SPUMS JOURNAL
South Pacific Underwater Medicine Society
January to March 1982

CONTENTS

Registered for posting as a publication (Category B).
Publication Number VBH 3527

Printed by: Universal Copy Service,
140 William Street, Melbourne 3000

OFFICE BEARERS

EDITORIAL

The theme of the coming SPUMS Conference is Fitness to Dive and this issue of the Journal contains several papers highly pertinent to this very important aspect of Diving Medicine. They should provide a useful basis for fruitful discussion with others, and possibly self examination of long unquestioned, firmly held, opinions. Attention is drawn in particular to the suggestions that both pregnancy and diabetes may contraindicate diving for inescapable reasons, though the true significance of these communications cannot be established at this time.

The proposal to investigate the diving histories of asthmatic divers and to make a thorough assessment of the respiratory function of persons with a history of "asthma" who desire to scuba dive may ruffle a few feathers (or should we say "agitate a few fins"?). By hearsay it has been discovered that such persons may be passed as Fit to Dive after assessment by Consultant Physicians. To this time no ill effects have followed from such advice. However, such formidable diving medicine specialists as Drs Carl Edmonds and Paul Linaweaver Jr are vigorously opposed to such views. They hold that any whiff of "asthma" makes the person is unfit to dive. Such views are not shared by everybody. It is hoped that everyone with an interest in finding the truth on this matter will supply information concerning both the times when asthma has been implicated in some incident and the cases of divers with this diagnostic label who have never suffered any morbidity. Our members, both lay and medical, have an opportunity to improve understanding of a small but important matter affecting large number of (potential) divers. It is to be hoped that more light than heat will be generated during the coming discussion.

One matter on which none will disagree is the danger of unconsciousness in a diver. The three cases here reported illustrate the truth of the assumption that the presence of an alert buddy or buddies can effect the outcome favourably. It is to be noted that two of the victims were thoroughly trained and inflated their bouyancy vests though they retained no memories of their last conscious moments. The reasons for their loss of consciousness and for their escaping drowning, deserve discussion.

The papers by Drs David Elliot, Tony Slark and Jimmy How deserve careful consideration. They are each in the position described by Harry Truman, whose desk carried a notice "The buck stops here". As Dr Elliott notes, things get difficult when a 250 feet diver wants to be mended by someone who only has a 165 feet chamber.

Commander Warner and the UK Department of Energy continue to advise us on the experience they have gained in the hard school of North Sea diving. That conditions in the Northern Hemisphere can be severe has been tragically illustrated by the recent rig disaster off Newfoundland. A demonstration that the forces of Nature can be beyond our power to resist. The basis of diving safety is to understand and live with an environment we cannot beat into submission by brute force.

Understanding is based on adequate and accurate information. So let us support attempts to collect and share information. Newton claimed to pick the occasional pebble of knowledge. Let our Society humbly seek to follow his example.

REPRINTING OF ARTICLES

Permission to reprint articles from this journal will be granted on application to the Editor in the case of original contributions. Papers that are here reprinted from another (stated) source require direct application to the original publisher, this being the condition of publication in the SPUMS Journal.

NOTES TO CORRESPONDENTS AND AUTHORS

Please type all correspondence, in double spacing and only on one side of the paper, and be certain to give your name and address even though they may not be for publication.

Authors are requested to be considerate of the limited facilities for the redrawing of tables, graphs or illustrations and should provide these in a presentation suitable for photo-reduction direct. Books, journals, notices or symposia etc., will be given consideration for notice in this journal.

SPUMS ANNUAL SCIENTIFIC MEETING 1982

Place:	MADANG RESORT HOTEL Madang, Papua New Guinea
Dates:	June 26th to July 5th
Main Topic:	FITNESS TO DIVE
Guest Speaker:	Dr AA (Fred) Bove
Organiser:	Dr John Knight, 80 Wellington Parade, East Melbourne, Victoria ... 3002
Travel Agents:	Allways Travel, 168 High Street, Ashburton, Victoria ... 3147 Tel: 03-25 8818 (Reverse charges)

The Committee of SPUMS has chosen a beautiful site for the meeting. The diving is excellent. The guest speaker, Dr Fred Bove, will be lecturing on the following topics:-

A basis for drug therapy in decompression sickness:
Strategies for treatment of decompression sickness when no chamber is available:
Exercise physiology:
Fitness for diving:
Cardiovascular disorders and diving:
Pulmonary disorders and diving:
Other medical problems and diving:

Dr Bove is well qualified to educate SPUMS members as he is not only a cardiologist who is also a diving instructor but also the Chairman of the Education Committee of the Undersea Medical Society. His research projects have included working with David Elliott and John Hallenbeck elucidating the part venous stasis plays in the production of spinal decompression sickness.

The Committee hopes that the meeting will be able to produce, or at least start the process of producing, a statement on the minimum standards of physical fitness required for Australian sports diver trainees. That this is necessary was shown by the letter from the FAUI National Executive published in the July–September issue of the Journal. The relevant chapter in the Second Edition of "Diving and Subaquatic Medicine" by Edmonds, Lowry and Pennefather, with this and the last two issues of the Journal will help members prepare their contributions to the discussions.

That is not to say that there is no place for papers on other topics of underwater and surface interest at this meeting. Already papers on decompression sickness, decompression tables, flying after diving, hyperbaric oxygen therapy, jelly fish stings, dysbaric osteonecrosis, the minimum requirements for a sports diver medical and other topics have been offered.

IMPORTANT NOTICE

WARNING

ITEMIZING ACCOUNTS FOR

DIVING MEDICALS

IS

FRAUD

DO YOU WANT TO JOIN THE 900

DELINQUENT DOCTORS WHO ARE

CHEATING ON HEALTH BENEFITS?

THAT IS WHAT YOU ARE DOING IF YOU

ITEMIZE YOUR ACCOUNT FOR A

DIVING MEDICAL EXAMINATION

YOU HAVE BEEN WARNED

Section 1B, Paragraph 27 of the Medical Benefits Schedule dated September 1981 has NOT been amended.

EXECUTIVE COMMITTEE OF SPUMS

Nominations are required for the following positions:

President
Secretary
Treasurer
Editor
Three Committee members

Nominations signed by the nominee, the proposer and the seconder must be in the hands of the Secretary by MAY 15TH 1982. His address is:

Dr CJ Lourey,
43 Canadian Bay Road,
Mount Eliza, Victoria, 3930

SUBSCRIPTIONS

Members pay $20.00 yearly and Associate Members $15.00. Associated Membership is available to those neither medically qualified nor engaged in hyperbaric-or underwater related research. Membership entitles attendance at meetings and the Annual Scientific Conference and receipt of the Journal/Newsletter. Anyone interested in joining SPUMS should write to the Secretary of SPUMS, Dr Christopher J Lourey, 43 Canadian Bay Road, Mount Eliza, Victoria, 3930.

MINUTES OF ANNUAL GENERAL MEETING OF SPUMS

Held on Monday, 8th June, 1981
at Argao Beach Club, Cebu, Philippines

Attendance

37 members

Apologies

Chris Lourey (Secretary), Douglas Walker (Editor), Beryl Turner, Bob Emmanuel, Harvey Evans, Mark Frandorfer, Michael Davis.

Minutes of the 1980 AGM

David Davies moved that the Minutes of the 1980 AGM be accepted, seconded by John McKee. Carried without dissent.

The Secretary's Report for 1980-81

This has been published in the JulySeptember 1981 issue of the Journal.

Treasurer's Report

Once again this will be a short and brief Treasurer's report. Our Journal is a bigger and better and more regularly edited thing this year, and so naturally enough it has cost more money. We have got about 340 members now, about the same as last year. We have a lot of dropouts, but we have also got a lot of new members. As you can see, the funds are down a little bit on last year, but we still have got a surplus.

We need a fair sized float. The bills for one issue of the Journal are around $700 to $1,000 because of all the typing that has to be done. Printing works out at over $1.00 per copy. Postage is somewhere around $100.00 for sending out 400 copies. I hope people feel that they are getting their money's worth.

The statement of receipts and payments has been published in the July-September 1981 issue of the Journal.

David Davies moved that the Treasurer's report be accepted, seconded by George Weaver. Carried without dissent.

President's Report

This is printed on this and following pages.

Election of Office Bearers

The President accepted the nomination of Dr John McKee, proposed by Fred Jones, seconded by John Knight, from the floor.

There being no other nominations the following were declared elected unopposed

Dr John Knight	President
Dr Chris Lourey	Secretary
Dr Bill Hurst	Treasurer
Dr Douglas Walker	Editor

Of the four candidates for the position of Committee Member, Drs Victor Brand, John Doncaster and John McKee were elected.

Other Business

The meeting expressed its commendation of the efforts by the editor, Douglas Walker, and congratulated him on the high standard of the Journal.

Discussion took place on a number of topics including the Australian Resuscitation Council, the organisation of meetings in Australia and choice of speakers, the history of SPUMS, the organisation of Annual Scientific Meetings (and the failures of organisation), and the choice of sites and travel agencies. Madang was recommended as the site for the next ASM.

Dr Ray Leitch volunteered to act as Regional Representative for South Australia.

There being no further business the meeting was closed.

John Knight
President SPUMS

PRESIDENT'S REPORT

On your behalf I would like to say how happy we are to have Dr David Elliott, who besides being half of "Bennett and Elliott" is President of the European Undersea Biomedical Society, as our visiting speaker. I am sure that you will all agree that his contributions to the meeting have been excellent. He brings with him greetings from the European Undersea Biomedical Society and from the Undersea Medical Society. The latter has offered Associate status to SPUMS if 10% of SPUMS members are UMS members, a condition which I understand is already met.

I think it is very important to emphasize that SPUMS is an international Society. It is not just Australian or New Zealand, it is international. Jimmy How and Robert were here. Last year we had our meeting in Singapore and Paulu Tioman. We get letters from places as far apart as India and Scotland. We have got many members in North America. The thing about SPUMS is that it is different from the other Underwater Medical Societies. We are doctors who dive and the other societies are mainly doctors who do research or look after divers. The Undersea Medical Society in America now has a large proportion of doctors who dive. They have a problem, because they can not make up their minds what they want to be. We do not have that problem, we know what we are. However we have problems filling the requirements that other people put upon us.

The one thing that is important to the Society is education. About 10% of the membership of 300 to 400 are known to have done one or other of the courses at the School of Underwater Medicine. A lot of the members have done Carl Edmonds' courses, but only Carl knows how many

and who they are. I have no idea of how many of us have really made a strenuous effort to educate ourselves. It is extremely important that people who join SPUMS should set about improving their knowledge. The other thing that SPUMS does in education is to publish the Journal. We are trying to get it out on time. I suggested to Douglas Walker two years ago that I should take over the production, so consequently late publication is my fault. Douglas Walker continues to choose the content of the Journal.

After I became Secretary in 1976, SPUMS held some meetings besides the annual scientific meeting. We had a meeting organised in Canberra last year, which had to be cancelled because of the petrol strike. Beryl Turner said that she would organise a meeting at the School of Underwater Medicine early this year, but did not do so before she left the Navy. I feel that it is well within the powers of any member of SPUMS to pick up a telephone, or even tell his secretary to write a letter, to selected speakers, and organise a meeting. There are people in SPUMS who will speak and are willing to pay their travelling expenses. This is a hobby-horse of mine, which I am expressing now for the third year, and I hope somebody acts on it. We can not educate the Australian diver unless we have meetings in Australia.

The Diploma of Underwater and Hyperbaric Medicine at present requires that you do both courses at the School of Underwater Medicine, the Hyperbaric course at Prince Henry Hospital in Sydney and six months full time or equivalent part-time experience in diving or hyperbaric medicine. The Diploma is being taken up by the Institute of Public Health which is going to change its name to the Institute of Occupational Medicine. Unfortunately, our contact man in that unit has recently transferred to Shell, Melbourne, and our contact woman in the Navy has recently left the Navy, so I suspect that negotiations are at a standstill. There is a push from the Commonwealth Government to have a list of approved doctors to do medicals on Commercial divers. The suggested requirement for that list is that you have done both courses at the School of Underwater Medicine.

SPUMS has been a bit slow as a body handing out advice. As SPUMS is a group of doctors who dive, you can understand why the executive has been slow to push out unasked-for advice. In fact we have never pushed out unasked-for advice and we have backed away from asked for advice. This cannot continue as we are getting asked for advice by lots of people. Over the last year, the executive has started to produce a poster to send to hospitals to publicise the essentials of the treatment of decompression sickness and pulmonary barotrauma. A subcommittee of Victor Brand and myself has produced a simple poster which says that if you have to deal with a diving accident, do not forget decompression sickness and pulmonary barotrauma, the first aid, and gives a telephone number to ring. There is space for local telephone numbers. I think that is the level at which one pitches unasked-for advice to hospital casualties.

Nothing has happened from the discussions in Paulu Tioman, where Darryll and Margaret Wallner were going to organise some sort of input into the Australian Family Physician.

Frank Poole, who is National Director of Coaching for the AUF asked me about first aid for decompression sickness. I told him that the French had had great success with salt-containing fluids, aspirin and oxygen. I suggested that he include the telephone number of the School of Underwater Medicine in his handout on diving first aid.

Various members of SPUMS do go out into the community and give lectures to divers clubs, instructional organisations and such like. Janene Mannerheim has put in a lot of time into producing a first aid kit for the East Australian area, which is being handed around the dive shops and clubs of Melbourne.

For those who want sets of slides on the physics and physiology of diving, slides are available from the UMS.

On the subject of membership any dive school instructor who wishes to pay his $15.00 a year, is more than welcome to join SPUMS. A number of Melbourne instructors are members of SPUMS. What we should do for them is to give them meetings to come to, in Australia. The constitution says that there is associate membership available to those who are interested in Underwater Medicine. Anyone who earns his living teaching people to swim underwater should be interested in underwater medicine.

Carl Edmonds' diving medical centre in Sydney includes cardiopulmonary resuscitation training in the diving medical. Not many doctors have as much space and as many skilled staff. I think that CPR ought to be taught by the dive schools, as not every trainee will get the training otherwise.

Looking to the future, the Diploma looks like hovering and not getting anywhere. Last year in Paulu Tioman Chris Lourey was saying that SPUMS would have to take up a teaching role. We do not have the skills, or the equipment or the chambers to do that. He thought that civilians would be frozen out of the Navy teaching courses. I do not think we will be. If we are, SPUMS should not run courses in competition with Carl Edmonds.

I would align myself very firmly with Tony Slark, that as a doctor, one can not forbid somebody to do something, one can only advise him. If an employer insists upon certain requirements, that is a contract between the employee and you are arbitrating in their argument. But with the sports diver trainee and the instructor, there is a problem. It is fine to say that I will give him a certificate with these provisos if necessary. But these trainees are going to doctors who know nothing about diving medicine. There is a need for a very simple, easily understood, not too controversial, series of guidelines for non-diving doctors, so they can safely do diving medicals for their patients. Of course if FAUI starts to say that only those doctors on the list approved to examine Commercial divers can do the medicals, I can afford to give up anaesthesia, but I do not think that is likely.

There are rumblings reaching my extended ears that people are grumbling about SPUMS being a Melbourne based Society. There is only one reason it is a Melbourne Society; no one else has volunteered to help. I am willing if anyone is interested in joining the executive, to throw the constitution over the side, and accept his nomination at this meeting. So if there is anybody in any other State who would like to help invigorate our Society, would he please stand up or would she please nominate for election. We do need new blood on the committee at regular intervals. We corralled John Doncaster in a corner and twisted both arms round his back, and told him he could not escape being nominated. If there is anybody else who would like to contribute his ideas and his time to the Society, who has not nominated, I am willing to take his nomination at this meeting. It involves about three meetings a year. We would alternate the meetings between Sydney and Melbourne, if there were any other Sydney members besides Douglas Walker.

THE FIVE O'CLOCK GAME ANSWERS

Dr David Elliott

The game demonstrates that each of you is very independent. You have your own ideas of what diving medicine is about and of what you would need in the case of an emergency. Whatever list you have prepared as an individual is not the same as the one your group prepared. Also there will not be much better than 60% agreement with the other groups.

The list of items was:

- Intravenous giving set
- Doppler Bubble Detector
- Battery operated ECG machine
- Patella hammer and tuning fork
- Miscellaneous sterile catheters
- Heparin for injection
- Trocar and cannula with Heimlich valve set
- US Navy Diving Manual
- Four litres normal saline and one litre Dextran
- Various airways, an Ambu bag or equivalent
- Lumbar puncture set
- Auriscope cum opthalmoscope
- Corticosteroid for injection.
- Space blanket with respiratory heat exchanger
- Anaeroid sphygmomanometer with stethoscope
- Low reading mercury thermometer
- Note pad and pencil
- Assorted needles and syringes
- Oxygen cylinder and regulator complete
- Portable suction unit
- Laryngoscope with endotracheal tube or an oesophageal obturator airway.
- Urine testing kit
- Analgesics

Intravenous giving set, I think we generally agree, should be on that list. The Doppler Bubble Detector can stay at home, so can the ECG machine, so can the patella hammer and tuning fork. However a fistful of catheters may be very important. Take the trocar and cannula with Heimlich valve because he may be unconscious because of pulmonary barotrauma and air embolism as he may have a pneumothorax. The US Navy Diving Manual I think you could leave at home, because if you do not know it by now, you will not have time to read it in detail before you get to the patient. The intravenous fluids, the airways, the Ambu bag, the laryngoscope etc., the oxygen, the portable suction and sphygmomanometer are all essential.

In the last group of doctors who went through this, none of the four teams would take the lumbar puncture set. It is one of the things I would put in if I had an unconscious diver because we have had three cerebro-vascular accidents in divers in the water in the North Sea. It is rather nice to know that you are actually dealing with something which is not a diving accident. It would be about number 15 on my list, but I would certainly give that serious consideration and I remark on it only because the other bunch of doctors thought it ridiculous even putting it on the list. It has been very useful for making a differential diagnosis in the past. With an unconscious diver at depth you wonder whether you should begin decompression or if this is some form of cerebral gas embolism with the symptoms not quite right. Finding the blood in the CSF we could relax from a diving management point of view and need not start a therapeutic decompression of many days. We could use ordinary decompression rates to get the man out and into hospital.

