The breathing pattern in air is a pause after breathing out. In water the pause is after inspiration with inspiration following immediately after expiration.

Cardiovascular changes include an increase of 38% in cardiac output, with an increase in stroke volume of 25 ml (35%). Diving bradycardia occurs with face immersion. There is an increase of up to 700 ml in the central blood volume. The CVP rises. There is a bradycardia which increases with time immersed. The diving reflex, apnoea and bradycardia on face immersion is more noticeable with cold water. The forearm blood flow is decreased by 60% while the forearm resistance is increased by 40%. Although the heart rate goes down the energy cost is unchanged.

The sudden death syndrome has recently been described. Middle aged men return from a dive on the surface, are alright for a while then develop respiratory trouble and die. The post mortems have normally given the cause of death as drowning. There is speculation that what kills them is a hypertensive episode opening intracardiac shunts L-R.

Diuresis is almost inevitable. A diver working hard at 150 feet will develop a 3 to 4 pint (American) decrease in his plasma volume. Negative pressure breathing induces a diuresis of up to 500 ml/hour; diuresis subsides after 2-3 hours with individual variations. Sodium excretion is increased. Cold causes diuresis, as does alcohol. Respiratory water loss is 500 to 600 ml a day in normal air, dry gas increases the water loss. The effects of water loss in terms of performance, work capacity gas uptake, etc. is not understood. Immersion diuresis is reduced by positive pressure breathing. The diuresis varies with water temperature, fitness, age, etc.

Skin does not take kindly to being constantly wet, the diver develops pain, cannot work properly and the skin eventually sloughs.

NEW TOYS
Glen Egstrom

This was a review of various advances in diving technology.

1805 - Fullarton produced a diver’s suit which protected the areas of high heat loss.
1918 - De Graaf produced a 1 atmosphere diving system. It leaked.
1918 - Leavitt produced a 1 atmosphere diving system with articulated arms and legs. There were problems with the ends of the arms.

The USN standard diving dress Mark V is very similar to that introduced by Siebe Gorman over 100 years ago.

The Mark VIII is capable of 1000 foot depth in theory, however 600 feet is as far as it has been taken. There are two 90 cuft 5000 psi bail out bottles which give a bail out capability. This is enough for a no-stop 300 foot dive ascent. No dive to that depth is no-stop. It is a hotwater suit with an umbilical connector block weighing 23 lb. There are troubles with the umbilical - 300 feet costs $17,000. Although the umbilical was designed to weigh 1/10th of a pound per foot it has flexible walls and at 450 feet actually weighs 6/10th of a pound per foot. The helmet is buoyant and the diver is weighted on his chest and waist.

The Mark XII should have been in service two years ago. The helmet is neutrally buoyant. The diver wears the weights on his thighs which gives him better mobility. It is in its 7th year of development. The major problem is that Mark V trained divers are reluctant to learn the new skills demanded by this equipment.

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