symptoms, pain only) affords less risk than Type II DCS (serious symptoms, central nervous system involvement) but in either presentation aggressive oxygen therapy and prompt recompression has produced nearly a 98% success record. Many academicians find fault with the commercial operators' confidence in resolution of symptoms but their track record is enviable.

In March of 1991, I was an invited speaker at the joint DAN/AAUS/NOAA Multi-day Repetitive Diving Workshop held at Duke University. For the first time, this conference included representatives from the sport, commercial, scientific and "high tech" diving communities assembled to compare notes on actual DCS incidence rates in the field. Some interesting statistical patterns developed as the workshop unfolded. The overall incidence of DCS for commercial divers was (approximately) 1 in 1000 dives, for the sport divers it was 1 in 10,000 dives and the scientific diving community rated an extreme low of 1 in 100,000 dives. Sampling from the tech segment was too low at that time to be realistically tallied.

With this rather startling multiplier of 10 between groups, it would be tempting to draw the too obvious conclusion that the scientific diving group is 100 times safer than the commercial diving group. Actually, the incidence rates are interesting for discussion purposes but do not reflect much data to produce true comparisons of relative dive safety *vis-à-vis* DCS risk. Rather, a clearer pattern of diving "attitude" was defined. Discussion of what an acceptable rate of DCS would be provided the best indication of how several schools of thought can basically approach a complex problem from entirely different angles.

Most scientific diving projects are planned from inception at eliminating as much risk as possible in all phases of the diving operation. This is accomplished by strict supervision and training of divers and a markedly conservative discipline in dive profiling. In short, every possible precaution is taken to reduce the possibility of a DCS occurrence. At the other end of the spectrum, the commercial diving community must deal with a job performance/task completion goal motivated by economics. Therefore, the concept of "acceptable risk" comes into play for both groups but each deals with risk differently.

By extremes of discipline, supervision and training the scientific community hopes to prevent DCS incidence. With the use of highly trained supervisors, diver medical technicians and on-site recompression facilities, the commercial companies aim to effectively manage any accidents that may occur. It is difficult to quantifiably gauge the "end user" effectiveness of either group since DCS still occurs in scientific and commercial divers; the distinction being that if a commercial diver gets hit he is benefited by immediate and state-of-the-art medical treatment which may not be available to a science diver in a remote situation. Per capita DCS rates may or may not reflect the effectiveness of either approach to accident management, but the commercial operators are steadfast in their opinion that immediate evaluation and treatment are an acceptable alternative to a lesser statistical incidence rate.



The near vertical wreck hung precariously on a drop-off in the Solomon Islands provides a perfect vehicle for deco staging. The top the bow is at 10-ft. depth.

All would agree that no bends hit is a good one, especially if you are on the receiving end. Terry Overland of Oceaneering International made this point at the conference: "While most sport and scientific dive operations would like to reach a goal of zero per cent DCS incidence, in commercial diving this is simply unrealistic. Ideally, we would like to reach a zero rate on Type II hits, but we still feel that our protocols allow us to treat DCS effectively enough that Type I hits are essentially manageable. A good analogy is that we accept the fact that if we give a worker a hammer, he will eventually hit his thumb and when he does we'll treat it. If we put a diver in the water to work, eventually he will get bent and we'll treat that as well. That's the simple facts.

"We have the technology to handle such hits and we feel that this is a more responsible outlook than attempting to unrealistically eliminate DCS. It's going to happen; we all know that. Let's be prepared to treat it. Importantly, our divers feel that our system works and it's their butts on the firing line, of course," says Overland.

Further distinctions are sometimes made between "deserved" and "undeserved" DCS hits. Simply put, hits following a dive profile that would suggest the high-risk of DCS exposure such as clear Table limits violations or deep repetitive or reverse profile dives can be categorized as "deserved". Hits following dives that were within accepted limits are considered "undeserved". This is not to say that as chamber supervisors we sit back and blithely pass judgment on patients; categorizations of DCS hits using such terms merely allows a perspective on reasons for the presentation.

First and foremost, we have to encourage reporting of symptoms at the earliest observation. Second, the importance of surface oxygen by demand valve/mask cannot be overemphasized. Dr. Jefferson Davis was one of the earliest advocates of aggressive 100% O2 delivery in the field and his pioneering work has resulted in the now accepted practice of oxygen therapy as a first line of treatment en route to the chamber. A significant percentage of symptomatic DCS patients will relieve following a 30 to 45-minute oxygen breathing period if delivered by demand valve/mask.

I ran the Ocean Quest diving program along similar guidelines to a large commercial operation: expect the worst and be prepared to deal with it. We were very successful in encouraging divers to report any symptoms and had a 100% resolution rate on every one of the DCS cases we treated. Our overall incidence rate came out to be approximately 1 case in 12,000 dives; this is significant since we allowed an unlimited diving program with respect to depth and numbers of repetitive dives daily. In the space of one year we conducted almost 80,000 dives!

Thankfully, we are seeing more and more fully operable field chambers coming into use. Grand Cayman, Cozumel, Roatan, Provo, Ambergris Cay, Saba, and the Virgin Islands feature state-of-the-art treatment facilities that would have been unthinkable only a decade ago. But remember, the chamber is only an effective tool if used (hopefully as soon as the diver notes a problem). It's incumbent on all divers to take responsibility for themselves and report any abnormality that could even be remotely linked to DCS. Use 100% O2 at once and seek professional evaluation and a test of pressure if the possibility of DCS is suspected.

With the advent of affordable medical insurance such as available through DAN, the financial deterrent to admitting DCS and seeking help should be removed. With good diving practices and some luck you may never need to see the inside of a recompression chamber. But it is more than likely that you will encounter a DCS incident

during your career for another diver.

There is nothing "macho" or "cool" about denial of DCS symptoms that could result in lasting injury such as paralysis or worse. It's time divers woke up to the fact that bends is an injury like any other and common sense dictates its treatment. Finally, the encouragement of prompt reporting with no associated peer or professional blame will vastly improve the safety of a sport infamous for symptom denial.

Bret Gilliam has operated diving chamber facilities since 1971 throughout the Caribbean and aboard ships internationally in some of the most remote areas of the world. Additionally, he has trained the response teams in resorts and aboard vessels in field treatments including in-water recompression therapy protocols. He has treated or consulted on nearly 300 cases. He is credentialed as a recompression supervisor through the Association of Diver Medical Technicians (ADMT), Hyperbarics International, and the International Board of Underwater Medicine (IBUM). Those groups, as well as the International Association of Aquatic Medicine (ISAM), the Diver's Alert Network (DAN), the Undersea & Hyperbaric Medical Society (UHMS), the National Oceanic & Atmospheric Agency (NOAA), and the South Pacific Underwater Medical Society (SPUMS) have published his medical papers. He also was the contributing editor and author of the chapter on "Diving Emergency Medicine" for the reference text ***Pre-Hospital Trauma Life Support*** *published by Mosby-Lifeline for use by physicians, nurses, DMTs, EMTs, and Paramedics.*

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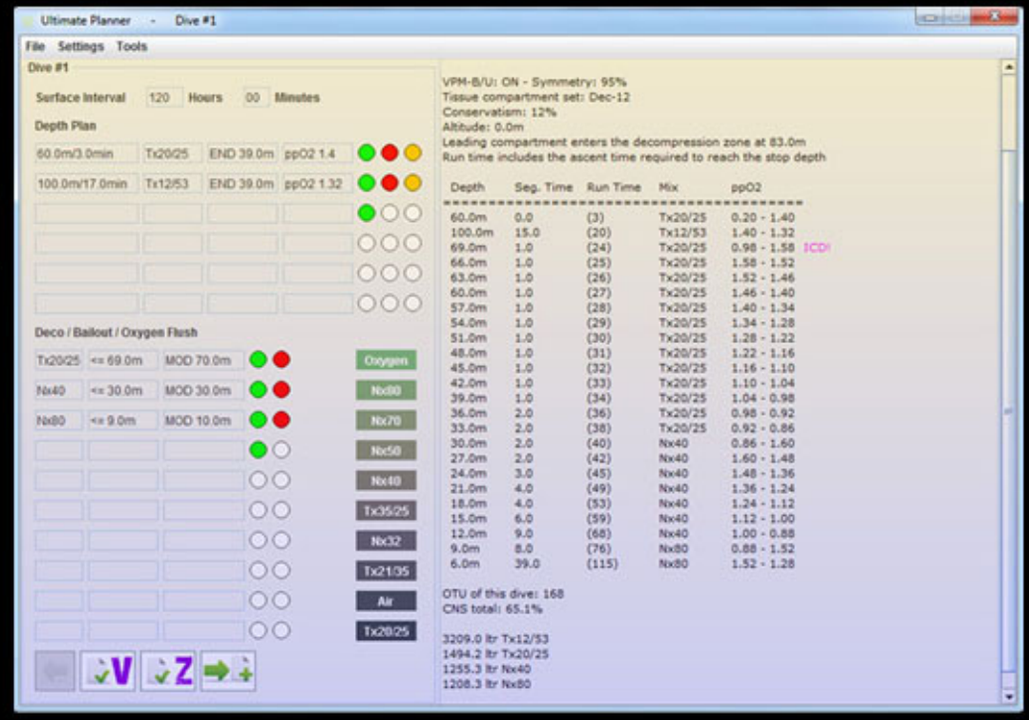

"Counting close to 500 mixed gas dives on this excellent piece of software!"
Ben Reymenants - Instructor Trainer (TDI, SSI, PADI)

Solo Cave Diving: Just How Safe Is It?

By Peter Buzzacott

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"Does not other sports demand a solo jump or a solo flight before you get the appropriate license? In fact should not cave diving demand a solo 1500 foot penetration to insure you have learned your lessons well?" Bill Rennaker, Cave Excursions, Florida

Down here in Australia we've enjoyed decades of fatality-free cave diving. This enviable run of good luck ended recently when we lost three of our close community in relatively quick succession. Concurrently with the ongoing Coronial investigations our cave diving association purchased their first cave, a wonderful, phreatic maze called "Tank". Of our three recent tragedies two occurred in Tank Cave and one may have involved planned separation, which occurs when a diver explores a potential lead alone. This practice is known as "solo cave diving" and it's controversial, both in Australia and elsewhere, mainly due to a lack of hard evidence either for, or against, allowing or banning it.

While we wrestle with the issue in Australia, dampening the enthusiasm of our explorers, advising our non-diving legal system, mindful of our insurers, let's take a moment to consider what we do know, and what we don't.

The largest peer-reviewed study into cave-diving fatalities considered the circumstances surrounding 368 American deaths.[1] Among untrained cave divers multiple deaths were far more common, whereas trained divers were more likely to die alone, but not necessarily while diving alone. There were many cases of solo diving, and dives involving either intentional or unintentional separation, but there was no clear link between solo diving and risk of death. Even if we determine what proportion of cave diving fatalities involve solo dives, we still won't know if that proportion is over, or under, represented because we do not know what proportion of cave divers, or cave dives, are solo. Recent posts on the cavediver.net main forum suggest the practice is widespread and popular. Until we determine what proportion of cave dives involve planned separation, we simply cannot say if solo cave divers are more exposed to risk, or if they take such extra care that they are actually safer in the same way that Formula One drivers are at less risk of death than ordinary folk on the highway.

Here in Western Australia, where I live, we have around 30-35,000 active recreational divers out of a population of 1.9Million at age ≥ 15 years, so about 0.017% of the population dive.[2] Between 1999 and 2005 there were 10 recreational diving fatalities in Western Australia out of 76,108 deaths at age ≥ 15 years, or about 0.013%. While it is tempting to conclude this suggests diving does not add to the risk of dying, that may not be the case. However, in an analysis of the risk factors among 24 diving fatalities in Western Australia untrained divers broke significantly more established safety rules than trained divers and were obviously over-represented in the fatality stats.[3] Training, therefore, was found to lower the risk of dying whilst diving and cave divers are among the highest trained divers of all.

Australia's longest linear cave is in the west (6.4 km), so too the second deepest (110m), and in recent years extensive new caves have been discovered here and mapped, cave diving courses have been held with increasing regularity, a West Australian cave diver recently broke the Australasian cave diving depth record, at 221m. And yet, despite the flourishing cave diving community, none of the 0.013% of the population who've died whilst recreationally scuba diving in the last 20 years have done so while cave diving.

These days in Australia there are 800 or so members of the cave diving association, out of a population of 17.5 million, or about 46 out of every million adults. Since the association was formed in 1973

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there have been five deaths in caves, all around the town of Mount Gambier in South Australia. During this period there have been approximately 650,000 deaths aged ≥18yrs in South Australia alone, suggesting cave diving has accounted for an average over 40-years of 8 deaths per million all-cause adult mortality in that state. How these stats relate to each other isn't simple. What is clear though is that we are rare, and cave diving fatalities are even rarer, in fact, extremely rare. Indeed, some cave divers think we may even have a longer life expectancy than the general population due to a number of factors, including:

- A higher than average income which coincidentally offers better nutrition, access to healthcare, safer cars, etc.
- A higher than average awareness of healthy lifestyle practices, such as low number of smokers and general fitness
- The physical activity itself which involves sustained moderate exercise and the development of social capital (camaraderie)

Measuring Risk

There are two common measures of mortality risk in adventure sports; risk per unit of activity (per number of dives, per hours of rock-climbing, per parachute jump), and the risk per number of participants per year. Now, for the average cave diver the one that makes the most sense when considering his or her own level of personal risk is the risk per dive. This is probably for two reasons, firstly the risk associated with the individual doesn't change from dive to dive, (same age, same sex, etc), and secondly this measure relates more closely to the next dive at an individual level. For example, if I do "X" then my risk on the next dive might increase, rather than my risk over the next year might increase. But, the second measure of risk, (per number of participants, per year), has wider application in two main areas: insurance, and comparing us with other sports. Insurance is basically a game of probability. The insurer estimates the likelihood of losing money (a death), looks at the size of the payout, calculates the amount someone should bet to reach that payout (the "premium") and adds a percentage (profit margin). If the premium is too high then another insurer can safely under-cut by offering a lower premium, until eventually the premium approaches an approximation of the mathematical risk. The higher the risk of death then the higher the premium to be paid for coverage. So, how does Australia's largest diving insurer, the Divers Alert Network, view cave diving? Well, from the policy document it appears that, provided the activity is not a record attempt or obviously foolhardy, there is no additional premium for cave divers over recreational divers, nor is solo cave diving banned for suitably qualified and experienced cave divers executing a well-considered solo cave dive. Rebreather diving, however, is specifically excluded from death coverage.

