

The second alteration is to replace the Mapleson C type bag with a Laerdal brand resuscitation bag.

The Laerdal bag consists of a Laerdal non-rebreathing valve and a self-inflating bag with an air entrainment valve and a collapsible oxygen reservoir bag. This brand of resuscitation bag is probably the most popular brand in New South Wales and is the standard bag used by the NSW Ambulance Service.

The advantage of this particular brand is the valve itself, which is of low resistance, non-corrosive and can be used both for mechanical ventilation (resuscitation) and spontaneous respiration. Most similar valves available will not allow spontaneous respiration. Being a self-inflating bag, the system may be used for ventilation and will continue to do so if the oxygen supply is exhausted.

Gas analyses of the Mapleson C and Laerdal bag systems were performed using a mechanical lung and chest model to simulate a 70 kg patient. With a tidal volume of 700 ml and respiratory rate of 10 breaths per minute. Various fresh gas flows were used.

When the fresh gas flow was equal to the inspired minute volume, namely 7 litres per minute, the inspired oxygen concentration was over 97% in both cases. However it must be remembered that the Mapleson C system is a rebreathing system and "acceptable" levels of rebreathing require a fresh gas flow of at least twice the minute volume. The Laerdal system is more economical of oxygen. The fresh gas requirement for the Laerdal system can be judged clinically by ensuring the reservoir bag is fully inflated at end expiration. (Significant air entrainment only occurred at fresh gas flows of less than minute ventilation. Taping over the air entrainment valve is thus not necessary).

The Laerdal resuscitation equipment (with whom I have no affiliation!) is readily available through the medical supply company, Drager and can be purchased in a compact, durable, plastic box complete with Guedal airways and masks but without a nose clip or scuba mouthpiece for just over \$200. (Laerdal Silicone Resuscitation in Compact Case, catalogue number 87 00 03). To give oxygen an oxygen regulator (reducing valve) and a flow meter will be needed.

This combination of Laerdal bag, scuba mouthpiece and nose clip represents a simple and significant improvement for oxygen delivery to the awake patient.

Dr KJ Wishaw's address is 5 Chorley Avenue, Cheltenham NSW 2119, Australia.

FUTURE MEETINGS

IX INTERNATIONAL CONGRESS OF HYPERBARIC
MEDICINE
Hilton Hotel, Sydney, 1-4 March 1987

UNDERSEA AND HYPERBARIC MEDICAL SOCIETY
Hyatt Regency Hotel, Baltimore, 27 - 30 May 1987

NITROGEN NARCOSIS AND THE CAVE DIVER

Peter Horne

The increasingly popular pastime of recreational scuba diving is today becoming better understood by both the diving community and the general population. However, there are three aspects of the underwater world which still tend to dominate the headlines and affect the "average Joe's" perception of our activity, SHARKS (giant man-eating fish a la Jaws); THE BENDS (an agonising and usually fatal disease which afflicts all divers who surface too quickly, according to midday TV soap operas); and RAPTURES OF THE DEEP, a form of drunkenness caused by diving "too deep", invariably resulting in drowning when divers hand their scuba gear to passing fish!

