

The world as it is

Diving medicine through a corrected-lens face mask

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I was invited to jot down for the Journal some reminiscences of my activities in diving medicine in a light and personal style – I know of no other way. For those who want the gory details of our research activities, I recommend the 30-year retrospective of diving medicine prepared for the SPUMS Journal in 1995,¹ or the books and research reports listed at the end of this paper.

Introduction to diving

It was all a mistake. Nothing was planned. It was due to the weather. I suspect a Brazilian butterfly was responsible.

After two years' postgraduate training in neurology and cardiology, I spent a year in general practice, becoming the flying doctor at Derby, Western Australia. It was there that I first treated marine animal injuries. Fish stings responded to heat and local anaesthetic. A Chironex (box-jellyfish) case was screaming with pain and so delirious that all I could do was to anaesthetise and intubate him for a few hours until he could be controlled with narcotics and analgesics. With the same 'outback' conditions, I am not sure that I would do anything different nowadays.

That was when it happened. Cindy and I headed off to London, for the MRCP exam. I went via Hawaii so that I could spend a day or two (extended to six) trying out the surfing scene with a few gregarious locals. Then the seas went flat. As I headed to the Qantas booking office, my new friends said, 'No, now we dive.' And so we did - no medical, no disclaimer, no tuition, no safety equipment (bouyancy compensator, quick releases, etc.), no problem! And I was hooked; twin hoses with leaks everywhere and the increasing resistance to breathing substituting for a contents gauge. I do not think that any of us had ever heard of decompression sickness.

Amateur diving

After three years in the UK, picking up separate memberships in internal medicine and psychiatry, we returned to Sydney so that we could re-enter the ocean. Sailing was my major interest then. While working at Prince Henry Hospital as a senior registrar, I joined the Underwater Research Group (URG), mainly enthusiastic amateurs who exploited scuba to extend scientific observations. They taught me to dive responsibly, at least when they were watching.

Only one other of the URG guys is still diving, but having formal qualifications, they are still all counted as 'active divers' for epidemiological studies designed to prove how safe diving is. Even those who died diving are still counted as active divers. It is called creative statistics, and is used to imply a death rate of 3–4 per 100,000 divers per year, instead of the more realistic 20–30 per 100,000 (2–3 deaths per 100,000 dives). Analysis of the causes of diving deaths was to occupy much of the rest of my professional life.

The one incident that I remember from the URG is being praised for my unflappable nature when exposed to real danger. I did not mention that the reason for my unresponsiveness was that, in those days, corrective lenses were not available for face masks, and I was totally unaware of any problem.

The Navy

I noticed an advertisement in the Medical Journal of Australia for physicians interested in diving and aviation. I was interested in both. I contacted the local Surgeon Captain and was told that I would be expected to spend an extended tour at sea and complete an apprenticeship in naval protocol and military medicine before they would consider me for the two areas that attracted me. Forget it!

A year later, I received an unexpected visit to my little physiology lab, where I was doing some unsanctioned work on the diving reflex, by Admiral 'Mumbles' Coplans, the Medical Director General (MDG) of the Royal Australian Navy (RAN). We negotiated.

He wanted someone who could reduce the number of diving deaths in the Navy, and he also wanted to increase the success rate in clearance diving courses. I wanted to dive and fly, to not leave Sydney (the 1960s were too good to waste on a ship), and I could not countenance a drop in salary without a divorce. My diving training was to cover all parameters of navy diving. Thus I became a 'ships diver', then a supervisory diving officer, and finally completed clearance diver training (rebreathers to a maximum of 240 ft).

I became a Lieutenant Commander (for the financial reasons), to be trained at the School of Underwater Medicine (SUM) and the School of Aviation Medicine. Promotion was not possible unless I went to sea, but this suited me fine. Who the hell wanted a desk job? Mumbles insisted that I wear a

uniform. I acquiesced on that one point, but years later his successors were pleading with me not to keep wearing it!

My medico 'supervisor' was not enthusiastic about inducting me into the SUM. He wanted to stay, and I was a well-qualified threat. He phoned up late one night to tell me of my first decompression sickness (DCS) case – him. He had treated a hyperbaric patient that day and developed a 'type I bend'. As I was unimpressed by the severity of the injury, and knew absolutely nothing of the illness, I suggested that we retire to the wardroom, for rum-and-cokes, to consider the matter.

He then instructed me on DCS, how it had such potential complications, and how it impaired one's judgment. In his case, I had always questioned the latter, so I recommended that we change to gin-and-tonics, his favourite drink, on the grounds that it may be his last. I cannot remember much more about that night. Unfortunately, he survived. The Navy dispatched him to sea (an action with which, with a slight variation in mode and depth, I agreed) and instead of attending the SUM course in diving medicine, I ran it.

