same manner as we observed Neil Armstrong when he touched down on the moon.

Salvage was already an established profession, due to the many groundings on the Dutch coasts, especially in the South-west, the approach to Rotterdam and Antwerp. It was here that the founder of our company, Mr Willem van den Tak, saw the advantage of men working underwater. He bought some hand pumps, helmets and diving dresses and looked for some volunteers from amongst his crew members to start diving.

These first divers, who in reality were all deckhands, skippers and the like, were all from the same family and up to a few years ago, we still had some members of this family working in our company. Over the years, as the company got bigger, more divers were required and diving went deeper. During and after the second World War, diving became a daily routine and international.

As already mentioned, the early diver had the function of skipper, deckhand or engineer and specialised himself as a diver for the occasion. Becoming a diver was a long process because firstly, the established divers in the company went down first when a job was to be done, in order to receive their extra payment of Dfl. 2.50 for six hours' diving, and secondly, there was little demand for diving work. Another important factor was the protection of the trade - if you did not belong to a particular family or at least come from the same island, it was very difficult to get yourself dressed in a diving suit for the first time.

Most of the time it started in assisting to dress the diver, keeping the signal line, cleaning the equipment and if you then after some years of deck experience had proved to be a capable hardworking "Jack of all trades" and had shown interest in being a diver (also the foreman had to be in a good humour that day, the job not too difficult, water not too deep), then you were allowed to make the first dive. Without payment of course: monies went to the diver whose turn it really was. Whenever the man diving for the first time was a bit scared to let go the grip he had on the rungs of the ladder, the older diver would step on his hands and the new diver was sea-borne. If this first dive was not satisfactory enough for the foreman, you could forget diving in the company for the rest of your life. It must be clear that this way of self-selection produced the best divers. This was in respect of their capabilities and craftsmanship in using their imagination and ability to improvise. They were hardworking, brave people and, of course, very healthy but had little or no notion of dangers, other than weather or currents. Safety precautions, doctors' examinations, decompression, etc., were subjects never heard of.

When I joined the company in 1954, we employed 15 men who, apart from being skipper, deckhand or motorman, practiced diving. The equipment was still the same as during the start 70 years before - Siebe Gorman hard hat equipment. The hand pump was still in use although most of them had been replaced by compressors. The diving telephone had been introduced, but because of the many failures which occurred, one had to rely on the signal-line system, which was much preferred, especially by the older men. Diving Tables were hardly heard of and the established divers thought of them as nonsense. There was no Dutch diving manual available, nor diving Tables except with the Royal Dutch Navy, so my first work was to partly translate the USN and RN Diving Manuals and to introduce diving Tables, in-water decompression and some diving safety regulations. I also started to send divers to the doctors for examination. If I compare this with today's medical examinations I wonder about the effectiveness of the examination in those days, but it was a start. The training continued more or less on the existing principle of "do it yourself" and was for the greater part based on the experience of the older divers and the fundamentals were grounded on facts of what to do and how to do it in practice, rather than theoretical possibilities and the physiology and medicine of diving.

In the early days of oil exploration and wild catting in the North Sea, a lot of wild catting also occurred in the diving industry. Many young men were put in sophisticated dresses, bells and mixed gas and quite a few of these men have never been able to tell anyone about their last experience. But now we have an almost ideal education program in order to maintain the high standard of quality divers and to keep accidents to a minimum, while using our divers in the most economic way, the intensive course of training culminating in an examination on all subjects, the diploma being also signed by the Inspector of the Dutch Department of Energy.

SPUMS ANNUAL MEETING 1980

Tuesday 24th June

SYMPOSIUM ON FIRST AID, TREATMENT AND TRANSPORT OF DIVING CASUALTIES

Dr Christopher Lourey

Tonight's theme is purposely very broad. It raises probably more questions than we can provide answers. In many ways it is rather akin to the sheik's problem in the harem. You know what is required of you, the problem is where do you start.

The best form of medical treatment is prophylaxis. If we can prevent the problem we will have a decreasing incidence of treating problems. A special tribute should be given to Douglas Walker, for his continuing analysis of diving fatalities and also non-fatal incidents in an attempt to make diving safer for everyone.

Throughout the world there is a continuing analysis of diving accidents and incidents and fatalities. I think the amazing thing, when one looks at all these statistics, is the similarity between nations of the percentage influence of factors involved. Going through

them very briefly, we can say that human error is responsible for about 50%, equipment failure in 30%, poor diving supervision in approximately 25%, inadequate training in changing surface interface conditions, as many would have appreciated today, in and inadequate medical supervision in the commercial situation in 4%, but in the sport diving situation it is considerably higher. These statistics provide an indication of the problems. They also give an insight into the methods available by which we could probably prevent and treat them. In essence, they can also provide, because of the problems of transport, bureaucracies etc., more questions than they solve.

In addition, I think each region, each nation, has its own specific problems. We will exclude the commercial Bass Strait situation from consideration. For example, I am sure that the Victorian members will appreciate that in the region where I come from there is among sports divers almost no incidence of decompression sickness. However, there is a rising incidence of problems of mild hypothermia, near-drowning and drowning. The rescue network is very good. We have a very efficient coastguard and police network, we have a Bell helicopter rescue network and we have a helicopter ambulance network. The problem often is that they take the victim to the first port of call, which is not necessarily where the expertise that the fellow needs is available. That is really what I basically want to say.

But there are a lot of questions to consider tonight. I think that there are problems of inter-referral amongst our profession, there are problems of transport there are also the problems of poor diving supervision, equipment failure and human error. These are the largest of the percentage in those statistics. How far and to what degree should we train individuals when they do their diving training? How much freedom of treatment should we give our diving supervisors and senior instructors? I think that all those with military experience will appreciate the enormous benefits that the paramedics give under the field conditions. In the development of the MICA (Mobile Intensive Care Ambulance) and coronary ambulance services, there is a continuing controversy about these non-medically trained individuals performing venesection, intubating etc. However, I think it is generally recognised that those paramedics have in fact contributed significantly to the treatment of severely ill people. Certainly they have the occasional problem, but the balance is beneficial.

