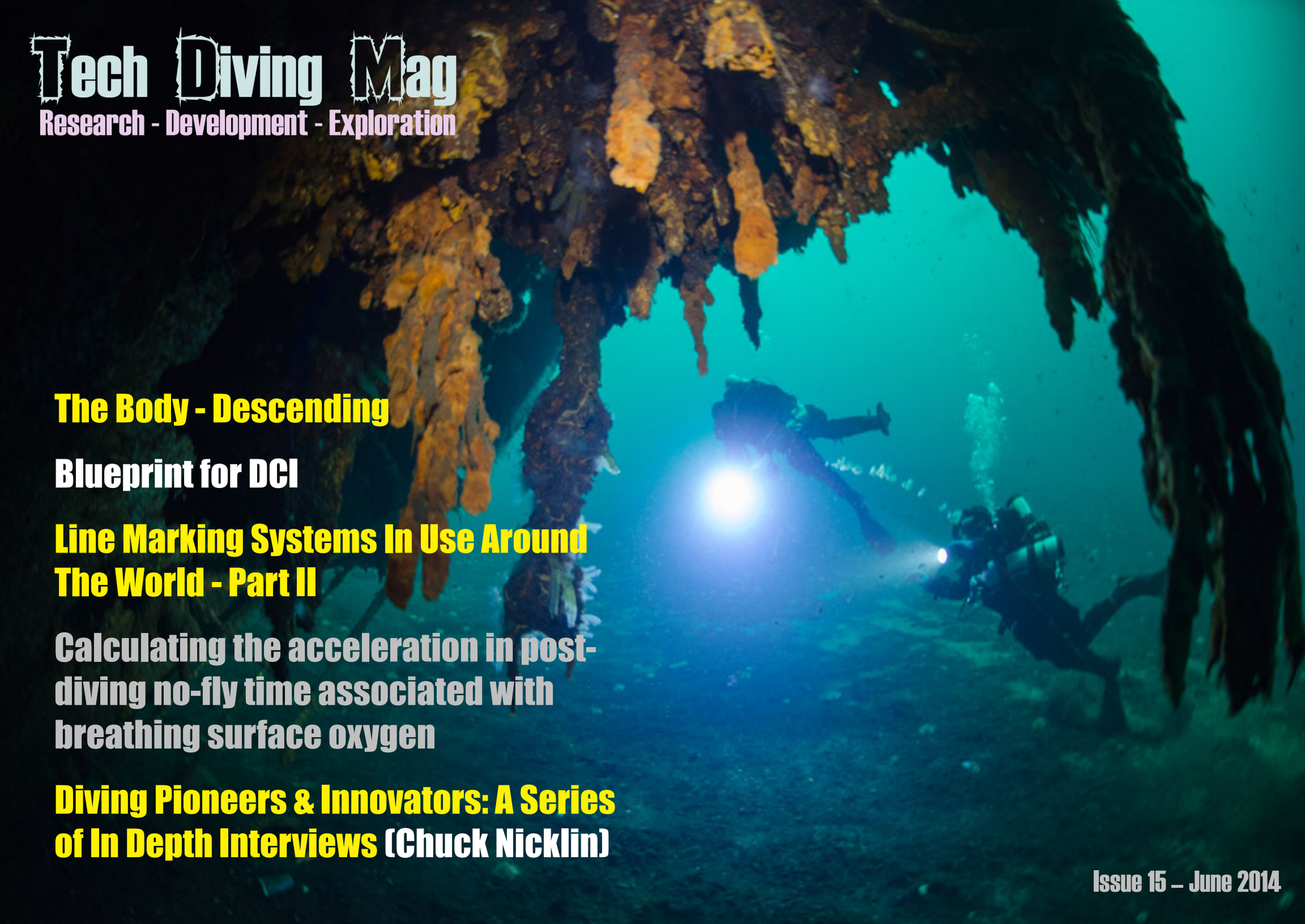
Tech Diving Mag

Research - Development - Exploration



The Body - Descending

Blueprint for DCI

Line Marking Systems In Use Around The World - Part II

Calculating the acceleration in post-diving no-fly time associated with breathing surface oxygen

Diving Pioneers & Innovators: A Series of In Depth Interviews (Chuck Nicklin)

Issue 15 – June 2014

Contents

Front cover image © René B. Andersen (www. uvgalleri.dk).

Editorial

Welcome to the 15th issue of Tech Diving Mag.

I discovered that some readers find it rather challenging to obtain information from my articles on accelerating the pre-flight surface interval (published in the first and fourth issues of Tech Diving Mag). That's why I "compiled" this effort in a single paper, written in a more formal style.

The contributors for this issue are renowned technical diving instructor trainer Ben Reymenants, hyperbaric medicine expert and technical instructor Derek Covington, cave explorers Forrest Wilson, Denis Bourret and Eduardo Macedo, along with SCUBA training pioneer and accomplished writer Eric Hanauer. Get to know more about them and read their bio at www.techdivingmag.com/contributors.html.

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Asser Salama
Editor, Tech Diving Mag

The Body – Descending

By Derek Covington

The underwater environment challenges the human body via a myriad of environmental assaults. From extreme temperatures to spatial disorientation to changes in cardiac function, it's all happening. Often at the same time. Fortunate for us, the rapid, incredible adaptations of the *homo sapien* body allow it to dive to incredible depths and very often return unharmed to the surface and resume terrestrial life.

Immediately upon immersion, the body senses a decrease in ambient temperature. Physiologic reflexes for cold environments begin to engage. Small, peripheral blood vessels in the extremities and those in the superficial layers of the skin narrow in caliber. As a result, warmed blood from the body's core loses less heat from the vasculature near the skin's surface and the nearby cool ambient temperature. These physiologic changes act to maintain normothermia – or a normal, static temperature. As a result, we avoid the consequences of hypothermia, such as anincreased respiratory rate (and associated increase in gas consumption), shivering (which increases the body's requirement for oxygen and can cause undue stress on the heart), cardiac dysrhythmias, mental confusion, decreased blood clotting, and altered drug metabolism.However, hypothermia itself is rarely the cause of injury or death in divers. Rather, cold temperatures can lead to fatalities via cold shock (an immediate physiologic reaction to cold), cold incapacitation (limited dexterity or strength due to blood shifting away from "non-essential" musculature), and exhaustion followed by drowning. Even if one makes it back on the boat or shore, the effects of hypothermia often remain. In up to 30% of hypothermic people on the surface, the body fools one into paradoxical undressing, which is exactly what it sounds like.[1] As one's temperature continues to drop, your body's temperature control center (the hypothalamus) tricks one into believing he or she is actually too warm. Without clothes, fatal hypothermia usually quickly ensues. Assuming one stays dressed and wore adequate exposure protection, the dive and physiologic insults continue.

Upon further descent, the changes to the cardiovascular system commence. Ambient pressure increases and induces a shift of blood from the peripheral circulation to the central circulation. It is estimated that this volume averages 700mL, or approximately 1/7 of an adult's entire circulating blood volume.[2] And, this occurs as shallow as 6 feet. As a result of this volume change, the heart must increase its cardiac output by up to 50%.[3] The kidneys then sense an increase in blood pressure and release factors into the blood stream to induce diuresis, or urine production (which may alleviate the hypothermia for a brief moment for those diving wet). This increase in urine production is well studied and is accurately termed immersion diuresis. In the setting of coronary artery disease or impending heart failure, the aforementioned shift in fluid volume into the thorax may precipitate a heart attack, heart failure, or pulmonary edema. A healthy heart will adapt to this change without "skipping a beat."

Next, the ear drums begin to howl. The increasing ambient pressure is now transmitted from the outer ear, through the ear canal, and to theear drum, or tympanic membrane. One side of this delicate cone-shaped, pearly white structurelies the ambient pressure, while on the other lie the three, in-series, delicate bones of the middle ear. By forcing air from the oral cavity, through the Eustachian tubes, and into the middle ear, these forces equalize and do not cause discomfort. Without pressure equalization, the pressure against the delicate tympanic membranefrom the water column pushes it inward and causes severe pain via the signals from three separate cranial nerves: V, VIII, and X (which explains why ear canal stimulation may cause you to cough. Yes, cough.) Don't want to worry about equalizing? Join the Bajau people in the Pacific. Many of the Bajau intentionally pierce their ear drums at an early age to facilitate diving and harvesting sea life.

Not surprising, may elder Bajau people are difficult of hearing.[4] Nonetheless, your eardrum is intact and equalized. Keep descending.

While the temperature, cardiac, and airspace equalization mechanisms quickly adapt to the environment, the cognitive consequences of visiting the subaquatic environment begin to manifest. Increasing ambient pressure induces a parallel increase in the partial pressure of each breathing gas. The first gas to have adverse physiologic consequences is nitrogen. The nitrogen load first equilibrates at the level of the alveoli (miniscule lung sacs) and the bloodstream. Eventually, equilibration occurs at intersection of the bloodstream and brain tissue. At depths as shallow as 30 feet, the increased partial pressure of nitrogen loads into the lipid bilayer of the neurons. The mechanically interrupted membrane of the nerve no longer conducts impulses effectively (Myers-Overton theory of narcosis). As a consequence, the anesthetic or narcotic effects take place. Supportive of this theory is the fact that the degree of narcosis is directly correlated to the lipid solubility of the specific gas. Although diffuse interruption of nerve signals throughout the brain remains largely unchallenged as the etiology of nitrogen narcosis, other mechanisms have been proposed. Some research supports a multi-site expansion model, while other studies suggest a protein-binding model involving changes at neuronal channels, like NMDA and GABA receptors, which are activated during anesthesia, may play a role in the cognitive impairment.[5] For users of alcohol, marijuana, pain medications, such as opiates, and benzodiazepine medications, the effects of these drugs are known to be additive to nitrogen narcosis.

We now find ourselves at a depth unable to see neither the surface nor the bottom. Visibility is excellent. 17 feet… plus. (We are in California). Without the normal visual, vestibular, and somatosensory clues to maintain our spatial orientation, we may quickly become spatially disoriented. Decreased ambient light and visibility limit our visual input. The weightlessness of neutral buoyancy acts to decrease the utility of the body's vestibular system, which is composed of fluid-filled canals and voltage-coupled cells with hair-like projections covered with viscous gel embedded with otoconia crystals. (I'm not kidding. Look it up.) Topside, these structures allow us to sense linear and rotational accelerations. Underwater, their efficacy is minimized. Finally, bulky exposure protection acts to decreases our third input: somatosensory information. Yet, spatial orientation is more often than not maintained. Secondary to the baseline redundancy of these systems and the body's ability to adapt to the limited contributions of each independent mechanism, the body endures.

Finally, the eery, yet so beautiful, wreck of the *HMCS Yukon* begins to emerge. We've made it to the bottom. Although the advances in modern open circuit scuba gear and closed-circuit rebreathers (CCRs) continue to advance and to impress, the physiologic reflexes and adaptations to underwater exploration by the human body remain as impressive as ever. Due to these physiologic adaptations of the human body, we can continue to visit the underwater world that beckons us to its peaceful and beautiful escapes.

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Brain Coral off of Fort Lauderdale, Florida: As nitrogen partial pressures increase at the level of the blood: brain tissue barrier, neuronal transmission is interrupted.