While comparing cave dives with parachute jumps or kite-surfs may not be entirely sensible, it may be valid to compare risk over time between adventure pursuits, for example per 10,000 participants per year. People being people, these rates vary between locations. Table 1 presents mortality for various adventure pursuits.[4] In the last 40 years membership of the CDAA has averaged around 500-600 per year, giving 20-25,000 member years. There have been five deaths, but only four were members, so 4 or 5 out of 20-25,000, that's one death per 5,000 member years (give or take 1000), or 2 per 10,000 member years. As shown in Table 1, this puts cave diving in the same category as riding an ATV or mountaineering, and about twice as risky as recreational diving.

Where does this leave the solo cave diver? In summary:

- Solo cave diving occurs in Australia and internationally, and has since man first ventured into a sump

- Cave diving organisations and cave managers often have to secure insurance which may or may not require solo cave diving to be banned
- Individual cave divers may even be required to hold current DAN insurance to dive certain caves
- DAN insurance does not ban it, however they do exclude rebreather diving from death benefits
- Recreational diving appears safer than riding an ATV, skydiving and mountaineering, cave diving is probably on par with these
- Recreational divers are not obviously over-represented in all-cause mortality, therefore diving itself may not actually add to the risk of dying (our chances of dying may be the same as if we did something else instead)
- Cave divers are the highest trained recreational divers and could even have a longer life expectancy than the general population
- The two main cave diving areas in Australia are in South Australia and Western Australia
- Despite widespread cave diving in both areas, cave divers account for just 0.0008% of the South Australia all-cause mortality statistics and are not found at all among West Australian recreational diving fatalities
- It remains unknown whether solo cave diving has a higher likelihood of death or if it may actually carry less risk because it is undertaken by the sport's elite.

Until someone invests research money into this issue we simply cannot say one way or the other. Meanwhile, the more passionate elements of the cave diving community remain philosophically divided between "Team Divers" and "Solo Divers", and exploration continues nonetheless. That is, after all, why we do what we do.

Table 1: Adventure pursuit mortality[4]

Pursuit	Deaths per activity	Risk per participant (per year)[a]
Hang-gliding	-	0.2 per 10,000 pilots
Recreational diving	0.06 - 0.21 per 10,000 dives	0.3 - 1.3 per 10,000 divers
Kayaking	0.02 - 0.09 per 10,000 days	0.04 - 0.05 per 10,000 kayakers
Rafting	0.05 - 0.09 per 10,000 days	-
Canoeing	-	0.07 - 0.09 per 10,000 canoers
Skydiving	0.5 per 10,000 jumps	-
BASE jumping	4 per 10,000 jumps	-
Skateboarding	-	< 0.7 per 10,000 boarders[b]
All Terrain Vehicle	1.1per 10,000 rides	1.2 per 10,000 male riders 2.5 per 10,000 female riders 0.9 - 1.4 per 10,000 vehicles
Mountaineering	1.3 - 22.1 per 10,000 hrs 18.7 per 10,000 days 30.8 per 10,000 summit attempts[d]	0 - 12.6 per 10,000 climbers

[a] Not all research specified "per year"
[b] 0.7 includes other catastrophic injuries, therefore deaths <0.7
[c] Above 6000m in the Himalaya
[d] At Mount McKinley, Alaska

© Maciek "Lama" Olinkiewicz (Poland) at Volacka Jama cave (Montenegro). Honzo (Poland) from Cave Divers Group Poland in entrance restriction.

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A Few Words About Decompression Schedules:

please get a grip and don't sweat the details, because it will all come right in the water

By Steve Lewis

This is an excerpt from Steve's new book on mixed gas diving scheduled for launch at OzTeK in March of 2013.

Today started early and I awake, drinking black coffee, mixing gas just like yesterday and the day before that. The only light is coming from a couple of bare 25-watt bulbs strung under the canvas awning that covers the aft deck and our gear. And just like yesterday and the day before that, it is raining; but that will stop soon. In an hour or two, the sun will be strong enough to burn off the clouds, raise the temperature a dozen degrees, and push the humidity across the border which separates uncomfortable from ridiculous. At this time of year, and at this latitude, the only break is when we are underwater or when the wind is blowing; and the wind has not blown for a week.

But, regardless, the diving here is easy. The water is warm, the visibility is fantastic, the wrecks are amazing, there are snacks and cold drinks waiting for us between dives, and we have video replays of our dives at night. To cap it all, the folks I am guiding are easy-going and demand little hand-holding or spanking. The only issues any of them seem worried about are the fluctuations in their gas mixes. The deviations are minor but several people fritter away valuable dive-time every morning fussing over things that simply do not matter. I promise myself to do some "remedial training" during breakfast.

The simple facts are that partial pressure gas mixing for deep diving – for any diving actually – is a bullshit science at the best of times. This unscientific, rather sloppy blending practice – although common among technical divers – presents logistical and "engineering" challenges under the best conditions; and ours are not the best of conditions. We are mixing in the dead of night on a boat in the middle of the ocean with a booster older than one of our dive team; and our supply of oxygen and helium is limited. This is true expedition blending. Plenty of fun with numbers and little room in the equation to fix the small errors that often accompany this kind of aquatic adventure. Actually, I love it.

At issue, and the reason I'm going to put time aside over breakfast to explain to this group the need for realism concerning our deco schedules, is that in the general scheme of things, a couple of points (tenths of a bar) more or less oxygen in nitrox blend, or even ten percent difference in the helium in a trimix, can make little actual difference to the length of an ascent schedule or the shape of the curve coming back up through the water column.

What I am faced with every morning is people running off to their laptops to "cut new tables" because the 18/45 mix they asked for analyses out at 19/38… or, even more frustrating, their 50 percent nitrox is coming in a couple of points either side of what they asked for!

OK. Let's back-up for a minute or two.

My concern is not about analyzing oxygen content and modifying one's operational window accordingly. I have friends to whom I no longer send birthday cards because they ignored or neglected one or more basic steps when it came time to plan around CNS toxicity; so my stance on analysis, labeling, tracking and staying well within accepted limits is unmovable. I make a point of sticking to NOAA's suggestions for all diving operations including daily CNS limits, the often neglected big-bad-sister to single-dive limits. And I have promoted this practice in the face of resistance for many years. Nope, my issue is that when it comes to decompression schedules – how fast one gets back to the surface post dive, and where you stop on the way up – there is no real difference between mixes that have quite remarkable differences in their constituents.

This morning over breakfast, I will share some "wisdom" with my shipmates.

Here are some "facts" about ascent schedules that I believe support my "don't sweat the details" attitude. First, I am a big fan of standardizing mixes. Using the same mixes for dive after dive builds a greater understanding of what's needed to conduct the dive; and what will help to get everyone out of the water safe and sound. Using similar mixes again and again also makes blending easier since the numbers for a normal fill (let's say a 175 bar trimix fill) can be chiseled into a stone tablet and packed into the top or your dive kit... or at least written in ink in your dive log or notebook.

However, partial pressure blending and using the same numbers all the time – even in similar circumstances – does not guarantee success to within limits anything better than a few points here or there. In addition sometimes standard mixes are simply not possible because of gas logistics. This last point – for example – may translate into having to put slightly less helium in a mix… or slightly more and top with nitrox on a second fill. In the real-world, away from armchair quarterbacking and when diving in remote areas, a diver has to live with these inconveniences or not dive.

Moreover, decompression is far from an exact science. We – divers – don't really have a clue what's going on in our bodies from dive-to-dive, day-to-day. The best we can hope for from a set of tables or fourth-generation personal dive computer, or the controller wired into our CCR, is a rough guide that we hope will probably get us back to the surface whole and intact: statistically speaking that is We are, as has often been stated, all guinea pigs in a great big decompression experiment. And once again, a diver has to accept this or not dive.

And lastly, execution is never as perfect as we think it is. At any time, the suitability of a decompression schedule to our particular circumstances is predicated on several factors. We learn from the standard texts that one of these factors is to follow what the decompression schedule tells us to do with exact precision; exactly the correct speed, arrival at each waypoint at the exact time, departure from each waypoint after the correct number of seconds or minutes, and switching gases exactly when and where the algorithm says we should.

We drum these provisos into our students during training, we talk about them with our mates, but the truth is, we all get a bit sloppy. Ascent speeds are rarely exact, our arrival or departure from waypoints can vary considerably, and it is common practice to breathe deco gas at its MOD even when the ascent schedule indicates a shallower switch.

In addition, the instruments we use to measure depth are rarely correctly calibrated, and more emphatically, the instruments with which we actually analyze our gas mixes are little better than kid's toys: both of which lend an interesting, and additional level of slop into our methods and operational tolerance.

All in all, this would seem to paint a pretty bleak picture for anyone who maintains that decompression diving is an exact science and who tells you with a straight face: "I have answers." Nobody understands the actual workings of decompression and none of the experienced decompression divers I have spoken with have a clue what the definitive answers might be. They may know what works… what often works… for them… on a good day. But all of that is almost pure alchemy with very little science involved.

OK, so now let's look as some examples of actual ascent schedules to see just how an algorithm responds to slight variations in gas mixes. By the way, to pump out these profiles, I used my personal copy of V-planner with the degree of conservatism set at 3. V-planner uses a

VPM algorithm.

I started with a 25-minute dive on an 18/45 trimix to 60 metres, with the diver switching to EAN50 at 21 metres and polishing off the deco with 100 percent oxygen from 6 metres up. All pretty standard mixes, standard depths and common practice.

Figure 1:
60 metres – 25 minutes on 18/45 with EAN50 and Pure Oxygen

Dive #1 | Profile #1 | Details

Depth	Stop	Run	Mix	pO2	
60	-	2	18/45	-	-
60	22	25	18/45	1.22	22
42	-	26	18/45	-	-
42	0:12	27	18/45	0.91	14
36	2:00	29	18/45	0.80	11
30	2:00	31	18/45	0.70	8
27	2:00	33	18/45	0.64	6
24	2:00	35	18/45	0.59	5
21	2:00	37	50	1.50	9
18	2:00	39	50	1.35	7
15	3:00	42	50	1.21	5
12	4:00	46	50	1.06	3
9	6:00	52	50	0.92	1
6	4:00	56	100	1.55	0
4.5	17	73	100	1.40	0
-	-	73	100	-	-
Depth	Stop	Run	Mix	pO2	

The total runtime (the combination of bottom time and ascent time) comes out to 73 minutes. We can confirm this by consulting the seat-of-the-pants guideline that tells us that the ascent time from this depth using these gases should be about twice the bottom time. In our example the bottom-time is 25 minutes and the ascent time adds up to 48 minutes. If I were to do this dive on these gases, I would probably stay in the water until the runtime was 50 minutes by adding those additional two minutes over and above the 48 called for to get from the last staged stop to the surface.

Anyhow, let's ignore my adaptation during actual dive execution, and take note that the algorithm states that the total runtime for this dive should be 73 minutes.

Now let's mix things up. How about a similar dive – same time, same depth, same deco gases – but using an 18/35 for bottom gas? That's a whole 10 percent less helium.

Figure 2:
60 metres - 25 minutes on 18/35 with EAN50 and Pure Oxygen

Dive #1 | Profile #1 | Details

Depth	Stop	Run	Mix	pO2	
60	-	2	18/35	-	-
60	22	25	18/35	1.22	31
42	-	26	18/35	-	-
42	0:12	27	18/35	0.91	20
36	2:00	29	18/35	0.80	17
30	2:00	31	18/35	0.70	13
27	2:00	33	18/35	0.64	11
24	2:00	35	18/35	0.59	9
21	2:00	37	50	1.50	9
18	2:00	39	50	1.35	7
15	3:00	42	50	1.21	5
12	4:00	46	50	1.06	3
9	7:00	53	50	0.92	1
6	3:00	56	100	1.55	0
4.5	17	73	100	1.40	0
-	-	73	100	-	-
Depth	Stop	Run	Mix	pO2	

The total runtime is 73 minutes. Hold on. The runtime is the same? How can that be? Who knows… who cares… it just is! And unless we want to start tinkering with the algorithm itself and go completely outside the box, it is as stated, the same. There are a couple of very slight differences in the arrival and departure times from very shallow stops, but nothing outside the operational slop discussed and admitted to earlier.

How about a dive where the back-mix contains slightly less helium? Let's drop the content to 30 percent. This would have an effect – possibly – to the narcotic loading, but how about the deco schedule?

V-planner is still spitting out a 73-minute runtime! Admittedly, the shape of the ascent curve varies slightly once again. That's to say, the arrival and departure times at a couple of stops is different, but only by a minute or two; certainly well within the vagaries of the actual operational slop of most recreational divers (which for the sake of this conversation includes everyone who is not being hoisted up to the surface on a platform tethered to a surface supply manifold).

OK so much for "slight variations" in helium content. They do not seem to make much of a difference do they? What about decompression gases? Surely they will make a more of a difference.

Figure 3:
60 metres - 25 minutes on 18/45 with EAN53 and Pure Oxygen

Dive #1 | Profile #1 | Details

Depth	Stop	Run	Mix	pO2	
60	-	2	18/45	-	-
60	22	25	18/45	1.22	22
42	-	26	18/45	-	-
42	0:12	27	18/45	0.91	14
36	2:00	29	18/45	0.80	11
30	2:00	31	18/45	0.70	8
27	2:00	33	18/45	0.64	6
24	2:00	35	18/45	0.59	5
21	2:00	37	53	1.59	8
18	2:00	39	53	1.43	6
15	3:00	42	53	1.28	4
12	4:00	46	53	1.13	2
9	6:00	52	53	0.97	0
6	4:00	56	100	1.55	0
4.5	17	73	100	1.40	0
-	-	73	100	-	-

We might start with a relatively common situation: an EAN50 that turned out to be richer than expected… an EAN53 for example. Let's keep the same bottom time, an 18/45 bottom gas, and the EAN53 and pure oxygen for decompression. This gives us a total runtime of 72 minutes (one minute less than before) and virtually no difference in the ascent curve apart from a little shallower MOD for the rich deco mix. Once again, what small differences there are in ascent times, are certainly not enough to worry about cutting a new table, in my opinion.

To set-up variations in the deco gas scenario in a similar way to what we did with bottom-mix, let's see what changes would have to be made to the ascent schedule if the nitrox had slightly less oxygen: let's say a 47 percent instead of a 50 percent.