Dr Michael Davis
I want to really take this chronologically if you like, or at least start the logical process. If we are going to talk about the evacuation of divers, then something must have happened to them. They may have required some immediate treatment at the site of the accident or injury, but even before that, something went wrong. And I really think we want to try to keep this oriented very much towards sport diving this evening. That is what a great many people are particularly interested in. Because of the type of practice they are involved in and their own sport diving interests, as a participant. One of the very interesting things to my mind about the way in which amateur scuba diving has developed in Australia and New Zealand is the total contrast between the way in which it is practised in Australia and New Zealand and the way in which diving was practised at the time that the British Sub-Aqua Club was first developed about some 30 years ago. In relationship to service diving, which was more or less, apart from hard-hat, all that was ever done then, the actual diving techniques were very different. If you learnt to dive in the services, you learnt to do things by numbers. In the navy there was an immense back-up to most diving operations in terms of the logistics that could be brought to bear and the actual diving techniques were very different because it was hard work.

I think it took the navies of the world really quite some time to come to grips with the concept that sport diving, scuba diving, was actually safe. You have only got to look at the record and compare it to other adventure sports to realise that really that is a true statement. Certainly there are fatalities, there are accidents, but it is a surprisingly safe sport. You know we have only got to go out here and think about some of the incidents that have already occurred in the past few days and think “Well, if something else had happened as well, maybe we would have had somebody in problems”. I think this is the whole point about why scuba diving is safe, it is the safety in depth if you like, pardon the pun. You can look at the way in which it is built up in a hierarchical format in that there is a definite training establishment, a training programme, supervision of that training so that people are taught basic techniques and skills. As far as the diving itself is concerned, you need to consider all those aspects of equipment and of diving techniques. All the little things, like carrying a knife with you, so that you, and I have not been in this situation, but I have been on diving trips where people have got caught in lines, can cut yourself free. When you think about all the little bits of equipment that we are taught to use. They all come into play at some time or another and there is always a back-up of some sort. If your regulator packs up you have always got a snorkel for the surface. If you were using some of the original equipment, the older naval diving gear with a full face mask, that sort of extra safety aspect was not available to you. All you had was a stop cock which opened to the atmosphere or opened to your re-breathing bag. And you can go on thinking about the techniques. Diving as buddies, having someone on the surface to cover you and so on. And the whole concept of dive planning, from right back to looking at charts, thinking about organising boats, knowing about weather, it all adds up to a very safe form of diving without there being an immensely structured aspect to it. One of the interesting things to my mind is that when things go wrong it is very unusual for somebody to get into serious trouble because only one

thing goes wrong. Most diving accidents are the result of a series of things which do not fit together properly and they build up to make things worse. An inexperienced diver with poor equipment, diving with somebody they are not familiar with, or in a diving site they are not familiar with and they do not know what the currents are going to do, the sea conditions change, they run out of air. You can think of a dozen or more scenarios and I think it is always worth remembering this, that it is a very multi-faceted thing. These sort of things gel together, unfortunately according to Murphy's law, when you least expect them and usually when you are least capable of coping with them as well. I think we have got to bear this in mind when we start to talk about sport diving accidents. So I think that as physicians interested in diving medicine, we also have to be interested in the whole philosophy of sport diving, training and practice. And I think we have to be prepared as practical devotees of the art, to express our concern, or comment on encouragement to lay divers, those people who actually run sports diving in different countries. I think we have got a real part to play in the prevention that Chris Lourey talked about and it goes right back to looking at these things that I have just mentioned.

The next big problem to my mind is what do you teach people in terms of coping with a diving accident? Who has actually been involved in a serious diving mishap? Either himself or with a group of divers out on a boat and have had to cope? Let us see just what our practical experience is, hands up. Well, nobody. So to my mind, the problem is equally relevant to a medical audience as to a lay audience. How do you react to this situation.

I have watched doctors in hospitals reacting to emergency situations and they do not always do the appropriate thing. So if that is the case, maybe we have got to sit down and think rather carefully about how we should react to this sort of situation. Then we have got to take it a stage further and think how we can teach lay people without medical knowledge to react correctly to an emergency situation.

What happens in fact is that you end up with a bloke on board the boat who looks bloody crook. Usually you have no idea what is wrong with him immediately. This is certainly true of the sport diver. We doctors tend as a group, because medicine is of necessity performed and practised that way, to be concerned with diagnosis and perhaps we are too concerned about diagnosis in this situation and we should be thinking more about immediate life-saving resuscitation. What are the most important things to deal with, right from stage one. Not necessarily teach people that there are a whole series of diving illnesses they need to know about, decompression sickness, air embolism, carbon monoxide poisoning and this, that and the other. We can go through the list and talk about each one separately. At present we say the symptoms to this are such and such and the treatment is this or that and so forth. A diving mishap does not present that way. People with air embolism, with early decompression sickness, problems from gas impurity, hypothermia, all kinds of things, one can go on making a long list, all tend to present in a remarkably similar fashion. They have a range of signs and symptoms which are on the whole, except for one or two exceptions, not pathognomic of a particular condition, headaches, unconsciousness, nausea and vomiting just to name a few, occur across almost the entire spectrum of diving problems, including those that we talked about last night. So I think it is very difficult for lay divers and instructors and so on to really appreciate the correct approach to emergency care medicine on a boat if they are taught it from the basis of a set of diagnoses, symptoms and then treatment.

I think we have to turn the whole thing around in much the same way as has been done with the training of para-medical people with the ambulance services, certainly in America and probably in Australia and as is beginning to happen in New Zealand. The way in which it has been done with cardiopulmonary resuscitation. You do not try to decide whether the man has got a myocardial infarct. Your prime responsibility is to provide emergency resuscitation both cardiac (circulatory) and respiratory. So one of the things that I would be very keen for us to talk about, to argue about, this evening, is the way we should be teaching people to cope with these situations. I have got one or two slides that we might put up as an arguing basis later. To go along with that, one of the most important things we should decide is what sort of equipment we should advise people to carry. There is an enormous variety of devices and bits and pieces that dive clubs and instructors and charter boats take out with them. Almost every group you dive with carries a different range of equipment.

