One atmosphere suits have a future. The Galleotzi suit of the 1930s had limited visibility and the articulated joints leaked. JIM, the current widely used one atmosphere suit, has articulated arms which don't leak and a large viewport in the helmet giving very good visibility.

It takes only 6 hours training to learn to operate JIM. JIM is a one man submersible which can walk. It is non-combatant. It can work in currents that immobilise a Mark V diver. It is comfortable and the life support system allows temperature control. It is highly mobile. In an emergency the operator can ditch the weights and ascend. There is no need for decompression. With all these advantages go some drawbacks. It is bulky. It is expensive. To lease a JIM cost $300,000 for six months and $500,000 for a year. It is air transportable, and the four man crew need 12 hours to prepare it for operation after it has arrived. The life support system lasts for 10 to 11 hours. It has made successful dives (working) to 1700 feet and under the icecap.

Under development are SAM, a slimmer version of JIM designed to work between 150 and 2000 feet, and WASP. WASP is a development of the idea of Lethbridge in the 18th century. It is a one atmosphere system with moveable arms but no legs. Mobility is by means of thrusters at the side. Vision is good, but the development is halted as the designers lost a patent conflict. It should be more mobile than JIM.

Most diving companies are now equipped for saturation diving (the state of the art) and are not keen on changing to one atmosphere systems. There are advantages in the new system. The operator has no need for diving experience, he only needs work skills. There will be problems with unions and divers when the 1 ATA systems become widely used especially as it is likely that the cost of the systems goes up the divers wages will go down. However it seems likely that JIM and WASP will be widely used for work below 150 feet within the next 5 to 10 years.

Dysbaric Osteonecrosis

John Knight

Dysbaric osteonecrosis is only one of many causes of osteonecrosis. It has been known to occur in compressed air workers since 1911 and in divers since 1941. It was not thought to be an important condition until the late 1960s when Walder and McCallum described the incidence in compressed air workers. Of 1694 men, 334 had definite lesions (19%). 40% of the lesions were juxta-articular, which meant that 7.6% of the men had a potentially serious lesion. 1.9% had a disability. Other series showed lower incidence, for instance the RN survey by Elliot and Harrison of 383 men had a lesion incidence of 8% and the lesions were only found in men over 30.

The Medical Research Council in the UK formed a decompression sickness panel which monitors the X-Ray films of all compressed air workers and commercial divers . Last year Dr Davidson, one of the consultants to the panel, visited Australia. In September 1977 the panel had X-ray films of 2300 compressed air workers with an incidence of 383 lesions (17%) and 2316 divers with 60 lesions (2.4%). Of the divers 804 had never been below 150 feet and were presumed to have never used helium. They had an incidence of 0.4% of lesions while the 1138 men who had been below 150 feet and presumably had used helium had a 2.7% incidence. The incidence in divers is low but this may be an artifact as the statistics for divers have not been "collected" for long.

The classification was discussed and illustrated with X-ray films. All schemes divide lesions into juxta articular (A Group) and Medullary lesions (B Group) with different sub groupings depending on the origin of the authors. The MRC group do not believe that bone islands or cystic areas are indicative of osteonecrosis, while the Japanese do. Some cystic areas clear over the years, which suggests that they are an on-going process of repair of damage.

The main problem with osteonecrosis studies is that the lesions are followed by X-rays, it is a diagnosis based on shadows which take months to appear. Experiments using glass spheres have shown that it takes over 3 months for the X-ray change to show up while the histological change is visible under the microscope in days. Not all areas damaged show the X-ray changes so the current techniques which show promise, estimation of the urinary hyxroxyproline and technetium scans (which often show areas which do not go on to X-ray change) have problems. Could one really tell a diver to give up his occupation on the basis of a urine test, only to find no X-ray changes ever developed?

The Japanese have a large experience in dysbaric osteonecrosis as they have diving fishermen who do not pay much attention to decompression. In one survey 268 of 450 divers had definite lesions (59%). The incidence was higher after 5 years of diving and in those who had been deeper than 30 metres. 73% of the men with lesions had been treated for decompression sickness. On the other hand, Sealey has reported that using the Washington State Tables his series of 86 men have only minimal bone changes in 6%, all in the youngest third of the men.

Whatever the causes of dysbaric osteonecrosis, and arterial blockage by bubbles (unlikely), gas induced osmosis (no longer favoured) and venous bubbles have all been postulated, there does seem to be an association with careless decompression. Navies which on the whole are careful about decompression have much lower incidence than other series. Sports divers used to be considered unlikely to develop the changes but in Williams and Unsworth's paper from Sydney there were three cases in 19 sports divers surveyed. What the real incidence in Sydney sports divers is anyone's guess as there are certain to be more than 19 such cases in Sydney.

One of the things that stands out in the literature is that the X-ray diagnosis is very dependant on personal opinion, which needs to be checked and checked again. More is being learnt about the progression and incidence, but why some lesions progress and others do not is still unknown.

Physiology of Diving Mammals

John Knight

This paper followed that by Glen Egstrom on the physiology of immersion. It was a rapid review of the various adaptations by the marine and aquatic mammals to their environment.

The diving responses which are present in all mammals are, bradycardia, vasoconstriction, lactic acidosis and anaerobic metabolism. This is normally precipitated by putting the snout under water. The advantages of these responses are better perfusion of the heart and brain, decreased oxygen needs, increased oxygen extraction, energy production without oxygen and maintenance of the core temperature. The disadvantages of diving include an oxygen debt, tissue anoxia and hypothermia. Man is an inefficient diver, his pulse rate only drops from about 75 to 40-50 while that of the porpoise drops from 60 to 30, the whale from 100 to 12-24, the seal from 70-140 to 7-14, the hippopotamus from 100 to 10-20 and the beaver from 75-90 to less than 10.