Figure 4:
60 metres - 25 minutes on 18/45 with EAN47 and Pure Oxygen

Dive #1 | Profile #1 | Details

Depth	Stop	Run	Mix	pO2	
60	-	2	18/45	-	-
60	22	25	18/45	1.22	22
42	-	26	18/45	-	-
42	0:12	27	18/45	0.91	14
36	2:00	29	18/45	0.80	11
30	2:00	31	18/45	0.70	8
27	2:00	33	18/45	0.64	6
24	1:00	34	47	1.54	12
21	2:00	36	47	1.41	10
18	2:00	38	47	1.27	8
15	3:00	41	47	1.14	6
12	4:00	45	47	1.00	4
9	6:00	51	47	0.86	2
6	4:00	55	100	1.55	0
4.5	17	72	100	1.40	0
-	-	72	100	-	-

Because the diver can actually start to breathe this leaner mix three or so metres deeper in the water column the actual suggested run-time is 71 minutes, a couple of minutes shorter than our "standard" schedule. Two minutes and a slightly different curve: enough to warrant new tables? Not in my book.

I am not advocating that divers disregard safe practices, but let me explain why in each of the cases cited above I would stick to the original "standard" schedule.

The first reason is that the slight variations in actual gases over "perfect" gases are of no consequence. The examples prove it. The little difference they make to the required stop times and overall running times is well within the slop of the average technical dive. A minute variance here or there is perfectly normal in the real world and in the more than 1000 trimix dives I've logged, a minute or two translates into "what works."

Secondly, I dive conservatively by which I mean when I cut tables for a dive, I usually do not spend the whole bottom-time at the maximum depth: 60 metres in this example. In fact, unless there is something physical to make it impossible to do so, I would likely spend most of the 25-minute bottom-time at least a few metres shallower than the maximum depth. Also, I would only rarely get to the target depth as rapidly as the tables suggest. Looking at all the figures above, the algorithm has the diver hitting maximum depth with two minutes elapsed time. It would be a set of rare circumstances when I choose to drop 60 metres in two minutes. I believe this is true for the vast majority of technical divers. Therefore, the "actual" time at maximum depth would be slightly shorter than that shown in the schedule which results in a slightly more conservative exposure. I also monitor the other factors that are thought to have some influence on the outcome of staged decompression dives including hydration, fatigue, stress levels, and fitness. All of this translates into being conservative, and these are habits that fall into the "best-practice" folder.

But just as important in many ways is that by adopting to use a standard table cut for standard gases and understanding precisely what degree of slop this practice allows, it is possible to memorize the ascent schedule. Run the schedule a few times and it becomes second nature and in the event of a contingency, is in the memory bank ready to help get you back to the surface.

An effective way for a technical diver – either new to staged decompression or a seasoned pro – to pass an idle 30 minutes or so is to run a familiar profile with gases that are a "mistake:" ones that vary a few points plus or minus. I believe that doing so provides some valuable insight, and even those divers who use a fourth generation personal dive computers, should carry a back-up and having that back-up committed to memory is the best policy.

Steve Lewis has been an active technical diver, instructor and expedition leader since the early 1990s when diving was an antidote to a career in marketing and brand management. In 2002 he retired from the corporate world and became a dive bum full-time, and is currently a training, and product consultant for a major rebreather manufacturer and design consultant for a leading open-circuit dive equipment company.

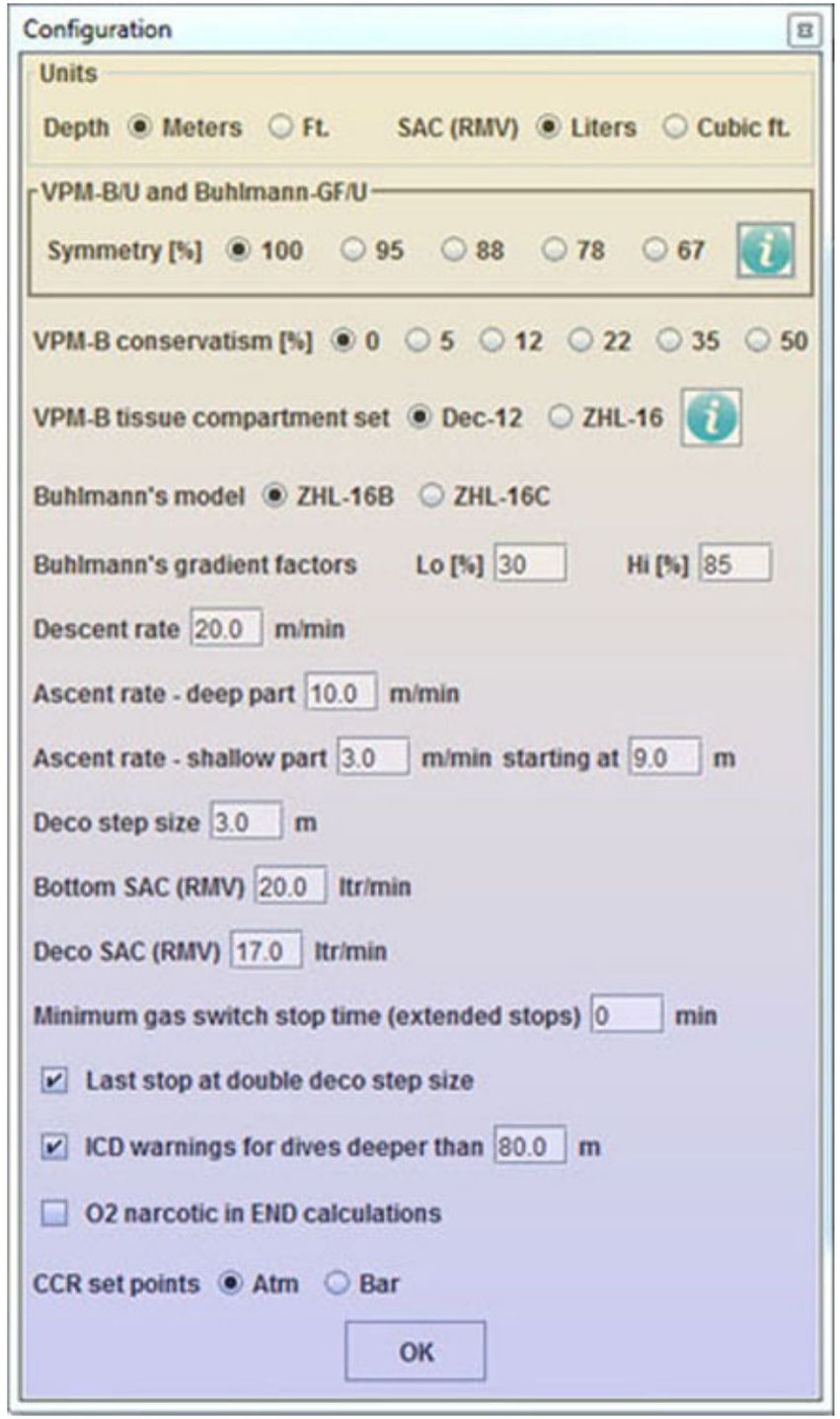
His other professional credits include serving on the Training Advisory Panel for TDI, SDI, ERDI, working as managing editor for Diving Adventure Magazine, and a contributing editor for Underwater Journal. He is also a regular contributor of articles and essays for several onLine publications. Steve has authored and co-

authored several diving textbooks including the best-selling Six Skills and Other Discussions and is currently preparing the "follow-up" Deep Diving in Age of Social Media for publication..

Although he has a home near the eastern shore of Lake Huron in Ontario, Canada, he travels extensively and delivers diver and instructor training programs across North America and the Caribbean, Europe and Asia.

As a speaker, educator, and blogger, he is best known for promoting safe diving practices to technical divers using both open and closed-circuit kit, in caves, on wrecks and in open water environments.

To find out more, contact him: doppler@techdivertraining.org.



Ultimate Planner utilizes both VPM & Buhlmann GF

Cave Diving Into The Dominican Past

Text By Cristian Pittaro
Photos By DRSS

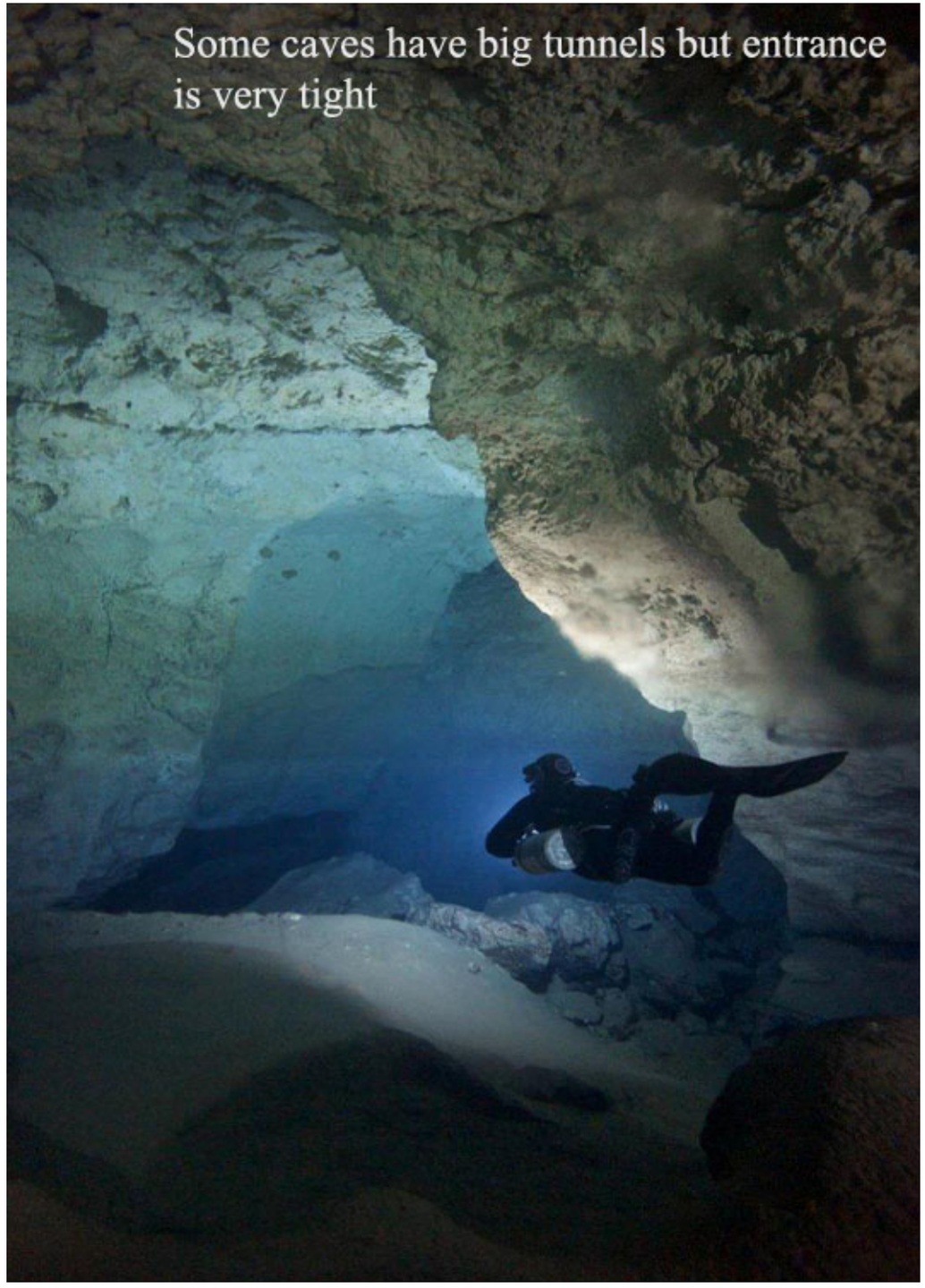
In the Dominican Republic it is not easy if not impossible to discover fossil material on the surface, because the island is mostly made of limestone and is hit by the hottest sun in the Caribbean that can destroy even the strongest material when exposed.

Thanks to the latest ongoing explorations by cave divers, and in particular the most active local explorers the Dominican Republic Speleological Society (DRSS) who work in conjunction with local and international scientists and governmental offices such as the Ministerio de Medioambiente and the Museum of The Dominican Man, part of the Ministerio de Cultura, have made a series of major scientific and paleontological discoveries.

During the past two years, DRSS has been very active, and together with the exploration of many new springs and cave systems comes the discovery of literally thousands of fossil remains inside these water-filled caves. Frozen in time and perfectly preserved, these fossils bear witness to an ancient past when these cave systems where still dry and the many now-extinct species were still alive and well.

Everything started about 3 years ago, after the discovery of the longest submerged cave on the island. In this cave came the discovery of a very strange looking bacterial growth forming goo stalactites, for lack of a better word.

It was only after analysis of some samples that it was discovered that they were in fact a new kind of bacteria colony completely unknown to science. That attracted the interest of scientists like Jenn Macalady, who is researching similar kind of extremophile bacteria worldwide that grow in the most inhospitable environments where no other life forms could survive.