The diving medical kit is something that maybe needs rehashing and re-thinking about as well. And finally on that sort of immediate care topic, should we be recommending people to purchase air vivas and other resuscitators, you name them, as their method of providing oxygen and resuscitation? My experience is that, unless you are an anaesthetist and are used to managing the airway, the majority of doctors and nurses are not capable of using these devices properly at all, unless they have had special training and regular practice. I think this applies even more to lay people. It certainly applies to the Surf Life-Saving Organisations and their members, who are taught to use this sort of equipment and go through a very thorough course. But it is not the sort of gear that any Tom Dick or Harry in a diving club can immediately use. So should we be encouraging dive clubs to use and to possess this sort of equipment? Certainly in New Zealand there are quite a number of groups, dive clubs, that actually carry this gear with them. If you go through it with any cross-section of the club, a vast majority of them have no idea what so ever of how to use it. They do not even necessarily know the basic principles of caring for the airway. So I think there are quite a few areas of concern for us to talk about, as far as the immediate care of diving problems goes.

Dr Tony Slark
I will just give you a few stories about various evacuations that I have been involved in and had to deal with the end products of. This is not a formal instructions in how patients should or ought to be evacuated from the site of the accident. I got to thinking about this matter some time ago, because my house is situated about equidistant from the airport that the helicopters take off from and the naval hospital where the patients may be landed by helicopters. I knew that accidents had occurred and I was asked about various matters of first aid. I was told that the patient would arrive in about an hour. So I made sure that I did not have any more grog that Sunday evening. It always is Sunday evening when these sort of things happen. So I got to know that it took very much longer than people expected for those helicopters to be flying past my house on their way to the other side of the Coramandel Peninsula or wherever it was that the diving accident had occurred.

Just recently this delay was emphasised by a diving accident which occurred on the Hauraki Gulf. Somebody had surfaced too quickly and had suffered an air embolism. The boat was well equipped and had a radio. They told the coast guard organisation that they had somebody who was obviously suffering a severe bend, he was very crook indeed and asked what they should do. They were put through to the senior sergeant at the police station who was in charge of search and rescue for that day. I do not how whether he did it regularly or even if he did it often. But he was certainly on call for that day. They asked the sergeant what should be done. They were told to stay where they were until a helicopter arrived. He telephoned through to Watsonville to check on the availability of a helicopter and he was told that one was ready and available. The crew was about, on two hours' standby. I expect that the sergeant did not really know exactly how long it would take to become airborne. But anyway, he told the boat that all was well. They should not move the boat. They were to keep the chap on the deck and keep him warm. The helicopter would soon be arriving for the patient, to take him to the naval hospital. He let us know of course that this was going to be happening, so we spent the next few minutes expecting to see and hear the helicopter come past us, as it would have to do, to get to the site of the accident. Well, two hours went past and I phoned him as I had heard nothing of the helicopter going past and I was told that it was going to be on its way fairly soon. Low and behold, two and a half hours later, the thing started past and I knew it was on its way. Three hours later it has brought the patient. He was landed on a playing field that is fairly close to the naval hospital and taken by ambulance to the naval hospital. We checked things out and it went on to the matter of recompression. The whole procedure had given us a fair time to get things organised for the arrival of the patient. Also plenty of time for getting the chamber flashed-up and the crew in and ready to work it.

However, this highlighted the whole stupidity of relying entirely upon a helicopter. Because in fact, the site of the accident is only twelve miles away. And had the boat turned tail and run straight into Auckland, he could have landed on the steps just below the naval hospital within about half an hour of his accident. It seems that everybody reacted with a complete lack of understanding of the time that various procedures may take. Although a helicopter may go fairly rapidly through the air, it does not necessarily get anybody back to the site of more definitive aid very quickly. It may be much easier and better judged to seek travel by ambulance. And there are a lot of difficulties with helicopters and using them in country such as we often have to cope with.

Looking back at some of the other stories, I remember a long time ago when the use of a helicopter was agreed to by the search and rescue operation people. Time passed as they got the crew together and then it was dark. So the patient had to be brought half way towards the helicopter over the hills. And then transferred to the chopper at the local racecourse on the other side of the hill. All the cars in the locality formed up to produce an illuminated landing strip for the chopper to come in on. The delays in that case were such that again it took just as long as if the man had in fact remained in the ambulance and had come straight to us.

I can think of another story, when there was an accident on board a boat off the Poor Knights, about fifteen miles off shore. There was a diving doctor and he diagnosed that this person had had an air embolism. And I am sure he was right. They rang through and got the helicopter arranged and it duly arrived. It took about two hours before it came in, and that was pretty good going. And it would have taken, I suppose, an hour to an hour and a half to get back once they had got the patient on board the helicopter. There was a strong wind blowing and the boat was anchored in the lee of a cliff. Over the top of the cliff, just at the level the helicopter was trying to station itself over the top of this relatively small launch, the wind was blowing and howling loud. Although it seemed very calm to the people in the boat, it was terrible on board the chopper. They winched a man down and he was swinging back and forth over the top of the launch. Wishing to be very helpful, the chaps on board that boat were all set ready to catch him, to grab him by the feet as he was swinging past them. He told me afterwards that he was absolutely terrified that somebody might catch him, because it seemed to him that he would be ripped in two. Anyway, they managed to get him down eventually without that happening. They winched the patient up to the helicopter, during which time he started to recover. And by the time they got him back to the naval hospital all his problems were over and he was very much better. He did not require recompressing although the incident suggested that he certainly had had an air embolism.