As one is not going to take any drugs, there is no need for needles and syringes.

The space blanket and auriscope both got some votes. My list is not meant to be definitive. The game is an exercise to make people think. In the last game the space blanket got one vote out of the fourteen.

YOU KNEW ALL THE TIME, DIDN'T YOU?

In a sudden fear of wowser pickets on the dockside when their nuclear-powered submarine USS FLASHER visited Perth recently (they are used to the anti-nuclear pickets now), the US Consulate in Perth added a hurried addendum to the prepared press statement. Someone had noticed that both in the USA and Australia Webster's Dictionary definition of "flasher" tended to convey the wrong impression of the visitor. They hurriedly disseminated the information that Flasher was a small town in north Dakota and the origin of the name. "Be that as it may", as most TV commentators say at one time or another, the new information was misleading. Certainly the town is there in north Dakota, but the submarine is named after a fish. Doubtless you, dear reader, never thought otherwise. To the pure, they say, all things are pure.

SPUMS SCIENTIFIC MEETING 1981
DECOMPRESSION DISEASES PART II
TREATMENT

THE NEW ZEALAND APPROACH

Dr Tony Slark

In New Zealand most diving is done in the north. There is a rocky coastline, with many offshore islands, which provides us with a tremendously wide range of diving areas. One of the most popular ones is the Poor Knights Islands, about 15 miles offshore. One of the dive sites there is the Rico Rico Caves. You can sail straight into it. Boats often take visitors there, going right in and out again. At the base of the cliff, the bottom is at 120 feet. But as one goes around the point it gets deeper, going down to about 150 feet. We can not say to divers that they must not go down there, because they are free people. They are just as inclined to explore as anyone else and were we to say that nobody must dive below 150 feet the rule would be disobeyed. You may say that this is far too deep, but we had to settle for what people will accept. Divers go there and it is often beautifully calm. They will go down to the bottom at 120 feet where one can still see a great deal of fish life. One may see black coral trees and a whole host of interesting things in very deep water. To say that one must not dive to the depths of interest would be to negate the whole idea of amateur sport diving.

Many people go diving to the Poor Knights hopefully to depths not greater than 150 feet. Occasionally of course, people do go much deeper than 150 feet, indeed to 250 feet. Then of course they find that they have run out of air, which happens all too readily at those depths. So they make a rapid ascent. If they are lucky the boat has an attendant in it, who helps them into the boat and looks after their sickness while (hopefully) somebody else speeds them back to the harbour. If it is a well-equipped boat it has a radiotelephone so arrangements can be made for an ambulance to be waiting. Hopefully after half an hour's trip at full speed, they will reach the coast and the ambulance will take the patient 120 miles south to us at the Navy Hospital and its chamber complex. There are two chambers so we can treat two patients at once.

In the past we would reach a snap diagnosis on the basis of their presenting symptoms and the history and put them in the chamber. This seemed to work fairly well in most cases. However, I was left with a feeling of inadequacy when things did not happen according to the text books. There was always a delay due to transport difficulties. We could put them in the chamber quickly and reach a diagnosis. We could put them onto oxygen using a Normalaire mask which is quite comfortable to wear for long periods. We treated a lot of people with oxygen on the longer air tables long before the Goodman and Workman oxygen tables came in.

Nevertheless, this did not seem to be entirely satisfactory. We had a diver come to us in 1972 who had been to 250 feet. We put him in the chamber with all haste, we did not go into any great medical investigation of his situation. There was no doubt about the diagnosis - he obviously had either an air embolism or decompression sickness. It was impossible to get a history. We treated him with the long air tables and found that his general condition did not improve. He remained comatose for the whole of the duration of his time in the chamber. Subsequently he became a quadriplegic. His dive pattern was descent to 250 feet for a dubious period of time, then a rapid ascent to the surface. We know that his decompression meter was into the red sector. He lapsed into coma, was given some treatment and eventually brought to us. He was treated for two days in the chamber and really we did not do him very much good.

At the same time we received another man who had dived at the same place, who had also been to 250 feet. Henry was a bit delayed reaching us, so the other patient was already under pressure. So we had to put him into the second chamber. Its normal working limit was to about 100 feet, but because of the severity of Henry's symptoms we decided to push it to its maximum depth. But Henry came to us having also dived to 250 feet in the same area going for groper. He had seen a fish and had gone after it to 250 feet. He had come to the surface knowing that he needed to decompress. It was his practice to call to the boat "Throw me another tank and I'll go down and de-coke". But the people on the boat were busy because someone had opened one of the sea-cocks of the boat and it was sinking. They were not interested in Henry on the surface and he did not get the aid that he expected. By the time they had stopped the boat sinking, Henry had already lapsed into stupor. By the time they got him into the boat he was in a coma. He convulsed a couple of times and then seemed to come right.

When his party tried to organise an air evacuation the people on the evacuation service did not really believe that there could be yet another neurologically bent diver from the same place and they were also rather slow in arranging the process. So Henry got to us very much later that Sunday evening. I went over him carefully, following all the rules in all the text books and the diving manuals about wasting no time at all. I sent Henry to the chamber post haste. He said to me just as he went into the chamber "Silly bloody business this", and I replied "Henry, you will be fine". He was quite lucid at this stage and seemed to me to be already coming right, all his vital signs were good, his blood pressure was good, and he seemed to be the one who was least at risk.

Henry started to go to sleep, then was unrousable and eventually died in the chamber. To have somebody die in the chamber is a sobering experience. It was not a two compartment chamber, so the attendant had to stay in with the dead man, which was an unpleasant process. Afterwards I had to write to the coroner and tell him all about it. I had to say that we had not investigated the case, that we had not done any real thorough workup of the management of this particular person's illness. In my view he had not been treated as a sick man should have been treated. He had not been treated as a hospital patient at all. We had not done a chest X-ray. We had not done any investigations. We had treated him as we thought best at the time and I did not

feel that this was satisfactory.

The diving manuals deal with divers who are well disciplined. Navies and big commercial organisations do not like to lose too many people, they find it difficult to explain away. But sports divers are a law unto themselves and should be. I do not think that we should try to legislate against people who are trying to do their own thing. All our patients are sports divers. Now following that incident of Ulf and Henry and another diver from the same diving site, on the same weekend, with a neurological bend also, who had preceded Ulf into the chamber, we treat every patient who comes to us as a hospital patient to be properly investigated before treatment. Ulf was treated with a very prolonged air table. The newer tables give us a great deal more scope. I always put the patient on oxygen whilst treating them.

Most people are against the decompression meter (DCP). Many would say that one of the reasons that we have a very high incidence of decompression sickness in New Zealand is because we always use these meters. We have watches and we have tables, and the meter should be an added help to the management of the dive profile. If it is used to make sure that one does not get into the zone requiring decompression, and if the diver used it as a guide to remaining in a state so that one can surface fairly rapidly, then the device is very helpful in spite of its manifest inadequacies.

When we were chopping up the Wahine, which sank in Wellington Harbour in a position where it had to be removed, after getting two bends using US Navy tables, we started a system whereby they also used DCP's. The divers clocked up something like 12,000 diving hours on the Wahine, at a depth of 60 feet to 70 feet without a single bend. The same system was used on the Seawise University in Hong Kong Harbour. I think they did something like 50,000 hours diving in relatively shallow depths using the DCP as an aid in decompression procedures. So it has its uses even though it is anathema to all Australian divers and to most European divers.

I will mention another case prior to the days of admitting people to hospital. A man who had been on the Wahine consulted me with a simple limb bend, pain in the knee. After he had been treated, we X-rayed his knee and found an osteonecrotic lesion which decided us to explore further. He had positively refused to have any investigations before treatment. He wanted to get into the chamber as quickly as possible. So we put him in the chamber, re-compressed him quite quickly and his pain was relieved. When he came out of the chamber he had a very nautical gait. So we X-rayed his hips and found that he had grossly distorted hip joints which was surprising as he did not have any pain. He had shifted more steel off the Wahine than any other diver despite having severe osteonecrosis. His age then was about 48.

Not all the cases that come to us, although they are diving accidents, are necessarily decompression sickness. This again is a good reason why one should treat everyone as a hospital patient. I went down to the helicopter one day to meet a patient. I started to get some sort of history from him, when he said "To hell with that Doc, I must piss". I felt there was every good reason for getting him into a situation where he could be treated. In the hospital bed when I started to examine him again he said "Oh, Doc, I must shit now". That indicated that there was nothing much the matter with him from a decompression sickness point of view. We had a chest X-ray done which showed diffuse mottling. His problem was water inhalation. He had got his regulator caught in a fishing net that he had gone down to retrieve. He had choked and spluttered when he came ashore. Someone said "You have been diving. I knew someone who was in the Navy once. All divers get bends. You must go to the hospital at Devonport, because you have got the bends". We put him on oxygen and we gave him some frusemide. The next day he was a much happier man and he spoke quite civilly to us despite his earlier rather less than courteous way of describing his symptoms.

A chap who had been diving to i00 feet on his first check-out sea dive at the Poor Knights (that is a crazy thing to do but most of them manage without getting into difficulties). He had had a good medical beforehand, which included an X-ray that did not show any significant abnormalities. When he came to us he was stuporose and very obviously severely ill and when I tried to listen to his heart, I could not hear any heart beat at all. Just after we had taken a chest X-ray he suddenly vomited blood all over me. So we put up a drip, took him down to the chamber and started off his therapeutic regime with a 6A oxygen table. We had to change to a prolonged air table because he convulsed with the oxygen. When we finally brought him out of the chamber and transferred him to the critical care unit at Auckland Hospital, he was still comatose and still obviously very severely ill. We had done nothing for him by putting him in the chamber. After his spell in critical care where he was in coma for about two weeks, be went to the neurological unit where they decided that he had certainly not had an air embolism and that it might be some strange demyelinating disease. At a seminar where we discussed this case, the physician in charge of critical care was so affronted with this neurological diagnosis that he jumped up and said "Oh, bilge", which would typify the reaction of most people who knew something about diving accidents. Amazingly this patient has gone back to work as a surveyor. He has virtually no lesions at all. It staggers me to think that anybody could be so severely ill and can do so well with medical management.

PROJECT STICKYBEAK

Send incident reports to

DR DG WALKER
PO Box 120
NARRABEEN NSW 2101

THE SINGAPORE APPROACH

Dr Jimmy How

I do not intend to say very much on the Singapore experience because most of you heard about it last year. So I will carry on from where I left off last year and present a few cases. Just to stress again what I said last year, although diving illnesses are emergencies to be rushed to the chamber, do not forget the examination and a proper history. It is so absolutely important that we take a clear-cut history and find out exactly what is wrong with the patient and then do a proper, thorough physical examination. That man is already late, by quite a number of hours, and an extra fifteen minutes really will not cost him that much. So I try to get a diagnosis before he goes into the chamber.

The first case I want to present concerns an Eurasian aged 30 who was a professional diver. His story starts in 1976 when I examined him for his annual physical. On the X-ray there were some apical scars and the radiologist reported that they were old tubercular scars. They are very common in Singapore. We are very much exposed to tuberculosis, even children get primary tuberculosis, most of us are exposed. Some scarring somewhere is a common finding. So I watched him, but I was not particularly happy because the lung function was dropping. His FEV1/VC% came down to somewhere around 80, then 79. Then instead of a yearly physical, I put him on a six monthly physical. This is one of the things we should do. When you are not happy, bring him back sooner than the annual physical examination. Then his percentage was only 75 and I got onto the radiologist. Now besides the old scars there was also minimal infiltration in the left first intercostal space. He had active tuberculosis. He gave a history of tiredness, loss of weight, etc. there comes a point when diving is contraindicated. I stopped him diving. After eighteen months of treatment, he came back and said that he wanted to dive again. What do you do? You do a lung function test. There was no change and I could not consider him fit for diving.

In Singapore, where we take X-rays in full inspiration and full expiration, we do occasionally see cysts which also contraindicate diving. However, I have sent two cases to the thoracic surgeons. What they do is abrade the pleura and remove the cysts. I have sent one man back to professional diving.

The second case was an American belonging to Solus Ocean Systems. He made a very interesting dive on 26th January 1981. I finally saw him on 9th February. The working conditions were very strenuous and cold. He dived to 256 feet, the decompression stops were inadequate and he had to do a surface decompression. Thirty minutes after he was out of the chamber he got pain in the small of his back and difficulty in breathing. He was rushed to the chamber and while descending to 60 feet his condition became worse. He had pins and needles in his right leg and arm. The right arm was totally paralysed, while only the toes could be moved in the right leg. He could not micturate. They contacted Dr Lambertsen in the USA. Due to his severe condition he was taken to 165 feet. Then he started on a 6A table. That did not work and Dr Lambertsen decided to change to 7A. Back at 165 feet he had chest pain with other symptoms, there was relief for a short while and then they came back. But the back pain was gone. After completing the 7A table he got back touch sensation in his right arm and right leg. He had regained some motor power, but he was still very, very weak. After this he was treated five times with table 5 until he started to get spasms. They decided that they could not treat him any further and flew him to Singapore, where he came to my Diving Medical Centre.

After I examined him I decided that I could not help him any further. Not because it was already thirteen days since the incident. Thirteen days is not long by our standards. We have seen people who are twenty or twenty-five days delayed who are totally paralysed and we put them in the chamber. If he had come direct to me I would have put him in the chamber. But his lungs were so damaged by oxygen that we could not help him, not even with an air table. With 100% oxygen on the surface he got severe spasms and was coughing, had chest pain and tracheitis. One has to be very careful to avoid oxygen toxicity. There is a way of calculating oxygen dosage academically. I find it a great help to do Vitalograph test before you put a patient into the chamber. Slow down, and do some preliminary tests before you shoot the patient into the chamber. It is too late later on, you do not have a base line. We could not help this man so we sent him to the rehabilitation centre, where they work on the patients' bowel and bladder problems. He was put on physiotherapy and by March had recovered pretty well.

The third case demonstrates that we really have to examine patients. A fisherman diver had as his presenting symptom a swelling on the right side of the face. A huge swelling going right down into the neck. He had been diving with a surface supply. He went to 50 feet for an hour, then he repeated the same dive three or four times and came up with this problem. One of my medical officers saw him and was just about to put him into the chamber, when I said "Slow down and let us examine him". We examined him, percussed him and found that one side of the chest was dull, and the upper chest entry was poor. So we took an X-ray and there was a huge opacity on the right side. There were jagged edges which made us suspect it could be carcinoma. When he went diving he could have ruptured some part of the right lung and the air went up to his face. We gave him surface oxygen and packed him off to hospital where the diagnosis was confirmed. It would not have been a wise thing to have rushed that particular case into the chamber for a simple emphysema. Again, you do not really want to rush patients in too quickly.

My last case is a man who came to me with grade 4 paresis on both sides and loss of sensation from TlO downwards. The loss was patchy and this made me wonder. When you have loss of sensation from decompression sickness either it is diminished all the way down or there is total loss of

sensation. With the latter there is usually loss of bladder function and bowel action. But this chap was patchy. He also said that when he came up he coughed up blood which made me very suspicious. You normally get this sort of patchy loss of sensation as a residual effect. I said to him "Have you been here before?" and he refused to say very much. Finally, after about half an hour my secretary managed to discover that he was admitted to our place in 1977 on the 27th May and when he left after physiotherapy he did have these areas of patchy numbness. We had managed to convert him from complete paralysis back to grade 4 or 5. He went back to work as a fisherman diver because the money was good. Each time they come back with a boatload of fish it is worth $60,000 which is good money. Obviously there was something happening to his lungs, so we sent him for an X-ray which showed tuberculosis with haemorrhage. Yet another case where by slowing down we find great returns. I have learnt to slow down and apply a mental discipline to every case because of the time factor, the delay in reaching us.

THE PRINCIPLES OF TREATMENT

Dr David Elliott

It was kind of the Chairman to introduce me as the Medical Advisor for Shell, but one of the things that I am really quite proud of is that I was employed as diving adviser to Shell, not as the medical adviser, advising on their commercial contracts all around the world. Not that I think that makes any difference to this lecture.

The principles of the treatment of decompression sickness, pulmonary barotrauma and arterial gas embolism you all know inside out. You have got three things to play with, pressure, oxygen and drugs.

Pressure

Pressure is obviously good at squashing down bubbles. But to be a bit iconoclastic, an awful lot of bubbles are cylindrical in shape and all you do is shorten them. Nevertheless experience has shown that pressure is good news for somebody who has got bends. In fact some limb bends are extremely pressure sensitive, so much so that it is very, very difficult to believe that they can be so sensitive. I am talking of bends at as deep as 1,000 feet or more, where 3 to 5 feet of difference in pressure can actually make all the difference between pain and relief. Pressure is definitely the important treatment.

I will say a little more on the type of pressure. Do you go to the depth of relief, or do you go to some arbitrary depth? The depth of relief is obviously the best thing to do. If you can cure the pain with pressure, you have no more problems. The problem is getting them back from that particular depth. However, the depth of relief is not an easy end point and there are some conditions where there is residual bruising. If you are running an ENG (electronystagmogram) on somebody with vertigo the ENG will not necessarily revert to normal for 48 hours after you have in fact cured his lesion. So depth of relief even in skilled hands is not a good depth necessarily to go to. Certainly in unskilled hands it is asking for problems. The depth of the dive is a very useful treatment depth and indeed for blowup we find that the depth of the dive is the depth of relief. A blowup can be from a depth deeper than your chamber goes to and this can be embarrassing.

With 150 foot diving, a 165 feet chamber will be adequate. But people who go down to 250 feet on air, could be in real trouble, because 165 feet would not necessarily be enough pressure to cure them.