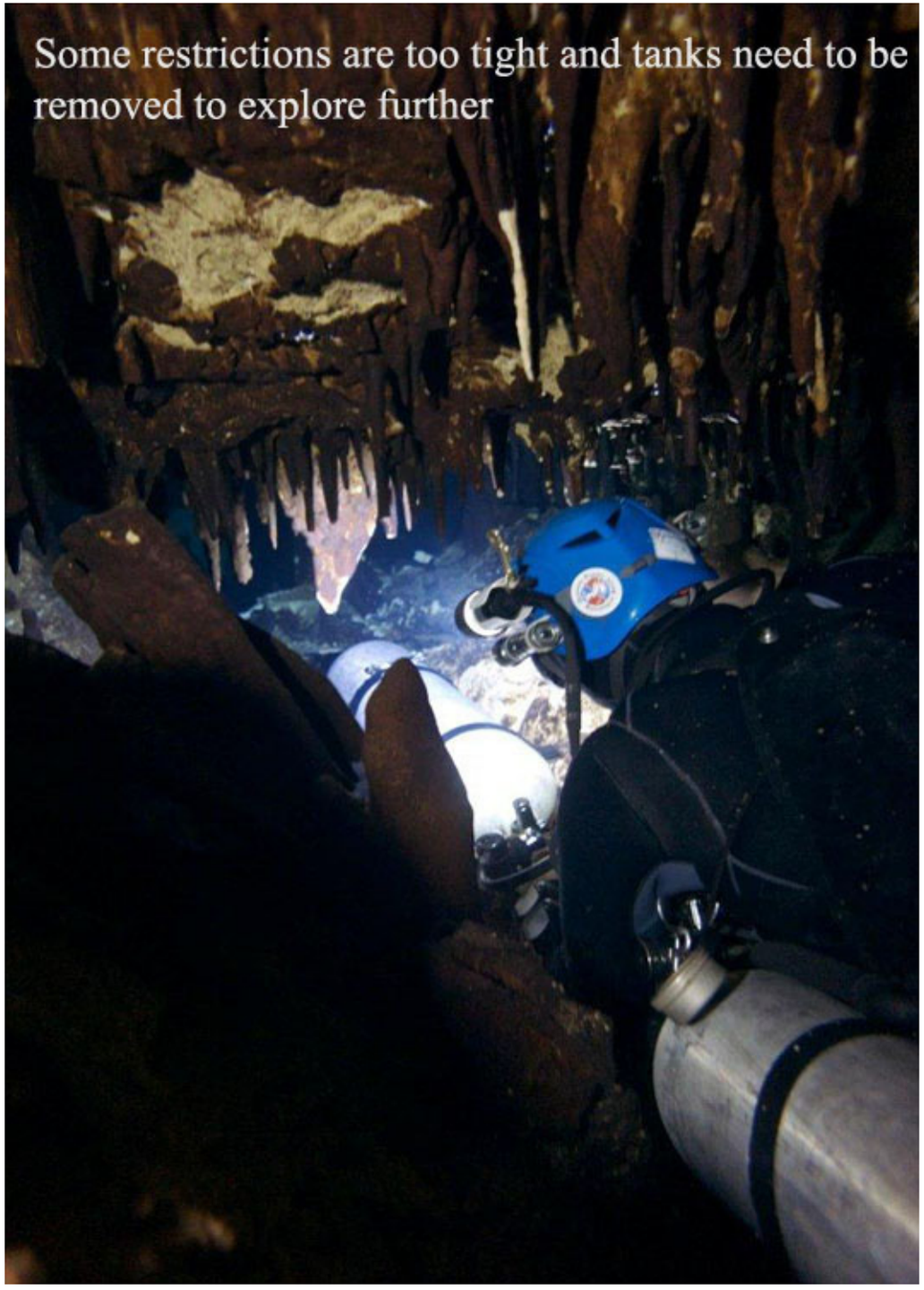
During Jenn Macalady's visit, she brought with her two of the most experienced scientific and exploration divers: Kenny Broad and Brian Kakuk. And on one of the research dives while doing a chemistry mapping to compare the water chemistry in the different caves, Brian pointed to the DRSS members something that changed their vision of cave diving.

Brian has a lot of experience with fossils in the Bahamas, and has been instrumental in many very important discoveries of long extinct species there. He pointed out a bunch of small tiny animal bones lying far inside the cave, something that never really caught DRSS divers' attention before. That day sparked a new dimension and focus in cave exploration, namely paleontology and the search for fossil remains.

With picture and video material in hand collected during several dives, a new collaboration began with the Museo del Hombre Dominicano, which has a paleontology section. DRSS got involved in an ongoing project in search of ancient primate remains under the direction the anthropologist Alfred Rosenberger from the Brooklyn College CUNY and Renato Rimoli for the Museo del Hombre Dominicano and the UASD in Santo Domingo.

Since that day, DRSS has been involved in several expeditions helping to build the Dominican Republic's collection of fossil species that used to live in the island many thousands or even millions of years ago, opening up new windows in science and research for the island.

Most cave diving and explorations in La Hispaniola is done using sidemount gear configuration, which provides divers with more flexibility at the time of carrying the gear to the caves and to the water and provides exploration divers an unparalleled level of safety and flexibility.



Getting to the caves with the gear sometimes takes hours of walking through the jungle, using horses or donkeys, and at times ropes to descend to the water, which would be made much more complicated using doubles.

In many, if not all Dominican caves, there are numerous major restrictions, most of them only passable in sidemount, some may be passed removing only one tank, some require removing both.

That makes the recovery of the fossils a real challenge for the divers, a high level of experience and skills in tight and silty caves is a mandatory, and as in all cave diving absolutely perfect buoyancy control is also critical and goes without saying.

The discovery of the remains of several crocodiles on the far eastern side of the island, a first for this part of the island, was made thanks to a friend, Oleg Shevchuk. While exploring a new cave, Oleg noticed the remains and contacted DRSS, and with him, the Museum, Rosenberger and the financial help of the WAITT Foundation from National Geographic, DRSS recovered the remains, together with many remains of several different species of bats, birds, snakes and other mammals which are all being studied to determine the exact species.

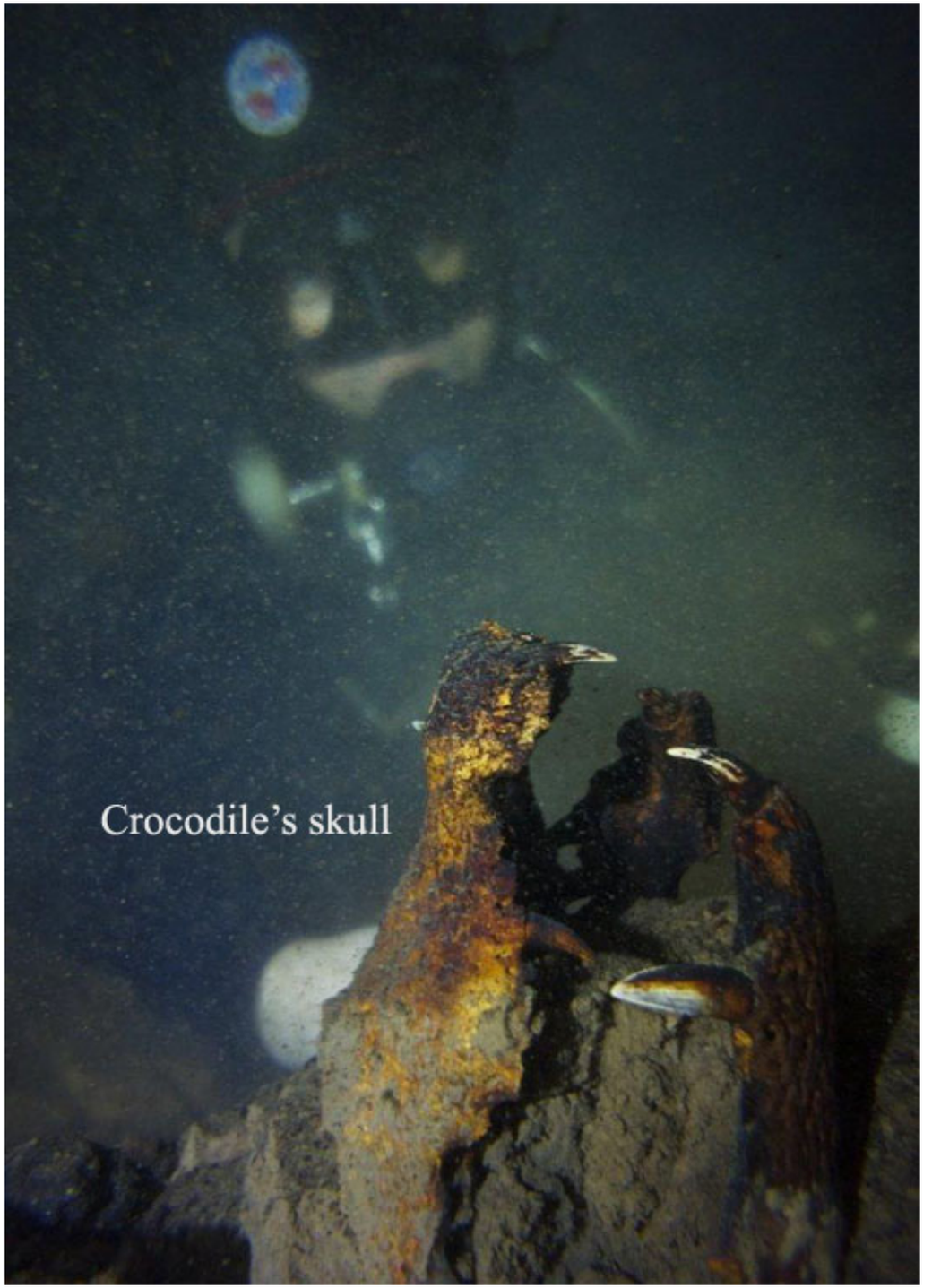
Since the discovery of the strange-looking bacteria, DRSS has found thousand of fossils, remains of many extinct sloths, and remains of several now extinct species of monkeys, along with many other fossils from a variety of different living and extinct species. Thanks to the growing scientific interest, DRSS is slowly helping to unravel the mysteries of the Caribbean's ancient past, changing old assumptions and theories and gradually shifting scientific interest to the importance of the Dominican Republic's flooded caves.

Carrying gear to remote spots


Ancient bat heads recovered from a cave

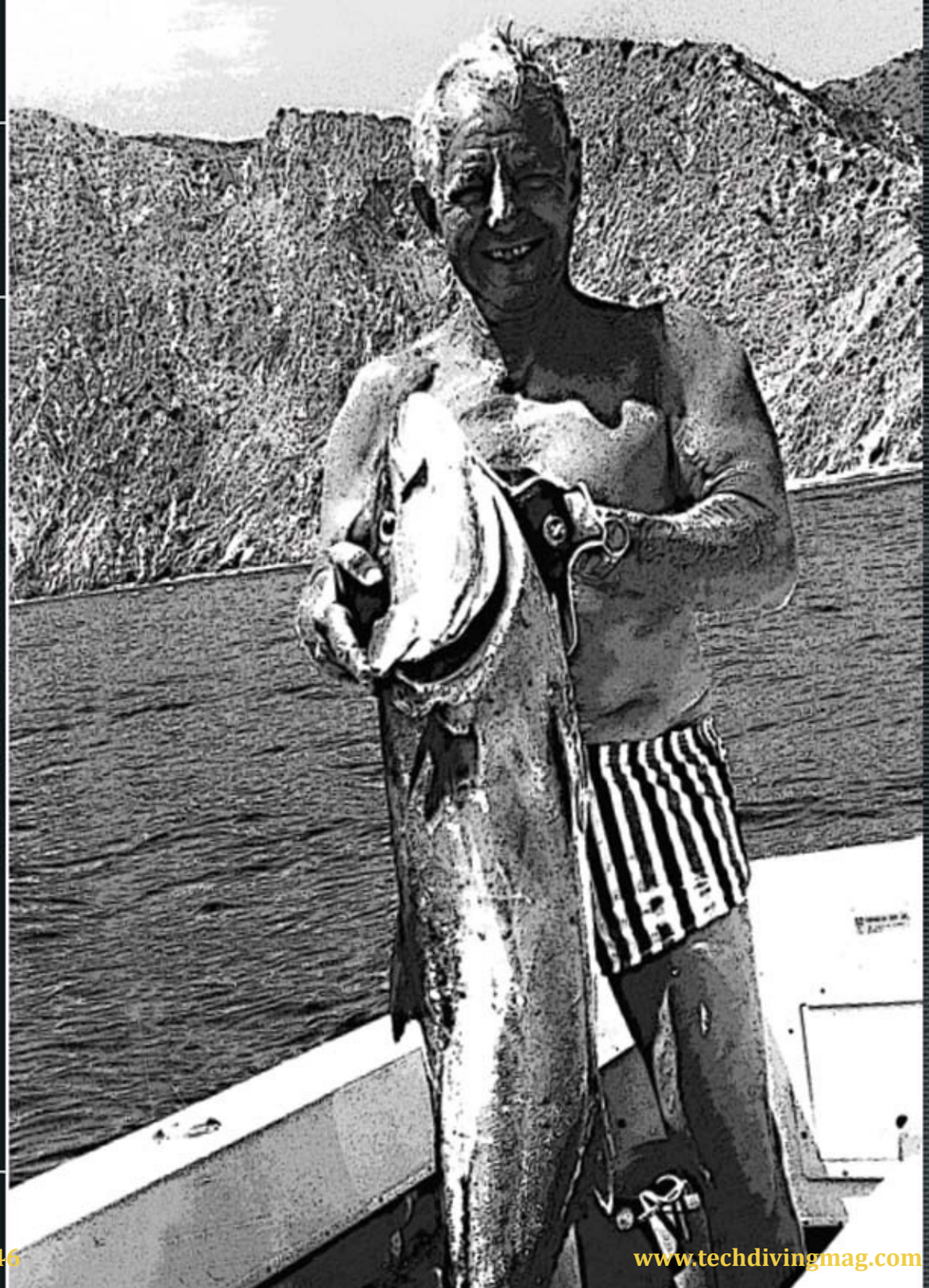

Fossils from snakes and bats

As exploration continues, many new caves open possibilities for new and spectacular finds. But this does not make the continuous diving of the more popular and regularly-dove caves in which some of the Dominican Republic's most important finds were discovered any less important. These finds are an example of how even in the most well known cave can lie the next major new discovery. DRSS strongly believes that cave diving and exploration go hand in hand with science and research. The more we know about the underworld the more we know about ourselves.



Bacteria stalactites - unknown specie of bacteria


Bones are usually found in the tighter spots



ALL PHOTOS FROM DICK BONIN COLLECTION EXCEPT AS NOTED

::: dck bonin

Dick Bonin

FOUNDER OF SCUBAPRO

BY BRET GILLIAM

When I originally started the interview series many years ago in *Deep Tech* magazine, the people chosen were relatively high-profile individuals – most with a background in filming or photojournalism excellence. But this series would have been woefully incomplete if I had failed to profile one of diving's most innovative leaders and pioneers in manufacturing. »

Dick Bonin, the co-founder of Scubapro, has been responsible for some of the most technically advanced equipment lines the industry has ever seen. For those who started diving in the late 1960s or early 1970s, the Scubapro line was revered as the Rolls-Royce of scuba diving. Virtually all other manufacturers were viewed as "also rans" who played second fiddle to the stuff that was stamped with the memorable "S" logo and marked a person as a serious, committed diver.

The list of diving notables who swore by the Scubapro brand included Stan Waterman, Paul Tzimoulis, Dick Anderson, Jack McKenney, Dr. George Benjamin, Tom Mount, Ann Kristovitch, Sheck Exley, Jim Bowden, Wes Skiles, Hal Watts, Rob Palmer, Howard & Michele Hall, Marty Snyderman, Bob Talbot, Jimmy Stewart, Chuck Nicklin, Dr. Sylia Earle, myself and just about every Caribbean and Pacific divemaster who knew that the gear from Dick Bonin would endure just about every abuse and still bring them back alive. It was a brand built from the outset on the reputations of Bonin and his staff who promised high performance and reliability without compromise. Bonin also took the unprecedented step of offering a lifetime guarantee on his equipment including parts!

In addition to earning the respect of hundreds of thousands of divers who bought his gear, Bonin became a mentor and father figure to his loyal retailers who showcased his line and his philosophy of diving excellence. Bonin was the first to offer business counseling and focused marketing programs to help the dive stores of long ago realize their profit potential. He stood shoulder to shoulder with them in delivering and supporting a brand that became the "gold standard" of diving for nearly three decades.