So helicopters are not always the answer. I think it is very necessary for people at the site of the accident to realise that seeking this sort of help is not necessarily wise. Everybody reacts with tremendous keenness and enthusiasm to help. The Air Force is very willing to put the choppers in the air and send them away. But they are not always readily available. Everybody wants to help. The senior sergeant who was concerned with search and rescue operations wanted to help, but he did not understand the situation. The flight controller will want to help, but he may realise that the weather is deteriorating and he may feel that it may not be wise for him to hazard a crew in the weather conditions that he fears may exist when the chopper arrives at its destination. This happened with two divers in the Royal Navy quite a long time ago when their back-up medical support was entirely by the supposed provision of choppers for taking away any person who had suffered an accident. In fact, when it did occur, the weather was too bad and the evacuation had to take place by sea, because the support from the air was unavailable. The rough weather had produced the situation that produced the rapid surfacing of the divers. As a result, they had inadequate decompression for the work dive they had done and the two divers required evacuation. But helicopters were not available due to the weather. So that the concern of the flight controller must be taken into account by those who are seeking the support of what is supposed to be a rapid form of evacuation. A chopper may be available within two hours. It is said that the crew of the helicopters that we have are available at twenty minutes' notice. But this is perhaps ideal and it might happen on a working day. But it certainly will not happen on a Sunday evening when most of these sort of accidents occur. In fact, most diving accidents that require recompression are likely to occur on the second dive of the second day of the weekend. So it is usually going to be Sunday evening.

When a rapid evacuation is sought, please think about the alternatives. Please think about the risks that your patient is likely to be put through in being transferred to the helicopter from the boat or from a larger boat to a smaller boat to get to shore to get to a landing space for the helicopter. And then by further transfer from the helicopter to an ambulance and so on to hospital and to the chamber. These transfers always take time and may reduce the speed of the helicopter to an item of no concern in the overall timing of the evacuation process. The turbulence of the helicopter can be very dangerous for somebody who is severely shocked. I have no doubt that although helicopter evacuation has great benefits in many circumstances, even the acceleration of the machine can be detrimental to somebody who is in severe shock.

Turning to other methods of evacuation. Light aircraft may be speedy, but they must fly over mountains and cannot fly through them. We always find difficulty at our diving sites where these accidents occur, because the light aircraft that are available more readily than a helicopter near the site of the accident, have to fly over a range of hills to reach Auckland and must climb at least 2,500 feet for safety and it is going to make the patient worse, undoubtedly. Now, even a helicopter winding its way along the road safely, in clear visibility, must go to at least 1,000 feet to get to Auckland.

Of course, if the patient comes by road the same effect is going to occur but will be more prolonged. And this again has to be considered in the evacuation. In other words, the terrain that exists between the site of the accident and the place where the patient is being taken to, will influence decisions about transport. We have had quite a number of patients who had a great deal of difficulty being got into a light aircraft, being got out of it again and then being put into an ambulance and being taken on another journey. So very often one gets back to the situation that the best way of evacuating the patient may be the ambulance that already exists fairly close to the site of the accident, or at least as close as the coast is to the site of the accident. In the ambulance there will always be some oxygen to give the patient. There will always be somebody to give the patient some oxygen. There will certainly be someone who is a skilled paramedic and thus better able than most people to deal with the needs of the patient during the evacuation. And when one considers all these sort of factors I have mentioned, this may indeed be the quickest sort of evacuation that can be possible for the patient.

I think I should just mention the use of oxygen here. We are finding with the patients that we are getting now that those who have been placed on oxygen that had been made available at an early stage on the boat seem to do very much better. And indeed, very often the symptoms seem to resolve more readily. If the patient has been on oxygen the whole time, by the time we get him it may make it less necessary to recompress the patient. The whole business of supplying oxygen is of considerable importance to diving casualties. I think the provision of oxygen facilities on large diving charter boats is a worthwhile safety aid and one we should learn to consider more than we actually do at the moment.

I should mention that if one has a diver who has suffered a diving accident and it seems that it is a case of decompression sickness, for goodness sake get his buddy back with him as well, in case the buddy is also developing decompression sickness.

Dr John Miller
One has to remember that particularly in the case of decompression sickness that a critical time period exists between the onset of symptoms and the development of the stable refractory lesion. Particularly when one is dealing with spinal cord decompression sickness. Decompression sickness is a whole body phenomenon regardless of whether or not the symptoms are restricted to pain only. When one is talking about a simple "bend" with pain only in a knee or elbow or something like that,

there is also gas formation in the circulation. Most times this does not cause very much of a problem, but one has to consider in all cases of decompression sickness, one is indeed dealing with a whole body phenomenon and therefore it is not too staggering to imagine the co-relationship between the development of pain-only symptoms and then subsequently a neurological lesion. The critical time period that is important between the onset of symptoms and the stabilizing of the lesion is somewhere in the region of four to six hours. This is because the mechanisms of some of the clotting factors, the platelet aggregation things, prostaglandin activity and all that sort of stuff mean that the reticulo-endothelial cells take that long to produce a stable rind of protein around the gas in the circulation.

It is obvious, particularly from what Tony Slark said, that in the majority of cases that we see at some place where we can treat a patient, that the transport time is frequently going to be prolonged. So that the patient is going to arrive there after the four to six hour period because, generally speaking, people do not get their diving accidents in the region of a recompression facility. When they do, the results are spectacularly good, with something like a 90% or 95% success rate with simple oxygen treatment and very little else. We are not talking about that situation. We are talking about the sort of situation that Tony Slark is talking about, where we have to consider the first aid management, and the transport.

Last year, at a workshop that we held at Duke on the treatment of diving accidents and their early management, Xavier Fructus of Comex presented the work of several of his colleagues in the south of France, in the area around Marseilles and Toulon. You appreciate that the terrain in the south of France and along towards the Spanish Riviera and the Italian Riviera, is in a sense similar to the sort of terrain that Tony Slark is talking about. There are narrow roads, high cliffs and frequently mountain ranges to be crossed. Therefore there are prolonged delays in getting the patient to a recompression facility and almost invariably in excess of six hours. These people started using a regimen that initially they felt was working. Then subsequently, they worked a semi-controlled series that was presented by Fructus and was shown to work very effectively. Fructus presented an evaluation of 97 cases of various diving accidents. They ranged from decompression sickness through to cerebral air emboli of which 67 had had this regimen of first aid. The regimen consisted of the immediate use of fluids as soon as possible after rescue. If the patient was conscious, oral fluids were given, usually starting with water and going on to something like fruit juice. Quite palatable sweat substitutes are now marketed in the United States, such as “Gatorade”. You can make up your own sort of thing if you have to. This was demonstrated by a Carl Moyer, who was a burns specialist, about 25 years ago. You take some lemon juice, a couple of teaspoons of sugar, a teaspoonful of sodium bicarbonate and a little extra salt and add to a pint of water. That makes a fairly palatable substitute for a balanced salt solution. Fruit juices are good because of their extra amount of potassium. Intravenous fluids should consist of a balanced salt solution also, and the quantity that they recommended was an initial load of at least a litre of this fluid. This makes a tremendous difference. This seems to be borne out by our experience and that of others in the United States. One of the features of decompression sickness is the development of a capillary leak and subsequent haemo-concentration. Consequently, what you are doing from the onset is something that is very simple, that can be done on a boat and that can go a great way towards ameliorating the development of the stabilized lesion that is going to happen later.