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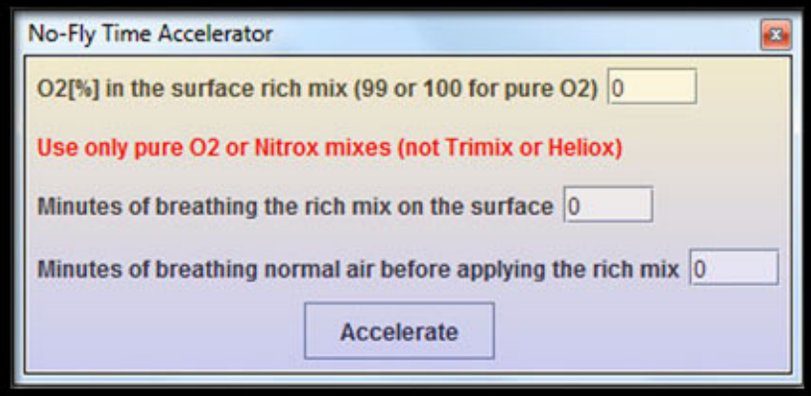

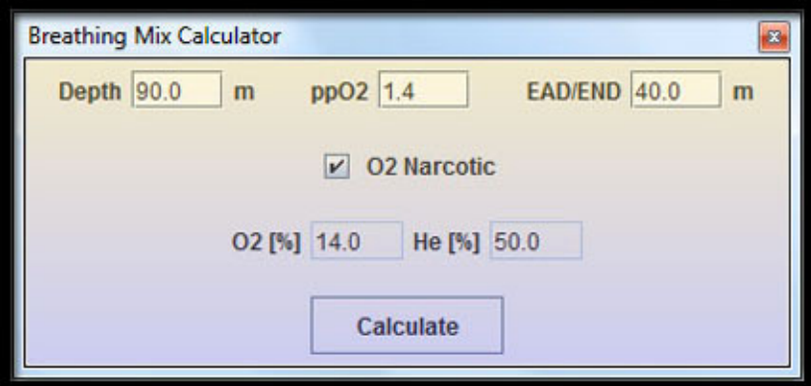

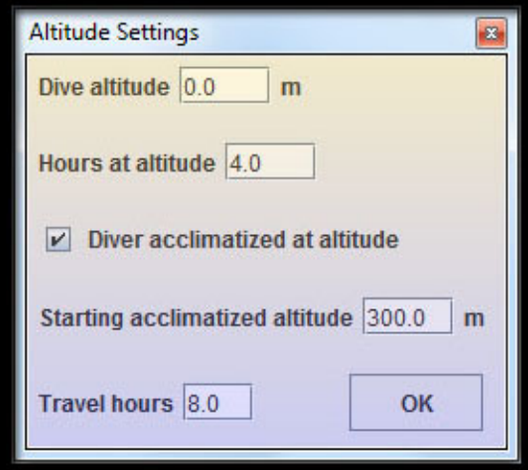

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Instructor Trainer (TDI, SSI, PADI)

Blueprint for DCI

DECOMPRESSION ILLNESS OR DYSBARIC INJURY:
condition arising from dissolved gases coming out of solution into bubbles inside the body on depressurization

By Ben Reymenants

Take away drowning and equipment malfunction and diving is a very safe sport. As long as you don't surface. That's the issue. A pressure drop and a chain event of biochemical and biomechanical processes jump into action.

As a mixed gas instructor trainer, I had a rough time in the early days. In the late nineties, there were 3 mixed gas manuals available to the daring public and a couple of diving medicine books written by professors and hyperbaric gurus.

In those days, a Trimix course would be a costly event and I would receive quite a number or physicians and engineers who would ask annoying questions… I would look up mechanisms of oxygen toxicity, HPNS and narcosis to simply bury my mixed gas students just with expensive terminology… Blank stares would follow and I knew I had to go smell the roses on the other side. I moved from Egypt to Thailand, presented myself as a part time volunteer at the local decompression chamber.

3 years later I was managing 3 chambers and a handful of clinics through South East Asia and realizing every day again how little I knew about diving physiology, DCI in specific.

Let me rephrase that. How little the industry knew about DCI?

My most memorableexposure was during a diving medicine course for Diving Physicians in South Africa, run by DAN and the University of Stellenbosch. A supreme collection of Professors and experts in the field was gathered there to discuss the latest findings. Great was my surprise that for half of the DCI manifestations like simple skin bends (cutis marmorata, skin rash), they had no sound explanation. Only suspicion and suggestions!

What followed was a decade of personal observations in more than 10 chambers worldwide and a good 400 DCI cases. I'll try and paint a picture how and why divers get bent.

First of all, DCI is nothing to be scared of. Anyone will get bend, sooner or later. Just like the flu. Don't look for any causes, shit happens. You get bend, your buddy doesn't, even if he has been partying all night, hardly slept and you're miss/mister Healthy.

On a good note, 99% of DCI cases are benign, on the borderline of discomfort.

Let's start with the bottom line; subclinical DCI.

We've all had a heavy days of diving; 2-3 dives a day, fighting a current. Didn't really have time to properly hydrate or eat or rest. 90 minutes after your last dive it suddenly hits you. You feel like getting flu, you're very tired, little aches all over your body; you're not hungry and just want to go to bed.

This is your immune system that just kick-started. It has detected foreign objects in your body (in the form of bubbles) and has raised the alarm. Raising the alarm is a long process or enzyme release (sometimes referred to as complement chain of enzymes) which takes about 1-2 hours to fully activate. We call this subclinical DCI, because most people don't bother going to the chamber as there's not really a specific manifestation of symptoms.

The next common occurrence step is in case of a present stress point in your body; an old fracture, a pulled muscle or an already pinched nerve. Off gassing heavily relies on a good blood flow (perfusion). If this is compromised in certain regions, bubbles have a hard time

being removed and may cluster around the affected area, giving cause to local inflammation and pain. Here, in most cases, the first denial is given; “no, that’s just that old fracture playing up” – or, that’s that muscle I pulled this morning, lifting tanks.

These divers are right, but it’s still DCI. The mechanical trauma has now been amplified because it’s been sandblasted by bubbles and is now properly inflamed, likely giving that throbbing feeling.

Stress points in the neck or lower spine, can cause a compromised blood flow in the small blood vessels inside our spinal cord. The abrasive effect of bubbles (think of sandblasting) can cause the small vessels to become inflamed and as a result, they will start swelling. Think about drinking soda through a straw that is bent; it creates even more bubbles.

Our spinal cord is wrapped into the dural sheath, like a plastic bag, this package is protected and tightly packed inside the bony structure of our vertebra. Not much place to expand there. The swelling now causes pressure on the actual nerves, and furthermore limiting the blood supply, causing all sorts of reactions.

Think or what happens if you sit on your foot; it goes numb. The same will happen if certain nerves are deprived of blood flow; first tingling/pins and needles, then numbness follows.

If a load of bubbles passes through C5 and C6 (neck area) some peripheral nerves lose partially their function and commonly, half your hand experiences tingling (paresthesia), commonly described as pins and needles. If this process progresses the hand goes numb (anesthesia). There’s nothing wrong with your arm or your hand, it all originates from the spinal cord.

Slow tissues are tissues that are a bit slower in the uptake and release of inert gas, simply because of the lower blood flow. If these tissues also become cold, they will trap blood and gas. Subcutaneous fat is one of those. Lower belly, breasts and upper thighs are a common area to collect bubbles. The exact mechanism is unknown, but a supersaturation after diving can create subcutaneous congestion of bubbles and blood, causing a mottled or marbled reddish area, so called skin bends.

The above manifestations make for more than 80% of the DCI cases and resolve easy with one or more chamber treatments.

Depending on where the biggest bubble load passes, or where stress points are, the outcome will differ from tingling, numbness to paralysis of limbs. This process manifests usually unilateral, meaning, on one side.

This process usually kick-starts 90-120 minutes after the bubbles have passed. By the time the divers arrive at the chamber, most bubbles will have gone. And we have to treat what we call 'secondary DCI'.

Oxygen helps in all cases in a number of ways:

- It sets a pressure gradient to help clean up the remainder of bubbles
- It 'calms down' the reactivity of your white blood cells
- It reduces the local inflammation and takes away swelling of tissues
- It force-feeds oxygen to the deprived tissues

The worse cases

If both sides of the body are affected within 20 minutes of surfacing you should be worried. Then a larger bubble(s) might have actually 'set' itself some where inside the spinal cord or brain and mechanically 'cutting' the 'fiber optics' to your brain. This is usually called an embolism, but is rare (<1%) yet can be quite dramatic, from decreased power, to loss of organ function, paralysis or death.

Embolisms or bubbles trapped in limbs tend to initially grow before dissolving when a diver goes on oxygen. This is mainly because the dissolved inert gas in the tissues kept the bubble stable. With the inert gas washed out, there's nothing to stop the bubble growing, before it slowly diffuses. This means that signs/symptoms tend to get worse in the first 10 minutes of oxygen breathing before stabilizing. Inside the chamber we used to call this the 'good pain' as indicator that there is indeed a bubble and it is being fixed.

So, overall, cases that present at the decompression chambers are mild cases of DCI and give merely a bit of discomfort. The cases that are brought in paralyzed or half death are the one-a-year freak accidents and they take a long time to fix: daily 5-hour treatments up to two weeks.

Most cases walk out without symptoms after 2-3 days, 2.5-5 hours inside every day. Not too bad is it? Mostly chambers will have some form of entertainment inside like movies or a happy tender singing karaoke for you (kidding).

That's right; most cases that did not go in denial, but grabbed oxygen in the first couple of hours get fixed with no residuals and continue their holiday.

Why do people get bend? A combination of factors. People fly in, start diving like mad or jump on a liveaboard to log dives. They are usually nicely jetlagged, stressed from work and immune systems are down,

dehydrated from the tropics and drinking alcohol and caffeine. Add a spicy curry and even more fluids leave your body in less pleasant ways.

80% of patients suffering DCI are dehydrated. And over 70% of cases are 'underserved' where the divers didn't do anything dangerous, didn't go deeper than 25 meters (80 feet), performed a safety stop, did everything 'right'.

One should not forget that 30% of the world population has a PFO; a small hole in the heart allowing bubbles to jump from one side of the heart to the other, bypassing the lung filter.

So, one really shouldn't be too paranoid about getting bent. It's just as likely as getting the flu.

Are women a higher risk group? Yes and no. besides the fact that women have more 'slow tissue' and this at higher risk, they are also more cautious. Women tend to address a problem sooner where men go in denial and call me up at 11pm because it's not going so well.

One tendency we saw was; women during their periods do have a higher chance on getting DCI. This may be because core temperature is raised, blood is thicker; immune system unstable etc… Rehydration here is key. Remember, diving should be fun. If you're feeling miserable, don't dive. Have chocolate ice-cream instead.

On a lighter note, DCI can present itself in more entertaining forms; like swelling of certain area's to giant proportions, breast and scrotums seem to be a popular hit point when a rare form of DCI hits called lymphatic DCI. Here, bubbles lock up the fluid drainage of tissues, resulting is temporary swelling. Patients with pectoral muscles like Schwarzenegger, or female patients inquiring if we can enlarge the other mammal gland to the same proportions!

4 points to remember; if something seems wrong, it is wrong; start drinking isotonic fluids, lay down to relax and call the chamber.

Actually no, in the world of medical litigation, first call your insurance company.

Line Marking Systems In Use Around The World - Part II

By Forrest Wilson, Denis Bourret and Eduardo Macedo
Edited by Peter Buzzacott

Florida (by Forrest Wilson)
In the early days of US cave diving, it was common practice to run a reel in for every dive, and remove it on the way out. A few explorers began to leave line in caves, but only beyond the zone that novice divers frequented. It was common for there to be over a 300 foot (90 meter) entrance gap. In the early days in the US, explorers used un-marked "Ts" for side passages. After some fatalities due to confusion at "Ts", most were replaced by gaps (jumps). It wasn't until after the advent of the plastic line arrow that properly marked "Ts" began to be left in caves. There is still reluctance to use "Ts" in many US caves.

The popular U.S. caves (tourist caves) have a main line running in the most used passage(s). It is 4mm gold coloured line (goldline). The less popular passages have smaller white line, from 1mm to 3mm. They are generally separated from the goldline with gaps (jumps). The more popular side passages are marked with double arrows. There are many un-marked gaps/jumps. It is common practice to place a single arrow, pointing to the exit, and tie a "jump" reel (or spool) on the mainline at the single arrow. There are a few "Ts" in the popular caves, using arrows to mark the way out. Many of the popular caves have arrows every 100 feet (30 meters) with distance to the exit marked on the arrows.