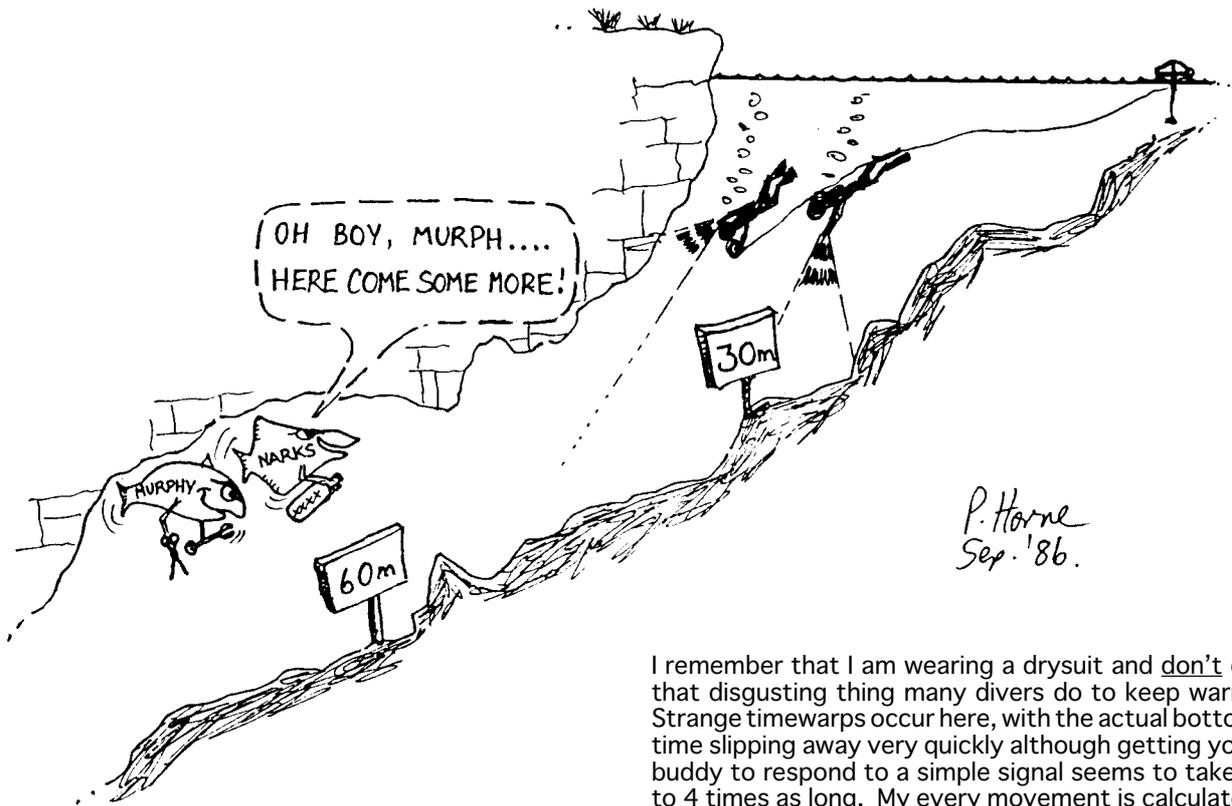
Fortunately, those of us who actually dive are very well educated in recognising such hazards and know how to deal with them ... DON'T WE?! We all know that you carry a big knife to fight off sharks, and that responsible divers who follow the decompression tables can't get Bent, only fools who break the rules will cop it! (Don't worry DES, I'm only kidding!!)

The third well-known problem, nitrogen narcosis ("Raptures" to the ignorant peasants) is a bit trickier to handle. Divers going to depths of around 30 metres or more enter the realm of the esoteric and infamous "Narks", and funny things begin to happen.

In the warm, clear ocean waters of tropical regions, divers often report feeling elated at depth, enjoying the experience immensely. Likewise, people put under pressure in recompression chambers frequently have a great time, giggling and marvelling at their "Donald Duck" voices in the warm, secure confines of the chamber. However, such reactions seem to disappear totally when you substitute this relatively comfortable environment (in which you are dry, breathing normally and able to communicate clearly with others) with the cold, dark and often silty world of the waterfilled caves and sinkholes. Instead of euphoria, divers may experience negative and potentially very dangerous effects which need to be quickly recognised and carefully handled, not the easiest of things to do when you are heavily task-loaded.

The waterfilled sinkholes of the Mount Gambier region of South Australia are of special significance to me, and whilst they rarely provide me with cause to feel euphoric at depth, such experiences are nevertheless possible ... especially if you happen to see the stars shining through a mirror-calm surface at midnight in Piccaninnie Ponds from a depth of 33 metres! Although many sinkholes may contain crystal-clear water at depth, the limitations of underwater torches are such that the clarity generally cannot be fully appreciated and it is very much like doing deep ocean night-diving in many cases. Seeing stars or clouds from such depths underwater though may inspire feelings of genuine awe, and might in fact be little influenced by narcosis, who can tell?