Then there was some debate about whether or not it is advisable to use various types of drugs. People in the South of France use large doses of aspirin and very large doses of steroids. We are not sure what the role of steroids is. So we are not sure whether or not it would be a good thing to use them. In fact, in order to get the platelet activation or deactivation mechanisms going in terms of drug therapy, all you need is two aspirin tablets. So that now we have a regimen that is based upon some kitchen type commodities that are available in the galley, a little bit of aspirin and the other factor, which is important in the drug therapy that Tony Slark alluded to, is oxygen.

Frequently, in an exposed situation the patient is going to be cold and therefore needs to be kept warm. I am not going to get into the problems of dealing with the hypothermic patient. I will just talk about maintaining an adequate homeostatic balance as far as warming the patient is concerned.

Now these patients as I said were transported for periods in excess of six hours. Almost all of them showed considerable improvement and many of them had complete relief of symptoms from this treatment. They were tempted not to recompress these patients because they had apparently got completely better and had lost all their symptoms during transport with this type of therapy. Thirteen of these patients who were not recompressed had a significant relapse and then turned out to be difficult to treat. So even if the patient is better, the idea that you give the patient something like one of the short oxygen treatments in the chamber.

The majority of patients will be transported by road and, as Tony Slark said, that is often quicker than air transport. We are finding the same sort of thing. We have virtually given up the use of light aircraft and only in certain circumstances do we use helicopters mainly when there has been an altitude decompression accident at one of the Air Force bases around the place. We have several Marine and Air Force bases within 200 miles of us and they invariably turn on their own transport. For long distances and the long distances that I am talking about in this situation is the

distance from the Caribbean or the Bahamas to Duke University Medical Center which is somewhere in the vicinity of 800 to 1,600 miles. Over those distances, jet air transport is very important. Jet air transport has some advantages as well. They are all pressurised. The only aircraft that have appropriate pressurisation systems that enable you to transport a patient at close to atmospheric pressure, are very expensive aircraft. At the present time in terms of the smaller commercially available aircraft, the best one is the Lear jet. The latest version of the Cessna Citation which will be coming out soon has a type of pressurisation system that enables it to operate at its most efficient altitude of 30,000 to 35,000 feet and at the same time transport the patient at a pressure close to sea level. Most aircraft cannot achieve this and are forced to operate at somewhere around 20,000 to 22,000 feet. This creates a double set of problems. It creates a very high fuel requirement because fuel consumption doubles in going from 31,000 to 21,000 feet. There are other problems from the reduced altitude. For instance, at the time of the Cuban crisis several weeks ago, one case that we had recently had to be transported from Grand Cayman Island, which is a little bit south and west of Jamaica, across Cuba. The aircraft had to cross Cuba at 22,000 feet which is below the normal jet route, which is protected by international law. The Cubans are quite happy about commercial aircraft travelling across at 30,000 feet. At 22,000 feet, they have that airspace covered by SAM 3 missiles. We had a major delay in being able to go and get this patient simply because of the diplomatic arguments involved in having access to that lower airspace. Indeed, when the aircraft turned up having picked up the patient, the Cubans tried to turn them back, then changed their minds and this went through several gyrations with continual warnings that they were violating Cuban airspace covered by missiles. So you see that there can be some problems with flying at 20,000 feet. Commercial aircraft are very reluctant to fly at those altitudes. Most commercial jet aircraft operate at cabin altitudes of around 8,000 feet with an operating altitude of 31,000 feet and 39,000 feet. If they are required to drop to 22,000 feet or 25,000 feet they too double their fuel requirements and that increases the cost of their operation enormously, because you are talking about an aircraft that costs about $1,200 a minute to operate. In the United States, and perhaps also in Australia, the patient can be expected to bear the cost of that. So that we find that the best method of transporting the patient over these sort of distances is to use a relatively small executive type jet like a Citation or a Citation Four or a Lear jet.

Because we have a small air ambulance group that has been formed by the local paramedics trained in handling these sort of casualties, we find it best to charter the jet by our own group. The time delay is considerably shortened because our group knows how to handle all the logistical problems of getting hold of an aircraft, all the communications, who to talk to in the government department when you have to go over someone else's airspace, all these sorts of problems are ironed out and can be rapidly dealt with. We have found that it makes the transport of these patients a whole lot easier. Also we found that other air operators have tended to charge the patient for the total round trip as though the aircraft had to travel at that lower altitude all the way. The patient only gets transported one way, so they tend to rob the patient. We no longer have that problem.

The sort of aircraft that we are talking about are executive turbo-prop aircraft which, in contra-distinction to most of the other light aircraft have considerably more space in them to do things. You can maintain an IV, you can maintain a patient on oxygen, you can get to him, you can monitor him. They tend to have somewhat better communications and better navigation systems as well and that also helps. We maintain the first aid treatment, fluids and oxygen therapy, maintain adequate body temperature throughout the whole transport period, no matter how short or how long and generally what we are dealing with, particularly with referred patients, are long transport periods.

One thing I did want to ask, there is a thing that has come out in the United States fairly recently. I do not know whether this has spread to this part of the world yet. It is an absolute requirement that all physicians nurses and paramedics have certifications in cardio-pulmonary resuscitation. And they must maintain currency in that. Has that sort of little device spread yet? It has good sides and bad sides you know. You have to show proficiency about how good you are on a plastic doll and then how good you are with the real person.

