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