During the past few years, I have undertaken nearly 200 cave dives to depths of 30 metres or more, and have encountered narcosis frequently enough to almost regard it as an unwanted dive buddy who is up to no good. Strangely, many of my cave diving companions



even today still seem to have an ego problem when it comes to admitting to ever being narked, and many in fact still believe that the effect can be totally conquered by simple concentration. Like seasickness, they think that it is "all in the mind". The often-published statement that narcosis only affects those of us with low intelligence makes it hard for me to understand why some real "dead-heads" I know never get affected ... perhaps they are simply too stupid to know that they are narked! The relatively simple act of merely swimming around, shining a torch on the wall does not really give narcosis a good chance to express itself, unless something goes wrong. However, because I have frequently been involved in doing some sort of manipulative or other skill such as taking bearings, reading thermometers and writing notes, I have been acutely aware of how nitrogen narcosis can affect even the simplest of operations. The danger with concentrating on overcoming one aspect of narcosis is "task fixation", which can result in divers losing track of other important things like monitoring air supplies, whilst putting their total concentration on the "problem" at hand.

My first awareness of narcosis usually occurs around 30m, where I feel a little light-headed and find my vision becomes a little out of focus (my built-in corrective lenses might explain this a bit). At this stage I tend to recheck my torches, the reel, and all other gauges to be sure that all systems are "go" before descending further. Between around 35 and 50m, narcotic effects are much more noticeable, my fingers feel rather numb and writing on a slate requires a bit more concentration than usual. Opening containers with floating lids becomes a tricky operation, often resulting in the glass bit dropping away into the gloom as the lid shoots off towards the surface. Sudden feelings of warmth and unusual comfort sometimes cause immediate feelings of concern, until

I remember that I am wearing a drysuit and don't do that disgusting thing many divers do to keep warm! Strange timewarps occur here, with the actual bottom time slipping away very quickly although getting your buddy to respond to a simple signal seems to take 3 to 4 times as long. My every movement is calculated and very slow.

Beyond a depth of 50m, I notice more serious effects, especially in confined regions where silt lies waiting to be disturbed by a single careless movement and may add to any feelings of anxiety. The air often takes on a metallic-oily taste which makes me feel a little nauseous (who serviced my regulator last time?) and feels cold and thicker, almost liquidy. Exhaled bubbles tinkle like glass shards hanging above an open window, and I can stare at the larger dome-shaped ones for ages as they rise out of view without bursting, unlike those released in shallower waters. Over 60m, I believe that divers are exhibiting suicidal tendencies as they may suddenly find themselves in a trance-like psychological state which I call "DREAMTIME", an effect which causes you to lose your normal awareness of reality, making the whole dive seem to be strangely unreal and almost dreamlike in nature. This is a very scary feeling, because although you somehow know it's not really a dream, you realise that you can't seem to get back to "reality" and must force yourself to go through the actions of great importance such as checking your air, time and all the rest.

Dreaming may be fine if all goes well, but if a problem, ANY problem, should come along, a "Dreamtime" dive can suddenly become a very dramatic, short-lived nightmare. This is always a very real danger of deep diving, our old mate "Murphy", is particularly active at such depths.

Although people seem to adapt reasonably well after repeated exposure to depth, I suspect that narcosis does not go away. Once any unexpected feelings (such as light-headedness or slightly blurred vision) are accepted by the subconscious, anxiety is naturally diminished and divers can more readily handle the other problems that narcosis generates. The only way that this can occur is through frequent repeated exposure to such depths.

One of the most worrying aspects of severe narcosis is the loss of peripheral awareness divers experience. A diver may snag his foot in a line or his guideline might stop reeling out, but it can often take many seconds for him to realise that this has happened. In a truly critical situation, such slowness of thought could mean the difference between life and death.