Question: Dr Nick Cooper
One subject that has been mentioned but not discussed that I think is of considerable interest for anyone handling diving accidents particularly in the southern part of Australia or in New Zealand, is the current management of hypothermia. I would very much appreciate the comments of the panel on how to deal with a hypothermic patient in terms of assessment, monitoring, rate of re-warming and methods of re-warming.

Dr Chris Lourey
I think how you handle the patient depends probably on the degree of hypothermia. Remembering that at the extreme end of the scale, that is profound hypothermia, the patient may appear to all intents and purposes dead. Here I think that one should continue intense cardio-pulmonary resuscitation until one gets to a unit of sufficient capability to intensively monitor all aspects and that includes blood gases and biochemical analysis and also has the capability of centrally re-warming the patient. At the other end of the scale and certainly in our experience on the Mornington peninsula, most of the patients we see are mildly hypothermic. I think that one of the problems that you have in this is an individual who is in the water, and for example had a near drowning situation, or has aspirated a considerable amount of salt water. There is no way you can adequately assess the pulmonary status of that individual without doing blood

gases. He is going to be blue. He is intensely vasoconstricted so you cannot assess that, but it opens a whole subject on its own which I think will be discussed in greater depth by John Knight in Singapore. I think that with a mild hypothermia that one slowly re-warms.

Question: What do you mean by slowly re-warming?

Dr Chris Lourey
Slowly re-warming, I think, is giving that individual intravenous fluids at body temperature and slowly re-warming to ambient temperature. I think that suddenly re-warming that individual by act of heating can induce problems on its own. I think there is one other aspect to mention, most boy scout organisations, most skiing places and mountain rescue teams, have these little aluminium space packs. That is fine if an individual is being transported to prevent cold. We have had a situation where we have had a patient transported in one of those shock packs. In essence, all it did was to keep that individual cold till he arrived. I think blankets and if he is conscious, warm fluids and the like all have a place. I am sorry to be brief, but it is going to be discussed in depth in Singapore.

Dr Michael Davis
Chris, I totally disagree with your management of mild hypothermia. There is really quite a lot of information about this that is about 25 years old. The thing that everybody forgets about mild hypothermia after immersion accidents is that the central body temperature goes on dropping. There have been many many people that have been recovered from the water in a reasonable state, who have subsequently gone on to die. If there is any way possible whatsoever of actively, rapidly, re-warming those people, peripherally then I reckon that that is the correct way. I do not believe that slow re-warming is the ideal choice in the acute immersion situation. If you have not got any other alternative, well, fair enough. There are plenty of things you can do even in an open boat to get people out of an exposure situation and at least reduce that after drop. You are never going to totally prevent it, the only way you can do that is by very aggressive central re-warming techniques. But if you have got any way of rapidly re-warming them then I reckon that that is the way to go. And I have had some personal experience of this. When I was keener and fitter and younger, I used to do a lot of long distance competitive sea swimming in the UK, and after six, seven and eight hours in the water, you were bloody glad to be put in a hot bath, I can tell you.

Dr Chris Lourey
One interesting case to show that hypothermia can present itself in an odd way. There were two chaps on a boat on the Mornington Peninsula about six weeks ago. A combined fishing-diving expedition conducted from a 12 foot dinghy. The fishing had finished and they were preparing for the dive. They overturned the boat. One was drowned and one spent eighteen hours in the water before he was found. When he was found he was transported to one of the more peripheral hospitals where he was warmed. He was transferred to us about twelve hours after that, anuric. We presume his anuria was due to the fact that after establishing an adequate CVP and after a questionable use of diuretics, he passed urine frankly myoglobinuric. We do not know whether it was due to the hypothermia and the intense shivering involved, or whether it was due to the repetitive trauma of hanging onto the boat during the night. So that the most simple case of hypothermia may in fact go on to other things.

Dr Peter Cohen
You made a comment that you wondered how or what the use of a diving club having an oxy-viva was. Well, I belong to a club. We have an oxy-viva and since I've been in the club there have been two episodes of bends on club dives. One was when the club president decided he would have a quick 45 foot dive on the way home with his spare tank. The oxy-viva was not used. I do not think that anyone in the club could use it.

When I became the Club Safety Officer I said "How does it work?" They said "I don't know, we have always had it in the club". The next time they were out was a deep dive, 150 feet wreck dive, and one of the chaps got his octopus regulator caught in his back pack and he did not realise that it was purging away the whole time. He should have done 10 minutes at 20 feet and 20 minutes at 10 feet on the way up and realised he was not going to make it. He signalled to his buddy that something was wrong. They all followed him to the top, climbed into the boat and made straight for Prince Henry's Hospital. But none of them used the oxy-viva on the way.

Dr Mike Davis
There are two aspects of this. One is the question of should clubs be encouraged to take oxygen on dives? The other aspect is should they have resuscitation equipment? Now, I would go along very strongly with encouraging all dive clubs to carry oxygen on club dives, on boats and so on. I always carry oxygen. The way we do it, virtually all the local clubs around Christchurch, is that we put an ordinary diving demand regulator on to an oxygen source. Every diver knows how to use of those, otherwise he would not be diving, or maybe that is why he got into trouble in the first place. But that is the simplest way of providing oxygen.

Now, when you are faced with an unconscious patient, there is no way that that will be ideal. Although, if he is still breathing theoretically you could probably still manage with a regulator. It is the unconscious victim that you need the resuscitation equipment for. Most people, divers, laymen, paramedics, doctors, are unable to use that sort of resuscitation equipment properly, and they would be far better off, in my mind, being taught to do mouth to mouth or mouth to nose, well, and being kept updated. As far as John Miller's comments about certification is concerned, I think that all club officers, all

diving instructors, all charter boat operators should be proficient. It should be part of the regulations. I do not necessarily believe that every single diver should have full CPR training and be updated every year. Maybe that is an ideal that we might achieve. It has got good points and bad points as John Miller said. I think that those people who are responsible for diving safety within any context should have that competence, and that it is a competence that I believe you can teach them.