Think back a moment to some of the "firsts" that Bonin's Scubapro company brought to the industry: the enduring flow-through piston design of his regulators beginning with the immortal Mark V introduced in 1970, the first low-pressure BC inflator, the first back-mounted BC for widespread distribution, the first silicone mask, the first jacket style BC (the infamous Stabilizing Jacket), the shotgun snorkel incorporating an exhaust valve that made clearing effortless, the first integrated inflator/second stage regulator called the AIR II, the first analog decompression meter, the first pilot valve assisted second stage called the AIR I, and last but not least, the celebrated Jet Fin that forever changed the design of what used to be called "flippers." It's a legacy unequaled to this day and perhaps forever.

Dick's passion for providing great equipment that constantly pushed the envelope in design and practicality along with the best dealer support in the industry made him almost a mythical character to those who had a chance to work with him. Above all, Dick was, first and foremost, a real diver who personally evaluated, tested and approved every item his company brought to market. He surrounded himself with the brightest minds in the industry and pushed his research and development engineers to produce the next great piece of diving gear that no serious diver could be without… every year for what seemed an eternity in the short history of the burgeoning diving business.

Bonin got his start as a Navy officer assigned to some of the earliest dive teams and cut his teeth testing gear and blowing up beach approaches

in some of the most distant locations in the world. When his Navy hitch was up, he decided to take a stab at selling dive gear for some early manufacturers before realizing that the only way he was going to get the kind of equipment and the company policies he believed in was to do it himself. A partnership with another diving pioneer, Gustav Dalla Valle, led to the start of their own company in 1963. Both men were working for the soon-to-be-bankrupt Healthways company. Dick had been brought in to manage a new division for diving equipment that would be sold only through professional dive stores under the name Scubapro. When the parent company bit the dust, Gustav bought the rights to the name and got its earnest hard-charging manager as well. He paid the princely sum of one dollar!

Dick has noted ruefully, "Gustav bought Scubapro for a dollar and got me with it. He always said he overpaid."

Well, if he did overpay, these two oddly matched entrepreneurs quickly turned that investment into one of the largest success stories in diving history. They built their company into diving's premier brand and then attracted a plethora of corporate conglomerates that wanted to acquire them for their continued growth history and ever-increasing profits. Finally, against Bonin's wishes as the minority shareholder, Dalla Valle sold the company to Johnson Worldwide Associates for a then unprecedented multi-million dollar sum. The following year Johnson forced Dalla Valle out but Bonin continued as President and directed the company's growth and continued profitability until 1991 when he parted ways and retired.

Typically, Dick is discreet about the controversy surrounding leaving the company he founded and nurtured to such success. Ever the gentleman and loath to stoop to the level of those who, in his opinion, have not met his standard of professionalism, he declines to comment on his abrupt exit. However, insiders confirm that his independence and refusal to compromise on issues of product quality and business ethics eventually made him persona non grata with the corporate suits that seemed only to care about bottom lines on the balance sheet with little regard to sustaining the brand in the long term. Whatever actually took place will probably remain shrouded in confidentiality agreements and other legalese. But consider the aftermath: a revolving door of inconsistent and oft times inept management making poor decisions doomed the once proud Scubapro line to shrinking market share and a virtual halt to new product innovation. Currently (2003) mired in a series of product recalls and litigation alleging product defects, the Johnson stock price has dropped and Mamdouh Ashour, the head of its diving division (Scubapro and Uwatec), a man Bonin once banished from the U.S. operation, has taken refuge in Europe in the face of pending lawsuits and possible criminal charges. In the ultimate irony, Johnson Worldwide is also suing Ashour, its own ex-chief executive of diving.

It's hard to imagine anything of the sort taking place under the leadership of Bonin.

There was no problem getting access to Dick. I've been friends with him since 1971 when I helped persuade the U.S. Navy to officially add Scubapro to its list of equipment for Navy divers for the first time. I later became one of Scubapro's top dealers through my Caribbean operation known as V. I. Divers. I visited Dick at his home in Huntington Beach, California in July 2003 to conduct the interview.

I vividly remember meeting Dick the first time at one of the old National Sporting Goods Association shows during a freezing 1972 winter snowstorm in Chicago. Back then, before the DEMA Show, diving manufacturers exhibited to dealers at this mammoth trade

show and tended to get lost in the endless aisles of tennis rackets, basketballs, footballs, and snow ski apparatus. Wandering the massive McCormick Place Convention Center, I finally found the tiny Scubapro exhibit and was wrapped in the firm grip of Bonin who seemed to instinctively recognize his farflung dealers. We talked about our common Navy heritage and I was thrilled to finally see the entire line of gear after previously only knowing some items from the catalog. By the time I left Chicago, I felt like Dick was a surrogate father and he promised to visit me in the Virgin Islands some time in the future.

1. Bret Gilliam, Bonin and Bill Walker in front of V.I. Divers original store, St. Croix, Virgin Islands, 1973
2. Gilliam and Bonin, 30 years later, 2003

Yeah, right. I figured I had about as much chance of seeing Dick in St. Croix as I did of seeing it snow there. But sure enough, he arrived a year or so later and cut a swath through the island's social scene as though a movie matinee idol had appeared. You have to remember that back then there were only about 7,000 expatriate Americans living there and it seemed that every one of them either snorkeled or dived and I'd outfitted every last one of them in Scubapro gear from my dive store. Dick was in his early 40s then and looked like an action movie hero. Every day we went diving and talked diving business. Then at night we took in dinner and closed down most of the popular bars in the wee hours. He won a series of arm wrestling matches in a particularly tough late night watering hole, including defeating a guy twice his size and half his age. When the vanquished opponent asked the name of his better, Dick replied, "Anthony Stunning" and they're probably still talking about this mysterious character even today.

Dick Bonin was a mentor, friend, fellow diver, and the single best example of how to conduct yourself in business that I ever met. Ask any of his dealers from that era and they'll tell you the same thing. The man exuded honesty, enthusiasm, and an ingrained sense of what was right and what was wrong… along with an unbridled energy for the sport of diving. He oozed integrity. I began my first business as a Scubapro dealer when Dick picked me to distribute his gear over a much bigger established company. He saw a future for diving in me as a gung-ho 22-year-old that transcended the hefty wallet of the larger company. It paid off for both of us. He got a dealer that bought hundreds of thousands of dollars worth of Scubapro gear over the next 15 years and I used that to springboard my tiny dive store operation into a series of successful corporations. Dick provided the initial opportunity to launch me in business and I owe everything I have today in business to him. There is no one that I have more respect for and I only hope that I can live up to the example he set for

all of us.

When I met Dick he was 42 years old and was the toughest guy I ever met. Today (2003) at 73, he looks like he can still kick my ass and those of anyone else who might challenge him. He's still an active free diver and spearfisherman who regularly lands trophy fish in the company of other top divers young enough to be his grandchildren.

If there is ever a Mount Rushmore for divers, I know Stan Waterman will hold the space for George Washington, and Dick Bonin will stand in for Teddy Roosevelt. The other two spots are still up for grabs in my book.

Dick and I settled in with full coffee cups and let the tape recorder run.

How does a guy from Chicago end up diving?»I grew up in the Midwest, always loved water, swam on the high school swim team. I went to college on an athletic scholarship.

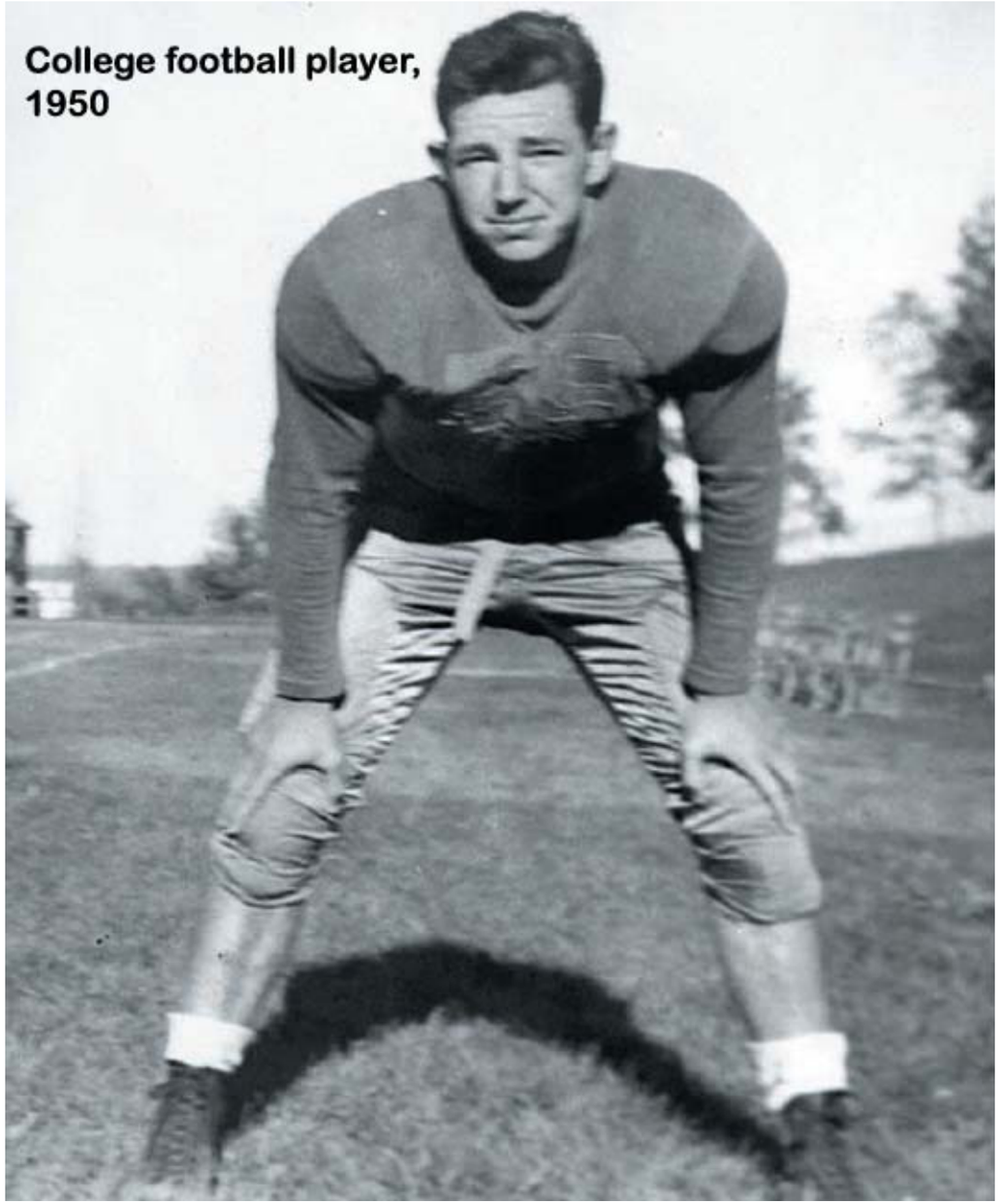
What did you play?»Basically everything, but the scholarship was for football, boxing, baseball, and swimming. Then, when the Korean War broke out, I enlisted in the Navy and they sent me to OCS. There was inter-company swimming, and an officer came over to me one day – I remember that he had a scar on his cheek – and asked if I liked sports. I said yes. "Do you like swimming?" Yeah. "When you finish OCS – you get a few choices, Destroyer, Carrier or UDT" (underwater demolition teams) – so I chose UDT.

Where did they send you?»I was at Little Creek, Virginia in January of 1953. The Korean War was on. I went through all the training. There were 137 of us when we started, 19 when we finished. When I qualified I was sent to extensive underwater training in New London and, in three months time, the Caribbean. Subsequently, I was appointed as a Submersible Operations Officer. There were two teams on the East Coast then, and three teams on the West Coast. Just 500 guys in the whole country! Each team was 100 men, with one diving officer on each team. I was appointed Diving Officer on the East Coast.

How'd you like the Navy?»It was great. I was an Ensign. Early on, our executive officer got a call from Chicago, from a fellow that ran a retail/wholesale diving business, one of the very first. He was distributing E.R. Cross's mail order study course, *Diving for Fun and Profit*. It was written by Cross, and was a classic. He wanted someone in the Navy to read and okay what Cross was writing. So I was designated for the job. When it was time for me to get out of the Navy, the fellow in Chicago that had the retail/wholesale operation said, "You're from Chicago, so why don't you come here and see about a job?"

Before we get to that, tell me some of the stuff you were doing in the Navy diving. They actually based you out in the Arctic or something, right?»Well, the first assignment I had was an operation up in the Arctic, blowing and surveying approaches to bring in supplies for the Far Distant Warning Stations. We would go from bay to bay. They would bring us in – there were about 12-15 men beside myself – and we would do a survey and then blast it out, so there was nothing left to tear up the landing craft bringing in the supplies. We did that for about three months. Way up north, I don't remember all of the places. It was dull as hell, except when we were operating.

It must have been cold as hell?»We were working in the summertime, but the water was cold, just above freezing.