Oxygen

50 m or 165 feet of air has a surface equivalent of 120% oxygen. The French Navy uses a 40% oxygen, 60% nitrogen table. At 30 m, which is 100 feet the PO2 of that is 1.6 atmospheres, which is equivalent to 160% oxygen at the surface. You can see that by pushing the oxygen partial pressure up while applying the pressure you can deliver a very good dose of oxygen to the patient. Comex, the French Diving Company, use a 50/50 mixture. They can even use that at 50 metres, which will give a partial pressure of 3 atmospheres or 300% oxygen at the surface. The 18 m oxygen Goodman and Workman tables give you very nearly 3 ATA of oxygen. Oxygen is easy to deliver. Before we leave pressure and oxygen, let us not forget that the balance is an inert gas, usually nitrogen. You may well hear in coming months some discussions as to whether or not nitrogen is the best treatment gas for air bends. As far as I am concerned, the hypothesis that helium may be a good inert gas for treatment of air bends remains an hypothesis until it has been further investigated. There is one particular centre that is pushing helium treatment for treatment of air bends. As yet the case is unproven.

Recompression is the treatment of choice. It should be given to any person who suffers virtually any condition within 36 hours of a dive. There are people who have had coronaries, acute appendicitis, cerebral vascular accidents, all of whom have been slung in the chamber because they might he slightly bent. Surprisingly, it did not do that correct diagnosis too much damage. They got through OK. The alternative, diagnosing bends incorrectly as a stroke or a heart attack or appendicitis, could leave the diver with permanent damage. So, when in doubt recompress.

To re-emphasize the point which I made yesterday about immediate recompression and no examination until you get to depth.

That is what one does if the patient reports immediately he has a symptom and it can be treated then and there. In cases where there is a more than 5 to 6 hour delay, I agree that one would want to examine the patient and to put up a drip and do all the other things that will be necessary, or in Tony Slark's words, to consider him as a hospital patient.

TREATMENT WITHOUT A CHAMBER

First Aid

Perhaps the most important thing is knowing what you do if you have a patient and you have no chamber. I will run through the list in case there are one or two which may be new to you or may trigger a distant bell in your heads.

The first thing is to put the patient in the head down position and on one side if conscious.

The second thing to do is to arrange for transport to the nearest chamber, preferably a helicopter flying below 1,000 feet or an aeroplane pressurised to 1,000 feet. Bear in mind that commercial aircraft are normally pressurised to 8,000 feet and also bear in mind that going over mountains can quite definitely make a patient worse. Altitude does not help at all. Nevertheless arrange for transport by the most rapid means possible.

Provide oxygen by a tight fitting mask. It is important to give as much oxygen as you can.

Avoid analgesics at this stage, even if the patient has got pain. Pain is a useful management guide. In particular avoid the mixture called Entonox. It is used in ambulances and by midwives as an analgesic agent in the UK. It is a 50/50 mixture of oxygen and nitrous oxide. It has been very well shown that nitrous oxide can be used as a bubble amplifier. So Entonox is contraindicated. I managed to get the British Oxygen Company to put a note about this danger in their detailed warning list for the analgesic agent. The same warning has been distributed to all UK ambulance services.

The next important thing is fluids. Oral fluids if the man will take it. The person is going to be dehydrated due to plasma shift. Lots of oral fluids are needed to keep the red cells flowing round smartly. At least a litre an hour. Setting up a drip even for somebody with a limb bend will not do him any harm. If you want to use dextran take blood for haematocrit first. For academic reasons dextran 70 if preferred to dextran 40 because it has a slightly better tapered effect. It does not last quite so long but it is not such a strong solution. 500 ml hourly appears to be the consensus view at the moment, what the majority of people in Europe would do for such cases. The other problem is hydration.

So if he is not having oral fluids, push them in as lactates, 5% dextrose, normal saline, plasma or whatever you have got. Try to maintain a colloid osmotic pressure of greater than 20 mm Hg to prevent oedema.

Drugs

There is tremendous scope for discussion about steroids which I shall avoid. The function of the steroids is to stabilize the vascular endothelium and to reduce the CNS oedema. I would personally give it in cord decompression sickness. I give a large star dose of hydrocortisone or dexamethasone and then a heavy maintenance dose, but not for more than two or three days, so that you can cut it off without tapering. I would give it to anybody who has got CNS problems following gas embolism even if it proved in retrospect to be unnecessary, because of the fatalities that I have seen.

Other drugs to consider are the osmotic agents. Glycerol tastes absolutely foul and is best given by nasogastric tube. 0.8 mi per kg in 50% flavoured water is the recommendation. The maximum effect is in one hour and lasts up to six hours. Mannitol has also been given successfully but there is a rebound after about 20 minutes or so, so it is a pretty desperate measure. There was one case written up by a guy from Guernsey, who managed to get apparently a complete relief, which did not relapse, using just mannitol.

Valium is very useful if you have got a problem with staggers, a labyrinthine hit. But bear in mind that it will suppress the manifestations. So it is going to make subsequent management rather difficult. I would withhold it unless I found it absolutely necessary, so that when we get to the recompression chamber we can see whether or not the recompression is working. If you do give it the chamber receiving the case must be informed. They should then give the patient the maximum recompression they can possibly manage on the grounds that the symptoms have been masked. Having no symptoms to guide them they had better assume that the patient is not responding to recompression and give him the maximum treatment.

Heparin is still mentioned. I regret to say that I recommended it in the first edition of the book. That was based on the lipaemia clearing activity of heparin. However Joe Farmer of Duke University has persuaded us that even in sub-anticoagulant doses of 2000 units there could nevertheless be a haemorrhagic effect. If there is any sort of problem in the labyrinth, heparin is contraindicated. The trouble is that even if you get a lot of cases you really cannot ever conduct a decent trial. So heparin is a bit of a myth.

Aspirin, which has a very useful platelet effect, is also contraindicated for the same reason, in that it may exacerbate labyrinthine haemorrhage.

Then do not forget some of the other practical procedures. Catheterisation should be considered and is a useful monitor, as you want to keep the fluid intake such that the output is about 1 to 2 ml per Kg per hour. Pleurocentesis, using the Heimlich valve may be required. Do not forget, and I am sure you will not, but the people accompanying the patient might forget, passive movement and pressure points for anybody who is quadriplegic.

I will not say anything about in-water re-compression, except to say that we do not recommend it in Europe, for the simple reason that the water is too cold. I think that in water as warm as we have here in the Philippines it would be quite reasonable to give in-water treatment decompression a try. I have no personal experience of it. Somewhere between these waters and European waters there is that water temperature at which I think it becomes inadvisable.

Those are the things that you can do in the absence of a chamber.

If the patient has got only chest problems, evidence of pneumothorax or mediastinal air but no neurological problems, there is no need to recompress the individual. But you have to keep him by the chamber just in case he does get neurological symptoms. The treatment needed is either pleurocentesis for pneumothorax or if it is mediastinal emphysema, oxygen by mask to help get the inert gas out.

TREATMENT IN A CHAMBER

I have got a few more slides and I have got all the gen here on treatment on bends in the chamber, treatment, the conventional treatment, the new treatments that are coming up, the problems that exist for those of us who are responsible for recompression chambers, selecting the right kind of treatment for the particular casualty. I have got the treatment of helium bends from bounce diving, the helium bends that occur from saturation diving, excursion from saturation diving, a copy of the world's deepest bend, which was deeper than 1,600 feet in onset which is quite an interesting story, and some further thoughts on the treatment of blowup, but in the interests of time I am going to scrub that tonight. I prefer to leave it until later in the programme.

DIVING ACCIDENTS

David Elliott

It is no coincidence that in the North Sea, although we resented the advent of rules and regulations for diving, they have in fact done a lot of good. Here are the fatality figures for commercial diving on the North-west European Continental shelf. In 1971 there were three deaths in an estimated total diver population of 200. The diver population is estimated from the number of annual diving medicals, which are required by everyone diving in the North Sea. It is only an estimate because some people have a medical and then go and work in other parts of the world. Then regulations were introduced, first in the UK and then virtually identical ones by Norway. Even so in 1974 there were ten deaths in an estimated diver population of 800. In 1975 there were nine deaths in an estimated diver population of 1,000. In 1978 and in 1979 the fatalities came down to three and the population went up to 2,500. In 1980 there was a record which we will be unable to beat, thank heavens, there was a fatality rate in the North-west European shelf of zero in 2,500 divers.

The philosophy of government regulations in Europe is not the American style of writing rigid regulations that you will do this or that. It is a philosophy of allocating responsibility and making sure if something goes wrong, that the person who should have been responsible is punished, if necessary in Court. The responsibility goes all the way up from the diver himself, who after all is responsible for saying whether or not on any given day he is fit to dive. If he conceals the fact that he has a hangover, or is on drugs, or any other condition which should have stopped him diving it is firmly his responsibility. It goes on up through the chain of command, supervisors, superintendents, the diving company as a whole and last but not least, to the oil company whose responsibility it is to make sure that its contractors are behaving in accordance with the principles of Health and Safety at Work.

So my job includes reviewing all our diving contractors around the world. For instance in North-west Borneo on one diving contract we had three bids. One bid was for a dive of up to 300 feet using a closed bell system. Another European company bid for bounce diving from a barge. They of course were very much cheaper. The company which actually won the contract had an intermediate technique. That was sufficiently dramatic to make me insist when we call tenders for diving contracts, that they all bid to the same standards of safety. Throughout the world Shell uses the North Sea Rules and Regulations which have produced some useful effect, judging from the crude fatality figures.

CAUSES OF DIVING ACCIDENTS

There are accidents specific to diving, those that occur in the water and the accidents associated with decompression. We can subdivide these into those caused by compression, the things that happen at maximum depth, and the decompression illnesses (which we have already dealt with). Also we have the coincidental illness or injury. Commercial divers go into a dive and they live at pressure for as long as a month. So their pressurised environment is dry as well as wet. For your purposes, coincidental illness or injury is such things as blowing a hole in yourself using a water jet gun, or swimming around at 250 feet when some idiot drops a spanner off the rig and it hits you on the back of the head. Those have both happened. Incidental illness includes myocardial infarction and cerebrovascular accidents, both of which have happened to divers in the water in the North Sea.

The causes of these accidents are very difficult to classify. We can use the usual epidemiological approach of host factors, environmental factors and the actual cause of

death. Death is nearly always drowning but really due to decompression or anoxia, which are the major causes of death in the diving accident. In the North Sea hypothermia has occurred as well.

I think the most important cause is lack of experience. The rules and regulations regarding training are very well written and are adhered to very well. The trouble is that once trained the diver goes out to get his own experience. He may fall into bad habits. He may work for a slipshod company. He may start to take short cuts. The problem is that the diver is trained in one sort of gear to a particular depth. You are trained in scuba gear and you are trained to a depth of approximately 120 feet. No-one should ever ask you to go to a deeper depth nor should they ask you to use different equipment. Because under both those conditions you would then be, as it were, novices in the environment. One of those many fatalities which occurred in the North Sea was a deep sea oxy-helium diver with fifteen years experience. He changed jobs and went to a pipe laying barge where he was expected to do compressed air diving. This diver died because he was doing a 50 foot dive on a stinger, which is a 300 foot long arm that goes out into the sea on the after end of the pipe laying barge. North Sea swells are 30 to 40 feet, so that 300 foot arm on the stern of the barge does rise and fall a little. This diver got mixed up with a part of equipment that he should not have done and died because of lack of experience. When you look at the fatality figures compressed air diving is more hazardous than helium diving. In helium diving you are nicely insulated and you go down in a bell and everybody has got their eye on you. In compressed air diving you are quite on your own as you are in sports diving. The problems are mostly at the surface of the sea.

INVESTIGATING DIVING ACCIDENTS

The first things that we ask when we are investigating a diving accident are - (a) was he properly trained, (b) was he trained to the depth of the dive, (c) was he trained in the equipment that he was using and (d) had he got adequate experience.

Fitness

The next question is about fitness. By fitness I mean firstly medical fitness, the exclusion of any medical condition that would make diving for that individual a hazardous occupation to himself and others and secondly and just as important, physical fitness. Because in an emergency a diver will have to use every last ounce of energy that he has and work through the maximum effort. The limiting factor for effort under water is not cardio-vascular but respiratory. The diver must be physically fit and in UK commercial diving we expect a diver to do a modified Harvard Step Test. At least it means that every year for two weeks before his annual examination, the diver does get off his backside and do something. Under fitness I would also include a little group of CO_2 retainers. People who do a lot of diving get quite used to the effects of CO_2. The respiratory centre does not increase ventilation as much as usual. In a few men the rise in $PaCO_2$ has been so large that it has been blamed for their loss of consciousness during dives.

The Environment

Next one considers the environment which is cold frequently and wet always. One must not forget that the wetness is a cause of hypothermia. Silence and poor communications, impaired visibility and neutral buoyancy with diminished proprioception, are all part of the environment. So when the diver gets an ear problem he is in real trouble, particularly if at depth.

The next thing about the environment is the sea state. Wave action can not only bash you against rocks, structures and against the side of a boat, but can also impair inwater stops. What is a 10 feet stop in a 20 feet sea? Another problem is sluice gates and culverts and the number of divers who have been sucked into them to their deaths. Diving in a wreck is an obvious danger. There are other problems, but bear in mind when you are diving on a wreck, the possibility of contamination from cargo. Failing to note the tidal stream is another major problem.

One salvage problem had not only the obvious dangers of working in a wreck, but also the dangers of tetraethyl lead in leaking drums. The drums had been on the bottom of the sea for about seven years, gently leaking and killing the fish for miles around. How does one get divers to dive safely on something which can be absorbed into the skin? The series of dives took a year to complete by an Italian diving company. Only on the last dive (when we imagine that the lead went in through the breathing hose into the air circuit) did any of the divers' blood lead levels go up. The divers wore over their ordinary suits, which had to be a dry suit, a white plastic coverall. The tetraethyl lead had fluorescine in it and the fluorescine could be seen if it contaminated the coverall. The hose was positively buoyant so it did not drag in the contaminated mud. When he got back to the bell, we had Drager tubes and charcoal in the soda lime scrubber and all sorts of things to try to get rid of the problem.

Another problem is the use of epoxy resins by divers under the sea. These are very toxic chemicals when they are curing. If the diver brings the stuff back into the bell you have got to get rid of that contamination.

Hydrogen sulphide, although a contaminant of natural gas, is also generated by sulphur reducing bacteria and is often found in mud from where oil deposits have been dumped. So that H2S is another contaminant for people diving from diving bells.

To go onto things more likely to affect scuba divers. Underwater electric shock is a subject of at least two volumes on the problems of diving near electric currents. With the impressed anode system for preventing corrosion of metal you can feel the effects for about 100 feet around the anodes. It is normally switched off when divers are in the water.

Blast, underwater dynamiting can be quite a thump in the ear even when it is a couple of miles away. Although much of the information is classified, the British Navy has said quite firmly that you can dive to within some ten to fifteen metres of any sonar that has been made, quite safely.

More obvious causes of accidents include nitrogen narcosis. Obviously if you go too deep you are going to get narked. I remember a body that was pulled out of Lake Windermere from about 280 feet, which had a broad grin from ear to ear. We attributed the accident to nitrogen narcosis. Neither pulmonary oxygen toxicity nor oxygen neuro-toxicity are likely to affect scuba divers for the very good reason that you do not use closed circuit oxygen. Only European cave divers are prepared to do that. The thermal capacity of helium is a major problem and so is HPNS.

Breathing Apparatus

Our real problem is how to design breathing apparatus that is not going to compound the problems of diving.

To list the types of breathing apparatus that one can use: First there is the open circuit, of which scuba is one of the varieties. The free-flow helmet is the good old fashioned inverted bucket, with a hose just blasting air through it. Free flow with a venturi-assisted partial re-circulation is used for helium divers to conserve helium. Some of the exhaled gas goes around the soda lime scrubber and into the helmet again. Demand valve is the circuit in scuba diving. Demand valve with umbilical supply which can have a mouthpiece or an oro-mask; no great difference to an ordinary scuba set except that the gas is coming from a hose from the surface and the bottle on your back is the reserve. You can also have a helmet so that your entire head is dry and then have a little neck dam that wobbles up and down as you breathe in and out to provide flexibility. That too can be demand valve, umbilical supply, open circuit.

Now we come to the complicated things. The closed circuit pure oxygen. The constant partial pressure of oxygen/mixed gas closed circuit breathing apparatus. There are a lot of problems with these. Semi-closed circuits are ones which have a partial re-circulation of gas which can either be nitrogen with oxygen rich mixtures as used by the navies or helium as used by commercial divers, with low oxygen content.

Push-pull is a phrase that you read in the papers, when there has been a diving accident and it means a lot of things. Push-pull can mean that it is an ordinary demand valve with umbilical supply and a return line for the exhaled gas to the surface. The gas can be reclaimed, purified and used again. Unfortunately if the return line to the surface fails, the diver will go up the tube. You can imagine that with 600 feet of pressure, there would be no difficulty in getting minced diver through the top end of the pipe. So the return line must be fitted with very good safety valves. There has been one fatality with that kind of system. It can mean a demand valve with a closed loop back to the diving bell. Here the pressure differential is not so great, but the engineering problems are enormous. Or it can mean free-flow with a closed loop to the bell. The bell is exactly the same but has in it a pump pumping gas to the diver. He wears a helmet and the gas just flows past his face and then back to the bell. That is the ideal system, it is commercially available and it costs about $24,000 a set.

The principles of breathing apparatus design are, supplying oxygen at between 0.2 and 1.8 ATA depending on the depth, keeping the CO_2 down, keeping the gas temperature within US Navy limits and with adequate ventilation to a respiratory minute volume of 65 litres per minute. This is the kind of testing that is done on breathing apparatus including scuba demand valves. The work of breathing must be less than 1.7 kgm metres per litre of gas shifted, the inspiratory/expiratory pressure at T7, the delta pressure must be about 15 millibars which is very roughly equivalent to centimetres of water. One can run this on a laboratory test rig. But the important thing is manned testing. using respiratory physiology to make certain that the breathing apparatus is actually being properly utilised by the diver, that his CO_2 is normal and so on. But most important, comfort and ease of maintenance. It is the failure to maintain demand valves that may cause a significant number of problems to scuba diving. Important too are the reliability of the equipment, communications, noise, and the emergency procedures in the event that the equipment fails.