I do not believe that the majority of people can be taught to use oxygen resuscitation equipment successfully. So the people that need resuscitation are most likely to have those around them that are least able to use a resuscitator. And thereby hangs the rub. It is fine if you or I are able to use oxy-viva equipment competently, but this would not be true of the majority, and this is the distinction that I think one has to discuss.

To my mind, if you are just going to provide divers with oxygen for the sort of transportation situation that we are talking about, you slip the mouthpiece into the guy's mouth. I recommend the simplest and most likely to be effective way of doing that is to use an oxygen tank with a diving regulator. Obviously, all the usual precautions that it must be correctly coloured, not just be any old aqualung. That actually happened quite recently when someone put the oxygen tank on his back and had a convulsion under water. It must be clearly labelled "oxygen cylinder" and the thing to do is to build a little rack and mount for it. And that's a great way of providing the wherewithal. One bends patient was transported on oxygen gear, initially their own with a demand regulator like this, and then subsequently using the ambulance equipment. By the time he reached us he was symptom free in the way that John Miller commented on. Despite that we did treat him on a short oxygen table.

Dr John Miller
I would like to make another comment. It really is very simple to make out a short protocol for handling this sort of patient based upon all these sorts of kitchen remedies. They are effective. Certainly, I find that the figures that Fructus presented at that meeting were extraordinarily convincing. They are very simple things that can be done, and do not need a great deal of high powered expertise.

If for some reason the patient cannot take oral fluids then you have the problem that you need to have intravenous fluids available. Chris has just raised the question of using Dextran. I am sure that over the years many of you have had dinned into you the potential value of using either Dextran 70 or Dextran 40. Now, the initial use or Dextran in diving accidents at least, was on a volume expander. When you give Dextran in high doses, it creates a series of problems. Someone who has a haemoconcentration due to a capillary leak is likely to become oliguric. When the patient becomes oliguric, having had a Dextran load, he is likely to develop Dextran crystals in his renal tubules. That will give him acute tubular necrosis and complete renal shutdown. Dextran 40 has got a very short half life and therefore has a greater tendency to do that than Dextran 70. Neither of them has, except transiently for something like half a dozen circulation times, very much of a hyperosmolar effect. So it is not going to pull all the fluid back out of the tissues when you have a capillary leak.

There is a potential role for the use of dextran either 70 or 40 in low doses because of its platelet coating properties. This requires approximately a litre in the first 24 hours. Dextran also has the disadvantage that it is expensive. In terms of plasma expansion, it would indeed be a very expensive substitute for salt and water and sugar solution. Aspirin in normally used doses, of something like two tablets, is fine. That is sufficient to produce a therapeutic effect for about three days.

Chairman: Dr Darrell Wallner
John Miller, I would like to direct a question to you. With oral fluids to this situation, I would be surprised, when you have got pain, fear, stress, that you would get any gastric absorption of oral fluids within four or five hours. Would you like to comment on that?

Dr John Miller
Those sort of factors are important but you do get some gastric absorption and certainly it is slowed down. For that sort of reason and for simplification in terms of developing further complications, I generally prefer an intravenous line. But going back to some studies presented by Carl Moyer, I guess in the fifties, resulting from some of the stuff that came out of Korea, there was the development of what was called the "Moyer Cocktail", which is basically a balanced salt solution and some substitute for Hartmann's or Ringer's solution, in fact. That solution was used effectively in burns in operational situations and used orally. There is no reason why one should not make these things up. It is a hell of a lot more effective than not doing anything.

One of the most important elements in any diving accident, as it is in any accident, is the reassurance of the patient. The patient feels a hell of a lot better if he feels that something positive is being done for him. So give the two aspirins with reassurance and explanation as a positive therapy.

Dr John Knight
My point is that they may be able to get oxygen into air cylinders in New Zealand but you will not get CIG in Australia selling you oxygen to put in anything except a pin index oxygen cylinder or a large oxygen cylinder. Now a pin index cylinder (C size) contains oxygen for about 20 minutes resuscitation, if you do not use it too much. It lasts for about 10 minutes

with an oxy-viva being used with one of those resuscitator heads that inflate the patient for you. So most diving clubs do not carry them because they are going to have half an hour to an hour and a half's boat ride to get home. Now, this short endurance is a problem. One solution is a closed circuit oxygen resuscitator such as the Komesaroff units used in the Victorian ambulances, which make a C cylinder last for a long, long time. But the snag is that you really need to be an anaesthetist to apply the mask, because if you have got any leaks the oxygen supply is insufficient. It can only provide 5 litres a minute maximum. Any of those power assisted jobs are going to provide you with gas at up to 60 psi, which I am quite certain does not do George any good if he has torn his lung on the way up.

The suggestion that I have is that you make up a suitable Magill type circuit with a clear resuscitation mask, so you can see his face. You put in on 14 litres a minute, which will make a C cylinder last for the best part of half an hour. You can watch him breathing because the bag goes in and out with each breath. At the moment, the CIG are busy selling us the Robertson resuscitator head, which if it is used each week, works. But if you put it away for a year it either jams on or off. It is a pressure cycled gadget. When it reaches cycling pressure it turns off. You have no idea, except by watching the victim's chest, whether gas is getting in or out. I am quite certain that what you need is something simple, so that you can detect it when it is not working.

Dr Chris Acott
This is a very funny but tragic story. I think any oxygen cylinder or set to be used by laymen should be labelled "Only use if the patient is breathing". I can remember when I was working as a medico in Bermuda. We had to go and retrieve all the rich Americans coming over for their second honeymoons. A lot of doctors have conventions there, and this particular convention of doctors were pathologists. One of their members unfortunately had a heart attack in the water, which is quite common in Bermuda with Americans.

I arrived at the beach after running down and found this team of American doctors, rotating around saying, "Oh, it's alright, doc, it's alright doc, we've been doing cardio-pulmonary massage on this fellow. We started as soon as he came out of the water". It was great. On him was plonked the oxygen mask running at 10 litres a minute and they were doing their cardiac massage. But when I went to incubate him I found that his whole mouth was full of vomit and nobody had attended to his airway whatsoever. So what did I do? I had to intubate him although the guy was dead. I think that oxygen equipment should be labelled "Only use oxygen if the patient is breathing".