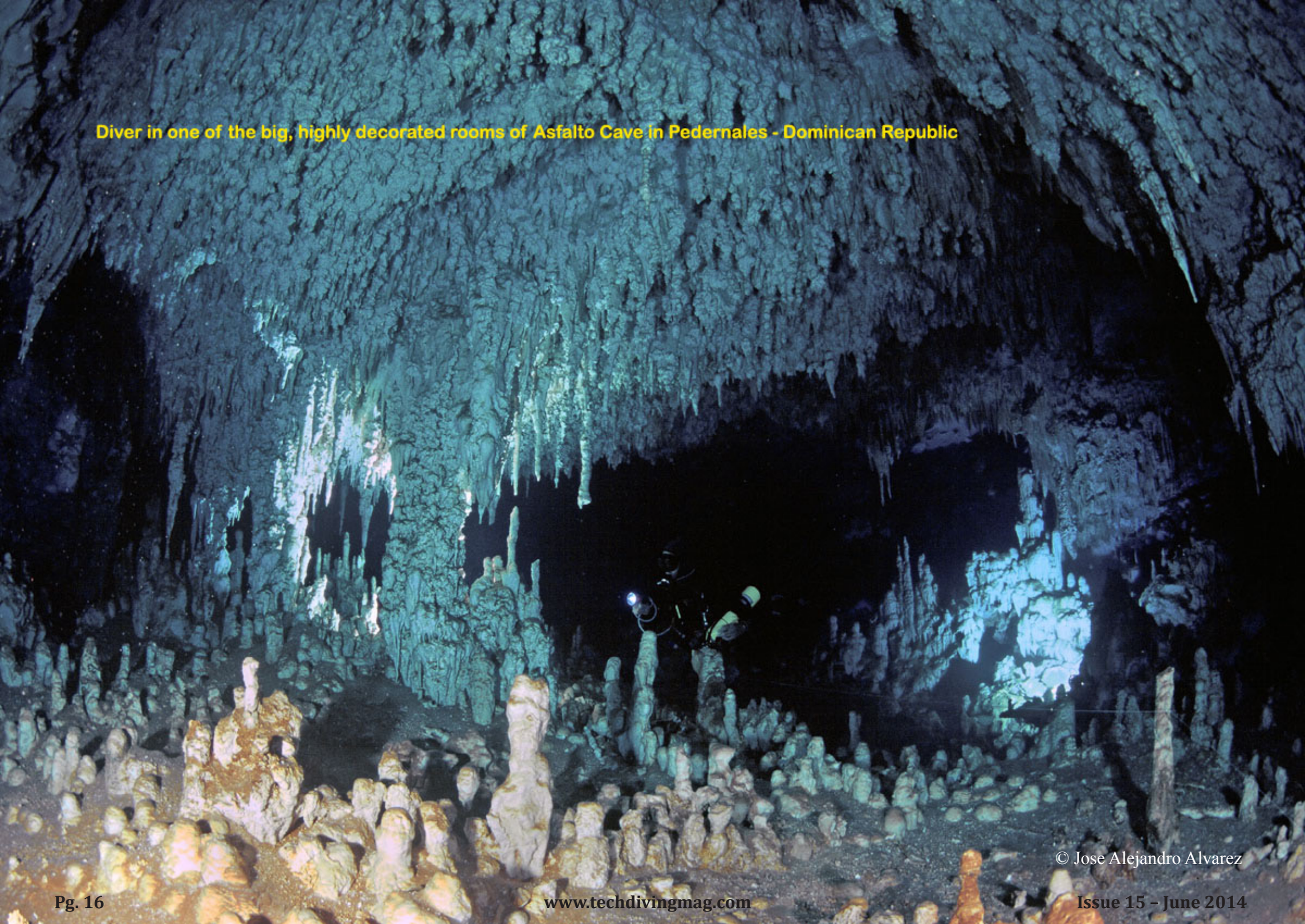
Most of the less popular caves use the same system of placing gaps (jumps) for side passages, but there are many less popular caves with "Ts". Most of the "Ts" are marked with arrows, but there are a few un-marked "Ts" still in some caves. It is recommended practice to use personal markers on "Ts". Some of the older divers still use clothespins (clothes pegs), but most younger divers use arrows, or cookies. Both have slots for easy attachment to guidelines.

Entry to Ginnie Springs - Florida

Dominican Republic (by Denis Bourret)
Cave diving in the Dominican Republichas developed substantially since 1998, due to the arrival of a resident cave diver Instructor Trainer. Most of the local cave diversa new cave instructor are certified IANTD, they are diving for different dive operators and for leisure dives under twomain non-profit organizations:

FEH (FoundacionEspeleobuceoHispanola) founded in 2003 by Jose Alejandro Alvarez, Santiago Camarena and Denis Bourret. Among their accomplishments are the exploration mapping of about 40 caves, locating about 80 caves and publication of the book "Las Cuevas Sumergidas de RepublicaDominicana".

Cueva Taina Entrance Pool - Dominican Republic



Diver in one of the big, highly decorated rooms of Asfalto Cave in Pedernales - Dominican Republic

DRSS (Dominican Republic Speleological Society) founded in 2010 by Philip Lehman, Cristian Pitaro and Thomas Riffaud. Among their accomplishments are the exploration and mapping of about 40 caves, discovery of remains of monkey and crocodile, as well as active filming of the cave.

Los Pozos is a popular local name for cenote-like sinkholes scattered all over the country. Others call them laguna, cueva, hoyos and manantial, depending on where in the country one is traveling. Some are easily accessible, like El Dudu and CuevaTaina, where we drive right to the step leading down to the water. More difficult caves require an hour's walk on karst-arid terrain infested by needle cactus and mosquitoes. There are also a number of dry caves leading to fresh water pools, in which crawling, climbing, rappelling and sweating is necessary. But the good thing about the Dominican Republic is that no matter where the cave is we always find good help to carry the heavy stuff for us, for a reasonable tip.

Ranging from 8 meters to 80 meters deep, the pozos usually have a fresh water layer on the top of the saltwater. A halocline can be expected in almost every system, depending on the proximity of the shore line, and may be found as shallow as 5 meters and as deep as 40 meters. Moderate to no current and impressively clear water is the norm in Dominican Republic caves. The temperature is around 24° Celsius and most of them are highly decorated with stalactites, stalagmites, draperies and big columns.

Caves used commercially, (like "El Dudu", "CuevaTaina" or "Padre Nuestro") either instructors to teach or by guides give tours are prepared for that purpose. Permanent lines are the regular #24 braided line, a primary reel is needed to get from the open pool to the main line. Line arrows are found every so often but no T's. Side tunnels are indicated by a double Arrow. They also have warning signs to warn non cave certified divers to go no further than they should. Some of the more remote caves or those still under exploration and survey may still have some T's left behind.The norm is to dive with double aluminium 80's, as all the tunnels on most of the cave are accessible with that configuration, one exception being "La Jeringa" which is mostly a Side Mount cave.

Open water diver stopping at the warning sign in El Dudu - Dominican Republic

Brazil (by Eduardo Macedo)
Cave diving in Brazil suffered a break for a few years due to problems with the federal government. Today few dive-able caves in Brazil have dive centers near to the caves. This means cave diving in Brazil has the character of a real expedition, requiring compressor and all replacement equipment, food, cooking and sleeping kit and tents.

Some places that have dive centres are just sinkholes with large lakes and great depths. Someplaces have snorkelling, recreational scuba diving and cave diving but without tunnels.There is now a movement of the federal government itself to try to make cave diving possible in some state parks. The future looks bright for cave diving in Brazil.

The line system used in Brazil follows the same protocols of Florida (Florida style) because all Brazilian instructors were tutored by the masters in Florida (Lamar Hires, Tom Mount, Bill Rennaker, etc).The conditions of the local caves are excellent, usually with visibilities of 20 to 40 meters or more. Water temperature in the Midwest region varies from 19 to 25°C and the Northeast 22-25°C.The site with the highest flow of cave divers and great diving is an old gold mine (shaft mine) with 130 years of operation for gold extraction where several tunnels can be dived.

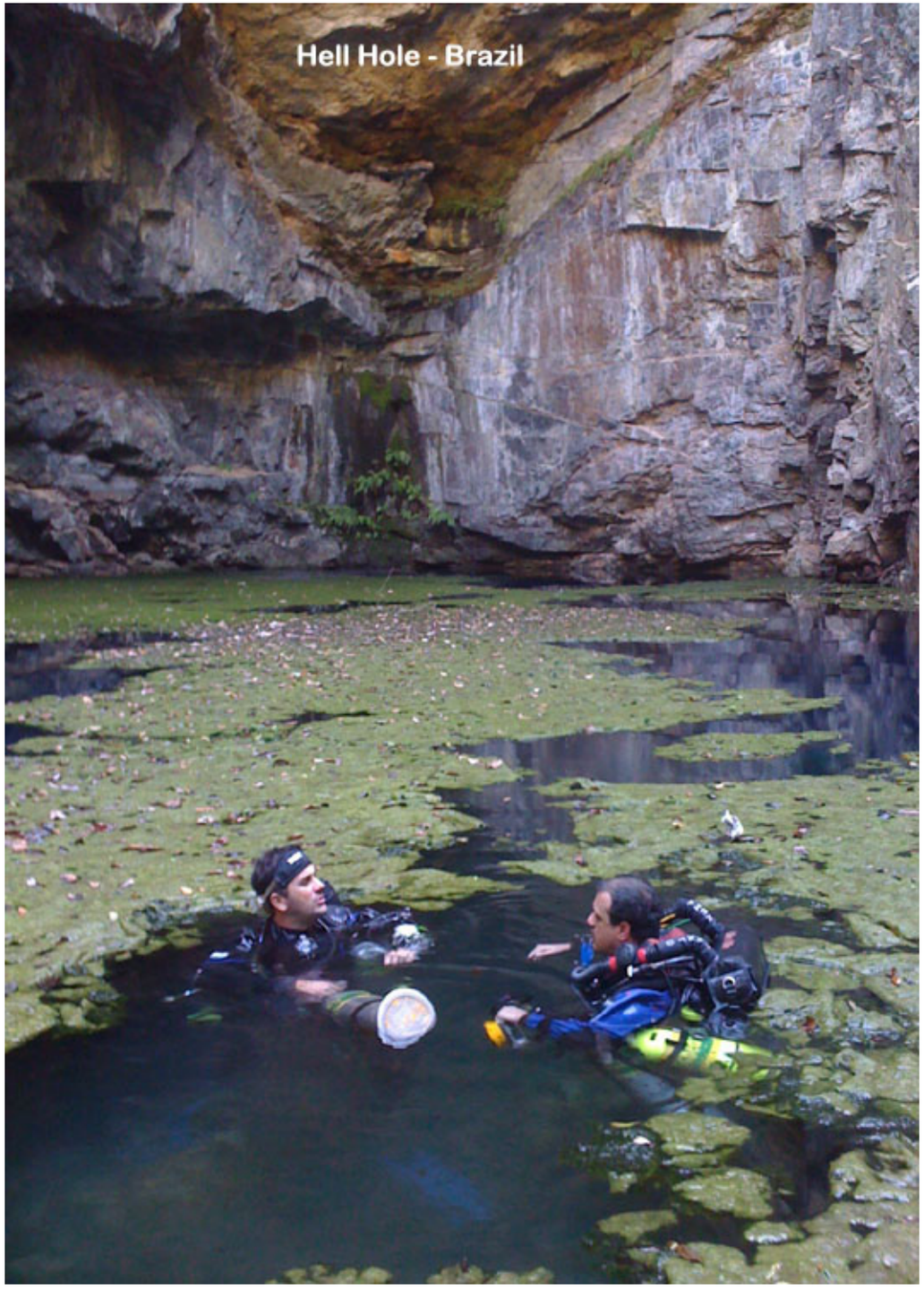
http://www.divegold.com.br/minadapassagem.html

This mine is used for training and maintenance of cave divers in Brazil and has all the structure, facility and comfort cave divers might want for. Visibility is greater than 50 meters and water temperature varies little, remaining between 19 and 21°C. This mine is located in the south-eastern state of Minas Gerais, near the city of Mariana.The line system follows the model of Florida, athicker golden line with large yellow arrows. Just one tunnel exists with a "T" but the two possible tunnels go to the same exit with almost the same distance. This "T" was maintained only for the purpose of training cave diving students. There are three main tunnels with golden line and five other jump tunnels in the shallow section. The jumps are lined with thin white cord and standard size arrows in white colour. The shallow portion has about 1,000 meters of line so far.We dive in level number five. There are four more floors below, completely flooded, where it can reach depths of over 120 meters.

Brazil has several floodednatural caves. We know probably only 10% of our potential speleological heritage.

Midwest

- Buraco das Abelhas (Bees Hole) – New line in 2006. Golden line thru tunnel A with large arrows, and two jumps with white line.
- Buraco do Sapo (Frog Hole) – Old exploration line.
- Gruta do Mimoso (Mimoso Grotto) – Golden line and white lines on jumps all very old.
- Nascente do Formoso e Formosinho (Spring Formoso and Formosinho) – Golden line and jumps very old.
- CeitaCoré (CeitaCoré Cave) – Golden line and jumps are very old.
- Buraco do Inferno (Hell Hole) – Exploration line up to 120 meters very old.
- Blue Pit Niquelândia – Exploration line up to 240 meters very old line white with large arrows (exploration by Gilberto Meneses).
- Blue Lake Gold Mine in Mara Rosa – Old Gold Mine (Naked Mine) with recently changed line by myself. Golden line with good conditions with yellow arrows, midpoint and jump recently changed (André and Renato) up to 75 meters.



- Lagoamisteriosa (Mystery Lagoon) – Excellent line, good conditions recently changed.

Northeast

- Poço Azul de Milú (Blue Cave's Milú) – Very old exploration line and jumps.
- Gruta da Pratinha(Pratinha Grotto) – Very old exploration line and jumps.
- Gruta dos Impossíveis(Impossible Grotto) – Very old exploration lines and jumps.