College football player, 1950

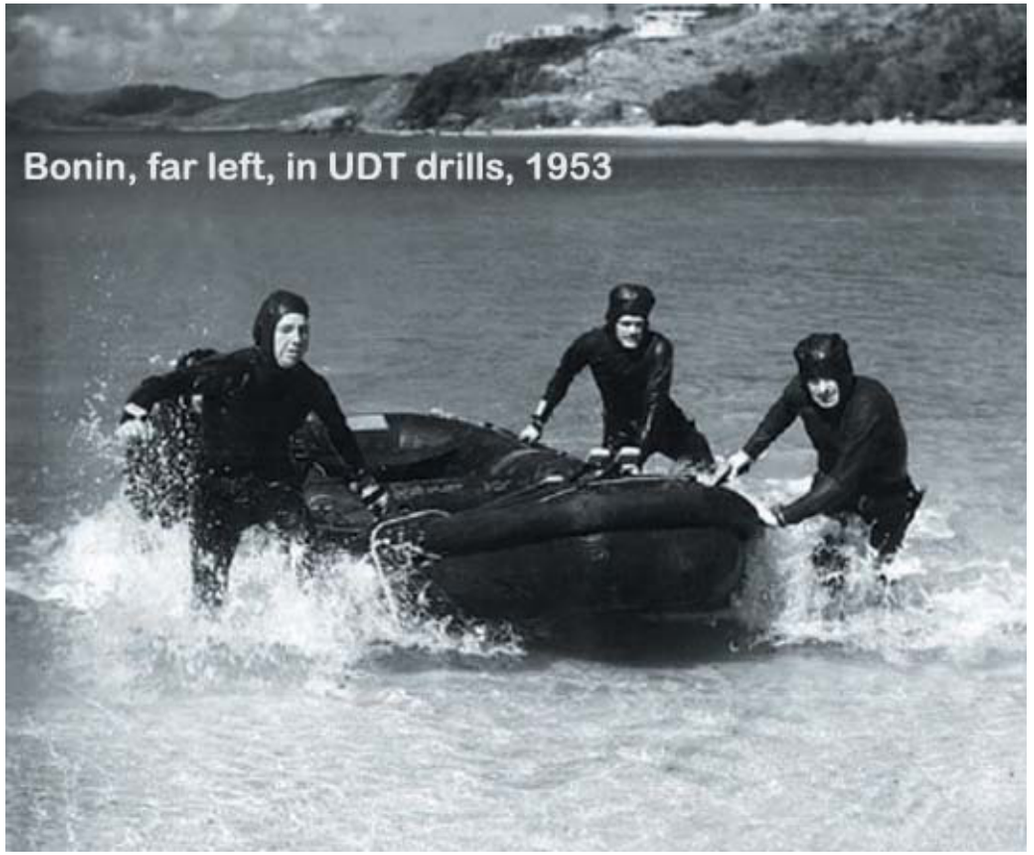
How did you stay warm?»We had good dry suits. They were made by U.S. Rubber. They were functional but you had to make sure you took care of them and wore a couple of pairs of long johns under them. You couldn't stay in the water for long, but long enough to get the job done. And we would go in and do it as fast as we could. It was pretty simple. You go into a bay, do recon, and then come back the next day with explosives and lay them out, and blast the approach.

Let me tell you a story. I was just an Ensign then, too. We really wanted to do a good job, so we came in and we surveyed one of our first approaches. I said to the men, "Okay, we have to do a thorough job, so this is what we're going to do. We're going to use this much C3 explosive to be sure. That's going a little heavy." So we swim in, set a heavy checkerboard pattern, and we blew that baby sky high! Rocks and debris are coming down all over the fleet! So we go back and the fleet's skipper is waiting there, and asks, "Is it always like this?" I gulped and said, "Yeah, you've got to blast big when it's a tough job." He said, "Well, maybe I'll anchor out a little further then next time." We had a lot of exciting things up there. We shot a polar bear on one swim because, when you are in the water up there, you look like lunch.

Was it making some moves on you?»Oh, of course! But we always had a boat, a landing craft or an inflatable, with one armed crewman on board. And, you know, polar bears hunt man. Outside of that, when we worked, it was exciting. But the rest of the time was boring. We read the same books over and over; showed only certain parts of movies because we knew the movies so well. Of course, there was no TV and no newspapers either.

Where did they house you? I bet it was some horrible Quonset hut or something?»No, we were on an LSD (Landing Ship Dock) ship. The first ship we were on hit an iceberg on our way to the next site. The skipper of the LSD was in tactical command because he was senior to the captain of the icebreaker in front of us leading the

way. A significant iceberg came around the icebreaker in front of us and hit our ship because we were steaming too fast in 70 percent ice coverage. It tore a hole about 10-14 feet high and 22 feet long. I was below when it hit and it knocked me over. I ran topside and there was complete panic. The ship was heeling over fast. It was a hell of a hole. One engineer saved the ship all by himself by his fast action. He got compartments sealed off before it got to the boiler room. We would have all been dead because, without protective suits, you had maybe 30 seconds in the water to survive. He saved the ship and us. They sent a helicopter in to pick up the skipper off of our ship and take him away. It's safe to assume they weren't bringing him in to give him a promotion!


Bonin, far left, in UDT drills, 1953

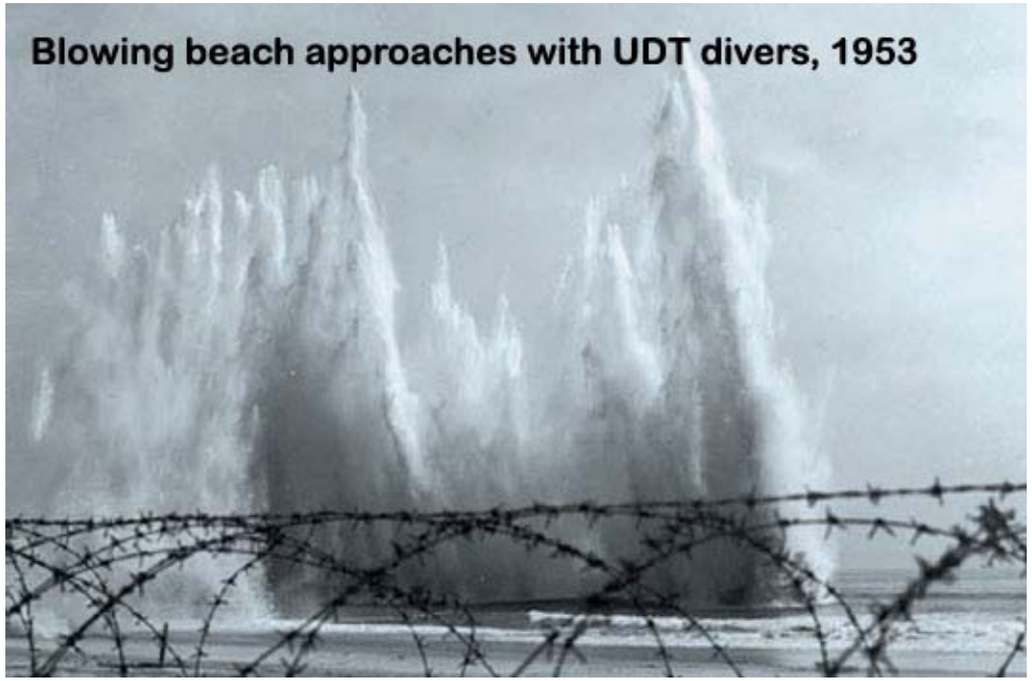
Not to a ticker tape parade, either.»No! Then they transferred us to another LSD and we finished our work up there. So, we had some exciting incidents in three months aboard.

I remember reading somewhere that you guys were testing some equipment and had a failure on something 250 feet deep or so.»I was in about my third year as a Submersible Operations officer. We were using three open-circuit units, the Aqua Lung, the Northill and the Scott Air Pak. Do you remember the Scott?

Yes, certainly.»We had been using it for a number of years, and a directive came down from the Bureau of Ships that they wanted us to do deep-water tests on those three units. I guess, for some reason, they were going to buy new equipment or something. So the Submersible Operations Platoon got on board a submarine rescue ship and we went out off of North Carolina to do deepwater tests. They wanted us to do 200 feet plus. Most of our diving was not really deep. There wasn't that much call to do much over 100 feet. We anchored overnight and put down lines the next day. Officer and chief go first so I had the Northill, and Chief Foster took the Scott. We got down pretty deep and I started taking water in and I cleared it out. Went a little further down, and took more water in, cleared it out. And I got to about somewhere over 200 feet. Anyway, I got to the point where I couldn't clear the water out and I said to myself, "You've bought the farm. You've got two minutes left in your life, and now all you can do is what you were trained for, and go up that line and whistle *Dixie* – ya know, blowing out the expanding air." So, that's just what I did, I went up that line, hand over hand and whistled *Dixie*. It seemed like forever before I got to the decompression stage. But I did get there!

How deep was the deco stage?»Twenty-30 feet. And there we had regulators you could breathe off. "Jack Brown's" (full face masks w/

surface supply hoses). The topside support staff didn't know what was going on because there was no communication, but they knew the line was going slack. And the night before, they had thrown garbage off the fantail that attracted sharks. There were hammerheads all over, circling the deco stage and the aft end of the ship. It was spectacular, but probably not really that dangerous in retrospect. Later the Navy sent down a representative to talk to me because it was one of the deepest free ascents ever. They had the submarine rescues with the old Momsen Lungs, but this was one of the very first unaided free ascents of significant depth.



Of course, in those days you had the old UDT vests, but that's not going to be any good coming up. What were you kicking with on your feet? Duck Feet?»Yeah, we went to Duck Feet while I was Sub-Ops officer. But on this ascent, I went hand over hand on the line. I just did what I was trained to do and it worked. What had happened is that the Northill had an exhaust valve right in the middle of the diaphragm, and it would invert under a certain amount of pressure.

You weren't going to resolve that underwater either.»No. Later on we sent another diver down shallower and it did the same thing. It was pretty exciting in retrospect, I guess.

Now after you survived all of this stuff in the Navy, you're getting out and going back to Chicago because you reviewed this diving program by E.R. Cross. Was the idea that you were going to take a look at a sport diving industry vocation?»I had no idea. I had always figured I wanted to be a salesman. I never really knew, even when I was in school. I took some accounting but I majored in economics and sports. I just always felt I should get into sales. And they offered me this job. It was a very humble beginning because it was in the early days of diving, and it was a little dive shop. Big for those days, but small by today's standards.

What year was this?»This was when I got out of the Navy, so about 1956. I said to myself, "If I like to sell, I'm going to sell something I like." So I went to work for almost no money and started selling diving equipment. I met all the original pioneers, including Cross, who was one of the most impressive men I'd ever met in my life. I worked there a little over a year. Swimaster had just started with a company called Pacific Moulded Products in Los Angeles. They had bought some fin molds and masks, but it didn't work. So they bought a spearfishing company that included Duck Feet, wideview masks, and a couple of other things. They had a fellow by the name of Arthur Brown, a former engineer, one of the truly smartest guys, product-wise, ever in the history of diving equipment. He developed Duck Feet. Swimaster bought the company from Brown, who was actually in this town, Huntington Beach. We used Duck Feet in UDT,

and the West Coast teams had them first. When I saw them, I brought them out to the East Coast. We were using Voit fins before that. Well, Swimaster sent out a marketing consultant scouring the country to find someone to run the company, because they were only doing $200,000 in sales or less annually. He picked me and I was thrilled. So, I left the shop in Chicago, and came out to Swimaster, and took over running things. We developed it into a tremendous little company.

But when you got there, you probably only had just rubber goods, right?»Yeah, you're right, when I got there, their inventory was all rubber goods. We had more inventory than their sales, so I came in and said, "Okay, we're going to introduce the professional store theory." Because of having worked for two years in the dive shop, I learned that the demand was created by the pro in the dive shop, and the instructor who teaches you how to dive. So, I set up the distribution strictly through dive shops. We had the Duck Feet and we put a foam rubber edge on the wide view mask. It was just me and the production manager, Jorge Calderon.

That was the whole company, the two of you?»There were lots of other people in assembly but, yeah, it was basically the two of us running things. We brought out the first flexible snorkel. In Chicago, they used to sell surplus aircraft parts so I took a hose and put it on a snorkel tube, and I never forgot that. Swimaster priced it at $2.95 and everyone said we were out of our minds, but we sold them like crazy.

By the way, do you know they sell snorkels now for almost $75 and they have music built into some of them?»That's incredible! Well, later I met Jack Prodanovich and saw the guns that he was custom making. I took them and we made the first American spear guns, and sold the hell out of them. At Swimaster, it was just one continuous product break after another.


In the Arctic Ocean ice fields

The focus of the sport in those days was geared to spearfishing, wasn't it?»Mostly, but not completely. You had a lot of competitions and people then were more inclined to be looking for power fins. There weren't many women in the sport. Everything we introduced

was a quality product and it was good. We had the best masks, fins, snorkels, spearguns of that era.

Bonin in UDT gear, circa 1953

What were you doing for hardware, like regulators and valves?»We really didn't have that stuff then. We did make weight belts. We made the first stainless steel quick release buckles. I never messed around with the regulators because the big boys were in the regulator business and there was just the two of us. I started experimenting with a silicone mask. We studied it. They make specialized aircraft parts out of silicone. This was when silicone was hardly known. It looked like silicone was magic. The chemist I worked with kept trying to make me a silicone mask because I figured if we were successful, it would last forever. We could never get it clear enough or pliable enough. We kept trying, but I eventually filed that idea away. Then later at Scubapro we had a rubber plant, and I went back to that project and we made the first silicone mask. If you think about it, the silicone mask is probably the most commonly used product out there. It was my dream but I didn't call it a silicone mask – I called it a "hypo-allergenic mask."

Before we jump ahead of ourselves, you were still at Swimaster, right? What year are we in?»Yes, I was at Swimaster for about three years and not making much money. It was about 1959. Sportsways was having problems, so they approached me to come and run their company.

Where were they based at that point?»They were in Paramount, California. They were owned by an automotive company. I don't know if you remember Dick Kline from the earlier days, but he was the original Sportsways founder. They were having serious problems so they approached me and offered me more money. Since it didn't look like I was going to make much where I was, I left for Sportsways. It was a good experience, but a mistake. I soon discovered I didn't like the way they did business. I had the privilege of working with Sam Lecocq, who was a truly gifted designer and that was very rewarding,

but there was a lot of nepotism in the company. Eventually I told one of the owners what I thought of him, and he fired me. But while I was at Sportsways with Sam, we established the single hose regulator.

We made that a major breakthrough. With his engineering and our marketing, we made the single hose regulator number one in the country.

Didn't you guys also introduce the original submersible pressure gauges?»It wasn't the original gauge, but it was the first one put out by an established diving company. We made the first successful one. We also did the first O-ring seals and specialized tank valves. It was a good start but we all had trouble with the owners.

When you left, what happened with Sam?»Sam remained and the company went on for a couple more years, then Sportsways went bankrupt. In fact, they went down so deep they had to hold a public auction to sell off the tooling. I then went to work with a marketing consultant who hired me for Swimaster for a while. He had some fishing companies and recreational accounts. U.S. Divers, Healthways, Voit, Dacor, and Swimaster – they were the original five diving manufacturers. Healthways, a mass merchandiser, sold to everybody. They decided that they wanted a professional line, like I had done at Swimaster, so they brought me in to develop that concept. At the time, Healthways had Gustav Dalla Valle as their R&D Department head, which meant a European connection for obtaining diving products.

So they paired me with him and said, "Develop a line for a new company." It was to be called Scubapro.

Did you guys come up with that name?»No, an advertising guy came up with that name. I wish I could take credit, but I can't. So, it was going to be Scubapro. I got on the phone and started calling our old dealer network, began putting things together, working with Gustav on products. Then the day after Christmas in 1962 the owners called us into the office and said, "We're in Chapter 11." So that was the end of Scubapro.

What was Gustav's reaction?»Well, he wasn't really surprised because he knew it was coming. He had a little garage warehouse, so we went there and said we were going to do it ourselves somehow. Gustav had a little money, not much.