SPECIFIC PROBLEMS

We are now going to have a look at one or two specific areas. Hyperventilation before breathhold diving can, by reducing the PCO2, harm you. You hyperventilate at the surface so that you can prolong your breathholding time. You go down to depth, where you can hold your breath for a significantly longer period. Hypoxia will not be evident because the increased pressure raises the partial pressure of oxygen until such time as you ascend. You return to the surface and lose consciousness from anoxia. This is why hyperventilation should be discouraged.

Snorkel deadspace is really important only with children. Children have problems with snorkels. They need to have it narrow, but not too narrow because the breathing resistance is then high. Too many children are given adult snorkels with a large dead space. They need narrow and short snorkels.

With breathhold diving there is negative buoyancy on descent, because your chest is compressed. You have got to swim up. If you wait to float up you could wait a long time.

With closed and semi-closed circuit apparatus, which is the same kind of gear, we have the problems of too much oxygen, too little oxygen, CO2 build up and soda lime cocktail. These are the reasons why in the UK we positively

discourage the use of oxygen breathing apparatus by Sub-Aqua Clubs. There are only a few cave diving clubs where oxygen is used.

The last category to deal with is external factors. In commercial diving we have such problems as blowups to the surface. Blowup can happen to anyone. Blowup can occur if you fail to deflate the buoyancy compensator properly before making your ascent, because it will inflate further, and bring you up out of control. If you splay your arms and legs out and keep your fins at right angles to your feet, this will slow you down considerably. Blowup is much more common with a dry suit, for exactly the same reason. They have inflated their suits to avoid pinches on the way down. They have to remember to come up with a finger in the cuff venting the gas as they come up. Otherwise they will come up like a great big balloon, far too fast, with the risk of pulmonary barotrauma. The problem of blowup also occurs with bells. In the North Sea a diving bell has lost its ballast weight. It was considered important that if a bell got dropped the people inside it should be able to release the ballast weight so that they could get back to the surface unaided. So of course the first accident that occurred was the loss of the ballast weight and the bell came to the surface. This killed one of the divers and the other diver is still paralysed.

The problems of external environment mostly apply, apart from diving near culverts and wrecks, to commercial diving. The six fatalities in the North Sea in the last three years were all due to procedural problems. Either loss of the bell because a bell wire parted, or due to the dynamic positioning system malfunction of the mother ship. They were not due to physiological causes and certainly not due to medical problems. Only one of all the fatalities in the North Sea was due to a medical practitioner failing to do his job. I say that very carefully because it has been to Court and the case is now closed. The doctor said that the diagnosis was pneumonia when in fact the diver had a pneumothorax. He refused to put a needle in and the main died on the way up. The post mortem showed both lungs absolutely plastered to the mediastinum. It was a very humbling lesson to the whole medical profession. This particular doctor had known nothing about diving. I will bring this up again when we start talking about the medical cover for diving and who should be trained, how and to do what.

SUMMARY OF CAUSES

Now a summary of what we have been going through. Although some of my examples have touched upon the use of re-breathers and other clever sorts of breathing gear, in fact scuba covers most of the problems. So when you find a dead diver in your club, these are the things that you will have to think about. Hypoxia with the snorkel diver, hypocapnia, inadequate training, faulty equipment, diving bradycardia from the face immersion reflex.

Accidents underwater are like accidents everywhere, there is no single cause. The most common cause of diving fatalities is a flooded face mask. Why? Because one thing leads to another and everybody can cope with a flooded face mask. The trouble is that if, in the middle of trying to cope with some other accident, like being tangled up in a bit of wire on the bottom or trying to get out of a wreck, you then knock your face mask and it floods, you have got two things to deal with. There is then the domino effect of one factor upon another which you may fail to cope with, leading to death by drowning.

My list includes things like diving bradycardia, which quite definitely impairs cardiovascular response to exercise and can be a contributory factor. Hypothermia we have mentioned. Marine animals you probably know more about that than I do. Aspiration of vomit is very common in the dead diver. Some current medical problems we have touched on. Underwater blowup, barotrauma and air embolism we have already discussed. Syncope of ascent is a differential diagnosis of pulmonary barotrauma. A dangerous one, because although it may be true, it should always be handled as though it were decompression barotrauma. Syncope of ascent is due to overpressure of the lungs impairing venous return and then impairing cerebral circulation. The diver loses consciousness temporarily on arriving at the surface, but makes a full recovery. This is an explanation, I think it is inadequate and dangerous to a certain extent. But you will read it in the literature and therefore it must be brought into this discussion.

Heat stress can be a cause of diving accidents, particularly for people who are diving in a diving bell, which is sitting at the surface for a long time before going into cold water for their dive.

Nitrogen narcosis, carbon monoxide, oxygen and CO_2 problems, dilutional hypoxia, which only applies to the semi-closed breathing apparatus, have all caused accidents.

Now back to scuba and its place in the industry. Because in scuba diving you have no communication with the surface, nor do you have a hose to provide you with continuing supply of compressed gas, we do not allow scuba diving in commercial work, unless it can be shown that it is safer to use scuba than to do hose diving. There are a few occasions when this is true, but it is very rare.

AN ACCIDENT THAT DID NOT HAPPEN

Now to discuss a photograph of a man at about 30 feet down on a structure using a water jet gun to clean off sea growth. The employing company told me that they were diving by North Sea regulations. But there are at least five infringements of North Sea diving practice in the photograph. The first is using scuba, when he should be using hose gear. Secondly, he has no bouyancy or compensator jacket and he is wearing a wet suit. Dropping

a weight belt has a 50/50 chance that it will snag on you somewhere. Thirdly, while he is wearing a life line as is required, the life line does not go straight to the surface. It goes around a leg of that platform then 60 feet across the structure and up the other side. As a life line it is absolutely useless. If he were to make an emergency ascent it would immediately become snagged. That is incorrect diving procedure. If you have a life line it must be clear to the surface and kept reasonably taut by the tender. He must be fishing you all the time. The next thing that is wrong is that he has no through water communications. We require communication for the short term memory defects. When you are at 165 feet you have a 10% decrement in mental performance and you also lose your short term memory. Now that does not matter too much when you are photographing fish, you will remember them later when you see the photos, but when you are doing a commercial job, you have got to be able to make a report on what you find. Through water communication is required for that purpose. But also, particularly if it is on a hard wire, you can hear the diver's breathing all the time and that is very, very satisfying.

Another thing that is wrong is that the diver is doing a job of work. We do permit scuba diving for exceptional tidal conditions in complex structures but only for inspection jobs. Not only is he doing a job of work but he is using a water jet gun, which pushes out water at several thousand psi in a very narrow jet, to get rid of all the marine growth. There is a retrojet so that there is an equal force in either direction. The trigger takes about a three pound pull, because it is a standard surface water jet gun. As the manufacturer only sells a few thousand to divers he does not bother to modify the trigger. So the average diver takes a bit of wire or nylon and ties the trigger down so that it will stay on. Then he drops it in the mud. While he is groping around the jet blows a neat little hole right through his hand. The water jet gun is a very dangerous instrument. The wound is rather like a stilleto injury. But the water jet can blow bits of wet suit, undergarment, any passing fish, plus skin and other tissue right through to the peritoneal cavity. That is a picture of a diving accident waiting to happen, but which did not.

MONITORING

Why not avoid accidents by monitoring the divers in the water? Well the control shack for an average deep dive is not unlike the control cabin of a submarine or an aeroplane. There is an awful lot for a diving supervisor to do. Some medical people want to monitor the diver's pulse rate, have an EEG on him and measure his end tidal CO2 while he is diving. Even if we could do it reliably, how would that help those two watch keepers? How would they know what the normal pulse rate of that individual is when he is working hard? How would they know at what threshold value they should say to the diver "Hang on, your pulse rate is too high". And the practical point of view - do they have to cancel the entire diving operation when the pulse rate metre is on the blink. The commercial diver costs something like $10,000 per hour to have in the water, so if all he is doing is waiting for the monitoring equipment to come on the line, monitoring is rather an expensive waste of time.

DIVING SAFETY

The most important part of diving safety is the surface control. Obviously the diver must be properly trained, medically fit, physically fit, right equipment and all that. Monitoring the diver from above consists of knowing when to talk to the diver to get a reply that he is OK, when to listen to his breathing. We now have every diver on a separate channel, so that the supervisor can hear the breathing of both divers at the same time, if there are two divers in the water. It is really a very delicate method of telling whether the diver is comfortable or not. Then there is the flying eyeball. It has 3 degrees of freedom. You can pilot it from the surface and using the TV camera in it you can watch the diver at work. For a dive below 1,000 feet, it is absolutely mandatory. It means that you can keep an eye on what is being done. If something starts to go wrong, you can get the standby diver in the bell to go out and assist.

You can see that the diving world that I live in is totally different from yours. When we do a dive it is a quasi-military organisation. The people topside are responsible and are in continuous two-way communication with the men underwater. The man in the water is on the end of a line, at the end of the hose, at the end of the communication link. I think because of this and because people are doing it conscientiously, we have managed to get diving fatalities down to the level they are now.

DISCUSSION

Question:

Could you please enlarge on the electrical field effect danger. You said that if there was an electrical anti-corrosion system working it was a danger to the diver.

Dr David Elliott

What one has with a structure in the sea is a method of protection by cathodes and anodes, electrolytic protection. One of systems is called the impressed current system. You have an electrical source that is sending out an electrical field from quite some distance away over that structure. There are dangers. The diver is not likely to go near it as there is a field effect from it. The trouble is that it must be supplied by an electric current and you never know when some passing bit of metal, fish, or diver, might have damaged the wire causing a leak. Then there will be very much more intense effects in parts of the structure. They can be sufficient, in theory, to put all the muscles into spasm and certainly to stop the heart. So one of the rules of that kind of system is that the current is switched off 30

minutes before the diver goes into the water.

Question:

There are quite a lot of small craft now that have that sort of thing attached to them connected to a 12 volt minimal current, what do you do about that?

Dr David Elliott

I was not talking about that sort of thing. I was talking about the really big ones. I am not conversant with the technical details, as I say there are two large books. It is one of the safety procedures that we merely put in, to say that diving shall be in accordance with the electrical underwater safety standards of the American Institute of Electrical Engineering. But I am glad you brought it up, because it does stress the complexity of diving. Although I do not think that sports scuba diving will ever run across this sort of problem, it is just as well to be aware of the sort of things that can occur. If one day some people decide to go off and look at a platform or went off to have a look at a wreck, unexpected hazards might occur that have not been mentioned in any scuba diving text books.

Question: Dr John Doncaster

I was wondering if you could elaborate on the risks of sonar - are the risks confined just to the ears, or the whole body.

Dr David Elliott

It is really an ear damage, basically. It is very, very painful. There is pain and a very high intense noise, enough possibly to disorient one.

Question: Dr Tony Slark

You mentioned a diving death off the coast of Scotland. I wonder if you could tell us why it was that communication was so difficult. When an inexperienced person, but hopefully a competent clinician, could be in that position and yet not be advised by more experienced doctors.

Dr David Elliott

I regret to say that in that particular case communications did not fail. That particular doctor was advised by a number of people, including myself, that he had got to get a needle into the chest and he decided that he knew better. As he was a doctor actually at sea, and we were a good thousand miles away, there was not very much that we could do about it.

Question: Dr Bill Hurst

What is the ratio of non-fatal to fatal accidents? Is it something that is monitored?

Dr David Elliott

Theoretically it should be monitored and Jackie Warner at the Department of Energy requires an accident report on all the near misses. But we are all fully aware, as is he, that he does not get them. There is no near miss reporting, so we do not know. The best way to find out the truth is by drinking beer with the divers. The other place you can get at the truth is during the medical examination. The doctors who do a lot of diving medicals get a tremendous lot of information which is very valuable. One or two doctors in particular in the UK are very useful to me in telling me what really happened on a particular occasion to supplement the official stories. The answer is that we really do not know. We have heard stories of bells being dropped on the sea bed and being recovered without loss of life and nobody officially has heard about this. Of course the diving company does not want anybody to know that they are so incompetent as to drop a bell on the sea bed.

Question: Dr Jones

What problems do saturation divers have with their ears?

Dr David Elliott

There are many kinds of ear problems in saturation diving. One is the thing called counter diffusion, which is where with a change of inert gas, for instance from helium to nitrogen, which one can do during an ascent. The different diffusion rate of gas in the body can cause vertigo, by creating bubbles in the end organ which otherwise would not have occurred.

The other kind of ear problem is when the divers get otitis externa and that is perhaps the most costly diving problem of all. I think we can avoid that by proper prophylaxis, but it does take an almost military style regime. How do you stop otitis externa? Using prophylactic ear drops three times a day and after wet dips. Usually Domobro solution which is an acetylsalicylic acid in alcohol solution, with aluminium acetate carefully buffered to a particular pH of about 5. The organism is usually pseudomonas, which is plastered all the way around walls of every saturation chamber. The important thing with those ear drops is that each diver has his own two bottles of drops, marked right and left, so he does not cross contaminate. He lies on his bunk, puts the drops in, and the diving superintendent stands outside the port and checks him off and times him for one minute. Then says to turn over and do the other one. If they do that three times a day and after a wet dip, they do not get ear problems. If anyone does get ear problems, it is because they are not doing it properly. Pseudomonas is

a major problem, so much so that a lot of diving companies will actually do a bacterial swab of everybody's ears before they go under pressure. Using non-toxic germicides such as Panocyde, cleaning of the pressure chamber is a daily routine. One of the reasons why one has to be very careful is in case an operation is necessary under pressure, which occasionally has to be done, the real problem will be trying to get a sterile field. You cannot use inhalational anaesthetics, you have to use regional blocks.

Question:

In aviation medicine near misses are reported.

Dr David Elliott

The real problem is getting people to report accidents. I do not know about commerce, but certainly in the Royal Air Force there is anonymous reporting.

WHAT SHOULD BE THE MEDICAL STANDARDS FOR SPORTS DIVERS?

John Knight

This session is necessary because the various sports diving teaching organisations have raised their standards over the past few years. Seven or eight years ago all one had to do to get a "C" card was pay the money and they would teach you. Instructors found that they were having difficulty getting people through the practical side because some of them were very poor swimmers. So the first standard was that everyone had to swim 200m in five minutes. About this time there were four fatalities under training in Victoria, all on their first sea dive, in one year. One was due to a dropped weight belt catching on a knife.

Some instructors started looking around for some sort of medical standards. The only medical standard available in Australia was the CZ 18 Air Diving Standard produced by the Standards Association of Australia for commercial divers. One reason for medical standards for commercial divers is the need for Workers' Compensation insurance. The insurer wants the divers to be fit and unlikely to cost money. So naturally they need long bone surveys. Also in the Standard, borrowed from the Royal Australian Navy diving manual, is the statement that the upper age limit for learning to dive is 35. That is quite reasonable when you see what they are put through on the Naval ships divers' course. There are no reasons why sports divers should not learn to dive after 35. An ECG to show whether the man had relatively normal electrical activity before he was employed was a good idea. Borrowed from the Navy were questions about whether you had VD, whether you had piles, or skin rashes which had very little bearing on a sports diver being likely to survive his training and his sports diving. This standard has now been superseded by AS 2299, which makes it compulsory to have exercise ECG's for commercial divers, because ordinary ECG's have not predicted who is going to die from a coronary before his next six monthly medical.

We have a standard, but it is not for sports divers, and FAUI, the Federation of Australian Underwater Instructors, is asking that trainees meet these standards. PADI, the Professional Association of Diving Instructors, gives the novice a note which says that the diver must have normal cardiovascular and respiratory function and be able to clear his ears. That is a fairly general sort of standard, which most of us meet, but it does not help the GP who knows nothing about diving. The problem has become acute because FAUI has taken to reprinting the appropriate medical exam form from AS CZ 18. Everyone who goes to a FAUI school is given one. Usually he is told the names of a number of doctors who understand diving medicine. They are also told that the alternative is to take the form to their own GP. One budding diver was knocked back as unfit because he had varicose veins. I am sure that hydrostatic pressure is not really going to risk his life by compressing his varicose veins. But his GP did not know anything about diving medicine.

When diving instructors told me that they were getting all sorts of medical knockbacks, on grounds that did not seem sensible to them, I wrote to the National Co-ordinator of FAUI in May 1979. By May 1980 I had still not had a reply to my letter. When in October 1980 I still had not had a reply I sent copies of my letter to all diving instructors known to me in Victoria.

My letter was along these lines: The object of a diving medical before teaching people to dive is to weed out those who are likely to come to harm by diving, especially those who are likely to die as a result of entering the water environment and its changes of pressure. I enclosed a draft letter for FAUI to send out with every copy of the diving medical examination form. The letter was headed "To the Examining Doctor" and it went into the reasons why I considered that people should not dive with certain conditions. My list of conditions why people should not dive are pretty basic when it comes to sports divers. (These letters were published in the SPUMS Journal of July-September 1981).

ABSOLUTE CONTRAINDICATIONS

I consider an absolute contraindication any illness which makes the person unconscious without warning. I do not consider the aura of a fit coming on as adequate warning to

get out of the water. The only other one is a diabetic on insulin, because if he works hard he may become hypoglycaemic. I do not believe that, even if you are good at telling your hypoglycaemias you are going to be able to find the pocket in your wet suit, take out the barley sugar, unwrap it, lift your regulator out of your mouth, pop in the barley sugar, put back your regulator and purge it, and then suck the barley sugar in time to guarantee that you will not go unconscious. The reason why I do not think it is a good idea for people to go unconscious under water is that a lot of people going unconscious under water drop their mouthpiece, but they go on breathing. Human lungs are not designed to run on either sea water or fresh water. You may survive if you drop your mouthpiece and stop breathing but if you go on breathing you are going to drown.