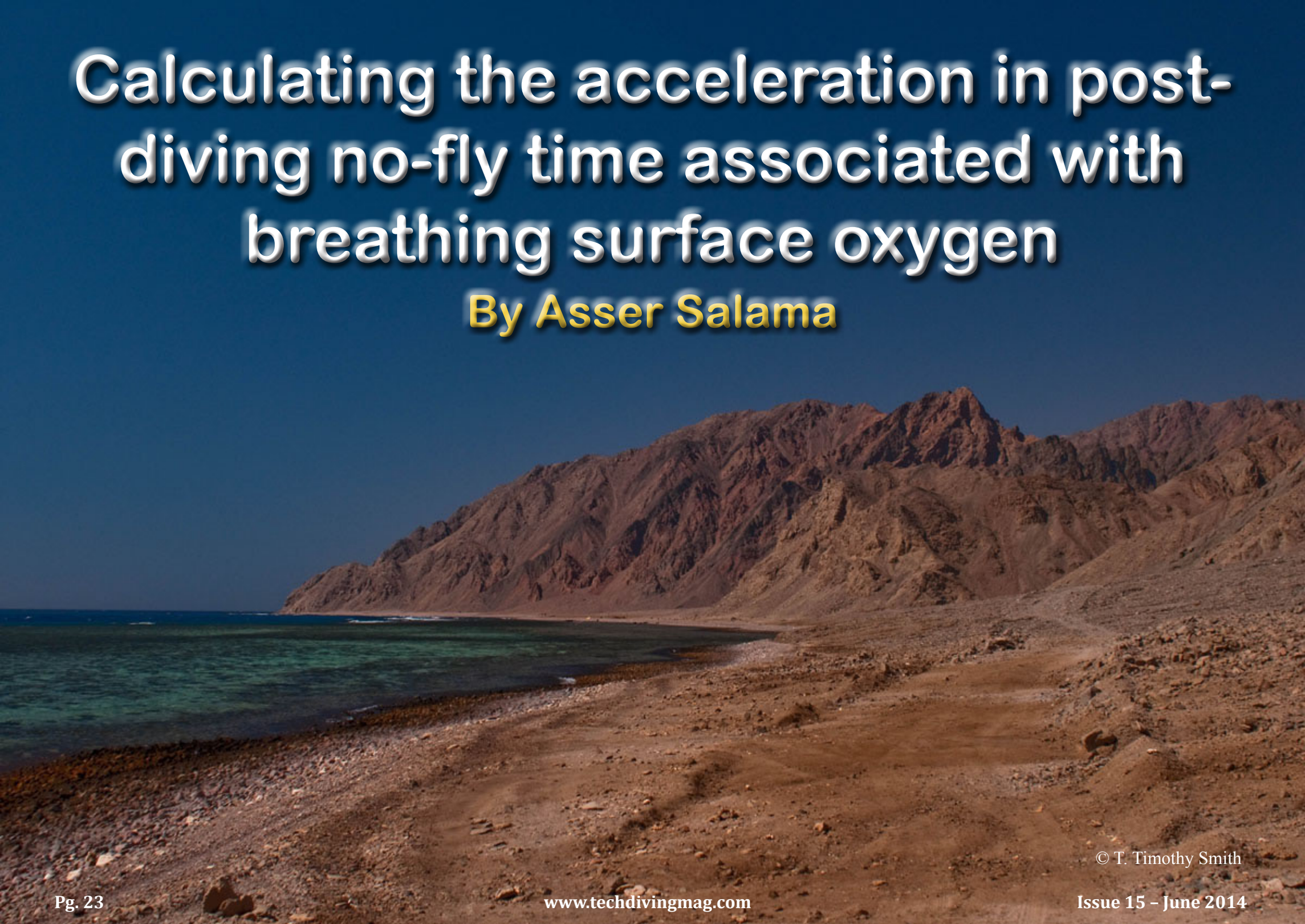
There are more caves being explored but their locations are not disclosed because of the problem with the federal government.The situation in Brazil should improve with new rules that should make cave diving in Brazil possible again, with more investment by the owners of dive centers and land owners. Much work must be done to replace the entire line systems of these "old" caves, following the protocols of the "Florida way".

Next issue of Tech Diving Mag: Part 3 – the Bahamas, Mexico and France (hopefully).

Mystery Lagoon - Brazil

Calculating the acceleration in post-diving no-fly time associated with breathing surface oxygen

By Asser Salama



Abstract
BACKGROUND: Some experienced scuba divers breathe oxygen on the surface after the last dive to accelerate their pre-flight surface interval.[1] This study investigates the possibility of applying a computational algorithm to estimate the time gain associated with this practice without attempting to calculate the no-fly time itself. It also compares the no-fly time savings when helium is added to the bottom mix, and when the timing of applying the oxygen on the surface is changed. METHODS: A stand-alone computer program to plan dives was developed and a recursive algorithm was implemented to calculate the no-fly time savings. A 40 minute open circuit dive to a maximum depth of 55 meters was simulated, first using air as the bottom mix then using Trimix21/25 (21% oxygen, 25% helium). The decompression gases were Nitrox40 (40% oxygen, 60% nitrogen) starting at 30 meters then Nitrox80 (80% oxygen, 20% nitrogen) starting at 9 meters. RESULTS AND CONCLUSIONS: Estimating the no-fly time acceleration associated with breathing oxygen on the surface is possible without calculating the no-fly time itself. The gain is lower in case the bottom mix contains a percentage of helium. The gain increases with the delay of oxygen application.

Introduction
A flying-after-diving workshop was hosted at Divers Alert Network in May 2, 2002.[2] The objective was to review the state of knowledge of flying after diving and to discuss the need for new guidelines for recreational diving.

The workshop recommendations were as follows:[2]
• For a single no-decompression dive, a minimum pre-flight surface interval (SI) of 12 hours is suggested.
• For multiple dives per day or multiple days of diving, a minimum pre-flight SI of 18 hours is suggested.
• For dives requiring decompression stops, there is little experimental or published evidence on which to base a recommendation. A pre-flight SI substantially longer than 18 hours appears prudent.

All recommendations assume air dives followed by flights at cabin altitudes of 610 to 2,438 meters (2,000 to 8,000 feet) for divers who do not have symptoms of decompression sickness (DCS). These recommendations were not predicted by mathematical models, but rather suggested from empirical data based on observations and actual occurrences of DCS.

Divers doing dives that require decompression stops usually subscribe to a minimum pre-flight SI of 24 hours. Some experienced technical divers breathe oxygen on the surface after the last dive to accelerate their pre-flight SI. However, the majority of them don't seem to have solid protocols.[1] Developing a tool to estimate the time gain associated with this practice appears prudent.

Methods
A stand-alone computer program incorporating VPM-B was developed to plan dives. The program uses the 16 halftime compartment set of Albert Bühlmann's ZH-L16 model.[3] A special algorithm was implemented to calculate the total inert gas loadings in the array of tissue compartments directly after the dives. The algorithm then re-calculates the total tissue loadings after breathing oxygen on the surface for a determined time period (T1) and loops back on all the compartments to calculate how much time would have been needed to reach the same total loading without breathing oxygen (T2). As soon as any compartment reaches the same total loading, the program exits the loop. The gain is T2 minus T1. The accuracy of the calculations is 1 minute.

The calculation procedure is a recursive application of two central equations advised by John Scott Haldane.[4] They are employed in popular decompression models like VPM-B and ZH-L16 to calculate the uptake and elimination of inert gases during intervals at constant depth, both in and out of the water.

$$p - pa = (p - pa) \exp(-k * t) \quad (1)$$

p: inert gas partial pressure
pa: inert gas ambient partial pressure
k: inert gas time constant
t: time

$$k = \ln(2) / h \quad (2)$$

h: inert gas compartment halftime

A 40 minute open circuit dive to a maximum depth of 55 meters was simulated. The descent rate was 20 m/min and the ascent rate was 10 m/min up till 6 meters depth then was slowed down to 3 m/min. The decompression gases were Nitrox40 (40% oxygen, 60% nitrogen) starting at 30m then Nitrox80 (80% oxygen, 20% nitrogen) starting at 9 meters. The decompression schedules were generated assuming the bottom mix is air then re-generated assuming the bottom mix is Trimix21/25 (21% oxygen, 25% helium). A 12% conservatism level was applied to both dives.

Results

Bottom mix: air
VPM-B conservatism: 12%
Total run time: 107 minutes

No-fly time saving (breathing pure oxygen for 60 minutes, directly after surfacing): 116 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 60 minutes after surfacing): 173 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 120 minutes after surfacing): 230 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 180 minutes after surfacing): 288 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 240 minutes after surfacing): 347 minutes

Bottom mix: Trimix21/25
VPM-B conservatism: 12%
Total run time: 96 minutes

No-fly time saving (breathing pure oxygen for 60 minutes, directly after surfacing): 73 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 60 minutes after surfacing): 110 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 120 minutes after surfacing): 147 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 180 minutes after surfacing): 183 minutes
No-fly time saving (breathing pure oxygen for 60 minutes, 240 minutes after surfacing): 218 minutes

Discussion

The No-Fly Time Accelerator (NFTA) is an attempt at developing a usable tool for calculating the gain of an already-proved concept.

Trying to calculate the no-fly time puts the developer on the horns on a dilemma. Using the commercial cabin altitude ranges result in

much less pre-flight SI than the recommended. Increasing the cabin altitude is an ad-hoc and would result in a calibration problem with the calculated time savings.

For these reasons, NFTA neither aims nor tries to calculate the no-fly time. It does not use the flight or altitude data either. The only input that NFTA receives from the decompression model is tissue loadings upon surfacing, so it is irrelevant to NFTA whether a dual phase model like VPM-B or a dissolved gas model like ZH-L16 is used to plan the dives. However, a dual phase model would be more flexible for further developments, employing a different halftime set for instance.

NFTA employs the straight forward approach of calculating how much faster the tissue compartments de-saturate on the surface when breathing oxygen instead of air for a certain period of time. The equations used are Haldane's.[4] They are already employed in scores of decompression planning tools incorporating popular decompression models like ZH-L16 and VPM-B.

NFTA does not assume that a particular compartment, or a set of compartments, control the no-fly time. The recursive loop does not look at specific compartments. It stops as soon as any compartment fulfills the condition: total tissue loading after breathing oxygen for duration T1 = total tissue loading after breathing air for duration T2. That's why the time savings are presumably conservative.

The gain is lower in case the bottom mix contains a percentage of helium. This is expected, as the inspired helium content on the surface is negligible anyway, so breathing oxygen won't accelerate helium elimination.

The gain increases with the delay of oxygen application. Although this might seem at odds with the current understanding of off-gassing gradients, it's a normal mathematical result for employing exponential equations like Haldane's. To illustrate, let's say (just for demonstration) that the diver surfaced with the 5 minute halftime compartment holding a nitrogen load of 2.76 bar. If the diver breathes pure oxygen for 5 minutes directly after surfacing, the tissue tension will be (2.76 – 0.0 / 2) + 0.0 = 1.38 bar. After 5 more minutes but on air, the tissue tension will be (1.38 – 0.76 (alveolar ppN2) / 2) + 0.76 = 1.07 bar. On the other hand, if the diver delayed the surface oxygen for 5 minutes, the tissue tension would be (2.76 – 0.76 / 2) + 0.76 = 1.76 bar just before the oxygen application, and (1.76 – 0.0 / 2) + 0.0 = 0.88 bar after breathing it for 5 minutes. So delaying the surface oxygen indeed boosted off-gassing.

Conclusions

Estimating the no-fly time acceleration associated with breathing oxygen on the surface is possible without calculating the no-fly time itself. The gain is lower in case the bottom mix contains a percentage of helium. The gain increases with the delay of oxygen application.