When I complained to the MDG that I was not knowledgeable enough to treat diving and hyperbaric patients (the Navy treated all these cases in and around Australia in 1967), the Navy circumnavigated that administrative difficulty by proclaiming me a Consultant in Diving Medicine. Thanks, that helped a lot. There was no one else, and we were running at one case per week over the years 1968–70.

Also, I am good at learning from mistakes, and I made a lot (but I tried to not make the same mistake twice), and I learnt fast. The literature was not very informative about difficult cases, and the only two 'diving doctors' in Australia were either at sea or unavailable. In 1965, there was only one clinical text on diving medicine. This was written by Sir Stanley Miles. It was a great little book, but contained a mistake on every page. Nevertheless, without it we would have been lost.

Following the recommended treatment guidelines often did not produce optimal results, so we experimented. Each patient was a learning experience, an uncontrolled series of one. We might have overdone the observations and investigations. I have never understood how doctors learn about DCS without sitting in the RCC, changing parameters (depths, durations, gases and ascent rates), and observing the results.

That was also when I used my flying doctor skills, and used the phone. The 'experts' in the UK were not very useful, or knowledgeable. They just regurgitated the manuals through a mouthful of eggs. In the USA, Al Behnke, George Bond and Ed Beckman were great. And they did not mind accepting calls from a perplexed Australian doctor. I switched allegiance from the UK to the USA.

Al Behnke introduced me to Hugh LeMessurier, in Adelaide.

Lem knew more about DCS than anyone I have ever met, but he was terrified about treating clinical cases. We worked well together. He knew what was happening technically, and I was prepared to do whatever was needed to get a good clinical response. That was the start of the Australian Tables, and I would still recommend them in difficult cases.

The Navy allowed me to complete four major projects: an investigation of diving deaths; a prospective survey of 500 diving candidates (diver selection); marine animal injuries; and otological aspects of diving. Each took about three years to complete and the last two spawned texts that influenced my life.

Diving accidents

First, we had to reduce the number of cases of unconsciousness and death. The difference relied on rescue availability, which partly explains my commitment to buddy diving. The causes were not clear, and the advice issued by the Brits (who used the same rebreathing equipment as we did) was as arrogantly confident as it was obviously wrong. They dismissed carbon dioxide (CO₂) toxicity in favour of nebulous explanations, such as 'oxygen syncope'.

That was when, in desperation, we introduced the 're-enactment of the incident' test. We would grab the diving set that caused the problem (modified to obtain gas samples) and try to emulate the conditions in which it had failed. When problems developed, we would take the samples for later analysis. The potential victim (I always did it first on myself and, later, my staff) was followed by a combined sample/rescue craft, usually a small inflatable with resuscitation gear and medics. We always used controls, doing the same dive with different equipment and different gases. The story is told in more detail elsewhere.¹

This led into years of testing old and new equipment, modifying CO₂ absorbent canisters, changing diving techniques, and redefining the various gas toxicities. We pushed all equipment and people to the limits. Without fear of contradiction, I can claim to have witnessed more cases of CO₂ toxicity than anyone else, most of which I induced. There were also an appreciable number of hypoxic unconscious cases.

Much later, at the age of 50 years, coughing up a little blood-stained sputum after reaching the surface from an unplanned 40 metre free ascent in Hawaii, while undertaking a 're-enactment of the incident' test, I decided that this sort of thing may best be left to younger divers.

The concept of inducing the problem under 'controlled' conditions may not scrape through the ethics committees of today, but remember, it was always done first on ourselves. It also allowed us to modify and thus prevent the problems in the field, where resuscitation was more problematical. Further, it allowed us to test hypotheses and then identify, investigate and describe the illness.

The results were impressive, although it is not hard to make discoveries in a new field like scuba. The salt water aspiration syndrome (SWAS)² was a contentious one for a few years, until many others experienced it. The Americans confused it with Key West Scuba Divers disease (as we also did, initially), but we demonstrated it conclusively by doctoring the demand valve and reducing the line pressure whilst holding the victim's face underwater, angled so that an ear oximeter could be attached. Those sick berth attendants ('volunteers') struggled like hooked fish.

This approach also allowed us to be the first to prove various causes of vertigo during diving and hyperbaria, mainly by the use of an improvised electronystagmograph. Orjan Tjernstrom, in Sweden, was doing similar work on aviators. As we expanded the known causes of vertigo in diving from one possible (alternobaric) to ten definite and verifiable causes, it became obvious that this sector of diving medicine needed to be promulgated.