Dr Mike Davis
That really backs up what I am saying and what John Knight has just said, you use the simplest device possible. It is all very well for us to talk about McGill's circuits and so on and so forth. The only thing divers know about is using a diving regulator. If they are unconscious, they cannot use it. That is why everybody who gets involved in diving should know how to do mouth to mouth. But one of the advantages of using a regulator in this way is that at least the oxygen consumption is only that of his minute ventilation. This is certainly more economical than oxy-viva equipment and all the other fancy types of gear. OK, I accept your point than if you were able to know what his minute ventilation was, you would be able to get the McGill circuit appropriately, but you do run into rebreathing problems.

Dr John Knight
I suggested 14 litres a minute, well above normal minute ventilation. So no rebreathing. This means that expired and fresh gas goes out of the relief valve. Even with that waste a cylinder will last 27 minutes.

Dr Mike Davis
Yes, well that is inefficient. A demand regulator is the most efficient way of using your oxygen supply. And it is the system that the diver understands, and the only one he understands, that is the point that I am trying to make. NZIG will not fill up any old cylinder either, but there are plenty of practical lads around who can knock up an adaptor any time they like.

Question: How much Stabilized Plasma Protein Solution should we use as a plasma expander?

Dr John Miller
I know this is a very controversial thing to say. For most situations in plasma expansion, particularly when you are dealing with fit, healthy people with normal serum albumens, then those are expensive substitutes for crystalloid solutions. Dear, basically. Later on there may be a case for getting into component therapy. Particularly when a patient with a severe diving accident may go on to develop a disseminated intra-vascular coagulopathy. Then you are using that for a component therapy on the basis of that symptomatology and not purely as a plasma expander. The simplest form of plasma expander is salt water. With a bit of sugar in it to help it along, provided that you do not put too much sugar in it and get an osmotic diuresis. I generally prefer to use a fluid regimen that gives you a urine production of 1 to 2 cc per kilo per hour. And we find that that has, well, we have not done controlled experiments so I should not say what I was about to say. We find, though, that that does not seem to prolong the effects of cerebral or spinal cord oedema.

Question: Dr Janene Mannerheim
How much time can elapse before it is not worth treating a person with an air embolism or decompression sickness?

Dr John Miller
I feel very strongly about this. In the last twelve months I have been involved with the treatment of five major cerebral air emboli that resulted from various forms of catastrophes in hospitals. One was a transbronchial biopsy, another couple were major pump catastrophes during open heart surgery, somebody else had 60cc of air inadvertently injected into his aortic arch. In all of those cases, there were prolonged delays, including one which was about 54 hours. Now all of those patients made improvements and all but one of them made a complete recovery. The last one had multi-organ disease and as he started to improve and perfuse his head he bled into an infarcted part of his brain and died. But the others recovered. I must admit to our surprise that the patient with 54 hours' delay after a catastrophic pump failure in the theatre, whose only activity before treatment was to seize on deep pain stimulation, recovered.

Characteristically, we find these people have about an 18-24 hour latent period, when you see nothing happen. Then at the end of that time, when you are about to despair, they start improving and over the next 6 to 8 hours they make dramatic improvements. That particular guy wanted his endotracheal tube out at the end of that time and then within a couple of hours he was on the telephone to his wife. We then managed him as a normal post-op heart and shuffled out of the chamber at the end of the treatment. So the point I am making is that the delay in getting the patient to the type of facility where aggressive, if necessary saturation treatment, can be performed, is a hell of a lot more effective than trying to rig up a series of make-shift systems to transport a patient. You are better off going through all the early regimen that I described, getting the appropriate type of aircraft, and getting to where the patient can be appropriately treated.

That obviously does not apply to the situation where you have a recompression facility that is reasonably right next to wherever the embolism takes place. But even then, that is not very effective as you know. The Royal Navy has had about three deaths in 50,000 submarine escape exercises, despite the fact that they have the full facilities there at the top of the tower.

Chairman: Dr Darrell Wallner
Any other questions? On this, or any related subject?

I would like to thank all our speakers for this information. Perhaps the executive might like to consider the questions we have heard. A group such as ours could well think about the educational aspects directing information towards the dive schools and instructor groups because many of them are keen to join SPUMS and are becoming members. A simple regimen of recommendations, if we could sort one out and publicise it through the various professional dive schools, would, I am sure, be welcomed and useful, because they must be just as confused as most of us. And we have the benefit of some degree of skill in this field.

SAY "FLY HIM" AND WE'LL STRIKE

Readers will be aware of the consensus of opinion among participants at the 1980 Pulan Tioman SPUMS conference concerning the relevance of helicopter or light plane use for most diving casualties. They felt that is was usually not the method of choice because of time, noise, space limitations and other factors. The use of rescue helicopters in certain sea and land situations seems a significant benefit, however. Readers may well be astounded to hear that New South Wales Ambulance personnel view the helicopter service as a threat to their future employment and have taken industrial action (which means inaction) to protect themselves. As the service is extremely costly compared with the alternatives and the time benefits are usually negligible in an emergency situation, their fears appear to be the result of the pro-helicopter PR Service "selling" the glamour too successfully. Possibly doctors are more at risk from the microchip Diagnostic Computers to a greater degree than the ambulance service officers ever will be from such a rival.

CLOSURE OF ROCHE INSTITUTE OF MARINE SCIENCE

The employees of the Institute at Dee Why (Sydney) have been told that it will close in June this year because of increased financial demands on the parent company in Switzerland. The Institute, which opened in 1974, has hosted a meeting of SPUMS members who were given a tour of the facilities and were greatly impressed by the equipment for the extraction of complex organic compounds from marine life. One critical factor leading to the closure has been its failure to win the jackpot by discovering a compound of commercial interest. Nature, red in tooth and claw, claims victims within the scientific community on occasion. We trust that those unfortunately displaced from their present researches will speedily find niches to re-establish themselves successfully.