TABLE 1

ABSOLUTE CONTRAINDICATIONS TO DIVING

CONDITIONS LIKELY TO CAUSE:

- UNCONSCIOUSNESS
- PULMONARY BAROTRAUMA
  - Previous spontaneous pneumothorax
  - Lung cysts
  - Scarred lungs
  - Obstructive lung disease
  - Lungs that empty unevenly
  - Previous thoracotomy
  - Asthma
- BREATHLESSNESS
- DAMAGE TO EARS
  - Inability to clear ears
  - Perforated ear drum
  - Previous middle ear surgery with insertion of prosthesis
  - Previous repair of inner ear fistula

The other absolute contraindication is anything that will make your lungs more likely to burst with changes in pressure. At the head of my list I put a history of spontaneous pneumothorax, because that lung can burst without being subjected to changes in pressure. Then I put bullae and other air traps that show up only with a chest X-ray. I include thoracic surgery, because you really can not tell what has got stuck to which when somebody has been fossicking around inside the thorax. Old tuberculosis and other scarring diseases, such as sarcoidosis or hydatids, which is not uncommon in Country Victoria are also reasons for not diving. I very nearly passed a man as fit to dive, because I missed the old scars in his lungs and he had forgotten to tell me that when he was aged 11 he had been in hospital to have an operation to remove hydatids from his lung. The night before he had a coughing fit and he brought up a lot of funny sputum. Next morning his surgeon sent him home as he no longer needed the operation. The radiologist picked it up and rang me to warn me. When I spoke to the patient he was really quite relieved that he did not have to go diving. He was only taking up diving to be a buddy to his 17 year old son, who had bullied him into learning. I also include foreign bodies such as bullets. They cannot get into your lungs without scarring.

I have left out of that list the things that cause problems with breathing out, such as chronic obstructive airway disease and asthma, although they are very important, because you have got to get all the others out of the way first. In my opinion somebody who has had asthma in his or her adult life should not dive. We had proof of this in Victoria this past year when four people have got into serious trouble by getting asthmatic attacks in the water. The last one I heard of was the Monday before we left for the Philippines. This was a girl doing a night dive as part of her training. It was in Portsea Hole, which is 80 feet deep, a stupid place to take people on their first night dive. However there were lots of instructors. One (who told me about this) was watching this pair of novices sinking steadily downwards because they had not inflated their buoyancy compensators enough. So he swam down and inflated the girl's compensator by mouth. As he put his own regulator back in, his light went across her face, and to his horror he saw the regulator was not there. He picked it up and stuffed it back in her mouth, but it just fell out again. He pulled the string on her CO2 vest and on his, both of them worked (Mr Murphy must have been asleep), and they shot to the surface. He had one thought in his mind on the way up. "Are we going to come up underneath the boat?" because it was a very solid boat, but luckily they came up alongside. She was unconscious and rigid. It was difficult to get her back into the boat. They gave her oxygen and after about 10 minutes she started to scream and kept this up for about 5 minutes. It came out later that she was an asthmatic needing constant treatment who had seen a diving doctor who believes that it is quite safe to let asthmatics go diving.

On the other hand a 22 year old who used to get asthma as a child, but has not had any asthma since the age of 12 and no treatment since the age of 10 is a different problem. If his vitalograph shows that he can empty his lungs at a normal rate I think that he can safely dive with the provisos that he has got to watch his contents gauge and never run out of air, and that he comes up slower than the 60 feet per minute recommended by the US Navy tables. If you really watch your rate of ascent 60 feet per minute is quite slow. Many divers take less than 30 seconds to reach the surface from 30 feet.

RELATIVE CONTRAINDICATIONS

The main relative contraindication is inability to clear their ears to your satisfaction, ie. you cannot see the drum move.

You have got to teach most novices how to clear their ears. It is no good saying "Hold your nose and blow" that makes one go red in the face but it does not necessarily open the Eustachian tubes. They have got to wobble their jaw muscles about, or swallow and then quite often you find that they can clear their ears beautifully.

TABLE 2

RELATIVE CONTRAINDICATIONS

FEV1/VC Ratio less than 75%
Poor physical condition
Previous myocardial infarction
Pregnancy

For those who can not clear their ears there is a lot to be said for looking up their noses and seeing if the septum is straight. If it is he has got more of a problem than if it is not. The Royal Navy some years ago assessed all the people who had failed to equalise their ears in submarine escape tank training, which requires a dry compression to 100 feet. If they had deviated septums the septum was straightened. 98% of those operated upon could clear their ears afterwards. Perhaps they were just frightened of having their nose done again! Nevertheless that sort of success rate with an operation is rare. When people can not clear their ears, you show them how, you give them decongestants and you tell them to go away and practice. But the most important thing is getting in the water and trying. For although they may not be able to wave their ear drums at you, they may be able to clear their ears in the water.

In Singapore last year, Chris Lourey told a very interesting physiological story of what happens to heart rhythms when people get into water. He pointed out that in cold water quite a large proportion of the deaths in the group over 35 are due to cardiac causes. That is an American statistic. Our death rate in Australia is mercifully so low that you can not do similar statistics. We can just point out that the great majority are inexperienced, many have borrowed a friend's gear and have had no training. I do not see why it is up to us, as doctors, to say that someone with an ST segment depression in his ECG should not dive for recreation. One should tell him that he might die from his diving, but I do not believe that we have any right to say that he should NOT dive. We have got every right to tell the commercial diver, an employee, that he should not dive, because he no longer meets the required medical standard. I have all the commercial divers' ECG's read by an expert as well as looking at them myself. If somebody comes to me with angina and says that he wants to go diving, I tell him that I think that he should not dive. If somebody comes to me having had vein grafts to his heart, I tell him that if he wants to go diving it is up to him, but if he is a commercial diver I tell him to give up diving because he no longer meets the standard. I can not see why somebody who enjoys diving should not be allowed to risk dying while he is diving as long as he does not inconvenience too many other people. After all he is allowed to risk dying while driving his car.

The reason for knocking back a prospective scuba diver (I am only dealing here with learning to dive) is that instructors want a standard. If you encourage people to dive who are going to die while learning to dive the instructor is in a very dicey position. He will be sued and so will you for saying that the dead diver was fit to dive.

I am looking for a standard that protects the instructors, so that they do not get people who are going to die on them and also protects people from their lack of knowledge. People get carried away by the beauties of the Barrier Reef and are not satisfied with snorkelling. They want to learn to dive. One university student I saw was an uncontrolled epileptic, a diabetic and had asthma. I managed to talk him out of diving. If you explain what the risks are, most of the people who should not dive accept your advice and stick to snorkelling.

SPUMS has been asked to produce a simple standard that can be understood by any doctor who has no diving knowledge (they do a lot of the medicals) so that the instructors can be certain that they have excluded those who should not dive for medical reasons.

DISCUSSION

Chairman: Dr Bob Hare

I want points of view. These will be noted and published.

Dr Mace Ramsay

I think that you have got a double standard. I mean if you are not going to allow someone with asthma to dive, why allow a heart case to dive. It seems crazy to me. The older group who have got arrhythmias should not be going underwater.

Dr Tony Slark

I think we have got to be very concerned about being too paternalistic in our attitudes to people. We have to allow people who are enthusiastic to do things.

If FAUI says that they want people to achieve a certain medical standard, we have to point out that the tests necessary cost $100 or $200 more than the cost of the course. So we have got to do a medical evaluation at a cost that bears some relationship to the cost of the diving course. There is no point in doing a whole lot of things that are paternalistically safe in order to make absolutely sure that there is no legal comeback. When somebody who has a disability comes to you, you can say "Yes, you may dive, but you must be careful". It may be careful of going too deep, or careful about going down without certain degrees

of surface support. Most amateur divers of course go diving with no surface support at all.

You must not say to the person you can not dive because you can not get into the boat because that bloke, if he is intelligent, can fix up some way of getting into a boat with a few buddies. You have to say to the instructors that this fellow can dive, as long as you take notice of his disability, which is recorded here on the report. I do not think that you should ever give a certificate to a person stating that they may not dive under any circumstances, because they chuck it away as soon as you give it to them. Your certificate should say that this person is fit to dive as far as we know, which is as far as the extent of our examination is concerned. Or it should say that this person is fit to dive with certain degrees of supervision, or in limited circumstances. Those certain limited circumstances might be in a swimming pool that is no more than 6 feet deep and with half a dozen instructors around him. As long as you say what those circumstances are you will not be at fault.

For goodness sake let us not try to play God by telling people who are interested in diving what they may or may not do.

Dr Peter James

Asthma is perhaps the best example to show how confused we are about our standards. Beryl Turner says that asthma is totally contraindicated and I read an article by Tony Slark, in Modern Medicine, which says you can dive if you have not had an attack for two years. I have also discussed it with several respiratory physicians who state that smoking is a greater contraindication to diving than asthma as you are more likely to block the small airways.

On the legal aspect, Beryl Turner said, at a Sports Medicine Conference, that asthma is an absolute contraindication to diving. Should a doctor let someone with asthma dive, and they die, she is willing to give evidence against that doctor. That is one opinion. Who are the experts? Who do I ask about asthma? What proof is there that asthma is a contraindication to diving? What proof is there that asthma has directly caused problems?

Dr John Knight

One answer is that asthma has been responsible for four cases of very near death, underwater, in Victoria last year. Of course one can not say that these were only due to asthma. What I think happens is that the circumstances of the dive and the asthma combine to give you the problem. Certainly David Cossar had a very sick customer, whose problems became evident at 15 feet, on his hands when he was doing his final checkout. That patient stayed blue for some considerable time on 100% oxygen. So they had a real gas exchange problem. But if you want controlled trial, cast-iron, evidence there is none.

I do not believe that you have to exclude every asthmatic from diving, but because of the cases that occur I think that they are stupid to dive, because they increase the risks. I can not stop my friends who have asthma and have been diving for years from diving. They are willing to take the extra risk. However, the instructor organisations are frightened of being sued and they want to exclude the common causes of death and problems, which I think is a fair enough request.

Dr Bob Hare

I think that it is also incumbent upon the instructors to insist on the medical being done before the client pays a lot of money for a diving course. On the course I was on they did not insist on a medical until the checkout sea dive. That is the wrong way to go about it.

Dr Wayne Lehmann

Quite clearly under these circumstances, all patients with known coronary heart disease should be excluded because they are liable to sudden death. We have excluded asthmatics, because very rarely their attacks may be sudden and they may die underwater. Obviously this applies to coronary heart disease also. I think that we should include also patients with known cardiac arrhythmias.

Dr John McKee

There are many retrospective examinations of students who have done diving courses. A fortnight ago I had a ring from a young fellow whom I had treated seven years before. He had had a motor cycle accident. The handlebar went right through his chest. He had completed his diving course in Sydney and was dismayed to find that his operation was a hazard to his diving.

Dr Greg Leslie

It has been shown that exercise is beneficial for people with coronary heart disease. Whether someone who has had a coronary or has coronary disease should be barred from active sport for life is a very disputed question.

What physical standards of fitness do you use in assessing whether someone is fit to dive?

Dr John Knight

The standard that I use is about as fit as I am (laughter). I think fitness is largely a subjective assessment unless you have got a laboratory where the subject can run on treadmills.

Dr Greg Leslie

You do not need a laboratory. You need a measured distance to be run or swum in a given time. I think that SPUMS should look into this because there is a tremendous

amount of published material on fitness. It comes down to ml of oxygen per kilogram per minute. However you do not need an oxygen consumption meter to register it. You merely need a few simple physical tests of endurance. I think this should be incorporated into the examination of divers.

Dr John Knight

I think that the most important thing about diving safely is that you are happy in the water. Remember that a third of the students who complete their course will never get into the water as a diver ever again and another third dive four or five times and then give up diving. Only one third of diving trainees continue to dive. Those are Melbourne figures, where the diving schools teach somewhere between 4,000 and 5,000 people a year. Your requirement that they swim a certain distance in a given time is part of the diving course.

Dr Greg Leslie

But that is a very small distance in a very slow time. If SPUMS is going to make recommendations, there should be a certain level of physical fitness.

Dr John Knight

Would you like to put pen to paper and send the executive your recommendations?

Dr Victor Brand

The Club Mediterranee in Morea had a very simple physical test. Your pulse rate was counted and your blood pressure taken. Then you did 30 knee bends and after a minute the pulse rate was counted again and your blood pressure was taken. There are more than one of these dubious medical tests, which I suppose could be used.

Dr Tony Slark

Physical tests should be just for commercial divers. Not for the amateur enthusiast who wishes to start a sporting activity which may encourage him to take physical exercise.

Question:

What is the Sharpened Romberg test?

Dr John Knight

You get the person to stand with one foot in front of the other with arms folded across the chest. When they stop wobbling you ask them to shut their eyes and you time, in seconds, how long they can stand there without falling over. Carl Edmonds has a mathematical formula for scoring the result. I just count the seconds. If he can stand there for thirty seconds I reckon he has fairly normal balance.

From what has been said it may be simplest to word the medical certificate as follows: "He wishes to dive. I have examined him and he suffers from asthma, coronary heart disease and cannot clear his ears, but it is up to him to dive if he wants to."

Dr Janene Mannerheim

You should say that in your opinion you do not consider him fit, but if he wishes to dive, that is his decision.

Unidentified Speaker

I fly for fun as well as dive. I do aerobatics for fun too. I have had a coronary. When I started I had to go before an av-med examiner. I failed my first examination because I had a history of a coronary. So I had extensive ECG's done and these were sent down to a triad of experts who decided I was stable. I had been stable for three years at the time and had the same ECG tracing then as on healing. I was allowed to have a student pilot's licence. It has been renewed every year. I have got an aerobatics ticket as well. However I am not allowed to go for a commercial licence, that is the only restriction. I took it that when I wanted to learn to dive the same thing would probably hold. Actually he was not in the slightest bit interested in the ECG or anything like that. He said "You know what you are about" and left it at that.

I think we need to think about having a sub-aqua medical examiner who knows something about the hazards the sports diver is likely to meet and we need some sort of referral system, that can advise against diving, not that you can not, but we advise against it. In aviation, it is that you may not get a licence.

Dr David Elliott

I have heard all this before. I am advisor to NAUI in the UK and to the British SubAqua Club. I have done several years of lecturing to the American Medical Association courses, where this comes up every year. I think that it is very difficult, if not impossible, to answer the questions which you are putting to yourselves.

The diver who is unfit puts himself at risk. He may, if the circumstances are pretty dodgy, put three or four other people at risk. A man in an aeroplane puts all the population on the ground below at risk, should he crash into the wrong sort of building. I think that the examination for aviators is not a precedent for divers.

What is the responsibility of the doctor, particularly when it comes to physical fitness as opposed to medical fitness? Physical fitness, provided there is no medical

contraindication for exercising the individual, is really the responsibility of the instructor. The question of what is the responsibility of the doctor with regard to asthma, cardiac problems etc., and to the diving paraplegic has been considered by many other groups. Quite a lot has been written about it. My only suggestion is that it would be worth while communicating with the British SubAqua Club and CMAS, both of whom have enormous discussions on this subject. I hope that you will disagree with some of the things that they have said but nevertheless it will give you a very useful skeletal structure on which to base whatever you decide.

Dr George Gray

I tell all of my stapedectomised people that it is unwise to scuba dive, that they should not scuba dive, they should not do aerobatics, they should not parachute jump and their wife should not clip them over the ear. That is not to say that they have asked me "Can I scuba dive" the moment I have operated on them. If they come back to me after I have operated on them and say "by the way, can I dive?" I then say "No, I would advise against that". Very often they will then try to argue the point. I then ask them to initial their history card to identify that I have in fact advised them against diving. There is a need to practise defensive medicine because patients do not always remember what you tell them.

Dr Terry McGrath

No matter how hard you try you are not going to be right. In January and February this year our group did the medicals at our local diving club. We try to do them properly. We include lung function tests and audiograms. In May our local club had a trip away. One of the best guys physically did not have the money to go on the trip, so while the majority of the club was diving at Lady Elliott Island, he was sitting at home watching television and had a spontaneous pneumothorax.

Question:

What is the reason for the audiogram?

Dr John Knight

It is not a defensive reason. It is in the patient's interest. Every now and then a diver comes in who has damaged his round window or his oval window. He is giddy and deaf, or he may just be deaf. Unless you can prove that he had normal hearing relatively recently it is very difficult to persuade an ENT surgeon that he ought to think of looking inside that ear. If you can show that the chap has had a whopping great hearing loss most ENT surgeons now will think about looking inside the middle ear and plugging the leak. If one does that sometimes the hearing comes back. Not for everyone but many improve. One chap I know has got his hearing back completely twice. Thankfully he has sold his diving gear now.

Dr Peter James

We have a responsibility to our patients, and we have a responsibility to ourselves to do the right thing, but as SPUMS we are also responsible to the community. The government is going to approach us, as the body who should know, to advise them. Where does the responsibility lie? I think that the answer is that it lies everywhere.

Dr John Knight

This discussion has achieved a lot. There is obviously a difference between the younger members of the Society, who are still physically fit and unlikely to suffer from ailments that might carry them off in the middle of the night, and those of my generation who are determined to go on diving.

I agree with Tony Slark that we can not stop people diving. But I can also see the point of the instructor organisations, who do not wish to be presented with people who die during their first sea dives. I think that is a perfectly reasonable request.

I think that all we can do is to say either that this person has passed a certain series of tests and he is probably fit, or this person does not pass the series of tests and can dive if he wants to, leaving it up to the instructor to decide about teaching him. That is the way I look at the medical examination before diving. After the exam the patient is given advice as to what he ought to do. I thoroughly agree that the only people who should do diving medicals are doctors with a knowledge of diving medicine. That is likely to occur with commercial divers in the next year or two. The British have a list of approved doctors for doing diving medicals. The Professional Divers Association of Australasia want the same sort of list. It looks likely that to be on that list you will have to have done the introductory and advanced courses at the School of Underwater Medicine.

