4. Potassium permanganate should not be used, as it will only cause local tissue damage and aggravate the wound.

Hospital management is directed towards pain relief, antivenom, bed rest, and treatment of any cardiovascular or respiratory problem. Attention should be paid to tetanus prophylaxis and local wound treatment.

THE UNDERWATER TRAINING CENTRE IN MORWELL

John Knight

Why have an underwater training centre 60 km from the coast? Largely because basic training and training in the use of equipment and tools does not need the sea, only water. In fact the sea can be a nuisance because it can get too rough to be safe. The Commercial Diving Center, which is now the College of Oceaneering, in Wilmington, California, has access to very protected water and yet has large on-shore tanks for training. The other reason is that Morwell is the base for the major activities of the National Safety Council of Australia (NSCA) Victorian Division which purchased the Underwater Training Centre (UTC) from its Sydney owners about 2 years ago.

The UTC trains divers to the standards set by Part 1, Scuba Diving (*'persons not normally working underwater but who are required to dive in connection with archaeology, non-commercial research, scientific work and observation tasks"), P*art 2, Restricted Commercial Air Diving (*'personnel who will be engaged in professional and/or commercial underwater operation, at limited depths .... using surface supplied compressed air or self contained breathing apparatus and not having access to a surface compression chamber. Such qualification is the minimum required by regulatory authorities who are responsible for the control of on shore diving, eg construction of jetties, dams.") and Part 3, Profe*ssional Air Diving with surface compression facilities *("Such qualification is the minimum required by regulatory authorities who are responsible for the control of off-shore diving, eg oil and gas exploration") of* the draft Australian Standard for the Training and Certification of Divers. Part 4, Bell Diving (*'related to the further training of experienced air divers and underwater workers to permit them to operate safely and competently as bellmen and lock-out divers")* has not as yet been started. There are a number of reasons for this including the present depressed state of the diving industry and its high unemployment and the lack of a safe 100m deep site at sea off the Victorian coast. This depth is necessary if the UTC training is going to be accepted by the UK authorities as equivalent to their standards for bell divers in the North Sea oilfields.

In addition to training divers the UTC is engaged in helicopter-crash survival training. They have the cabin of a helicopter sitting on a bar. It is held vertical by uprights at each end of the bar. The trainees get in, and the assembly is hoisted up and positioned over the pool and then rapidly lowered into the pool simulating a crash at sea. The RAN and ESSO-BHP are using this service.

Another group being taught by the UTC is the NSCA air-sea rescue paramedics who not only have to be able to winch down to a ship but are trained to parachute and scuba dive.

The UTC has a pool that is 6 m in diameter and 9 m deep which is used for most of the training. It is in this that trainees learn the joys of wearing a Kirby Morgan Band mask, so called because the hood is held to the mask by a steel band. These have an oro-nasal mask instead of a mouthpiece on the regulator, which is all part of the full face mask. The regulator can have its working pressure adjusted and can also be converted to free flow. There is a delightful gadget that pushes up and blocks the nostrils so that the diver can clear his ears more easily. The great advantage is that the diver can talk to topside and hear replies. There is a microphone in the oro-nasal mask and earphones lie against the ears. Like any other full face mask it must be held firmly onto the face by straps or it will fill with water.

The KM Superlite is hardly light. It is the much more comfortable successor of the brass "hard hat". The Superlite has the mask part of the KM band mask set in a complete helmet. Worn inside the helmet is a padded hood which provides comfort and insulation. It is worn with a neck dam, a tight fitting neoprene sleeve round the neck which broadens out over the shoulders to be attached to a metal collar that locks onto the helmet. Because the head is in air the diver can hear better than with a band mask. Because the neck dam seals the helmet it can be worn with both wet and dry suits.

The band masks and helmets are surface supplied. The umbilical has a hose for the breathing gas and another for the pneumofathomometer as well as wires for the communications. The pneumofathomometer tube is open at the bottom. Air is blown down the tube at a pressure above that at the diver's depth, then the supply is turned off and the pressure in the system will drop to that of the diver's depth. This pressure can be read off a pressure gauge calibrated for depth. This is a much more accurate system than relying on a possibly faulty depth gauge on the diver's wrist, which of course the supervisor cannot see!