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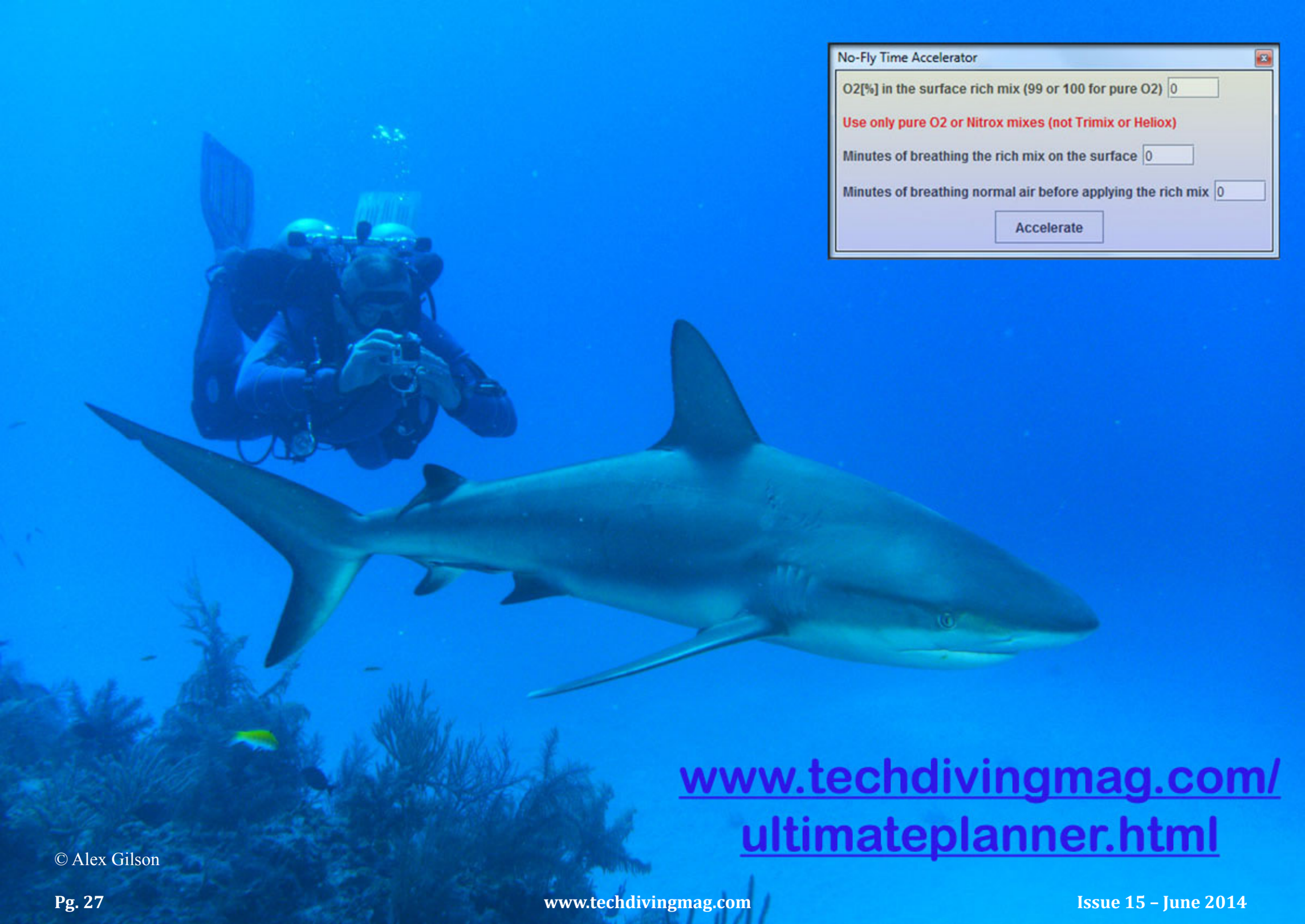


www.techdivingmag.com/ultimateplanner.html

ALL PHOTOS FROM CHUCK NICKLIN COLLECTION EXCEPT AS NOTED

::: chuck nicklin

Chuck Nicklin

RETAIL PIONEER AND FILMMAKER

BY ERIC HANAUER

Baseball hall of famer Leo Durocher once said, "Nice guys finish last." The first time I met Chuck, I was presenting a slide show on the Red Sea to a tough audience from San Diego Underwater Photographic Society. At the time they were putting on the most prestigious underwater film festival on the west coast.

For two days every year they filled the giant civic opera house for their shows. I was a carpetbagger from Orange County trying to get my slideshow accepted in the show, and felt about as welcome as Bill Clinton at the Fox News studios. When I finished the presentation, I looked at the frowning faces of the judges. But Chuck walked up to me and said, "Congratulations. That was the best show we've seen here in a long time." I was blown away that Chuck Nicklin, world renowned photographer, cinematographer, and diving pioneer, would make the effort to encourage a nobody like me.

Chuck has encouraged a lot of nobodies who later became somebodies. Some of today's leading underwater shooters, including Howard Hall, Marty Snyderman, and his son, Flip, got their start working for Chuck at the Diving Locker. Unlike photographers who feel threatened by newcomers, Chuck is secure in his own ability to keep raising the bar. And he's still raising that bar as he approaches his 80th birthday.

Most divers of the pioneer era have hung up their fins or moved on to the great coral reef in the sky. Chuck is still at the top of his game, traveling the world and capturing the action in high definition video, and leading trips to exotic locations with his wife, Roz. He has been an underwater shooter for nearly 60 years, ranging from stills in *National Geographic* to Hollywood movies, television, and IMAX films. Beginning as a breath-hold spearfisherman before the introduction of scuba, Chuck opened one of the west coast's first dive shops, the San Diego Diving Locker. He learned from some of the early legends: Jim Stewart, Connie Limbaugh, and Ron Church; then helped the next generation get started.

During the years he owned the Diving Locker, it became a Mecca for traveling diving dignitaries coming through San Diego. Marty Snyderman recalls, "I don't know if it was design or by good luck. But there wasn't another store anywhere in the world that I'm aware of that had that kind of body of energy about photography at that time. Chuck was certainly the leader of all that."

Mary Lynn Price, a rising star in underwater video, is another shooter who credits Nicklin with getting her started. In 1995 she went with his group on her first foreign dive trip, to the Bahamas. In the middle of a shark feed, Chuck handed her his Hi-8 video camera and signaled her to start shooting.

"Chuck has been my underwater mentor ever since," she said. Mary Lynn, in turn, has been his mentor in editing on computers. "He made the transition to the computer age before many of us did, and is one of the most computer comfortable people I've met," she concluded.

Nicklin is constantly on the move to exotic places, organizing and running trips. He keeps threatening to retire, but several friends have been on "Chuck's last trip" four or five times. His media of choice today is high definition video, and he hasn't lost that magic touch. The hardest thing in underwater video is shooting macro subjects without camera movement. Nicklin is a master at that, despite never using a tripod. He's still setting the standard for people half his age.

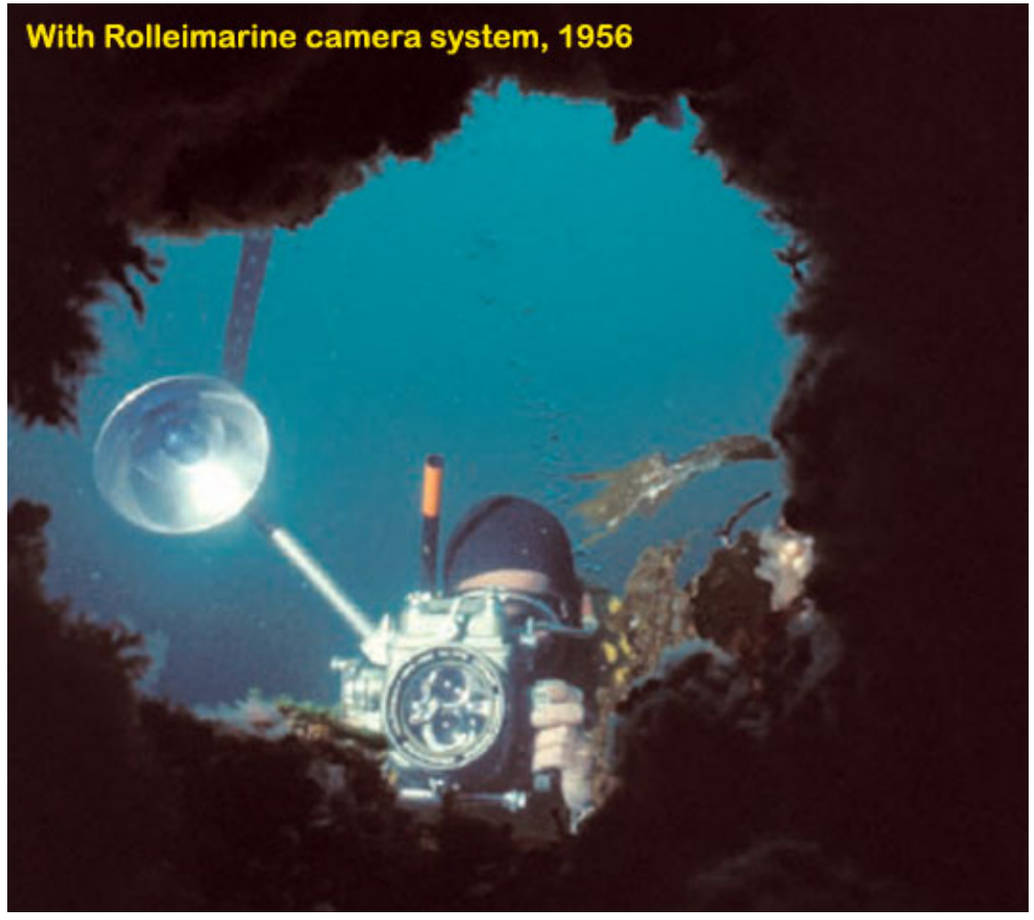
How did you get interested in diving?» When I first moved here from Massachusetts, I'd look down the cliffs at the ocean and thought that's really neat. After I got out of the Navy I went down to La Jolla

Cove one day because I just had this urge for the beach. There was a kid in the water with a diving mask. I asked his father, "What is that?" He asked if I wanted to borrow it. So I used this little kid's mask, one of those round, hard ones by Sea Dive. I looked around and said, "This is for me." A relative in the Navy bought me a pair of black Owen Churchill UDT fins. My Sea Dive mask came from a local sporting goods store; its hard rubber edge had to be sanded to make a seal. An old Navy sweater kept me from freezing on free dives for lobsters and abalone.

Do you remember your first scuba dive?» The first time I ever went underwater and breathed off anything, it was a gas mask and a little bottle of oxygen... I went to Mission Bay with my father and he put a rope on me. I said, "If you see me stop moving around, pull me in." I turned this thing on to take a breath, held it, turned it off. This was repeated for every breath... for maybe five minutes. I thought there's got to be a better way.

I was in the small grocery business, too poor to buy one of these fancy Aqua-Lungs. The first day of abalone season, it was a tradition to go to Bird Rock in our wool sweaters. I scammed a short Pirelli dry suit, with a band around the waist. Over the top of that I would wear a long john top and bottom. It looked weird, but was necessary to protect the suit. I spent all my free time talking diving. In the back room of the grocery store I had pictures of diving on the wall, I had scrapbooks, and was gung ho for diving.

When did you start on the Aqua-Lung?» In 1953. I had a friend, Bob Casebolt, who was working at Convair. They had a dive club, Delta Divers, and half dozen tanks. Bob wanted to learn how to dive and so did I. So I joined the club even though I didn't work at Convair. My instructor was George Zorilla. He was an Olympic swimmer out of Argentina, was in the swimming business for a long time, and taught my sons, Flip and Terry, how to swim. All the course consisted of was talking about it for a while, putting on those little weenie 38 cubic foot tanks, a double hose regulator, and making a dive at the shores. I didn't really get a C-card till I started the Diving Locker and took a quick course through the city of San Diego to be an instructor.


With Rolleimarine camera system, 1956

We did some weird things, makes we wonder how we got through it. I remember being on the bottom with a bag of ten abalone, the legal limit in those days... I was starting to breathe hard, kicking away and starting up, and all of a sudden my feet hit the bottom. I hadn't moved

at all... was scared to death and dropped the abalone. I couldn't drop the weight belt; it was a cartridge belt with lead in the pockets.

We used to dive in the north canyon and shoot rockfish at about 140 feet, deep enough so their eyes would pop. We knew we should be decompressing, but weren't quite sure how the whole thing worked. So we would take little 38s and lie down at the bottom of the pool at Buena Vista Gardens, thinking we were decompressing. This was probably 45 minutes after we got out of the water. I was a hunter in the early days. The last black sea bass I speared weighed 376 pounds. They would dive down and wrap themselves in the kelp; you're free diving 60, 80 feet to cut them out. Get that line wrapped around you and you're in a lot of trouble. I did all that and feel sorry about it now.

For ten years I spent any free time at the ocean, free diving and spear fishing. And that's how I met Connie Limbaugh (diving officer at Scripps) and Jim Stewart (Limbaugh's successor) and all those guys, through free diving.

Do you remember how you met Connie?» A friend of mine, Homer Rydell, was a salesman for Gallo wine, and he invited me to his house to meet Connie, and we went lobster diving at the cove before it was a preserve. Later we went on an overnight Baja trip together along with Elizabeth Taylor's brother, Howard, and over time became close friends. Limbaugh, Stewart, Andy Rechnitzer, and Wheeler North (researchers from Scripps Institution of Oceanography) were partners in a part-time consulting business, doing their research out of the back room of what would become the Diving Locker. In 1959, a contract on testing the offshore sewage outfall brought in enough money to expand the business into a dive shop. The problem was that they all were graduate students, and had neither the time nor the retailing expertise to run the shop. Rydell recommended me. I was in a small business, knew when the checks would clear and all that stuff; that's good training for running a dive shop. They had a choice of Ron Church or me. They finally decided I would be the manager and Ron would work with me.