The list will not apply to sports divers. It is quite impossible for FAUI and PADI to have all their trainees examined by these people. There are about 10,000 trainees a year. If you do the full works, as laid down in AS 2299, the bill, at the government rate, comes to somewhere over $130.00. There are X-rays as well, which can add up to another hundred and something if you throw in a long bone survey. I do not think that a reasonable cost as a scuba course costs something in the region of $180 - $200. Incidentally, there are no medical benefits for these examinations. I am just repeating the point that Tony made.

I think one should do a simple series of screening tests, that weed out those who are likely to come to harm. If it is necessary, tell them why you do not think they should dive, explain your reasons clearly and then leave it up to them to decide whether to dive or not. However they will have a problem finding somebody to teach them, if they do not meet the standard.

Question:

What do you think these simple tests should involve?

Dr John Knight

My list of tests includes a history that asks questions about such things as spontaneous pneumothorax and asthma. It includes a chest X-ray, because no-one can detect cysts and other lung lesions without a chest X-ray. It includes doing a vitalograph, because it has been shown that most of the people who turned up at the School of Underwater Medicine with burst lungs had FEV^1/VC ratios below 75%. They had all burst their lungs bobbing to the surface having run out of air. However, as a group, those with a low FEV^1/VC ratio are over-represented in these incidents. I include an audiogram to establish that they have got normal hearing. Not all divers complain of giddiness but they all have loss of hearing if they burst their inner ear windows. Divers may be accustomed to feeling giddy. I do a physical examination to make sure that there is a clear wheeze-free chest and that their eardrums move. Those are my basic requirements. As the exercise they are going to undertake is swimming exercise, I think that is the way their fitness should be tested.

LETTERS TO THE EDITOR

FITNESS FOR DIVING

1 Thomas Street,
Lewisham NSW 2049

Dear Sir,

There are a number of fitness parameters which can be fairly easily measured. A lot of experimental work on this has been done by K Cooper et al of Dallas. They have made a study of aerobic exercise and came up with the concept of a person's ability to metabolize oxygen - the greater the amount of oxygen an individual can consume while maximally exercising, the fitter he is. This is measured in ml of O_2/Kg body wt./min.

It is necessary to exercise for a certain period of time to get reliable measurements of this. One is interested in aerobic metabolism as opposed to anaerobic metabolism. (The latter is seen in short bursts of exercise). The suggested minimum period of maximum exercise while measuring aerobic fitness is 12 minutes.

Cooper made actual measurements of O_2 consumption during exercise in a laboratory using a treadmill. He has converted this to a number of everyday activities such as cycling, running, swimming etc., so that the distance travelled by a person in 12 minutes while maximally performing one of these activities can be related to his laboratory studies of O_2 consumption. An example of this is a person who can run a distance of 1.73 miles in 12 minutes has an O_2 uptake of 51 ml/Kg/ min.

Cooper has come up with many tables correlating fitness with O_2 consumption and relating it to different activities and age groups. He has six categories of fitness from very poor to superior.

1. Very poor
2. Poor
3. Fair
4. Good
5. Excellent
6. Superior

Here is an example from these tables for running for 12 minutes.

	CATEGORY	AGE 13-19	40-49	60+
1.	O_2 uptake ml/min	<35	<30	<20
	Miles run in 12 mins.	<1.3	<1.14	<0.87
3.	02 uptake ml/min	38-45	33-40	26-32
	Miles run in 12 mins.	1.4-1.56	1.2-1.4	1-1.2
5.	02 uptake ml/min	51-56	43-48	36-44
	Miles run in 12 mins.	1.7-1.8	1.5-1.7	1.3-1.5

I refer you to his book "The Aerobics Way" for further details of these tables. There are similar tables for swimming, cycling, etc., which give an assessment of a person's aerobic fitness, and relating this to one of the six categories and to the person's age.

To relate this to what level of fitness should be expected in diving is difficult. One has to consider the types of diving and obviously differing standards would be used for professional divers than for sports divers. Exactly what level of fitness should be expected for a person to become a safe sports diver is not easily decided. Obviously the person should be capable of a reasonably prolonged period of moderate exercise - perhaps category 4 at the minimum.

I would think that this could be discussed at one of our future meetings. Without doubt the present standards of physical fitness (in an aerobic sense) necessary to become a certified diver are quite inadequate.

Yours sincerely,
GREG LESLIE

INTRAUTERINE BENDS?

Sir,

Scuba diving is an increasingly popular sport. Any person diving to a depth greater than 9 m is at risk of developing the bends from nitrogen bubbling and venous gas emboli formation which may be clinically asymptomatic but detectable by ultrasonics. Theoretically diving could be a potential teratogen, either through bubble formation affecting the function of the placenta or circulation in the

foetus or as a secondary effect through hypoxia because of its effect on placental function.

Bolton (1) surveyed the pregnancy histories of 208 female scuba divers - 109 dived during pregnancy and 69 did not. Two out of the 20 who dived to depths greater than 30 m in the first trimester gave birth to babies with congenital anomalies, one had multiple hemivertibrae, one an absent hand. Four others diving to lesser depths had babies with other congenital malformations (2 with congenital heart disease and 2 with minor abnormalities). There were no recorded malformations in the babies of the mothers who did not dive during pregnancy. More than 6% of the babies in the diving group were small for dates compared with only 1.4% in the controlled group.

We would like to report a baby born with arthrogryposis and some dysgenic features whose mother went scuba diving in early pregnancy. She was a 22 year old prima gravida. Both parents went on holiday from the 40th to 55th day post LMP. The mother dived at least once daily to a total of 20 dives in the 15 days. Most dives were to a depth of 18 m or less but three were to 30 m and one to 33 m. The ascent rate used by the mother and her husband was 18 m per minute, though this was usually estimated rather than actually timed. When decompression was required, a modified version of the USN tables was used. All the dives except one were without complications, the exception involved an "equipment failure" of the husband whom she was buddying, at the end of a strenuous 15 minute bottom time dive at 18 m. The rate of ascent of both was described as "very rapid". She felt well but tired after this dive.

No medications were used apart from oral Sudafed 60 mg. on two or three occasions to aid ear clearing, early in the holiday.

The rest of the pregnancy was uneventful. The abnormalities noted in the baby were unilateral ptosis, small tongue, micrognathia and short neck. The penis was adherent to the scrotum. The upper limb joint movements were all normal except for the hands. The fingers were in fixed flexion with some webbing between 3rd, 4th and 5th fingers, the thumb was digitalised but had two phalanges. The hip joints were dysplastic with reduced range of movement and one hip was dislocated. There was fixed flexion deformity of the knees and bilateral equino-varus deformity of the feet. The head circumference was normal and motor development was appropriate for the baby's age at 3 months. Karyotype, EMG and muscle biopsy were all normal.

The embryopathic timetable of thalidomide affected the upper limbs around the 40th day and the lower limbs between the 41st and 45th day. Thalidomide specifically affects the migration of cells destined to form the posterior root ganglia. Arthrogryposis is presumed to result from either muscle disease or abnormalities of the cells forming the anterior root ganglion so the same time table may be applicable.

It would be wise for women to refrain from diving below 9 m if conception is a possibility or if they are pregnant. A course of perfection would be to abandon diving for the duration of the pregnancy.

Gillian Turner,
Prince of Wales Children's Hospital,
Randwick NSW 2031

Ian Unsworth,
Hyperbaric Unit,
Prince Henry Hospital,
Little Bay NSW 2036

REFERENCE

1. Bolton ME. Scuba diving and foetal well being: A survey of 208 women. Undersea Biomed. Res. 1980(7); 183-189.

DISCUSSION PAPER
ASTHMA AND DIVING FITNESS

Douglas Walker

Few will disagree with the present situation where an applicant who mentions that he has asthma is likely to be refused clearance to dive using compressed air should he attend for a "Diving Medical". However, with the increasing requirement by reputable diving instructors of a medical check before starting a course, increasing numbers of people are encountering problems should they mention that they have ever been saddled with that diagnostic label. As about 10% of the population is estimated to have an asthma tendency at some time, the problem is significant. As fewer and fewer instructors remain outside organisations with codes of conduct (and Insurance conditions) which limit their freedom to ignore medical assessment, as increasingly applicants attend doctors with diving medical knowledge, the problem will grow for those with a strong desire to dive and a "bar sinister" in their history. They may be forced to make a choice between honestly revealing their history and being cut off from qualified diving instruction or "forgetting to mention" certain parts of their medical history in the expectation that their deception will pass unnoticed. The justification of having a Diving Medical is to increase safety for all involved. Does the present absolute bar on diving fitness acceptance actually debar those it should, and does it increase diving safety? Nobody knows, for there are still many scuba divers who began before medical checks, or indeed qualified instruction, was considered necessary.

The term "asthma" is a diagnostic label which covers a wide spectrum of problems, ranging from the person with persistently disadvantaged respiratory function to the person who had a few "wheezy sounds" during a childhood URTI episode. Similarly, the trigger factors, degree of disability and response to appropriate medication vary widely. While the person who has episodic or persistent inadequate effort tolerance would be crazy to dive (though may, de facto, dive) the majority are able to maintain all normal activities with rare need for medication.

To encourage discussion of the medical cum moral questions involved in bestowing a medical curse or (modified) blessing on would-be divers with a history of asthma, a few clinical situations have been constructed:-

Case A: A youth aged 18 asks your advice concerning his skindiving (breathhold) activities. He describes having severe asthma attacks dating from whooping cough at the age of 3 years and they are still a major problem. He likes to go camping and the cool Melbourne nights aggravate his symptoms. He has, however, practiced skindiving despite tiredness after nights disturbed by breathing problems and suffered no ill effects. He wishes to know whether it is safe to continue breathhold diving,

Case B: A young man aged 20 has tried out scuba diving with a friend and now wishes to have a medical check before taking a course. He mentions that he has had asthma from childhood but never let it prevent him spearfish. He denies any problems while scuba diving but admits that track work, undertaken to improve fitness for Australian Rules football, causes asthma. His practice is to continue running until the attack passes, despite his lungs feeling "like a red hot poker, particularly in the upper lung". What advice would you give him?

Case C: The applicant is aged 35. He has been diving for several years with scuba and now intends to obtain formal certification. He gives a history of asthma from childhood which he did not let prevent his activities despite chest pain when running. He claims that he no longer gets asthma attacks and that the chest symptoms associated with running are "only a burning in the upper chest and trachea". He has recently moved to your area, the coast of NSW and has noticed some chest tightness when there are humid north easterly winds. He practices jogging without troubles resulting. It is admitted that if tired or he has dived several times (scuba) in the day he may experience a burning feeling in his throat and upper chest, but he never becomes tight in the chest or breathless. His FEV1/FVC is well below 75%. Would you pass him as fit to scuba dive on his proven ability to dive safely, or refuse a fitness certification on the health history and low expiratory flow % result.

Case D: A man of 41 years, diving with scuba for 22 years without diving problems, wishes to attend an instructor Certification Course. For this he requires a medical certificate stating that he is fit to dive. He has a history of severe asthma in childhood which has gradually ceased to trouble him, though there may be a burning sensation in his upper chest and throat. He has never had an attack during diving. When he first started diving with scuba it was the accepted wisdom that Free Ascent should be part of any reputable course of instruction and he had made numerous such ascents from 30 feet. He has even made a practice ascent of 115 feet in Kilsby's Hole, Mount Gambier. It is obvious that he suffered no misadventures from such ascents. Examination reveals that the clavicles are deformed through the constant lifting of the chest in the fight to breathe during asthma attacks while young. The vitalograph shows FVC 7.8 litres and the FEV_1 4.8 litres. There is still liability of an asthma response, in particular after contact with horses or cats. Grass produces severe hay fever. Would you give him a Certificate of Medical Fitness for scuba diving?

The above problem situations are based on actual facts and are offered to illustrate the nature of the difficulties which will arise once any exceptions are allowed and Fitness to Dive Standards are treated as a guideline rather than absolute and unbreakable. It will be harder to give fitness assessments without the comfort of being able to regretfully blame the "they" who produce standards for a refusal of a "fit to dive" certificate. Perhaps we must first decide the purpose of such assessments. Are we seeking to protect the applicant or to distance ourselves, and the diving instructors, from legal action should ill health be implicated as a factor in a diving accident? Should there be a certificate stating that certain unsatisfactory factors are present, the applicant has been made aware of them and that he can dive at his own risk but has been advised against such action? The devising of a document which would stand discussion in a Court of Law would be difficult. Should instructors and doctors be expected to "stick their necks out" for the borderline fitness cases in these days of litigation? These matters are deserving of thorough discussion.

NEAR-DROWNING AND SUCCESSFUL RESUSCITATION AN EXAMPLE OF THE DOUBLE JEOPARDY RISK FOR ASTHMATIC DIVERS

Contributed to the STICKYBEAK NON-FATAL INCIDENTS FILE by Peter Horne.

An untrained and inexperienced diver, using hookah diving apparatus for the third or fourth time, unexpectedly lost his air supply in 10-15 feet deep water. He was overweight and unable to remain at the surface. One buddy brought him to the surface and the other pulled him to land. He was found to be unconscious, not breathing and without carotid pulse. CPR was successful after 4-5 minutes but he developed an acute asthma attack about 15 minutes later, while still being observed. He had just recovered consciousness and indicated need for inhaled medicine. The spray pack was empty but fortunately another person, who had come to give help, had a similar spray. He was taken to hospital to continue treatment. He was allowed to return home about one hour later, when he said that he felt better. He felt unwell the next day, so rested. The following day he went to work but felt unwell, developing trembling and nausea in the evening. He was readmitted to hospital and remained there for thirty six hours. No residual ill effects have been noted.

Case History

Three divers were returning from a sea dive (using hookah) for crayfish and abalone. They decided to wash their apparatus in a freshwater pond often used by divers and to use the opportunity this offered for the least experienced member to practice ear clearing under controlled conditions. None of them had received formal instruction but they had a knowledge of diving theory. This diver had asthma and therefore could not obtain the medical clearance necessary before acceptance by a qualified instructor. However it is not known whether he had approached anyone about instruction. While he practiced clearing his ears at different depths in the pond his two buddies remained with the compressor on the pier to make sure that the airline did not kink or become fouled. There were a few snorkellers on the surface of the pond at this time also.

The diver suddenly found himself without air. He cannot be sure what occurred but possibly a snorkeller caught the floating line and the sudden pull caused him to lose his mouthpiece. He found himself without air and 10-15 feet below the surface greatly overweighted. He did manage to reach the surface but his best efforts could not keep him there and he soon sank back to the muddy bottom. He was seen and diver 2 jumped into the water, wearing only a wet suit, while diver 3 started to tow him to the jetty using the airline, which was still attached to the weight belt. Due to his inexperience he did not regain the demand valve or drop his weight belt. He recalls seeing diver 2 near him and feeling the exit ladder before blacking out. His buddies thought he would be safe at the ladder but then noticed that he was unconscious and had stopped breathing. They got him onto the jetty, noted the absence of a carotid pulse and commenced CPR. Although some spectators when asked to assist walked away, they were fortunate that there was a group of divers nearby, one of whom had recently undergone first aid training in resuscitation methods.

After about 4-5 minutes of CPR the victim suddenly coughed and groaned and resumed spontaneous breathing. However a close check was maintained on him for another 15 minutes, until he regained consciousness. He was now stricken by asthma and was barely able to indicate that he required his spray medication. This was found to be empty but fortunately one of the spectators was an asthmatic and had his spray available. The police and ambulance, notified of these events, now arrived and the victim was taken to the local hospital to continue treatment of his asthma attack. When this had responded, and the victim stated that he felt better, he was allowed to go home. The hospital stay was about 1 hour.

The next day he felt it was best to stay at home but returned to work the following day, although feeling unwell. By the evening he was trembling uncontrollably and nauseated. He was admitted for further treatment in hospital 48 hours after the initial incident, being given injections for the nausea and for sedation (it is believed). This stay in hospital was of 36 hours. No residual problems have been noted.

DISCUSSION

Not all divers recognise the necessity for instruction in diving from qualified instructors. Especially is this true for those who use hookah gear. Uninstructed and inexperienced divers are the group known to be at great risk should any misadventure occur, as it inevitably will from time to time. This incident records the sequence of events which may very easily follow. The victim was lucky to have alert and quickly responsive buddies who were skilled in CPR and also the presence of other persons able to help. His asthma history is unknown but his carrying of a spray medication indicates the probability of a significant problem. The fact that the spray was empty indicates inadequate forethought. The basic critical fact for discussion is whether persons determined to dive despite such a disability are better trained by, and advised to dive under the supervision of, experienced divers, or whether it is better to prevent them obtaining the benefit of professional instruction. It may be thought that the diver should have been retained in hospital for longer observation after suffering from first a near-drowning and then a severe asthma attack.

It is obvious that the lack of a C-card is no bar to obtaining diving apparatus.

IMPORTANT FACTORS

UNTRAINED. INEXPERIENCED. SUDDEN LOSS OF HOOKAH DEMAND VALVE. EXCESS WEIGHT. RESCUE BY BUDDIES. UNCONSCIOUS. NOT BREATHING. NO CAROTID PULSE. RESUSCITATION. ASTHMA ATTACK. ASTHMA HISTORY PRECLUDED QUALIFIED INSTRUCTION.

LOSS OF CONSCIOUSNESS IN A SCUBA DIVER ON THE SURFACE WITH SPONTANEOUS RECOVERY
A CASE FOR DIAGNOSIS

From a report to the STICKYBEAK NON-FATAL INCIDENTS FILE.

Summary

A scuba diver became unconscious in rough surface conditions but survived to make a spontaneous recovery because his buoyancy vest maintained him in a face-up position while his buddy gave effective assistance by removing him from the danger area.