Della Valle and Bonin from the 1972 Scubapro catalog

Wasn't he an Italian count or something?»Gustav was one of the most colorful men ever, maybe the most colorful man in diving history. He was the son of a count who cornered the silk market in Italy at one time. Gustav was given a fortune when he was a young man and

blew most of it. He was well educated and had studied architecture. A very cultured guy. He was a *bon vivant* in the fullest sense of the word. Finally, he took what money he had left and went to Haiti, and started a little glass-bottom boat business.

This was back in the day of Papa Doc?»He got there just before. He'd take people out in a glass-bottom boat and demonstrate snorkeling and spearfishing. Then Papa Doc came to power. Gustav was also involved in a gambling casino down there, so he had to get out of Haiti fast. With the new regime taking over, Gustav got out of town and migrated, actually he escaped, to Miami. He started up a business importing dive gear from Europe. His first account was Abercrombie & Fitch. Then he signed with Healthways and had them under contract for a lot of his European lines.

When you guys ended up at Healthways, was this a natural sort of teaming? I mean, you guys are so different. Gustav is so emotional and crazy, and you are so solid and controlled.»Surprisingly, we got along fine. Gustav was fun to work with. Every day was something new. People used to say that Gustav was not a businessman, but that's not true. He was a very good businessman, intelligent and shrewd. Anyway, we were thrown together and just happened to compliment each other and we worked together well. We used to fight a lot but in the best interests of the company. He used to take care of the finances and the purchasing. He couldn't handle the interaction of accounts and staff. I did that and the marketing. We worked on the products together. He bought the name Scubapro for $1 and got me, too. And, 'til the day he died, he said he paid too much.

Paid too much for both of you, huh?»Yeah! So we started out and it was tough. This was January 3, 1963.

Was that the acorn of the Scubapro company?»That was it. We opened up the garage door and said, "Let's go to work."

What was your first product?»Well, whatever Gustav could get from Europe on credit. Gustav had some money, but not much. Maybe $20,000 or so. And I had none. Anything he could get on credit we would bring in. For example, we brought in Squale masks that were *passé* even then. I would call the dealers and say, "Here's what I've got. Help me out and we will build a line for you." I called it "sympathy selling." That's how we started. The dealers gave us as much business as they could, not much, but whatever we could get. Then we made a regulator. This was a big step. We brought in a couple of part-time engineers that had done some work for Healthways.

Was one of these guys Dick Anderson?»Right. He came in, never really worked for us full time but gave us a hand. Dave Denis, who became our production manager and Bob Roberts, who we eventually hired, also came in. We developed the first reliable piston regulator. The first regulator we made was a true success. It was a workhorse and it was a winner. Then a little product by the name of Jet Fins came along. In the beginning, we couldn't pay the bills. Gustav and I couldn't take a salary. We couldn't pay the phone bill. We made that unforgettable mistake of bouncing the check for the taxes. I don't really know how we got through it. Every day Gustav would take the sales invoices and go to the loan shark. We did that for I don't know how long. But we finally turned the corner after about two years.

Oh, so you guys were floating loans against your sales?»We were existing off the receivables. We didn't take salaries or anything, but we made it. All of a sudden we started developing more products and adding to the distribution. Now all we had to do was get new products to the dealers out there, because I had the network built. And we did!

Then we started growing so fast that we couldn't believe it.

What year did you finally develop your distinctive logo, the "S"?»That was right from the beginning. It's an enduring logo. Memorable. Classic. I changed it by adding the black and the silver. They had the "S" shape and the name when I came there. It was a wonderful name and a wonderful logo.

The company is so well remembered for its initial regulator and the Jet Fins. You guys were getting them from France, right?»Rene Beauchat invented the Jet Fin. Beauchat was a good friend of Gustav, and was a very successful manufacturer of European diving equipment – spearguns, masks, fins, snorkels, very good stuff. He asked Gustav if he could get Jet Fins started in the United States. Gustav brought them to me, and he said "Dick can you sell these things?" And I said, "Gustav, these are the ugliest fins I've ever seen, but I'll take them to the trade show and see what happens." I had never used them. It was a cardinal mistake because I should have. Anyway, we went to the show. We were only a couple of years old when Jet Fins came out, maybe three or four years. I took a bunch to the show and I sold some. The dealers would laugh initially and buy some samples. Then, all of a sudden, the phone calls started coming in wanting to know if we had any more of those "ugly fins." I didn't even like the name. They said, "These fins aren't bad." That taught me a big lesson. After that, I tested everything that came to Scubapro. Jet Fins just took off. I've never seen a product accelerate as quickly. As a matter of fact, I think they are still popular today.

Listen, I just got back from a month at sea at Cocos Island, and four of the divers, professional photographers out there with me, are still using the 352 Jet Fin, the extra large Jet Fin. Frankly, I don't think they've ever built fins better than that original design. It gave you all the power you could possibly need, and none of the frills and nonsense associated with some of the designs today. I still have a pair of my original ones from 1971 that I keep on the wall in my office. I used them exclusively for, I think, 25 years.»It was a remarkable product. I understand that there are also still some of our original regulators working out there.

I can assure you that there are a lot of your original regulators in the Caribbean.»I'm now starting to get calls from memorabilia buffs. I received a letter just last week from a fella looking for our original Scubapro manifold. He's a commercial diver. I get these calls from people all the time who want to talk about the "golden days" of Scubapro. He mentioned in the letter, "I paid $160 for a copy of the 1970 Scubapro catalog."

It's history. You guys were not only the most innovative equipment product company, but also brought a breath of innovation to your marketing. Now, I can't remember the year but I'm going to take a stab and say it was 1973 or 1974 when you came out with that catalog with all of Dick Anderson's poetry in it.»We have a couple of catalogs that were classics. Dick Anderson's limericks. One with recipes in it and another with nautical poetry.

I remember one of them to this day. It was from the Dick Anderson catalog and it was in the watch section. It said, "A diver wears a watch to tell what sport is his. The secondary function is to tell what time it is." I never forgot it.»Those catalogs and the advertising campaign came from Roy Brizz. Roy is gone now.

Yeah, that particular piece was one of his innovative marketing ideas.»I'll look for some of the catalogs, and I may have a couple of them. Well, I hear they are extremely valuable now. A complete set is

priceless. But I don't know if there is a complete set anywhere.

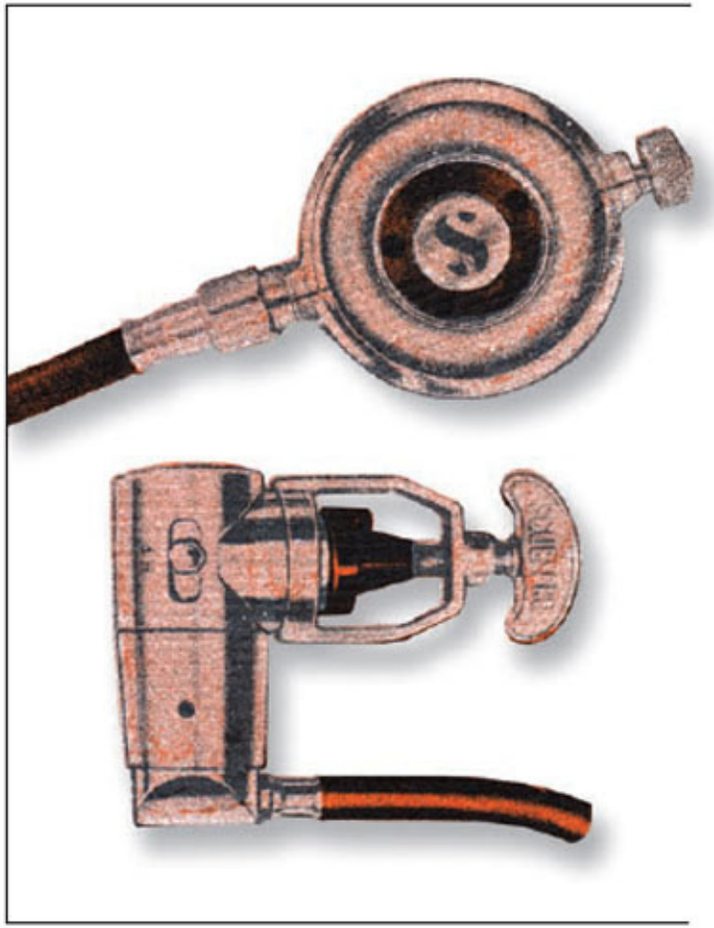

As president of Scubapro, circa 1970

That's one thing I really regret. I had the complete set of catalogs for the entire time that I was a dealer, 18 years, and I lost them in a boat fire in 1993. I had kept them all religiously for all those years.»They had to be worth a fortune.

Now we are coming into the early 1970s, and you guys have really made your niche. Your concept of the development of a product like this through a pro dive store distribution network was so revolutionary. Now you are really starting to get products that no one else had even conceived of. Things like, the Mark V regulator. How did that come about?»The Mark V was just really a product by committee. Our engineers, Gustav and I would brainstorm a product then construct an operating prototype and test the hell out of it. We had product meetings and were a diving company. We actually dove our stuff! We dove a lot. The whole company was divers. Our engineers were all divers. Our salesmen were too, of course. We spent more money on R&D than any other company. We hired the best engineers we could find. Some of them were instructors as well as divers. And we all tested our potential products for performance, for durability, for convenience, you name it.

When did you get Sam Ichikawa?»Sam came to Scubapro maybe two or three years after we started. Sam had worked with me at Sportsways. Sam worked for me longer than anybody else.

He taught me my original Scubapro repair clinic in 1971.»Sam was first in his field and did repair seminars all over the world. We picked out people like Sam for every department. We had the distribution and just needed new products and top people. Eventually we created the stabilizing jacket that revolutionized diving safety and convenience. The first time I saw that buoyancy theory being used was with Ed Brawley, when he was teaching diving. As it turns out,



The revolutionary Jet fin and the Mark V regulator, enduring classics

everybody I know took credit for the stabilizing jacket. As best I can remember, it was Mike Brock that first suggested, "Why don't we make a wrap-around version of this BC?"

As successful as the stabilizing jacket was, you preceded it in 1973 with the buoyancy compensating pack – which was the first production back-mounted unit to achieve widespread market acceptance.»We did pretty well with that. But although we gained a lot of notoriety with the BCP, the guys at At-Pac were originals with the first back-inflation style BC.

When the BCP came out in 1973, you had all these nutcase conservatives saying this is a terrible design because it's going to float you face down if you are unconscious and all this nonsense. And yet, leap ahead 20 years from there and everybody went back to back-inflated devices because it trimmed you better in the water. All the technical divers, all the cave divers, everybody that was doing wreck penetrations, they all went back to those designs. And they still dominate today; virtually the same as you guys built it back in 1973.»You know, I understand that there's not much new on the market anymore. Too bad.

There was another product you guys came out with that, in a way, revolutionized things – the shotgun snorkel.»That was Joe Schuch's idea.

That was an astounding product. It was so simple and, yet, so effective.»That was from having good people. That came from Joe Schuch, our sales manager. The stabilizing jacket idea came from Mike Brock, a salesman. These guys were in the water all the time. There were so many new products that I'm sure all the patents put together in the entire diving industry wouldn't equal what we did at Scubapro.

I don't think they've built a better snorkel yet. I still use one myself, and I've got one of the old rubber ones. You can hardly find those anymore. I remember when you brought that out. I think that snorkel sold for $20. And you were worried about selling a $2.95 retail snorkel a few years before then. When we first got them in my store, all we had to do was give it to customers once and it changed their lives. You know what a shotgun snorkel sells for today? I think it's over $50. Fifty dollars! When we started, you could buy a whole set of scuba gear for that.»We had ideas like that. Actually, the idea for the first inflator came from a retailer in the valley, a couple of young fellows, and we said, "Hey that's a good idea. Okay, guys, we want this. What do you want, royalties or cash?" They said, "Give us the cash." So we did. In fact, we gave them more than they asked for.

Probably one of the best deals you've ever made. How many 562 Inflators did you sell? You can tell I'm an oldie. I even know the catalog numbers. I used to have them all in my head.»Gosh, I don't know but it was a lot. It was just a natural evolution and it just went like that all the way down the line. We actually dominated in a lot of categories. The more technical the category was, usually, the stronger we were.

Well, you guys owned the regulator market for almost two decades. No one could compete with you.»And with the stabilizing jackets. The Jet Fins were amazing, and snorkels. Then, when we came out with the first silicone masks, we dominated masks. But after a while everybody had silicone masks. But for a while, we were king.

We have a section in *Fathoms* magazine called the Panel of Experts and we get different questions every issue. One of the ones we asked them a few issues back was what was their original equipment and what was the most innovative equipment that they've seen along the way. Your stuff from the 1970s and 1980s so totally dominated the responses that it looked like a sales hype. Between Howard Hall, Michele Hall, Marty Snyderman, Chris Newbert, Lina Hitchcock, Stan Waterman, everybody that came down the pike and went through that era, they all seemed to be outfitted with a stabilizing jacket and other Scubapro gear.

That's fantastic, that's a pretty good crowd to be in.

You guys were riding so high, what motivated you to consider selling the company?»In 1973, Gustav decided that he wanted to cash out. He thought it was time for him to get some security because we never did take big salaries for ourselves. So he wanted to sell. I was adamantly opposed. I was the minority shareholder. When we started I had 20 percent, because I didn't have any money and Gustav provided all the capital. He had control as the majority shareholder. So, I couldn't talk him out of it, and we had close to fistfights over it. Anyways, he put the company up for sale, and we had every major corporation around trying to buy it, because we were very profitable,

technically we were a cash cow. And we had glamour… we were THE diving company! So we had everybody, including some of the world's largest corporations, out to see us. Wining and dining us. Including S.C. Johnson. Ultimately we ended up selling to them in 1974, basically because it was cash. All the other companies wanted to give us stock. This was cash in our fists.

I don't know if you want to talk about it, this would be a matter of public record, but what did the company sell for?»Let's just say millions, but not enough when you look back on it.

A big payday in 1974.»A big payday in those days, and it was a steal. Gustav wanted the cash-out and I couldn't stop him, and he sold out. Now it gets delicate, because they "retired" him fast.

You guys had been so independent, running this innovative company and basically lavishing stuff on your R&D department. Scubapro was five years ahead of the rest of the industry for so long. With coming into the Johnson fold now, did this immediately impact the growth of the company? I know that the cash must have been nice, but were you also still free to do the innovative stuff that you wanted to do?»Yeah, we were doing so well – I wouldn't say that they left us alone but, in the early days, we had less interference.

What prompted their motivation to ease Gustav out?»For some reason they decided it was time for him to retire. They never did explain their thinking. I suspect it was basic economics, typical big corporate behavior.