In the pool the trainees work with various power (hydraulic) tools such as are used for construction work. Welding underwater was a skill taught at the Commercial Diving Center when I visited it in 1977. At present the UTC is not teaching this skill.

A commercial diver must not only be safe at work in the water but he must be able to provide a safe environment for others to work in the water. This means learning how to control gas supplies to the diver and how to work the pneumofathomometer. The control panel varies in complexity, being relatively simple for a surface supplied bounce dive. The control panel for a chamber has a full set of controls for each compartment and for the trunking joining any bell to the chamber. There are deep and shallow pressure gauges, ideally one pair for each compartment. But often gauges can be connected to more

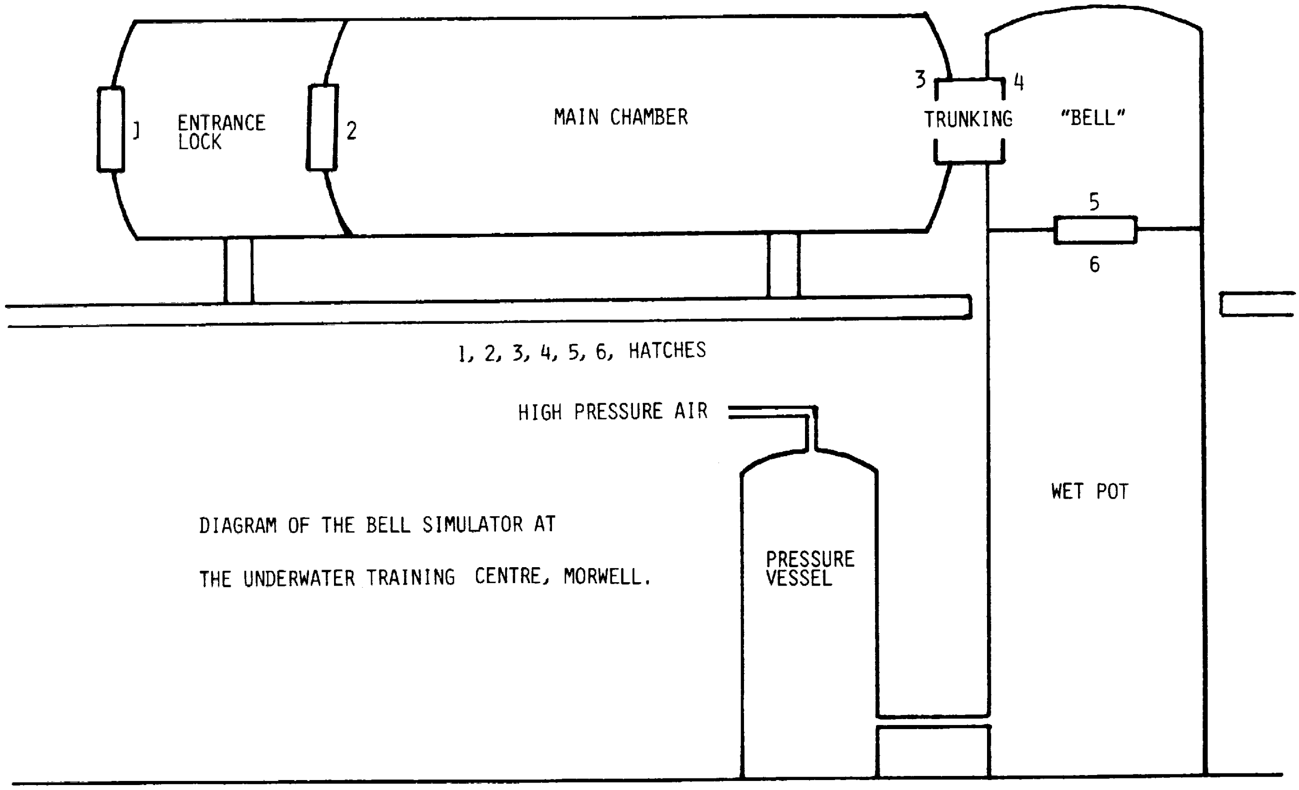

FIGURE 1

The hatches (doors) are on the chamber side (inside) their openings. They will stay shut as long as the pressure in the chamber is higher than outside. The exception is hatch no. 6 which will remain shut as long as the the pressure outside the "bell" is higher than inside.