Case report

The incident involved two divers in their early twenties both physically fit, properly trained, moderately experienced, correctly equipped and following accepted diving procedures. All these factors appear to have influenced the successful outcome of the misadventure. Before entering the sea from the rocks they made a shore reconnaissance and selected a suitable exit point. They entered the sea near the entrance of a channel leading to a blow-hole. The maximum depth of the dive was 15 m. In accordance with their training and dive plan they kept together and surfaced as soon as it became necessary to operate their reserve air. They discovered that the sea conditions had deteriorated while they had been underwater and that the planned exit was no longer suitable. They therefore decided to dive again and to swim clear of the rough water area. Unfortunately separation occurred during this descent. In accordance with correct procedure they both surfaced to regain contact.

When the victim surfaced he found himself close to rocks, in rough water. His memory of subsequent events is hazy but it is apparent that he managed to drop his weight belt and inflate his buoyancy vest before he lost consciousness. Fortunately this resulted in his floating face up on the surface. His buddy had also surfaced and was searching for signs of him. It was about five minutes before he saw the victim and about a further eight minutes before he made contact. He observed that the victim had lost his weight belt and fins, had his mask displaced round his neck and had an inflated buoyancy vest with a torn cover. He appeared to be unconscious. He was being buffered against rocks. The damaged was in fact limited to minor bruising and cuts. The buddy, who also had an inflated vest, managed to tow the victim away from the danger area.

It was about fifty minutes before someone ashore noticed these events and notified the police. Possibly another forty minutes passed before they were reached by the police launch. By this time the victim had recovered enough to be able to make some swimming effort to assist his buddy. He was brought ashore and taken to the nearest hospital for a check-up. As he appeared to be suffering from no ill effects from his experience he was allowed to go home under the supervision of his buddy after a short period of observation. The absence of morbidity was confirmed by the fact that he was fit to carry out his full normal work commitment the next day.

Discussion

The incident would undoubtedly have ended in a fatality had not a number of critical factors been present. These include the fitness, in the physical, training and psychological areas, of both divers. They followed correct procedures, buddy separation being the minimum possible under the prevailing circumstances. Nevertheless survival would not have occurred had the buoyancy vest been inadequate. Despite the tear in the cover the *TABATA (CO_2) Vest* maintained the unconscious diver face up in rough waters, saving his life. The buddy, who wore a SEAQUEST BC could not have provided such prolonged assistance without a buoyancy aid. Without the attendance of the police launch the divers might still have drowned.

The reason for the loss of consciousness is uncertain, both head injury and near-drowning being unlikely as the recovery was spontaneous and seemingly complete before removal from the sea. Readers' suggestions are welcome as to the possible mechanism involved.

POSTSCRIPT

The buddy was not allowed to bask in glory nor to receive unstinted adulation. He was told by a superior at work, who was a non-diver, that he had been a fool to dive in such a dangerous place. Shades of Caesar at his Triumphs where a faithful servant was near to keep reminding him that he, too, was only mortal.

A CAUTIONARY TALE
THE CASE OF THE SPOILT "DISASTER-DIVE"

Contributed to STICKYBEAK NON-FATAL Incidents file by S Bugg.

The following account records the fluctuating balance of critical factors during a dive led by a person who was "doing his friends a favour". There were no medical factors, beyond the suggestion that Diver 1 was temperamentally unsuited to diving, because the witness refrained from expressing his feelings concerning Diver 1 by direct action. Nevertheless this recital of an extraordinary dive is worth study.

The witness was present with a group of four instructors and twelve instructor candidates, using a jetty landing as base for swims and for boat pick-ups. The water was generally calm, though choppy seas were threatening. The jetty is a popular starting point for divers wishing to visit a wreck about 150 m offshore and a yacht race was scheduled to start shortly, its course cutting across the route to the wreck.

A group of five divers was seen getting geared up nearby, their ages, between 17 and 21. There equipment was as indicated in Table 1.

As they moved onto the landing stage the witness asked Diver 2 if he had a regulator and Diver 1 replied that they had four cylinders and two regulators and intended a change over when the first pair had dived. It was pointed out to them that Diver 2's vest was inside out and covered by the tank harness, the inflator hose being inaccessible against his chest. None of the group could work out this problem so they were assisted. It was noted that the vest, hired, lacked a CO_2 cartridge.

Diver 1 entered the water first and had to struggle back to the jetty, negatively buoyant. The witness introduced himself as an instructor and advised them all to check

TABLE 1

DIVER	MASK	SNORKEL	FINS	WEIGHT BELT	WET SUIT	VEST	TANK	REGULATOR	EXPERIENCE
1	+	+	+	21 lb	Full & Hood	CO_2 type	+	+	Trained?
2	+	No	+	12 lb	Shorty	CO_2 type	+	NO	NIL
3	+	+	+	+	Full	No CO_2 NO	+	+	Trained ?
4	+	+	+	+	Shorty	NO	+	NO	N/S
5	+	+	+	+	Shorty	NO	NO	NO	NIL

buoyancy and to tow rather than wear the two cylinders which lacked regulators. They were also advised to remain near to the jetty because of their inexperience, the yacht traffic, and the difficult swim to the wreck. Divers 1 and 3 claimed to be trained, to have hired the gear, to know that buoyancy checks were unnecessary as the vest was to compensate if they were too heavy, and that they were taking the others for a dive "to see if they liked diving before they were ripped off by a dive school". Diver 2 was shown how to inflate his vest, which he did not know how to do and persuaded to remove 4 lbs and check buoyancy. Under Diver 1's guidance he entered the water and tried to duck dive. Poor technique and a vest full of air made this impossible. Diver 1 claimed victory here and replaced the weights. At this stage the instructor group feared for Diver 2's safety and Diver 1's life: lynching seemed likely. Diver 2 was now ready to proceed, overweighted and without snorkel. Diver 1 was now aggressive but had to withdraw his claim to being trained at a certain dive school when an instructor from that school appeared. The group, without floats or flags, now swam out disregarding the passing yachts. The witness, anticipating trouble, arranged for a boat to join them. This proved fortunate.

Diver 5 was the first to be rescued, his tight wet suit having made it difficult for him to breathe. Diver 1 shouted to him "No names!" several times. He was assured that nobody wanted their names, only to save their lives. Divers 1 and 2 were struggling at the surface, negatively buoyant despite inflated vests. They were persuaded to hand their tanks and weight belts into the boat and then they decided to accept an offer to come aboard. Diver 2 came over the stern correctly while Diver 1 nearly swamped the boat by attempting to enter over the gunwale. He then turned a cylinder full on in error for turning it off and requested that the boat take him to the other two divers, now hanging on to pylons at the wreck, in order to hand over his regulator.

On arrival at the wreck the witness advised the divers to dive at the stern of the wreck as it would be calmer. Diver 1 took great exception to a comment that the divers should follow this advice as the advice from within their group had been poor. In response to being told that he was too incompetent a diver to be in charge of a group, he stated that dive schools did not allow students to have open water tryouts to see if they liked it and that he was doing his friends a favour. Diver 2 interjected that HE had wanted to learn properly but had been talked out of it. Diver 1 accused instructors in general of being to blame for high hire charges ($6.00 for his vest). He was asked to compare this with the price of a funeral but did not seem to understand the reference.

All present, except Diver 1, learnt much from the events. The incident highlights the dangers of being trained by a friend and of using diving gear, however obtained, without instruction in its correct use. It is not known whether Divers 1 and 3 possessed C-Cards and were therefore able to hire the diving gear; certainly divers 2 and 5 had no previous diving experience. Without the intervention of the witness and other instructors this dive could have ended in one or more fatalities.

AQUABOY, USA

Readers will remember the item (SPUMS Journal, July-September 1981) on Water Babies. A recent news report is to hand which states that a San Francisco couple had their baby in a (sterilised) horse trough filled with water. It is claimed that the baby was kept underwater for eight minutes after birth. Any comment would be inadequate.

TAKES ONE TO KNOW ONE

A merchant banker, on a recent sailing holiday in the Pacific, leaned too far over the rail of his yacht and fell into the water.

Which is not that uncommon an occurrence given the bibulous nature of banking, but seconds later his friends on board spotted the fin of a large and obviously hungry shark, scything through the waves towards the foundering financier.

The situation looked hopeless as the killer came within inches of its helpless victim.

But just as the shark was poised to strike, it abruptly swam off in the opposite direction.

"What happened?" chorused his friends as the man clambered back on board. "Professional etiquette", replied the banker.

Reprinted by kind permission from The Australian, 19 November 1981.

THE NEW UK DIVING LEGISLATION AND PROBLEMS ENCOUNTERED WITH ITS INTRODUCTION

Commander SA Warner, OBE DSC
Chief Inspector of Diving, Department of Energy

From 1st July 1980 there has been just one set of diving legislation in the UK which covers all diving operations at work whether it be in docks, harbours, inland waterways or in the offshore industry.

The drafting of the new legislation has taken several years. After considerable discussion the regulations have been introduced and generally accepted as being good for the industry. Initially, there was considerable opposition from many of the scientific and semi-scientific groups. The least opposition came from the offshore industry. This was probably because the new legislation is to a certain extent based on the old offshore installations diving operations regulations. In fact we have found it possible to reduce the amount of legislation and detail in the new regulations. The philosophy has been to confine regulations to statements of principles about what should be achieved leaving much of the details to guidance notes, which have been developed in parallel with the regulations, so encouraging the diving industry to take more responsibility for regulating themselves.

The regulations are not a diving manual and they do not contain details of how a diver should carry out a dive. They lay down the duties of those planning, managing and supervising diving operations, qualifications and standards of fitness for divers taking part and the kind of equipment that should be provided. The regulations are intentionally flexible to allow different methods of operating and different techniques or equipment in a variety of circumstances. They do not restrict the introduction of new technology and techniques.

Persons subject to regulations

The regulations apply to diving operations at work but not to sport and amateur diving.

The regulations are intended to protect persons employed on diving operations. They apply to all diving operations at work within Great Britain, within territorial waters and all diving operations outside territorial waters in the UK designated areas in connection with offshore installations and pipelines. They cover all diving activities associated with oil and gas on the UK Continental Shelf regardless of the nationality of the diver or the flag of the vessel from which the diving is being conducted.

Persons responsible for safety

Everyone whose activity may effect the safety of a diving operation has responsibilities under the regulations. Not only the diving contractor and others directly involved but such people as Masters of vessels, pilots of submersibles, Harbour Masters, managers of offshore installations, pipelines, civil engineering sites, etc., all have responsibilities if any of their actions effect the safety of diving operations. Responsibilities are also placed on the owner of an offshore installation, pipeline or concession and on a proposed owner. The duties vary with every situation but everybody involved in the diving operation from the prime contractor down to the diver himself has responsibilities for the safety of the diver.

Enforcement

The duties of enforcement rest with the Health and Safety Executive and the Diving inspector of the Department of Energy. In general the Diving Inspectorate deals with all diving activities associated with the offshore oil and gas industry and the Factory Inspectorate of the Health and Safety Executive deal with diving inshore, docks and harbours and civil engineering sites.

This means that anyone participating in diving activities to do with offshore oil and gas deals with only one government department, the Diving Inspectorate of the Department of Energy. Even if the subject involves other government departments correspondence and communications should be channelled through the Department of Energy's Diving Inspectorate. All our inspectors are diving specialists in their own right with considerable experience and expertise. This specialist knowledge is made available to the Factory inspectorate as required.

Our job entails investigations into accidents, periodical inspections of diving sites and establishments, education and the introduction of any new legislation that may be necessary. From the legal standpoint our role ranges from advice and warnings to actual enforcement in the form of either improvement and prohibition notices or legal proceedings. We also have an important role in monitoring training standards and ensuring that those standards are implemented in training.

Diver Qualification

Before a person may dive at work he must have certain qualifications. There are four standards, Part I, to all intents and purposes the offshore "Air Diver", Part II is the offshore "Bell Diver", Part III is the docks and harbours, inland waterways and civil engineering diver, and Part IV is very broadly the SCUBA diver such as the diving scientist.

To obtain a training certificate a diver must have obtained a satisfactory standard of competence in matters which are relevant to the specific category. We restrict air diving to 50 metres and require a diving bell for all dives deeper than 50 metres. The UK standards for the offshore air diver and the offshore bell diver have been established as a result of nearly ten years experience of diving in the offshore industry in the North Sea. These standards have been agreed with Norway and France and discussions are taking place with Holland and Italy aimed at achieving mutual agreement.

The "offshore air diver" has to obtain a minimum time underwater at certain depths carrying out work. He has to be qualified and competent in all types of air breathing apparatus and must have exposure down to depths of 50 metres. The “bell diver” must have had at least 12 months operational experience as a Part I air diver before he can undertake the bell diver’s course. The standard for the bell diver includes a minimum number of bell lock-outs, successful completion of bounce dives down to at least 100 metres and a saturation dive preferably with a bell lock-out.

In addition to the four separate standards there are established training modules by which divers can progress from a lower to a higher standard. For six months after the introduction of the new legislation diving contractors were authorised to issue certificates of training for the appropriate part or standard providing that the diving contractor was satisfied that the diver’s experience during the two years immediately preceding the issue of the certificate was such that the diver was competent to take part in diving operations of the category stated. Such transitional certificates are valid without limitations of time.

From now on any foreign national or a UK citizen who has been working abroad will have to satisfy the Diving Inspectorate that he has reached the particular UK standard before he can obtain a certificate and be allowed to work in the UK or the UK sector. There are no restrictions on foreign divers operating in the offshore sectors of the United Kingdom providing they are trained to the necessary standard or that they have achieved that standard by experience. Any foreign diver wishing to work in the UK offshore industry who is not in possession of a UK certificate should apply through the Diving Inspectorate of the Department of Energy for the appropriate certificate. It will be necessary for the applicant to prove to the Inspectorate that he has achieved the standards required. This can be done by the production of certified log books and other such documentation. I have already issued guidance on the minimum operational diving time that is necessary for the various categories. Unfortunately the certificate will cost 30 dollars.

On occasions divers with special qualifications may be required to fly into the UK sector at very short notice. A rapid process scheme has been introduced whereby a certificate of training/or experience can be issued for a limited time. Such requests must come through the Department of Energy’s Diving Inspectorate and can be processed either by telephone or telex.

Certificate of Fitness

All divers operating in the UK must hold a valid certificate of medical fitness to dive. This can only be obtained through a doctor approved by the Department of Energy.

The medical examination will be comprehensive and may in some cases include radiographic examination of long bones, audiometry, electrocardiography and spirometry. Considerable flexibility is built into the guidance and standards of medical examinations since the shallower inshore divers will not generally be required to have certain tests appropriate to deep offshore diving.

Equipment

The regulations require the diving contractor to ensure that all plant and equipment which is necessary to the safe conduct of the diving operations be available for immediate use. It is necessary that the plant and equipment is maintained in a condition which will ensure it is safe while it is being used.

The regulations and plant and equipment are not intended to be comprehensive in scope, neither do they lay down in detail all the equipment which is necessary. They do, however, cover such requirements as reserves of breathing mixtures, that breathing equipment, communication systems, means of keeping the divers’ body temperature in safe thermal balance, illuminations, depth measuring devices and surface compression chamber support.

The legislation requires that the equipment and plant is properly designed, adequate strength and good construction. It also covers the requirements for periodical maintenance and examination and testing of plant and equipment.

Documentation

Diving contractors are required to issue diving rules for regulating the conduct of all persons engaged in the diving operations. Schedule I of the legislation provides a format covering matters for which provision is to be made in the diving rules. There is also a requirement to keep diving operations log books, maintenance schedules for equipment, divers’ personal log books, history sheets for pressure vessels etc.

Exemption certificates

Any diving operation, or class of diving operation, and plant and equipment, or class of plant and equipment, can be exempted from any requirement or prohibition imposed on the regulation. Any exemption would require adequate alternative arrangements to be made for the safety of the divers and may be subject to specific conditions.

The introduction of the new UK Diving Operations at Work Regulations has not been without some hiccups. It is an unfortunate fact that there are still some people in the industry who do not wish to be professional. It has always been appreciated that diving is a potentially more dangerous occupation than most since, in addition to the usual dangers at work, the diver operates in a hostile environment. In spite of the hiccups and some opposition the actual legislation for the offshore industry has been reduced and diving is becoming more professional.

I think that the UK has proved that, in spite of the many obstacles, it is possible to introduce one piece of legislation, covering every aspect of diving at work, acceptable and practicable in both operation and enforcement.

The North Sea 1981

At the beginning of 1981 offshore diving activity was at a low ebb but it picked up fairly quickly until, at the end of the season, there was no surplus of diving effort. 1981 has also seen considerably more trade union activity than hitherto.

The continuing saga of the UK Underwater Training Centre is at last reaching a conclusion. I am convinced that in the end the solution will be satisfactory to all concerned and it could well become the premier diving school in the world.

The North Sea Medical Transfer Under Pressure System was used in earnest for the first time during 1981. The operation went exceedingly well.

Diving Incidents

The number of diving incidents in the North Sea continue to decline.

During 1981 there were several "dangerous occurrences" with diving bells. One bell was dropped due to a hydraulic failure. Another dropped a fair distance due to a nine inch wire coming off the sheave. An umbilical parted in mid-water. An upper deck incident resulted in a diving bell being fouled by wire.

There were three occasions when dynamically positioned vessels failed to keep station whilst divers were operating. Two divers were rendered partially unconscious by the supply of the wrong gas. One a diver, in a top bunk, lost consciousness due to layering of helium during blowing down.

Twice a pipe from an oxygen cylinder to an installation burst and on one occasion caught fire.

The reporting of bends continues on the same pattern as hitherto, with surface decompression dives producing the highest number of decompression sickness cases.

I am delighted that for the second year running the North Sea has not had a fatality.

SUCCESSFUL RECOVERY OF A DIVER UNCONSCIOUS UNDER ICE

A short report in DIVER (February 1982) records the dramatic incident in which a diver became trapped, unconscious, under ice in a UK river in December, 1981.