At that time, 1967–68, it was believed that diving did not cause hearing loss. By performing audiograms on all trainees, we soon dispensed with that theory. One severe case of bilateral hearing loss in a commando inspired us (Peter Freeman, John Tonkin, and me) to 'go in and look'. We had already hypothesised that diving could induce round window fistula, which was being identified in current otology from other causes. Demonstrating and repairing two fistulae on one diver, restoring his hearing, certainly proved the point.

Adding all this together, we combined with Bob Thomas (my second in charge and a stalwart lieutenant) and Frank Blackwood (the most versatile and accommodating technician in the world) to publish in 1972 the first book on diving otology, *Otological Aspects of Diving*. No royalties and we even had to buy our own copies at full retail price, to send complimentary ones for reviews. We had written a whole book about illnesses the experts said did not occur! This set me off on a professional tangent into aerospace.

The United States

Because of the space programme, and problems with motion sickness, in 1973 the Americans decided they needed contributions from other experts in vestibular disease. I was not aware that I was one of these, but Tjernstrom and I were both selected to have our brains picked. Pressure was applied to the RAN to have me sent over there for a few months. Fortunately, I was not obliged to do anything I did not want to do. The Navy did not fully agree with this proposition, but I had nothing to lose by saying no. I had my own interests, and going to the USA was equivalent to going on board a ship, it took me away from Sydney and my family.

After a series of escalating offers (threats) from Navy office, I finally accepted the invitation to visit the USA for a year, with all my family (wife and four kids), all expenses paid, with no obligation to undertake any routine employment, to become involved with research projects as desired, and to

visit naval and other diving units to review their work and promote ours.

No wonder the other guys at the Embassy were green with envy. We spent 14 months visiting Fiji and Tahiti (not part of the agreement), living at New London Submarine base, working at the Experimental Diving Unit at Washington DC, San Diego and Hawaiian naval bases, and making visits to San Francisco, Canada, Sweden, the Bahamas and the Southern Gulf states.

I became involved with activities in the Hydrolab saturation complex (a great dive), and the hyperbaric centres of Pennsylvania, Buffalo, Duke University, New Orleans, Miami, Long Beach, Tarrytown and Toronto.

I learnt a lot about research technology, but not much clinically (except in Hawaii). They all thought that I was an otologist. Since then, they have realised that I am nothing more than a simple clinician and an enthusiastic diving doctor, not an academic and not an administrator.

Decompression sickness

My entry into the Navy coincided with the introduction of decompression meters (Deco-brain, Farallon, SOS, Edge). This explained the explosion of serious DCS cases in the late 1960s. My debunking of the validity of these machines, with the experiments to prove it, had some sequelae; equipment manufacturers did not like me, and neither did the diving technocrats and many Americans who were believers in the new technology.

The meters, to which I am indebted for their supply of many DCS cases, allowed me to obtain a lot of experience at treating DCS, including the use of surface O₂ as first aid, and elective treatment and the introduction of in-water oxygen treatment. I was also able to play around with heliox as a preferred treatment gas. Fortunately, after a couple of decades in the diving medical wilderness, all these treatments are now acknowledged, and the facilities for diving safer and treating earlier are much improved.

It was not always so. I still have nightmares about the two abalone divers who died in a recompression coffin at Malacoota, because we could not go deeper and had no helium. In all fairness, after 6–8 hours at more than 30 metres without decompression, they did not deserve much else. Nevertheless, with more knowledgeable early treatments and better facilities, by the time we got there it could have been different. That scarred my life, and made me realise what great guys I was working with. Bob Thomas and John Manley come to mind. I would still put my life in their hands now, 30 years on, like I did then.

Marine animals

Yes, I like them. That is why I hate spear fishermen. Experience with their misbehaviour (marine animals, not spearfishermen!)

came to a head when a young clearance diver grabbed hold of a fortesque (*Centropogon sp.*) and got the full dose of venom. He was wheeled into the sick bay, semi-comatose, hypotensive, cyanotic and looking like death. The authoritative texts told me a lot about toxicology and taxonomy, but zilch about treatment.

I phoned up the Poisons Information Centre, explained the case, got reassurance that they could assist, waited about five minutes on the phone while they researched their material, and was then given the instructions: "No problem. Just phone up Dr Edmonds at the Navy School of Underwater Medicine. He can help you." It was then that I realised that if this was the standard of knowledge in Australia, we were in deep trouble.

After that, I toured Australia, with the help of the RAAF, with a tape recorder and a bottle of scotch, visiting fishermen, yachties, marine biologists, divers, doctors and hospitals. They gave willingly of their experience, knowledge and photographs. Back at the school, 'volunteers' contributed with a few therapeutic trials. The first clinical text on *Dangerous Marine Animals* was born in 1975, followed by three further editions.