I gotta tell you though, I'd have liked to have been there the day they tried to fire Gustav. That must have been an interesting little play.»Well, it really wasn't as bad as you think. They did it delicately and I suspect he knew it was coming. I warned him before we sold, "The company will never be the same, Gustav, and they are going to get rid of all of us."

Just as an anecdotal aside here, Gustav had a reputation not only for his flamboyancy but, also, for his rather explosive emotions at times. I remember when I first met him, in 1973 or something like that, at your offices, he had a chopping block on his desk with one of your diving stilettos on it. Somebody told me the story about how one day he accidentally stabbed somebody through the hand with it.»Almost, actually. One of the vendors who was selling us metal parts let us down, and Gustav took the knife and went 'whack,' and it was left there swaying with about half the blade buried… right between his fingers. The guy about had a heart attack. Gustav was volatile but, let me tell you, it was all controlled. He was in complete control – but he knew when to use fear and he was very good at it. It was usually justified when he did it.

When they finally did decide to let Gustav go, how did he take it?»He handled it well as he was no longer committed to being involved in the company. And he'd already made his payday. He made a lot of money. A lot!

And that's when he moved up to Northern California and got the wine place?»Shortly after. He went through a divorce and his wife took half the money. He then bought the place in Mustique in the Caribbean, where his neighbors were Mick Jagger, Princess Margaret, and all that lot. Eventually, he got tired of it, and came back and bought a vineyard in Napa and developed it into a first-class winery. His wine is sold out now, year after year production is pre-sold.


Bonin and Gustav at Scubapro's 25th anniversary, 1988

He passed away what, four or five years ago?»He did. He was about 75 or 76. He died of prostate cancer. I think Gustav packed an awful lot of living into the time that he had. I could make a movie on Gustav. He was the most colorful man I ever knew.

Well, let's take a twist here for a minute. You guys at Scubapro were such strong supporters of your dealers; there are probably more millionaires in the diving industry that came out of being Scubapro retailers than any other segment of the industry. You taught us about business and how to handle our money. That was a foreign concept then: to support and do sales within a professional network like that and not just throw the products everywhere they would go. You fought all sorts of battles along the way with, for instance, *Skin Diver* magazine and their mail-order ads. That's got to have some colorful history to it.»Actually, it always astounded me that nobody else did the same. Because it was apparent to me when I started out in a dive shop: Who created the demand for diving equipment? It was very simple, the fellow behind the counter and the fellow that teaches diving lessons. I put that into practice at Swimaster and it worked. Worked like a charm. It was not a complex theory. Basically it was sort of a takeoff on "The Golden Rule" but for business. It was pretty simple economics to me. Then down the line in my travels, there was a dive shop in Milwaukee owned by Ralph West, who was also in the ski business, and he introduced me to the Head ski system. At that time, they did basically the same thing with extra flourishes. They had professional franchises and I picked up a lot of inspiration looking at Head Skis philosophy in those days. We did have a lot of political battles, because nobody agreed with us. Our beef with the magazines was simple, too: we felt that, ethically, diving equipment should be sold by people that can teach you how to use it and ensure that you are using it correctly. And could also tell you where to dive and provide that extra service to get folks stoked about diving. We did not agree with the magazines that would allow mail order. I felt that someone who doesn't know how to dive, writing from 1,000 miles away to get equipment, was just wrong. So we went for a long time not advertising in magazines that accepted mail order. But we didn't have a lot of support except for our dealer network.

Ultimately you were proven to be dramatically correct, because the stores that were Scubapro dealers not only developed very quickly with reputations as the pro stores, they also had the best equipment. In the 1970s and 1980s, if you didn't have Scubapro as a line, you were already eight steps behind the competition. What were you going to sell? With the junk that was out there, it just was no contest. If you had Scubapro you were automatically the Mercedes dealer of everything in diving. Now it's always amused me, looking back with almost 30 years of retrospect here, that Paul Tzimoulis (the editor & publisher of *Skin Diver* magazine then), who was a very innovative guy in a lot of ways, used to appear in his editorial picture with a Scubapro regulator around his neck and a Scubapro stabilizing jacket. And yet, this was exactly the guy who you had to do battle with to try to resolve issues at that level regarding magazine mail order.»Yeah, that's a surprise. I didn't know he had our regulators.

The entire time that I knew Paul, and I met him originally in 1974 or something like that, he was always a Scubapro guy from top to bottom.»Well, that's a compliment. I didn't know that. Our later relationship with *Skin Diver* was really bad. There were some companies that came along that did agree with our philosophy, like John Gaffney's NASDS, but they were short-lived.

SCUBAPRO DIVES

(left to right) **MIKE BROCK** / MIDWEST REGIONAL MANAGER; **JOE SCHUCH** / EASTERN REGIONAL MANAGER; **GUSTAV DELLA VALLE** / PRESIDENT, UNDER SEA INDUSTRIES; **DICK BONIN** / PRESIDENT AND GENERAL MANAGER SCUBAPRO, VICE PRESIDENT UNDER SEA INDUSTRIES; **JIM CHRISTIANSEN** / VICE PRESIDENT SCUBAPRO AND WESTERN REGIONAL MANAGER; Not shown is **SAM ICHIKAWA** / TECHNICAL SERVICE MANAGER, for the simple reason that he hadn't come up yet.

There's an interesting name that comes up, Gaffney. Here was a guy who with the NASDS concept – which was also so closely linked to Scubapro, that many people in those days thought you guys were all under the same ownership. The innovative things that NASDS was doing dovetailed so nicely with the innovative things that Scubapro was doing. Back then NASDS probably was one of the most successful training systems compared to the likes of NAUI, YMCA, etc. They were the first to embrace the concept of octopuses, although they called them something else. NASDS always had a great name for things. A compass couldn't be a compass; it had to be a "direction monitor." A regulator couldn't be a regulator; it had to be an "air delivery system." If there were a way to make it more complicated, they would do it. In the early 1970s probably 80 percent of your dealers were affiliated with NASDS.»No, not quite. Remember you were a NAUI guy then and wanted nothing to do with them. Actually, NASDS, Gaffney and I had a long history. He was a hell of a free diver and was doing some work for *Skin Diver* magazine. That's where I met him. He was working for the founding publishers, Chuck Blakeslee and Jim Auxier. We immediately hit it off, and came to discover that we basically had the same philosophy. He started NASDS after leaving the magazine. It's a parallel story, it started after Scubapro, but it's the same type of history. A dealer supported him, and he built it up, and was quite successful. And we actually encouraged our dealers to join NASDS because of that cooperation and jointly held philosophy of how diving could be a business. We had a tremendous relationship with our dealers, but sometimes they looked at their supplier and said, "Why are you telling me how to run my business?" But if NASDS told them the same good principles, they were more likely to accept them.

Well, there were a lot of good principles there. I remember when you convinced me to go to a NASDS clinic in 1973, and I had a choice of going to someplace up in the Puget Sound, or Pensacola, Florida. I went to Pensacola and I'm glad I did. That's where I met Tom Allen (co-host of the television series *Wild Kingdom* and soon to be the southeast sales manager of Scubapro). He and I went through the same NASDS program in September of 1973. The other thing that really distinguished your company is that your sales representatives ended up being some of the most successful guys out there in helping the dive stores actually make coherent decisions about what they were going to do. Some of these guys really went on to have tremendous success stories.»The first was actually Jim Christiansen. When we started we couldn't afford anybody and I traveled everywhere, including all of the U.S., Canada and the Caribbean. We hired Jim, who was a fireman then and one of the top free divers in the world. We brought him in and trained him, and he worked for us part-time. Eventually, we said, "You've got to make a decision between us and the fire department." He came with us. Next I got Joe Schuch, because I'd always been impressed with Joe and his approach towards business. And I kept finding guys who were avid divers, who loved the sport, had some retail experience, instructional background, and a sense of humor. Then we worked together. We collectively trained each other. So, we all had the same principles, and they all put themselves behind the counter at the dealer's, so they thought like a dealer. They also knew our products inside out from a repair standpoint, a maintenance standpoint, and this was unheard of at the time too. They were all technically trained by Sam. He was the best.

That's right. I remember the first time that Tom Allen came in to us and could run, right there on the premises, a full repair clinic seminar. It was unbelievable for us. That took all the expense out of having to send people to California from the Caribbean.

Plus, they were always going to take us to lunch or dinner, which was something we had never heard of either, which was great. Scubapro was now the premier dive manufacturer. As you got into the 1980s and more manufacturers began to pop up, all of a sudden instead of having the original five dive manufacturers, now we have 24 manufacturers, or something like that. How did you see some of that evolution?»It was good. It kept you on your toes and I actually learned from some of them. Ralph Osterhut (originally Ralph Shamlian), who founded Farallon, I thought was a very sharp guy, a very imaginative guy. I watched and learned from them all. Ralph was an expert on the splash and sizzle. The one evolution that I was kind of tough on was colors. Colors came in and products became just a plethora of color. I was a little reluctant and I had this fixation on "professional black." I still do but I decided that you have to give in here a little bit. But I never went so far as to go into the yellows and pinks.

Pink? I'm trying to imagine Dick Bonin in pink and it conjures up an image that I'm not comfortable with.»I finally compromised and we went with teal.

Well, by the time the 1990s rolled around, with the whole technical diving thing sort of coming out of the closet, everything went back to black again. You can't buy a piece of technical equipment that's not black.»See, I was right, and they all were wrong!

With all of the innovative products that you have built, and put out there, and have stood the test of time, because they have remained largely unchanged to this day – did you ever produce a product that you aren't proud of?»Oh, yes. We developed a regulator and we had a recall. Actually, it wasn't our design and it was in our very early years, before we even had salesmen. We developed a product that had a piston, but the seat was halfway up the piston, instead of a flow-through piston. The seat, in certain cases, could become unlodged and stick and cut off the regulator. Fortunately, we didn't have a great number out there, but that was a close call and really taught us a lesson. It had been out there for a while before we ran into the problem. It wasn't because it hadn't been tested; the problem developed over time and long-term use.

So what did you do when you found out?»We got every one back. This was in the days before there were official recalls. But we got every one back. We had a couple of other things. We had the Aqua Bomber. The Aqua Bomber was a little craft that looked like a plane, and you got in and peddled. It was a little submarine; it was really a laugh. One of our dealers developed it and I didn't have the heart to say no. I brought a couple to show and our own salesmen razzed me unmercifully. It was a joke. Eventually I sold them to a quiz show.

You guys came out with one of the most enduring regulators in history, the Mark V. I can tell you right now, there are still thousands out there in use. And anybody who can get their hands on a Mark VII is grabbing those, because they have become real collector's items.»Mark VII, Air 1. They've all become highly sought-after collection pieces.

Now, were you still with the company when Doug Toth and Dean Garraffa were hired?»I hired them. In my tenure we had three different Chief Engineers, the last being Jim Dexter, who was a very talented young man. We looked for engineers that had a lot of diving experience, and really loved it, and we came up with Doug and Dean. Dean had done some work for Healthways after it had been resurrected from Chapter 11. Doug was actually a diving instructor. After the interviews it became apparent that these guys fit. They were

with us until I left, and they started the Atomic company.

There is a lot of irony here. You left the company in 1991. Doug and Dean exited not too long after that and went off to start a company that competes directly with Scubapro.»There's only one person left at Scubapro that I know. All the engineers are gone. Doug and Dean started Atomic and their regulators are wonderful.

I use them myself.»I've been told they are the best.

Let me ask you this. The Jet Fin, in its era, was such a revolutionary product that everybody used them. Have you had a chance to try out these new split fins?»Yes, I have a pair. I like them. I got them last year. I do mostly free diving and they perform well.

Whose split fins do you use?»Atomic. I'm the old mossback guy. I dive with a lot of industry people, guys I worked with like Doug, Dean, and Dexter. They came on board my boat one day, and I took them out diving. They said, "You're going to try these things." They are very efficient fins.

But somewhere you've got to have a pair of Jet Fins sitting around.»Of course!

You retired from Scubapro in 1991. I know you did some really great work through DEMA and, also, with Ocean Futures after that. But are you retired now?»I am completely retired. I'm 73 (2003).

Seventy-three years young. You are, of course, one of diving's first generation. I've known you for over 30 years now. You look to me like you could go out tomorrow, run a marathon, and still close the bar that night. Do you stay in touch much with what's going on in the diving industry?»No. My communications are basically

with the fellows that used to work with me that are still in the diving industry. That's pretty much it. The salesmen all still call, and I talk to them, and they are more up to date than I am. I'll be called for the occasional humor, to see how things are, or somebody like you. I'll ask what's going on but, really, I'm not up-to-date. Generally, I'll hear people say, "You wouldn't like this, but..."

Could you ever imagine back in 1959, though, that the diving industry would grow into the multi-billion dollar industry that it is today? Did you see that?»I always thought so. We went through periods of fast growth, but like any other business, that's an exception. You build it up and battle to survive. Whether it's diving, golf or software, it's all the same. But I always thought it would grow, and then a lot of things happened that you don't anticipate. Diving went through stages, the travel boom, and I guess the latest thing is the technical diving. That started just when I was running DEMA. I remember being asked if I thought it was here to stay. Most people said no, but I thought it was. Divers like a challenge.

It's very surprising how technical diving and nitrox became the largest profit-center in diving in the past decade. There was more profit in those segments of the sport and a renewed interest for divers who wanted to stretch out their limits. But a lot of the conservatives didn't want to have anybody daring to breach what they thought were absolute limits: no decompression diving, no diving below 130 feet, don't do this, don't do that. But then, again, if you think back, it's the same guys that didn't like dive computers. They didn't like inflators. They didn't like BCs. They didn't like wetsuits that weren't black. Whoops, I might be throwing you in that category, though. There is a segment of our industry that has always resisted change and innovation, and being the innovative guy you are, I guess you would be leading the charge today if you were still running things.»You just have to look at the changes, flow and rhythm, and try to get ahead of them. I remember the first time I was asked about technical diving at a seminar and I could just see all of the eyes peering, wondering what I was going to say. I said, "It's here to stay." And that's based on what I know about the people of diving and the people who like to dive. These are people who want to do adventurous things and they're going to try it. They are going to try cave diving, deep wreck diving, rebreathers, free diving. These are people who like adventure.

You're in your early 70s now, you still actively free dive, experiment a bit. Do you see any signs of stopping that?»I see the signs, but I'm ignoring them.

Editor's note: There are about 40 copies of the original book still in Bret Gilliam's personal inventory. They are available as a Signed/Numbered Limited Edition personalized to each buyer by Gilliam at $200 each, including shipping. He can be contacted for purchase at bretgilliam@gmail.com.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