The Diving Locker opened on June 15, 1959. I'll remember the date forever. June 14, 1959, was the only authenticated shark attack off San Diego, the day before we opened. Business was really slow. Our entire budget of $5,000 was spent on a Rix compressor. But because of Limbaugh's reputation and his connection with Rene Bussoz (Aqua-Lung), the manufacturers stocked us on credit. Jimmy (Stewart) and Andy (Rechnitzer) and those guys did more than just help running the store. Their reputation made our store a sort of scientific headquarters. Anyone in San Diego on a scientific mission went to the Diving Locker and that helped us get started. Many a day we had a lot of empty boxes on display... because we just didn't have the capital we needed. When Bev Morgan was closing his surf shop, he came down and taught me how to make wet suits. I was a one-man show for a while, made my first suit on the floor of my house. I would sell them the suit, cut it, glue it, try it on them, and take their money.

During our first class, Jacques Cousteau was in town. The class was in the back room, and we introduced him. He said, "This is your introduction to the ocean, I hope it's as good for you as it is for me." Every once in a while someone from that class staggers through the door and asks, "Do you remember when Cousteau welcomed us to the ocean?"

What was it like to run a retail dive shop in those days?» The main reason for diving was to gather abalone, halibut, and all that. That was the basis of our business. The main lines in those days were US Divers, Swimaster with Duck Feet fins, Waterlung, the first serious


Killing time on a deco hang with an apple and a magazine

single hose regulator, and Voit was in it then. Mike Nelson on *Sea Hunt* used to use Voit. In those days we had a sort of crane-like device outside the store. When people shot big fish we'd take a picture and the newspaper was just eager to have that kind of stuff. Rollo Williams was the outdoor editor of the San Diego newspaper, and we'd talk to him a couple times a week about the water temperature, the halibut are in, that kind of stuff. There's always word of mouth but in those days there were so few divers, the ones that were there got lots of attention.

How big did you guys become? How many stores did you have?» At one time we had four. We bought out Dick Long's retail business and ran that for a while. We didn't make a lot of money but we had a lot of fun; there were a lot of things going on.

When were you at your peak?» Probably in the mid 1970s.

What happened?» The biggest thing that happened was Flip decided he wanted to be a photographer. And Terry was sort of interested, and I was gone all the time. We had some poor management. I think the reason the Diving Locker finally was sold is that I didn't want to do it any more, and neither did Terry. It's tough on guys now that want to be in the business. Werner Kurn (Ocean Enterprises' owner) is complaining about the Internet. He told me about five people that came in, a family. Looked at all the suits, tried the fins on, checked out the regulators, and were there for three hours talking to his employees. When Werner asked, "Can we start to write this up?" the guy said, "We're going to buy it on the Internet." What happens is that guys in business these days stock the equipment, set up a location, hire the employees, and don't get to make the sale. Service and classes and travel are going to be a bigger part of the business as sales go south.

One of the things they have to do is make people realize diving is fun. It was so stupid and I talked about it many times; start classes that had their lectures and pool sessions in San Diego and then take them to someplace warm. Those people will stay in diving. To take people, especially those who are older and have a little money, and put them in that restrictive wet suit and throw them in that dirty water and in the surf, that doesn't make customers. Then you've got to make it a little jazzy for the kids. They want something extreme.

What's your opinion of the tech movement?» I think there's a place for it. It's not enough to make the sport grow. I had four friends who were good tech divers but they didn't make it.

What about today's equipment?» One of the things that makes it tough on the diving business is that equipment lasts too long. If you're in the camera business you got to get your shoes on because it's changing so fast. But in diving, there's not a lot of reason to buy stuff. Things don't change much.

How did you get started in underwater photography?» Connie and those guys picked Ron Church to run a film section at the store. Ron was the photographer for Convair; I think his early background was aerial photography. We used to go out with an old Rolleimarine with 12 exposures. He'd shoot while I looked for a subject, then I'd shoot while he'd look for a subject and we'd come in with six pictures apiece. Now you can go down and shoot 350 pictures if you want. Ron and I got along pretty well. It was his idea to start Underwater Photographic Society (UPS). He built a darkroom in the back of the store. That was our aim: to build a business out the Diving Locker name.

When Connie Limbaugh died in a diving accident, his wife, Nan, asked if I wanted his camera gear. So all of a sudden I had a fairly sophisticated 16mm camera and a Rolleimarine. I had a base. I had the wonderful friendship of guys like Wheeler and Jimmy that would steer photography to me. I had Ron to help me, and could get away, because after a couple of years there were other employees. It was a big advantage to be able to get away. When a job came up, a lot of other fellows couldn't do it because they worked five days a week. Convair would call with their submarine stuff and I would get involved. At first I was scraping money together to buy a roll of film. Later it was, I just sold a picture so I can buy some more film.

Your big break came on a whale shoot, didn't it?» That's right. One day in the early 1960s, we were diving off La Jolla on Al Santmeyer's boat, *Duchess*. Heading across the bay, we spotted a whale spouting. It was a Bryde's whale caught in a net, the ropes digging into its flukes. It was weak from trying to breathe and barely struggling. Bill De Court and I jumped in, dived to 20 feet, and cut the whale loose… shooting pictures all the time. It was just one of these things that hit at the right time. Nobody knew anything about whales then. Our pictures were in the paper, in *Time* magazine; people were calling from everywhere to interview us because we rode a whale. So this got a lot of publicity. I was getting a lot of calls, "You're the guy who shot the whale, can you shoot this?" So the first thing you know, I was doing more of that kind of thing.

What was your first movie assignment?» It was a Hollywood B-film called *Chubasco*. The producer director was a friend of Wheeler's and he suggested me. They wanted shots of local tuna boats at water level, in the net with the tuna and sharks. I said, "Yeah, I can do that." They said, "Bring diving gear. We'll supply the camera; meet us at the boat in San Diego." So I got on the boat and they pointed, "Well, this is the camera." I said, "Oh my God!" It was the first big Panavision 70mm,

about the size of a steamer trunk. It weighed 300 pounds and they had to put it in the water with a crane. And I had been shooting 16mm. I had no idea what it was, or how to load it, and had never even seen a roll of 70mm film. They introduced me to my camera assistant. After the producer walked off, I asked him, "What do you know about this thing?" He said, "'I know everything." I relaxed, "We are going to be a great team." So all I had to do was take it in the water and point it.

At one point I was in the net with the camera, all sorts of skipjack screaming around. A stunt man was supposed to fall in and the other actor was going to jump in and save him. So I'm in the water, the guy falls in, sinks about two feet, and panics. He can't swim. He wanted the job so badly and figured he would learn to swim when the time comes.

It was an easy time to be a photographer. Very few people were doing it. Red starfish pictures were a big deal. In the early days I did a lot of still photography. Ron Church, Chet Tussey, and I and some of the other early photographers started the Underwater Photographic Society. They used to have contests and a friend of mine, Ginny Kellogg, won with a picture of a red starfish. Even if it wasn't in focus, it was a winner.

I did the first diving on the Deep Submergence Rescue Vehicle (DSRV) built by Lockheed. Until they turned it over to the Navy, I did a lot of the photography. When they made their first deep dive, everybody got a dive on it and a plaque stating that they had ridden in it. On my plaque, they put "outside the DSRV" because I had always been on the outside to shoot it.


Spearfishing yellowtail, 1958

How did you get started with *National Geographic*?» Bates Littlehales was a staff photographer and we had become friends during a gray whale shoot in San Diego. He was assigned to go to Turkey and shoot George Bass's expedition on a Bronze Age shipwreck. But he ruptured an eardrum on assignment in the Bahamas and recommended me to take his place. They flew me back to Washington, said to throw away all my large format film cameras, handed me a Calypso, a Seahawk housing with a Leica and a 20mm lens, and a couple of Edgerton strobes that hardly ever worked. For three days they gave me Nikons with black and white film and I'd go off and shoot in Washington. They'd process that night then tell me what they liked. They gave me the little booklet on how to shoot for *Geographic*: You need a sunset, you need a scenic with a little animal or a person, you need so many close-ups... a long list.

So I went off to Turkey and shot this story. We had a bell and a submersible decompression chamber. We swam into it at 20 feet and then they brought you up to 10 feet for the rest of your decompression. We also decompressed on a line. They had a bucket with books in it. As long as you kept the books wet they would hold together and you could read underwater. We also did that on *The Deep* because we had such long decompressions.

You and Al Giddings have collaborated for many years. How did that begin?» I first met Al at the Pacific Coast spearfishing championships. Afterwards we were sitting around at Ron Church's house and he says, "I'm going to Cozumel to shoot a film with the backing of US Divers." I said, "That sounds like fun." He said, "Come on along; we'll shoot together." I replied, "I can't. I'm in business, it's hard to get away." A short time later Al was down here showing his first film, *The Painted Reefs of Honduras*, at a film festival. When he was up on the stage he said, "You all know Chuck Nicklin who owns Diving Locker. He's going to shoot with me in Cozumel." I told him, "I can't do that; I've got no money." A few days later he called and said, "This is your last chance." So I talked to my wife, Gloria, and said, "I'd really like to do this." And she said, "You only go around once."

That seems to be your motto now.» The "once" is getting shorter. (laughs)

16mm was expensive in those days.» That's why not many people did it. Through Scripps I'd end up with extra film, donations. People knew I was interested in it and but primarily if you wanted to shoot 16mm you had to have someone who was willing to pay for it. It wasn't like buying a one-hour videotape. I just started doing commercial things and that gave me a chance to improve my skills and learn the business.

What other kind of commercial things were you doing?» All kinds of stuff. I did a US Steel thing on FLIP (a Scripps research ship that flips vertically to do ocean measurements.) I did a beer commercial for a Mexican company, an Olympic commercial in a pool with synchronized swimmers. I did a lot of weird things. It was a very small group of people in those days, and what made it tough for new people was that the pioneers all helped each other. If Al had a job and didn't have time to do it, he'd call me. If I couldn't do it, I'd call Jack McKenney. It was a "good old boys" network. Al and Jack were the heavies. Bernie Campoli was in the Navy and he was one of the early guys. And Stan Waterman, of course.

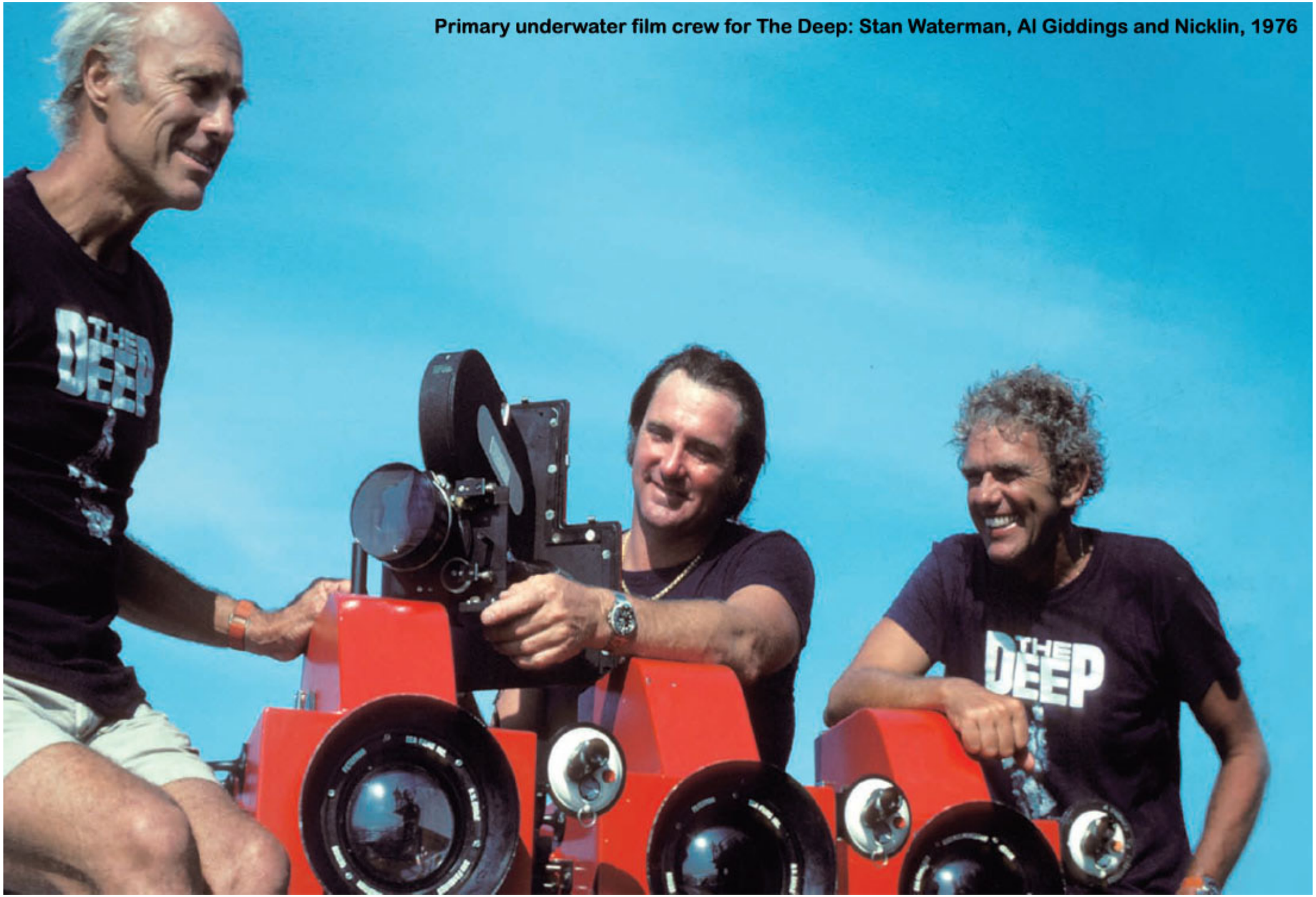
What was it like shooting Hollywood films?» That was always fun. Some of them were sort of crazy and some of them we were more proud of than others. Everything I did in Hollywood was with Al.