Travel and perks

Because of my obsession with the treatment of diving accidents in remote localities, and not in any way related to tax deductible diving holidays at exotic localities, I was compelled to visit other areas. They included:

- Dive sites around Sydney (as OIC SUM for almost nine years), the Great Barrier Reef, all states of Australia, and including abalone diving (NSW, SA, Tasmania) and pearl diving (WA, NT, Queensland);
- The Pacific Islands of Fiji, Tonga, Solomons, Palau, Sipidan, Manado, Truk Lagoon, Tahiti, Tuamotos, Rarotonga and Aitutaki, Lord Howe, New Guinea, Manus, New Zealand, Vanuatu, New Caledonia, Western Samoa, etc;
- Mediterranean sites around the Greek islands, Italy, Yugoslavia and Spain;
- America, including East and West Coasts of USA, the Gulf states, the Bahamas and elsewhere in the Caribbean and the Galapagos Islands;
- South East Asia, the Maldives, Sultanate of Oman, Africa, Antarctica,³ in bubble tubs and jacuzzis.⁴

Expeditions

Practical research and field work expeditions included:

- Antarctica, during a three-month diving expedition;
- Australia-wide survey of marine animal injuries;
- Abalone diver survey of southern Australia over a one-year period;
- Pearl diving surveys, involving northern Australia, at the request of the pearling industry;
- North American tour of diving research establishments, whilst attached to the US Navy for one year;

- Diving medicine courses, in dozens of remote and exotic localities (not entirely devoted to duty);
- Involvement with various expeditions and documentaries (more as a mascot than a medic), including the diving expedition to and excavations of HMS Pandora and the re-enactments of Joshua Slocum's voyage and the Antarctic expeditions of Sir Douglas Mawson.

It is probably unnecessary to stress that none of these were in any way related to hedonistic motivations or just to dive!

Private practice

After many years as OIC at the Navy SUM, my congenital glaucoma started to exert its malign effects, and I decided to move into private practice while I had time.

Leaving the Navy in 1975, with all its diving expertise and its research capabilities, was a challenge. For nine years I had done whatever I liked, as long as I did not mention it to the administrators. When I completed each project, if it was successful I would then request permission to undertake it. The result was an apparent 100% success rate. Many of the other projects have never been documented, which is a shame as negative results are often as important as positive results. But time was limited, and the main purpose of my employment was to find answers, not to produce academic papers.

We had already commenced SPUMS (1971) and the Diving Medical Centres (1972), and so setting up as a consultant in diving medicine was not that difficult. For the next quarter of a century I did the type of clinical work I loved – investigating and treating divers. My psychiatric training assisted me in handling professional divers, but my personality was incompatible with bureaucracy, government departments, committees and the legal profession.

I also have trouble with publishers, although our books now sell well and have been translated into various languages. Not like the old days, when we published our own first editions and Cindy and I did the distribution. That was not easy. Some of my collaborators expressed the view that they might have been coerced. I envisioned them being dragged along like a resistant pet dog, with front legs splayed out. Nevertheless, they did a great job and I needed their help.

By 2001, my vision had deteriorated to such a degree that I could no longer do my clinical work to the standard that I required, or add to our nine-book repertoire (two going into fourth editions). So I decided to fall off the professional perch, and spend the rest of my life doing what I wanted. I hear my Navy colleagues hovering over my shoulder saying, 'And so, what is new?'

Current interests

I have almost accepted that I should not engage in windsurfing any more, relying on others to get out of the

way. That leaves kayaking, surfing outside the flags so that if I hit anyone, it is their fault for swimming in the wrong area, bush-walking, television viewing, listening to audio-books, enjoying family and friends, avoiding work, playing with computers, refusing to acknowledge the effects of age, and not feeling guilty about spelling mistakes.

The Navy and other diving medical groups are still generous enough to invite me to lecture at their courses. I think they still enjoy my jokes, although they are not updated. Bob Thomas and I have now taught over 600 doctors to assess divers, and I guess the Navy courses have done about the same. That means there are now over a thousand doctors doing what I did alone in the late 1960s. But they probably do it much better.

Some are also receptive to my research suggestions, and I really enjoy involvement with these. The principle that I have used over the last couple of decades has stood me in good stead: if you cannot determine the answer within two weeks, you have asked the wrong question.

I have also picked up quite a few awards recently, obviously for things that I did in earlier more productive years, and I surprised myself by feeling appreciative of these. Being given life membership of SPUMS was one. The others, from both Australian and international organisations, were also welcome. I must be getting maudlin. Probably the most genuine praise comes from those who quote from our past work, and those who plagiarise it.

Do I still dive? Unfortunately I am no longer medically fit to dive, and thus I politely refuse to answer this question. Future intentions? Never to knock back a good offer.

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