An example of how people react under pressure is related here from my own experience. During a dive when I was the leader and at a depth of around 55m, I was just starting to carefully enter a rather confined silt-laden region when I became aware of the hurried flashing of my buddy's torch, as he swept it around from behind me to gain my attention. Normally in sea-diving or shallow-water conditions I would have turned around immediately, assuming something was wrong. However, on this occasion I became extremely agitated, thinking such things as "What the hell's that guy playing at? Can't he see I'm concentrating on entering this nasty little hole? He probably only wants to show me something unimportant anyway ..." However, I then realised where we were and, realising that he might have become entangled in the line or had an air problem, I proceeded to turn around. Fortunately in this instance, it turned out that he was worried about his camera imploding, as he had forgotten to leave it in shallower water and didn't want to take it any further. The interesting thing is that it took probably 10 to 15 seconds for me to realise that there could have been a problem, even though my buddy's torch-flashing had immediately gained my attention. Experience is the teacher!

It is well known that nitrogen narcosis affects people differently and can affect an individual in different ways on separate dives as well. I have been surprised to find myself almost narcosis-free after awakening in a fatigued condition, and conversely, I have been seriously affected at shallower depths than usual even though I was looking forward to the dive and was well-rested. Narcosis may also attack at unexpected times, on one occasion I was free of the effect until we turned around and started out, some 10 minutes into the dive, when it suddenly clobbered me like a ton of bricks! I also suspect that there are residual effects. One reason for this belief is the very relaxed, "switched off" feelings I have noted upon returning towards the surface, and promptly spending several minutes of valuable decompression time at the wrong depth!

Nitrogen narcosis is the biggest killer of cave divers in this country, with lack of safety lines to cave entrances being the major factor in the other cases to date. Unfortunately, the beauty and clear water found in many sinkholes can only start to be appreciated at depths of 30m or more, and the unavailability of improved deep-diving equipment such as the expensive Heliox mixtures etc. means that today's deep-divers, like our pioneers, must still carefully plan and execute deep dives, being forever on the lookout for narcosis. Such diving, I believe, is something akin to rock-climbing, not everyone can (or should) do it. It is, after all else has been said, a hostile environment we are going into and is thus potentially dangerous. It is a strangely beautiful world down there, totally unlike anything else in our everyday experience, with the potential for great discovery lying in the silt of every cave.

Hopefully, nitrogen narcosis will one day soon shed its aura of mystery to inquisitive researchers, so that we

may explore the uncharted depths with calm hands and clear minds!

EDITORIAL COMMENT

Sinkhole diving in South Australia has been controlled by the CDAA on behalf of the South Australian Government for over 10 years with an excellent safety record, except for two divers who disregarded CDAA regulations and dived in a sinkhole they were not qualified to dive.

Peter Horne's article is of great importance, emphasising a diver's eye view of nitrogen narcosis and its effects.

It is obvious from the article above that diving to depths below 30 m is dangerous. The diver may accept the risk, make a mistake and die which then puts those who have to search for the body at a similar but unnecessary risk. US Navy figures¹ show that few diving accidents occur shallower than 15 m, 0.69 per thousand dives. From 15 to 30 m the rate is more than tripled to 2.32 per thousand dives. Between 30 and 61 m that rate is more than doubled to 5.4 per thousand dives, which is nearly eight times the accident rate for dives to less than 15 m.

The Editor wishes to draw readers' attention to Regulation 61 of the Cave Divers' Association of Australia (CDAA) published in August, 1986.

Regulation 61 reads

No CDAA member shall dive deeper than 37 m in a categorised sinkhole.

(Penalty: Suspension of membership for a period determined by the Committee).

Unfortunately the CDAA AGM in September 1986, while voting to accept the regulation as published, decided that: "The '37 Metre Rule' (Rule number 61) has been declared to be a recommendation and not a Rule. A formal amendment to the Regulations will eventually be issued", 1 quoted from the synopsis of the minutes published in the November 1986 issue of the CDAA publication "Guidelines").

REFERENCE

1. Blood C and Hoiberg A. Analysis of variables underlying US Navy diving Accidents. Undersea Biomed Res. 1985; 12.3: 351-360.

Peter Horne's address is 3/9 Muriel Avenue, Somerton Park SA 5044.

THE DIVETECH RECOMPRESSION CHAMBER

The prototype of a 2-man transportable recompression chamber (RCC) will soon arrive in Australia to be set up at Port Lincoln Hospital, following trials at The Royal Adelaide Hospital. Designed primarily for the stabilisation and transport under pressure of a victim and an attendant, the chamber offers these unique features.