He and I had a good situation in that he wanted to be the producer, director, editor, seller… he wanted to be everything. All I wanted to be was a shooter. I wasn't real competition to him. He'd do all the work, then call and say, "Chuck, your ticket's in the mail." I'd get on a plane and go somewhere in the world for a week or up to four months as a cinematographer, and when the film was over, I'd get on a plane and go home. Al would spend the next two years editing and selling and promoting it. Al made more money but I had more fun. Al is really aggressive in the business; he's a hard worker. I was a little more independent than some of the others that worked for him, so I didn't have to take some of the hardcore rules that he would come up with. Often I was sort of the interface between the crew and Al. It always seemed to work. We worked together with Stan Waterman on *The Deep*. Al and Stan were the co-directors underwater; I was just an underwater cameraman. Peter Yates, the director, would say, "Al, you get the long shot. Stan you get the eyes. And Chuck, get something good." So I had a lot of time to go anywhere I wanted, shooting through holes and when the rushes came up I'd get a lot of comment because my shots were so different. One night we came back from the rushes in Bermuda, Yates and Peter Guber (the movie's producer) were standing in the lobby of the Southampton Princess Hotel when we got off the bus. They told Al and Stan to come right back down to talk about the shoot tomorrow. And I had a date with Jackie Bissett that night. Maybe there is something to just being a cameraman.

Tell me more about *The Deep*.» We were in the British Virgin Islands about a month. Peter Island was a great place. We had great parties. It was a really fun time. It wasn't tough diving, but we did a lot of dives. It was 90 feet to some parts of the wreck of the *Rhone*, and when you make five dives a day like you do when you're working with Al, we'd have an hour and half deco at the end of the day.

Were you using tables to control the dive exposures?» No, we were using the old SOS deco-meters from Scubapro. They had an analog screen and part of the display just spelled out SURFACE. We just moved the needle up the letters slowly for safety factors.

Nicklin with Ocean Eye housing and Subsea strobe, 1971



Primary underwater film crew for The Deep: Stan Waterman, Al Giddings and Nicklin, 1976

Were any of the actors there on the *Rhone* dives?» Oh yeah. They slipped in there for their close-ups. And Jackie did more diving than she would have. She didn't match up well with her diving stunt double. She didn't like the way that girl looked on film. So she did more of the underwater thing than she would have as a rule. Waterman and Al were the co-directors and the big shooters. I was the third cameraman. When they were shooting Jackie in the tee shirt, I was just there with my mouth hanging open. She didn't want to do it and she wasn't happy with it. Peter Guber talked her into it. But she sure looked good.

What were the actors like to work with?» Nick Nolte was crazy. He'd come in the morning just wiped out and lay on a table somewhere half asleep. But when it came time to work, he worked. Jack McKenney was his stunt double. A lot of things he did on his own too, because he wanted more in the film than just his face. In one scene when we had to swim through a wreck section to get to the jewelry, he had to hold his breath for long period. And he did it. But that night he'd be off crazy somewhere and he'd come in and look like he'd been dragged behind a car. But when it came time to film, he worked.

Robert Shaw wasn't around very much. He was friends with a lot of people in Bermuda. The last shot we had of him, where the eel came out and bites the head off the bad guy, they'd kept him all day in his hut and he was pissed. He kept drinking with one of his buddies while he waited and he was pretty wiped. I remember him sitting there just chatting while Yates, Guber and Giddings were deciding whether it was safe to put him in the water. Al turned to me and said, "Chuck, we really got to do this. I gotta have this close-up." So Al took him by the hand and tangled him up in the line that was supposed to have entrapped him and I took the camera. In the scene he really looks distressed. Because he was distressed. He did it in five minutes. We put him in the car and sent him home and that's the last we saw of him.

And Jackie was good. She didn't like to be in the water and it was cold, but she'd get in, smile, and do what she had to do. She was really a neat lady. All three of them were all right. They're movie stars. They just go in and have their pictures taken.

What about the *James Bond* films?» The one I felt I accomplished the most on was *For Your Eyes Only*. We worked on that movie for four months in the Bahamas. It was a nice film photographically. It was a bit hokey, but most films are a bit hokey. What we did with the cameras underwater is something I can be proud of. I've also done a bunch of funky little things where we did one or two scenes, falling into a pool or a raft. You get paid, it's part of the job, but nobody ever hears about it.

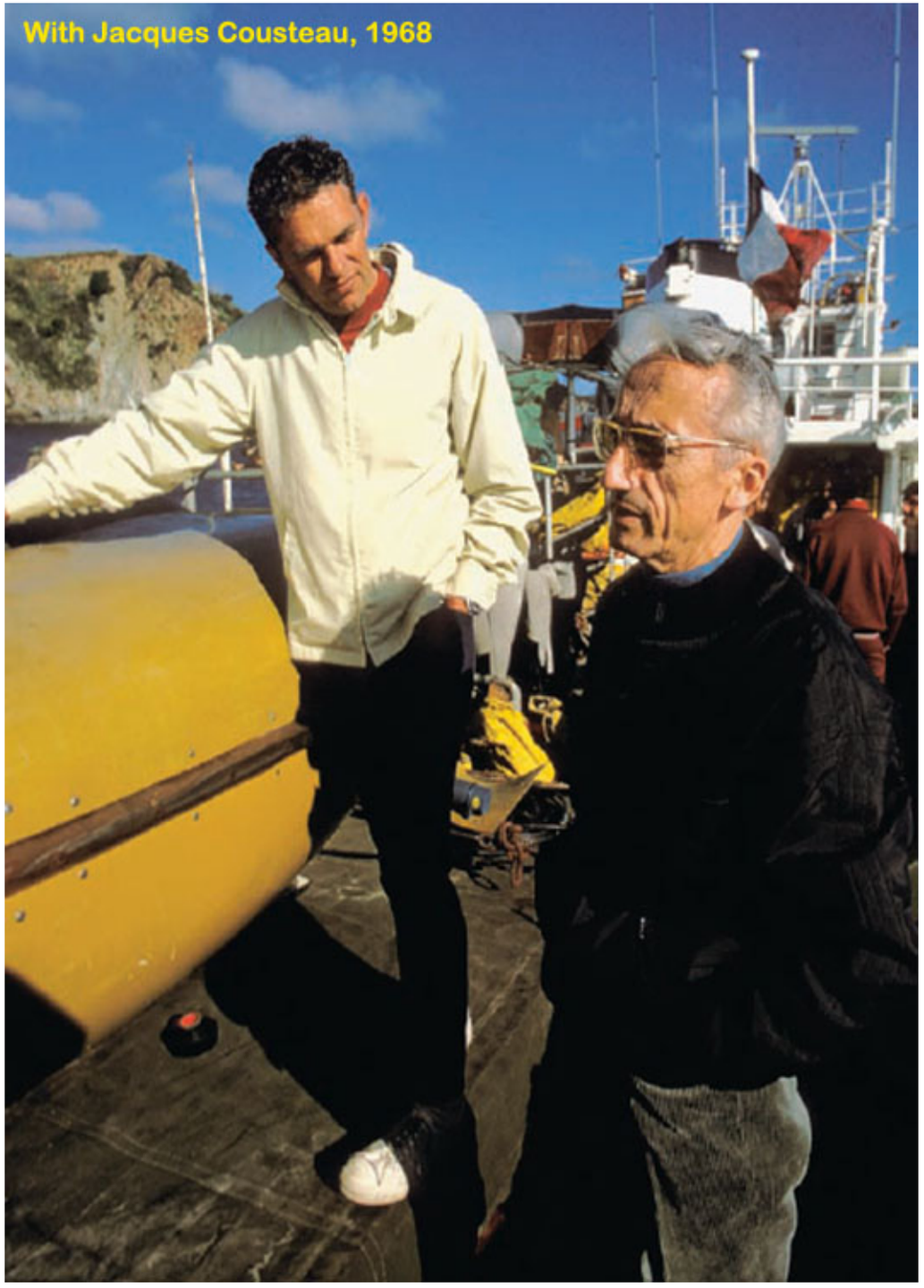
Then there's the time I spit in Sean Connery's mask. We did *Never Say Never* and there was a scene in a cave out in the Exumas. Sean was only going to be in there for his close-up but his mask wouldn't clear. In that cave there was an air space where you could get out of the water. Al and I could communicate just by looking at each other. So he looked at me waved his hand, pointed at the mask, and signaled, "get him out of here." We swam up so we could get our heads out of the water. I said, "Sean, I'm sorry but I've got to do this." He said, "Whatever it is, I really need my close-up." So I spit in his mask, put it back on his face, we went down, and got the shot.

You worked on the *Ocean Quest* television series that wasn't very well received by the diving community. How come?» They thought it was going to be the Cousteau series. It wasn't Cousteau; it was Hollywood. It could have been a lot better but it lost direction. Shawn

Weatherly (Miss Universe) was a pretty lady, nice to work with, and she and I hit it off. I had time to spend with her without trying to hustle her. It was supposed to be this pretty girl having adventures, and it turned out to be this macho guy (Al Giddings) taking this pretty girl on a trip. And that's what screwed it up. Al wanted to be the hero. It could have been really great, but it turned out to be a little hokier because of the way it went.

Was Al's bends hit real or staged?» I think he had an embolism. We were diving side by side at 130 feet at San Clemente Island. We took decompression and all that. The difference was he jumped in a hot shower right after the dive. We called the Coast Guard and they were going to send a chopper, but the bubble passed and he was OK. A couple of hours later he was having dinner. But he was in big trouble for a while, and we were nervous. What was staged was Shawn crying when she didn't want to go back in the shark cage. She'd enjoyed watching the sharks. But the director told her to cry.

How long was the shoot and where did you go?» Ten months all together. We went to Antarctic, Truk, Cuba, Baja, and Newfoundland. Lots of memorable things happened. The director had a big black Zodiac with a big engine and he shipped it all the way to Newfoundland. He was proud of it. It took the guys two days to make a trailer for it. We got it to the docks and he asked a fisherman, "Did you ever see anything like this?" He said, "Yeah, we have two or three of them in back." He could have rented one. Then we burned our hot air balloon. It caught fire in Truk. We took it all the way to Antarctica and never put it up. Shawn was great and she didn't get a very good deal out of it. It didn't help her career because she wasn't portrayed well in the film.


With Jacques Cousteau, 1968

Several of your protégés have gone on to bigger and better things.» The best is Howard Hall. I think he's the best underwater photographer out there, period. For the kind of things Howard does like deep stuff, 3D cameras, and that stuff, he's the best. He was an employee at Diving Locker and was very interested in photography and diving. He was interested in sharks and went with me on some of the early stuff with Blue sharks when we still thought they'd bite. We were putting together the crew for *The Deep* to go to film the shark sequences in Australia. Al said we needed someone who isn't afraid to shoot some fish and attract the sharks. I said, "I know just the guy." Howard hit it off really good with Stan Waterman. Stan took him under his wing and got him on *Wild Kingdom*. He worked on that a long time and built his ability and reputation as a professional. My only part was that I got him out there where he might get bit by a shark.

Of course there's Marty Snyderman, another guy working in the shop as an instructor. I'd come back from a trip with lots of stories and a little bit of money. And he said that's what he wanted to do. I think they were all shooting with Nikonos and the old Oceanic 35mm housing. One of my favorite people who came out of the diving locker is my son, Flip. There's some new guys, too. Mark Thurlow worked for us in the Escondido store at one time. Lance Millbrand worked as my assistant on a couple of jobs with *BBC* and he's worked really hard getting into the business.

When did you realize Flip had that drive and talent and was going to be so good?» I was doing a job for Sea World, shooting Panavision film in the shark tank and Flip was shooting stills for them at that time. When he was in my way I'd be yelling and screaming and when I was in his way he'd be yelling and screaming. It got to the point when I said, "Goddam it, this is my job," and he said, "All right, now get out of the way." That's when I realized he's serious. He's going to be tough and he wanted to be a photographer.