than one compartment. If the supervisor thinks it is connected to compartment A when it is in fact connected to another, inappropriate action may be taken. This happened a few years ago in the North Sea when the supervisor, thinking the master gauge was connected to the living chamber when in fact it was recording bell pressure which was being dropped, pressurised the men and induced fatal hyperthermia. Besides controls for the chamber there have to be controls for the supply of gas to the bell and to the divers. The diver's life is literally in the hands of the man at the control panel.

The UTC acquired a two compartment multi-man chamber (4.8 m x 1.8 m) from Comex when that company finished work in Bass Strait. It is a deep chamber rated to 200 m. The entrance lock has two entry ports at right angles so that another chamber can be attached and there is still access from outside. At the other end of the main chamber there is an overhead entry hatch and another in the far wall, which leads into the bell simulator (Figure 1).

The interior of the chamber is dimly lit. There are only two lights and they are not actually in the chamber. The lamps are outside the chamber and the light reaches the chamber through a fibre optic system. The main living space is cramped for four men (there are four bunks) and is fitted with CO_2 scrubbers and can easily be used for saturation, but there are no toilet facilities.

The bell simulator, which is attached to the end of the large chamber, is an ingenious device to train people to operate a bell (properly a personnel transfer capsule) to different depths without having to go to sea. It consists of a “bell”, fitted with all the normal controls, permanently mounted to a wet-pot. At the UTC the wet-pot, although rated to 200 m is pressurized only to 50 m at present. Pressurisation is achieved by having another pressure vessel full of water connected to the bottom of the wet-pot. High pressure air is blown into the top of this second tank and the pressure rise, but no air, is transferred to the wet-pot. In this way a dive to 50 m can be simulated.

The diver and his attendant enter the “bell” and close the hatches between it and the chamber. They hoist the outside door (No. 6 in Figure 1) at the bottom of the bell almost closed with the chain-hoist. They leave a gap of about 1 cm between the door and its sill. The supervision starts to pressurize the wet-pot. As the water starts to rise into the lower trunking the men in the “bell” pull the chain-hoist chain sideways, so lifting the door to touch its sill. The outside water pressure now pushes the door tighter and tighter shut. The chain-hoist is unhooked and put out of the way. This is the same procedure that is used as a bell is lowered into the sea. Once the “bell” has reached working depth it is pressurized. When the pressure in the bell is the same as outside the bottom door falls open as it is no longer being pushed up by the water pressure.

Now the diver can enter the water and perform his tasks. Training includes diver rescue, which is difficult through the narrow Comex hatches. At the end of the exercise the diver returns to the “bell”. The inside door (No. 5 in Figure 1) of the trunking is shut and the “bell” is slightly over pressurised to seal the hatch. Now the higher pressure in the bell keeps it shut. At sea the bell would now be hoisted aboard and the divers transferred to the chamber either to be decompressed or to be held in saturation. The same routine is undertaken in the simulator, the only difference being that there is no mating of the bell to the chamber as that link has never been undone. Nevertheless those in the simulator have to go through the same routine of having the chamber pressurised and then the trunking, joining chamber and bell, pressurised before they can open the bell and crawl through into the chamber.