The victim, aged 39, became separated from his two companions in a dive in the River Ribble just after Christmas. They immediately surfaced and raised the alarm. They saw him floating face up under the ice with his ABLJ (adjustable buoyancy life jacket, in Australia, BC, buoyancy compensator) inflated. One of them managed to make a small hole in the ice with his knife but as the body was drifting freely they were afraid left an injudicious jab might injure the victim beneath. Fortunately the dive party had a sledge-hammer with them and were able to break the 7 cm thick ice and reach the victim.

When removed from the water he was unconscious and "blue with cold". Expired Air Resuscitation (EAR) was immediately instituted. Spontaneous breathing efforts soon resumed though unconsciousness continued for an unspecified period. He was rushed to the Intensive Care Unit of the nearest hospital and kept under observation while he continued to recover. He was discharged from hospital after three days.

The divers were experienced in winter diving conditions and believe the incident occurred because the victim's lips became numb with cold. As a result he lost his regulator without being aware of what was occurring. It was estimated that only a couple of minutes elapsed between his disappearance and the rescue. No residual morbidity was recorded.

DIVING SAFETY MEMORANDA

Department of Energy Petroleum Engineering Division
Thames House
South Millbank London SWIP 4QJ

Commander SA Warner

DIVING SAFETY MEMORANDUM 11/1981 DIVING BREATHING GASES

During the past years reports have been received of incidents in the North Sea where divers have suffered from the effects of hypoxia or anoxia. These incidents are possibly attributable to the divers being supplied with the wrong breathing gases. It is also known that fatalities have occurred outside the UK sector by divers being accidentally supplied with pure helium rather than a suitable oxy/helium mixture.

The attention of all diving companies is therefore drawn to the need to ensure that all breathing gas storage cylinders are correctly marked as to their contents. In addition to an accepted colour coding, storage cylinders should be marked in large discernible letters with the gas content, quoting the oxygen percentage first eg. 10% O_2 90% He.

Sound operational procedures should also be followed to ensure that all gases are tested before being put 'on line' and, in addition, all main breathing gas supplies to the diving bell and divers should be continuously monitored for the oxygen content. Monitoring devices should be

fitted with a visual/audio oxygen high/low alarm.

DIVING SAFETY MEMORANDUM NO 12/1981 HYDRAULIC HANDLING SYSTEMS

A recent investigation into a diving incident showed that hydraulically operated winches, with automatic brakes, are possibly being used in a potentially dangerous manner.

Contractors should be aware that many hydraulic winch systems will not hold a load indefinitely after the pumps have been switched off if the brake is not fully effective. For this reason, if the bell is being "held" prior to a dive the winch should be locked mechanically by an alternative system. If it is being held by the hydraulic system then the hydraulic pumps must be kept running.

All operational systems should be capable of having the hydraulic system and the automatic brake system tested independently. If this is not possible with existing equipment then it should be modified accordingly.

Independent brake tests should be introduced and recorded in the maintenance log at specified periods. Brake linings should be closely examined for oil contamination and wear by a competent person at regular intervals.

Regulation 6(1)(2) of Statutory Instrument No. 1019 The Offshore Installations (Operational Safety, Health and Welfare) Regulations 1976 and Regulation 12(4) and Regulation 13(1)(a) of the Diving Operations at Work Regulations 1981 refer.

DIVING SAFETY MEMORANDUM NO 13/1981 DIVERS' CERTIFICATE OF COMPETENCE

It has been brought to my notice that some companies (who are not members of the AODC) have been issuing "divers' certificates of competence" in a form remarkably similar to that issued by the AODC. These certificates have been issued by people who are apparently totally unaware, or intentionally ignoring the implications of the Regulations and the requirements for the Part I and Part II diver.

Diving companies are therefore strongly advised to check and double check divers offering themselves in respect of transitional certificates and particularly where these may have been issued by a company which is not known to them.

DIVING SAFETY MEMORANDUM NO 14/1981 OFFSHORE INSTALLATIONS/UNMANNED DIVING SYSTEMS

A recent survey of diving accidents and incidents show a disturbing trend of an increasing number of incidents occurring on installations which are not permanently manned by a diving team.

The technique of siting a diving system and diving equipment on an offshore installation or vessel but only manning it with divers when a diving task is called for may make economical sense but could lead to a reduction in diving safety.

A diving team which is commissioned at short notice, possibly with divers and a supervisor who are not entirely conversant with the system, possibly with a group of divers who have never met before and probably with some divers who have travelled long distances before going offshore must be given time to completely check the diving system and carry out a work up programme before undertaking operational dives.

Diving Safety Memorandum No 7/1977 also refers.

DIVING SAFETY MEMORANDUM NO 15/1981 FATAL ACCIDENT ENQUIRY RECOMMENDATIONS

As a result of a Fatal Accident Enquiry held into an accident that occurred in August 1979, the Sheriff has issued his deliberations which conclude with five recommendations of lessons that can be learnt for the future.

The Sheriff did accept that the techniques employed in 1979 do not necessarily apply today. However, the attention of all diving companies is called to the recommendations:-

1) If regulations for the safety of divers are to be effective they must be framed in such a way as to place responsibility upon those responsible for the organisation and conduct of the operation who may not necessarily be the "employers" of the divers.

2) Where a diving bell has to be connected to a shackle or socket the connection should be closed with a threaded pin secured by a nut and bolt or castellated nut, rather than by a simple clevis pin and split pin.

3) Diving bells should, as a matter of regular practice, be equipped with transponders or similar location devices, which would enable them to be found by a diving vessel, even where normal communications had failed.

4) If an umbilical is to be regarded as part of the secondary system of recovering a diving bell, it should be of a composite type and preferably used in conjunction with a "Chinese finger" or similar device.

5) On any diving vessel there should be one senior member of the diving crew - a supervisor or superintendent - whose duties would include specific responsibility for the organisation of recovery operations and for ensuring the vessel's recovery systems were working effectively at all times when diving operations were taking place.

SPUMS GOES WEST

David Davies

In conjunction with FAUI, the Western Australian branch of SPUMS organised a seminar at the College of Advanced Education, Mount Lawley, Western Australia on 12th December, 1981. Attendance at the meeting was about 120 doctors, diving instructors, sports divers and professional divers.

There were three speakers used to cover the range of topics. Dr John Knight, President of SPUMS, generously travelled from Melbourne to discuss Medical Standards for Sports Divers, the Use of the Edmonds' oxygen apparatus for treatment of Decompression Sickness, and First Aid for Diving Accidents.

A comparison was made between the stringent standards required for professional divers as laid down in the AS 2299 and the nebulous area of sports diving requirements.

The role of the Edmonds' apparatus in treatment of decompression sickness lies in the diving accidents that occur in warm water a long distance from a recompression chamber. The apparatus can be used while transport to a chamber is being arranged. It has the advantage that 100% oxygen is being delivered so that the rate of nitrogen efflux is increased during the course of treatment.

At the end of the discussion on First Aid for Diving Accidents, Dr Harry Oxer of the Fremantle Hospital described the facilities and arrangements for the management of diving accidents in Western Australia.

Dr Nigel McKee, Chief Medical Officer to Woodside Petroleum, spoke of his experiences with deep diving in the Mediterranean and the North Sea. He then described some of the practical problems associated with saturation diving and how these may apply to the divers on the North West Shelf of Western Australia.

The seminar attracted interest throughout Western Australia such that the organisers were interviewed both on radio and television.

After the seminar finished the speakers were entertained by Dr Naom Haimson, a man who was involved in the early exploratory dives on the Dutch wrecks that litter the West Australian coast.

In summary, an eminently successful seminar was conducted in Perth which attracted wide interest and a great deal of support from the diving and medical fraternities.

"WARNING"
SPINAL BEND IN A DIABETIC

Dr John Betts has reported (DIVER February 1982) a second case of a spinal bend in a diabetic BS-AC member and suggested that there may be a very significantly increased risk of this grave occurrence in diabetics.

As a consequence of these two cases the BS-AC will no longer allow diabetics to become or remain members, refusing their application to join and withdrawing membership from those developing diabetes.

Case 1: This case was reprinted in the SPUMS Journal October-December 1981. The victim, whose age was not stated, made an 18 minute dive with a maximum depth of 95 feet but chiefly at 75 feet. The onset of symptoms was within a few minutes of his surfacing. A weak and unusual swimming return to the boat being noted. The ascent had been slow, controlled and in the company of two experienced divers.

Case 2: The victim, aged 60, had not disclosed that he was a diabetic. Details are unavailable concerning his diving experience and the severity and management of his diabetes. He made a 40 m dive for 17 minutes with decompression stops of 5 minutes each at 10 m and 5 m. A few hours later he noted difficulty in passing urine but performed a shallow (unstated depth) second dive. Following this he noticed a "woolly" sensation in his legs. He had a staggering gait by the time he reached his home late in evening. It was unfortunate that the RN treatment facilities were fully committed when contacted and so unable to undertake his treatment. Some delay ensued before a civilian decompression facility could be arranged. His response to the treatment was incomplete with some cord-damage symptoms persisting.

The BS-AC Medical Committee has suggested that there are good grounds for predicting an increased liability to decompression sickness in diabetics and that it would be of a type less responsive to simple recompression therapy. This is because there is increased platelet "stickiness" in diabetics. It is now accepted that although the initial critical factor in the evolution of decompression sickness is the appearance of bubbles, the picture soon becomes complicated by the accretion of platelets to their surface and the initiation of other blood changes. Thereafter the gas phase of the "emboli" becomes less significant and the condition less responsive to recompression per se. The Medical Committee noted that though there were fewer than 30 known diabetic divers in the BS-AC there had now been two cases of the rare complication of spinal bends after dives which appeared to follow acceptable depth/time profiles.

UNDERSEA MEDICAL SOCIETY
ANNUAL SCIENTIFIC MEETING 1982

The annual scientific meeting of the Undersea Medical Society, Inc., will be held from June 1-5, 1982, at the Omni International Hotel, Norfolk, Virginia, USA.

Scientists and technicians from all over the world who are interested in the undersea biomedical sciences are expected to participate in the meeting.

Opening the scientific sessions on Wednesday, June 2, will be a symposium on Diving Safety. It will be dedicated to the memory of Charlie Brown, prolific writer on diving medicine who died last July, with a eulogy by Paul Tzimoulis, editor of Skin Diver.

A highlight of the meeting will be the Suzanne Kronheim Memorial Lecture on June 4, presented by Dr John Dwyer of Yale University. His topic: "Understanding Modern Immunology: the Second Most Fascinating System in Biology".

Among other subjects on the agenda are respiratory limitations in deep diving, decompression sickness, the high pressure nervous syndrome, one-atmosphere diving system, and air ambulances to transport diving casualties.

Not all the exchange of information will be inside classrooms; there will be poolside demonstrations of diving and resuscitation techniques.

At the annual banquet, June 4, several annual awards for contribution to the diving community will be presented.

For further information contact:

Dr CW Shilling,
9650 Rockville Pike,
Bethesda, Maryland 20814 USA
Tel: (301) 530-9225

7th ANNUAL CONFERENCE ON THE CLINICAL APPLICATION OF HYPERBARIC OXYGEN

To be held June 9-11, 1982 at the

DISNEYLAND HOTEL
Anaheim, California

Plenary Sessions on Use of HBO in Neurological disorders and Anaerobic Infections.

For more information, contact:

Baromedical Department.
Memorial Hospital Medical Centre,
2801 Atlantic Avenue,
Long Beach, CA 90801-1428

Institute of Environmental and Off-shore Medicine,
University of Aberdeen,
9 Rubislaw Terrace,
Aberdeen ABI IXE

8th January 1982

The Secretary,
South Pacific Underwater Medicine Society,

Dear Sir,

As you may know, over the last few years there has been a series of two week courses in Advanced Diving Medicine for Doctors organised by Dr David Elliott of Shell. There seems to be sufficient demand for another course to be held in 1982, and on this occasion David Elliott has asked the Institute to undertake the organisation. It is intended that the course will last for two weeks commencing 20th June, 1982 and that it will be held at the Comex diving facility in Marseille.

In the past attendance of these courses has been limited to medical practitioners, but we feel that much benefit would derive from the attendance of physiologists and other scientists in allied fields who have experience in underwater physiology and medicine and who would be interested in attending the Advanced Course.

Any SPUMS member wishing to attend is requested to apply as soon as possible, as applications close (officially) on 28 February 1982.

Yours sincerely,
CM CHILDS

OUTLINE OF THE ADVANCED COURSE IN DIVING MEDICINE FOR MEDICAL PRACTITIONERS, MARSEILLE
20th JUNE - 1st JULY, 1982

Sponsored by Comex and the Norwegian Petroleum Directorate

COURSE STAFF: Dr CM Childs, Dr DH Elliott, Dr X Fructus, Dr T Fallowfield, Dr B Minsaas

Although this course is for medical practitioners, we are also inviting physiologists and those in allied fields, whose work encompasses the physiology of diving medicine, to attend. The course will cover:-

1) Revision of elementary physiology and medicine as applied to diving.
2) Advanced course lectures. These are not arranged in order of presentation or importance. Fitness to dive, Physics of diving, Barotrauma, Ear disorders, including electronystagmography, Oxygen toxicity, nitrogen narcosis, Thermal control in diving and thermal disorders, Decompression theory and decompression tables, Decompression sickness, air/gas embolism, Pathology and principles of treatment, including adjuvant therapy, Treatment of air decompression sickness, Treatment of mixed gas decompression sickness, Dysbaric osteonecrosis and other health hazards, Anaesthesia and surgery under pressure, Underwater breathing apparatus design, Organisation of medical services and communications, Respiratory function, High pressure nervous syndrome, Work and performance underwater, Handling of operational emergencies, including lost bell, etc., Safety procedures in operational diving, Atmosphere control and chamber technology, Ultrasound in diving, current and future diving research.
3) Site visiting: personal diving equipment, including underwater breathing apparatus and suits, air diving

systems, mixed gas systems, dry and wet chambers, diving bells.

4) In-water and chamber experience.

5) Projects which will be prepared by groups of course attendees, presented to a tutor, and then presented to the class.

6) Case histories presented by the staff.

Those attending will be divided into two groups: Inexperienced: Those who have little or no previous experience of diving or chamber work. Experienced: Those who have qualifications in diving (BSAC or equivalent) or can show sufficient previous experience.

Practical activities for the two groups will be different and it is intended that they shall include: Inexperienced: in-water swimming and snorkel training, chamber - up to 165 feet breathing air and up to some depth breathing heliox. Experienced: in-water air diving using surface supplied air and hot water suits, excursion from shallow diving bell, including rescue to the bell, Chamber - up to 165 feet breathing air and up to some depth breathing heliox.

Fees, inclusive of costs of practical sessions, are £ 1,250 ($2,500 approx) for the two week course.

A block reservation has been made at the Hotel Concorde, Palm Beach, Marseille, which is conveniently situated for Comex Marseille where the major part of the course will be undertaken.

UNUSUAL DIVES
AN INVOLUNTARY HABITAT "SATURATION DIVE" IN 1907

Varischetti was trapped underground when working for the Westralian Gold Mine at Bonnievale, Western Australia. Varischetti, an Italian immigrant who had left his four motherless children back home in Italy when he voyaged to make his fortune, was down a "rise" south of the main shaft in No. 10 level and did not come out when the rain began. It was Tuesday, 19th March, 1907, and in four hours a downpour had filled the dry creeks and broken the banks and the water had nowhere to go but down the mines. It rushed into the shaft of the "Westralian" and filled the workings up to the 900 feet level. The miners clambered out only minutes before the water overtook them, but when the roll was called Modesto Varischetti, who was working on the 1,000 feet level, was missing.

The mine shaft was two-thirds full and Varischetti was down below the water level in a watery tomb. There was only one hope and that was that the onrush of water up the rise may have made sufficient compressed air to force and keep the water back. It had happened before in mining disasters. Why not now? So they set to work baling the water out and wired to Perth for diving gear. In the meantime, they picked up the faint tapping that let them know that the Italian was alive - in an air pocket. The State Mining Engineer in Perth wired "Sending diver and outfit with special train. Will wire later when expect to reach Coolgardie arrange cab to meet them".

The train left Perth at 3 pm on 21st March with the divers and gear and was given an "open road" to Coolgardie. To save time coaling and watering, a fresh engine was hooked on at two stops on the long haul. At 4 am on 22nd March, the rescue train reached the goldfields, a thirteen hour journey which stood as a record for nearly fifty years until the coming of diesels.

The divers took down candles and food to Varischetti and a slate on which to write messages. When the sun was sinking behind the scrubby mulga on 28th March, nine days and two hours since he last saw daylight, Modesto Varischetti was led out of the mine.

This report was taken by kind permission from "Romance of the Australian Railways" by Patsy Adam Smith (published by Rigby Publishers Limited)

By the Editor

Varischetti appears to have been rapidly subjected to a pressure of 100 feet fresh water and to have been slowly but steadily decompressed as the mine was pumped out. The divers wore Standard Diving Gear and would have found it easier to communicate by use of a slate than to open their helmets and risk difficulty with closure sealing. Nowadays the availability of Hookah or scuba units would allow the option of rescue, and bring the risk of decompression to Modesto. He and the divers were brave people and the community response was wholehearted.

COURSES IN UNDERWATER MEDICINE

The RAN School of Underwater Medicine will be running courses in underwater medicine in September 1982.

The basic course will run from September 6th to 17th.

The advanced course will run from September 20th to October 1st.

There is no charge for the course. However, the RAN cannot provide accommodation for civilians.

Applications should be made in writing to:

OIC, RAN School of Underwater Medicine,
HMAS PENGUIN,
Balmoral Naval PO NSW 2091

Members' attention is drawn to the RAN policy statement on postgraduate qualification in Underwater Medicine.

Applications should include details of medical qualifications, age, experience and the reasons for wishing to attend the course. Places in the courses will be allocated by the RAN. SPUMS no longer has any say in who does the course. So do not apply to the Secretary, SPUMS, write instead to OIC, RAN School of Underwater Medicine.