How about your IMAX films?» John Stoneman was the director of *Nomads of the Deep*. We did that with humpback whales and Blue sharks in Hawaii and in the Red Sea. There was a lot of competition as to who would have his hands on the IMAX camera. Flip was the still photographer on that. He shot his first humpback pictures in Hawaii and that gave him a base for going back to *National Geographic* to eventually get an assignment. I did a couple of other IMAX shoots as well, just doing scenes on location. When we shot the stuff for *Nomads of the Deep*, the first pictures of the singing whales and all that, we used scuba tanks and got away with it. But now they didn't want you to use tanks because it would scare the whales. It would be a definite advantage to have a rebreather or a small tank.

I've heard Flip say that it's easier to shoot whales now than when he started.» It only makes sense. There's generations of them, especially in Hawaii, and their parents and grandparents are used to divers. They don't have that fear of boats and motors they used to have when everybody they saw was trying to stick a harpoon in them. Flip says some of them hang out there. You could even lay on top of them if you wanted to. Flip says while free diving, he can lay right by the pectoral fin. Sometimes what you are looking for is an inquisitive calf that hangs around while the mother is just saying, "Come on kid, we've got to go."

Do you have any strong opinions on shark feeding?» If you don't feed sharks… there won't be any left. Look at the places where they feed sharks: they are protected. And where they don't… they are fishing them for fins. It's made people more aware and realistic about sharks and their behavior. I don't see where it does any harm. Even at

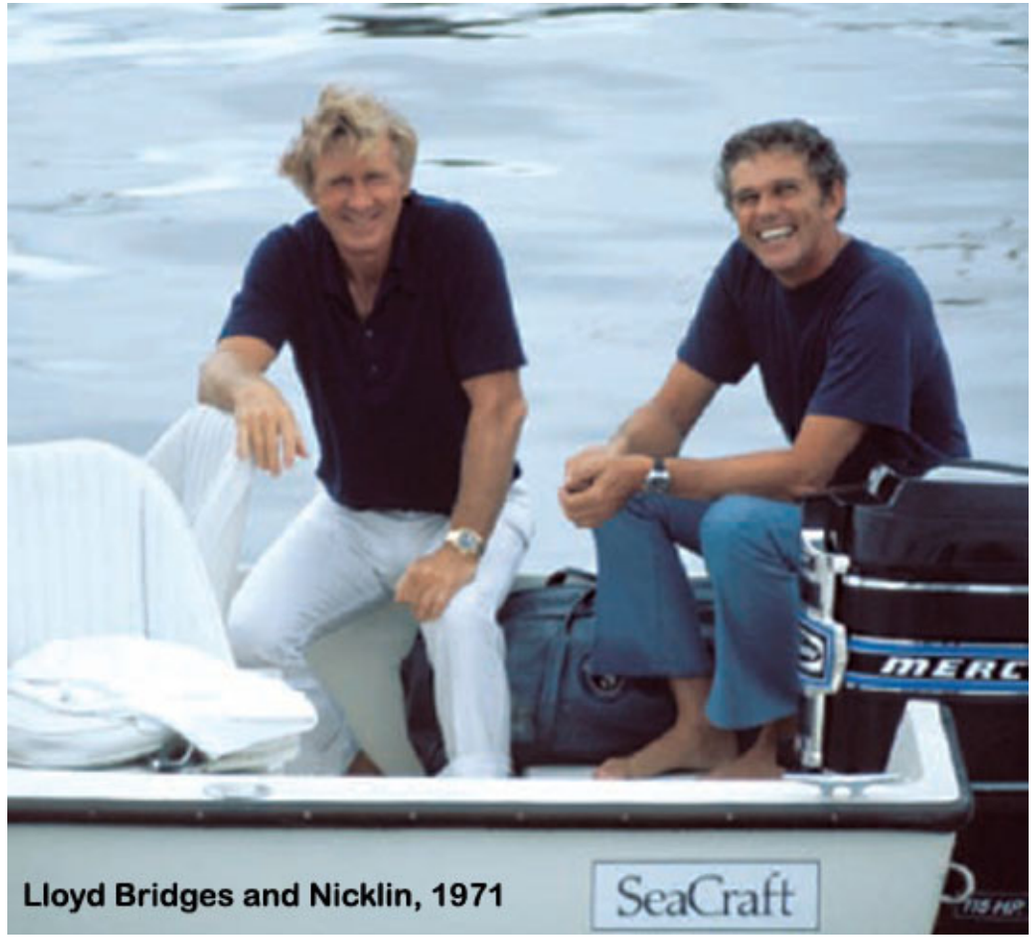
Cocos, it seemed like the shark populations were getting less and less until they started protecting them.

Out of all your films, what stands out most in your mind?» I like the stuff we shot on *For Your Eyes Only* on the sunken ancient city set. That was done in the ocean, not in a tank. They laid the tile floor and the whole thing. That was also when I blew up my condo. We all had condos up there in the Bahamas. One day I was sleeping on the side of the boat because I wasn't needed until the next scene when someone woke me up and said, "You're wanted on the radio." The message was that my condo just blew up. We'd had a party the previous night and somebody left the propane on. When I left for the day and closed the condo up, the propane filled the room and a burner set it off. It blew out all the big glass doors.

Speaking of sleeping, you have the reputation of being able to sleep anywhere.» My father always used to say, "Don't stand when you can sit, don't sit when you can lie down, don't stay awake when you can sleep." In the film business there is so much down time that you learn to take a break when you can because you may be diving for the next three hours.

I've always been lucky that if there's a space I can squeeze my body into, I can go to sleep. I'd crawl in on a shelf under the camera table that was covered with a blanket and go to sleep. Whenever Peter Guber or any of the big guns on *The Deep* showed up to start the day's activities, a camera assistant would pound on the table and I'd crawl out.

One time I was diving with David Doubilet and Howard Rosenstein from Red Sea Divers out of Sharm el Sheikh in the Red Sea. It was late, the boat was loaded with too much stuff, it was rough and looked like it might sink any minute. Howard said, "What are you doing?" I'd put all my stuff into my net bag and put on my BC, and laid down and went to sleep. There was nothing I could do; if we were going in the water I was ready.



Lloyd Bridges and Nicklin, 1971

In all those years, you must have had some close calls.» The closest call, and I think the most dangerous diving I ever did, was on the *Andrea Doria*. I was with Al and Jack McKenney. We were diving air and wreck deck is about 170, 180 feet. It was really dirty and cold, and if you miss the ascent line, you'd be in trouble because of deco

and current. We got to the bottom and I was using the K100 (movie camera). It was a hand wind and the trouble was that if you wound it too far it would stick. We hit the deck and started off and I signaled, "My camera isn't working." They signaled back, "See you later." So I pounded on the camera and got it working and filmed the ghost nets where lots of fish got trapped and died. I sort of kept track of where the ascent line was. Then Al and Jack showed up and we started up the line. Jack was right in front of me and all of a sudden kicked my mask off. So my mask is down around my throat, I've got a camera in one hand, a light in the other and I'm saying, "Oh, I've got to get this stuff together." Putting the light under my arm, getting the mask going…

Another thing that happened on one of those *Doria* dives is that Al and I were very competitive. On one of those dives he found a plaque that said "2nd class cabin" in three languages and he thought that was hot. On the next dive I found the plaque that said "1st class cabin" in three languages. It was a plastic thing on a piece of wood and I stuck it in inside my wetsuit. When we got to the deco stop, I signaled Al, "Look at this," and I reached inside my suit and pulled out just the wood. I'd lost all the stuff with the printing on it.

How about close calls with animals?» I got nailed by that lionfish in Lembeh last year. I've never been bit, never been bent. In Vanuatu one time I rolled off the boat on to a Silvertip shark and really spooked it. It came in on me and I had to beat it off with the camera. But considering all the things I've done and all the places I've been, the most pain I had was that lionfish a few months ago. But I only missed one dive.

When did you make the transition to video?» I always wanted to do the next new thing. I had one of the first video systems around here, an old JVC unit with a separate deck. The housing was a round thing that looked like a porcupine. Being new to video, I thought that I'd do it all down there; shoot and edit. Well, you don't. You shoot it and edit later. It gave me a chance to shoot more on my own without a budget because the price of tape was so much more reasonable than film. I've always been on the forefront of the people shooting video. Even now, as soon as they came out with high def that was in my price range, I jumped on it.

My idea of making a film is to do it on iMovie sort of like offline, hand it to Mary Lynn Price and have her clean it up. I'm not too excited about spending the rest of my life editing. I'd like to spend the rest of my life shooting. If I can get away with editing simply I'll do it. When I get caught up. (laughs)

Why did you start the San Diego Video club?» I felt that some of the still photographers hadn't accepted the idea that video was here to stay. There wasn't much support for video through the traditional photo groups. We were having meetings at the Diving Locker and I thought we ought to discuss video. It sort of outgrew that and we started picking up people who were interested in video. Mary Lynn really pushed for it and that sort of got it started. Then I started thinking we ought to have a way to share it. And that was the idea of the San Diego Undersea Film Exhibition: to share the stuff we worked so hard on and give more people an opportunity to present stuff because all they needed was five minutes. The first one was at the San Diego Zoo's auditorium and that wasn't quite big enough. With the new theater at the Natural History Museum, it's become a successful and very rewarding thing. It encourages a lot of people not only to do video, but to have more respect for the ocean. It not only shares our chance to show what we're doing but also shares how important the ocean is and how it should be protected.


Sleeping in ice cave

I really reflect on the old shit I used as camera equipment. What I use now I can hold in the palm of my hand. I can carry it on the plane in my shoulder bag. With my old Arriflex and stuff, I used to fill four Igloos. It's really great. Not only has being a cinematographer become easier, but the quality is so much better. I'm shooting stuff that's so sharp and so exciting that I can't wait to go into the water. That's why I'm going to New Guinea. I didn't have anything going on and said, "I've got to go somewhere." And when I take the stuff I shot with my high def camera and plug it into my high def video, I get so excited I can hardly stand it. I say, "Oh, I've got to do more of this." I think that's why I've always been in the forefront because I always wanted new challenges and wanted to make it better.

What do you see in the future of diving?» Pretty soon it's going to be a travel business with a little diving. The tail is wagging the dog. They've got to make it fun and still make it exciting. There's no excitement anymore. We're too careful. I think the best thing that's happened is some of the shark feeds and stuff. Just to look at Garibaldi fish isn't enough. People want excitement, especially the kids. Thank god, there's photography. Otherwise there wouldn't be any growth in diving. Everybody's got an underwater camera now. You don't have to be big-time any more. When the Nikonos came along, all of a sudden there was a push into photography. Now the same thing is happening with the digital point & shoots. Roz has this eight-megapixel camera in a housing and the whole thing is $400. It's not underwater photography any more: it's photography underwater. Photography is bigger than the underwater. Does that make sense? It's become more important than the diving.

How does that translate into growth for diving?» Some of my travel customers are going back to stills. It's so easy to handle the stills compared to taking a piece of videotape and making it into something people want to see.

Filming a river dolphin up the Amazon, 1994

Since the death of Jacques Cousteau, there doesn't seem to be a figurehead for diving. Do you see anybody on the horizon?» Howard Hall could be great, but isn't the kind of guy that wants to be. Someone could promote him and make him into the diving god. He looks good; he is good. But he isn't interested. He'd rather fly his airplane.

Do you dive locally any more?» I dove cold water for many years and I used it all up. I don't do any cold water diving any more. Been there and done that. Unfortunately 90 percent of the US is cold. It's not a good place to dive unless you get on an airplane and go someplace warm like Florida. You've got to get people in the water without making them miserable. Instead of trying to get them to take another course, get them in the water and let them count fish.

As you approach the age of 80, what accommodations are you making for your age while diving?» One of the first things I do when I get on a dive boat is tell the crew, "You know, I'm getting sort of long in the tooth and I don't want to carry all this heavy stuff. So I'll swim to the back of the boat and hand up my gear. That's the bad news. The good news is that I'm a big tipper."

That's one of the things that's important to understand. You've only got so much energy and you should use it most effectively. I use it most effectively when I'm in the water. I realize I'm not as agile as I once was, but in the water I'm as comfortable as I ever was. I might be a little more conservative as far as decompression. I'm aware age may have something to do with it and I don't want to take the chance. The youngsters sometimes look at us gray-haired guys and wonder what we're going to do. But then there's a surface current and they are busting their neck, and you're hugging the bottom, passing them by and waving.

Seldom do I get excited in talking about the past. I'd rather talk about plans for the future. I'm much better at looking ahead. I'm going to be 80 real quick and I want to accomplish as much as I can while I still can. And I can.

Editor's note: There are about 40 copies of Diving Pioneers & Innovators 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.