The UTC hopes to obtain another small chamber to mate to the entrance lock of the large chamber, with a hatch capable of accepting the bayonet fitting of a Dräger Duocom portable 2 man chamber. The NSCA runs a hyperbaric emergency service based on Morwell using Dräger Duocoms as the portable collecting chamber with the patient being decanted into a larger chamber at Morwell. However this chamber is limited to 50 m which might not be deep enough to give relief of symptoms. At present the patient cannot be transferred under pressure to the UTC chamber. An extra chamber, with a flange accepting a Duocom, on the UTC system would allow for such transfer.

Since this paper was presented the UTC has obtained the extra chamber mentioned in the last paragraph.

NEUROLOGICAL CONSIDERATIONS IN DIVING

David Brownbill

At the outset I wish to acknowledge the work that has been done in the field of fitness to dive with neurological conditions by John Hallenbeck and Hugh Greer who are both neurologists and divers and have been very closely associated with the United States Navy.

Any discussion on neurological conditions in diving must consider the neurological conditions that can result from diving and, probably more important to us here, advice to divers for their future activities when they have a pre-existing neurological condition or one that develops as a result of diving. Pre-existing neurological conditions fall broadly into three groups, head injuries, people who have undergone intra-cranial surgery for whatever cause, and those who have unrelated medical neurological conditions. The important problems are epilepsy, the changes that may occur to personality, which I will discuss later, and damage or impairment to the special senses of vision, hearing and balance.

There are two relevant statistical factors about epilepsy. The first being that 5% of the population will at some stage have an epileptic fit of some sort, for example as a youngster with a fever and secondly that 0.5% of the population will actually be termed epileptic, having recurrent fits requiring medication. The whole point about epilepsy is that it involves a low threshold to cerebral discharges. As a result of that low threshold precipitating factors may cause discharges that will result in that which we know as clinical epilepsy. The factors which are significant in diving include cold, decreased oxygen levels, or more importantly raised oxygen levels, decreased carbon dioxide which occurs with hyperventilation, hunger, alcohol and scarring of the brain. Here we might talk about the person who has undergone a craniotomy, surgery for let us say a meningioma. If it is in the posterior fossa and if there is no balance disturbance it is of no significance. However, if the surgery has involved the supratentorial region it carries, in the normal population without diving or the attendant precipitating factors, a chance of post surgical epilepsy approaching 10%. That raises the question of the incidence of epilepsy that one may expect in a person, following such surgery, who is diving and is therefore exposed to these precipitating factors. Epilepsy itself may occur with or without loss of consciousness. It may be just a momentary loss of awareness, but it does always interfere with the control of behaviour and performance and it does always occur without warning. There may be an aura that it may occur but the actual moment of occurrence is without warning. As I said before, in diving, vital considerations involve carbon dioxide or oxygen blood level changes which often happen and which may act as a precipitating factor in a person who already has a lowered threshold.

What advice should be given to somebody regarding diving who has suffered an epileptic fit? Now the first, and I think non-discussable, situation is if they have uncontrolled epilepsy, that is, they have epileptic seizures and are on medication. Without discussion I would say, not only should they not dive, they MUST NOT dive, full stop. The next question is regarding the person who has well controlled epilepsy, that is the person who has been on medication and has been seizure free for two years. Here we have to consider that such medication may make people drowsy and under increased ambient pressure these effects may be increased. Such persons have, of necessity, a remarkably reduced threshold to epileptic discharges which makes them more susceptible to precipitating factors. They should also be advised not to dive. The more controversial area is the one of, so called, arrested epilepsy, the person who has been five years free of epilepsy and has not been on medication. The current wisdom is that they be advised to avoid incidents where the oxygen pressure may increase, to avoid hyperventilation, to take care of currents, cold and stress. In other words they are to dive perfectly and never encounter any problems. I differ from the current wisdom and believe that anybody who has suffered an epileptic seizure should not dive. This advice is mandatory if they have uncontrolled epilepsy. In the other groups they make the decision but my advice is that they should not dive.

Personality was mentioned before and although this is not strictly a neurological consideration it does come into play, for example, following head injuries, cranial surgery or any form of cerebral insult. All of these may alter the personality but experience has shown that they accentuate a pre-morbid personality. Very rarely do these insults