

It is common knowledge that certain chemical reactions are speeded up or retarded by pressure, that some substances which are normally gaseous become liquid under pressure, and that some liquids become solidified. At depth all the normal physico-chemical conditions of living tissues are disturbed, and it is in such conditions that nitrogen and oxygen become harmful to our organisms.

If we want to go lower we must change the alchemy of our metabolism, adapting it to changed conditions just as certain holothuria and certain *annelidae* have adapted theirs to pressure of 1,000 atmospheres and more.

This may seem impossible and yet recent research seems to point in that direction, at least as far as the work on decompression irregularities is concerned. At the Faculty of Medicine at Marseilles a research team has discovered by experimenting on cats that an injection of adrenaline will prevent the formation of nitrogen bubbles. To use this knowledge on human beings will no doubt demand the use of analogous but more convenient substances.¹

However, if drug-taking is to be introduced into free diving then, frankly, it is going to lose a lot of its purely human interest. No, underwater tourism of the future will have to be a sport like any other sport, with all forms of "doping" prohibited.

On the other hand, exceptionally, perhaps for salvage or rescue operations, or for military purposes, the ability to extend, even if only temporarily, the physiological possibilities of the human body in this respect, may prove very valuable, and it is from this standpoint that we must treat the research now going on to give a diver a gaseous mixture which is different from air, a so-called "cocktail" and in fact record dives have been set up with such gaseous mixtures.

The Cousteau equipment has the same limitations as the traditional helmeted diving suit, and at depths of 250, 300 and over it has an additional disadvantage: its very lightness and simplicity can cost the diver his life because under the influence of depth intoxication he can let the breathing-tube fall from his teeth. On the other hand, temporary vertigo, and even unconsciousness, would not necessarily be fatal to a diver in an ordinary diving-suit.

The heavier traditional diving-apparatus, receiving its air by

¹G. Jullien, M. Léandri and L. Blein, *Communication au Congrès International de Médecine du Travail et de Médecine légale*, Naples, September 1954: "Serious Decompression Accidents."

pressure pump from the surface, can be fed with gaseous mixtures varying according to depth.

As pure oxygen is highly toxic, and as nitrogen quickly becomes so at depth, the solution of the problem is contained in the problem itself: dilute oxygen with a gas other than nitrogen. Argon, for example, might do if it were, unfortunately, not intoxicating even at relatively shallow depths. Hydrogen and helium seem to have no toxic effect, but they have other disadvantages. And, in any case, helium is almost non-existent in Europe. Hydrogen, on the other hand, forms an explosive mixture when mixed with oxygen. The unfortunate diver might find himself blown to pieces when his cocktail came under a certain pressure. However, to obviate such a *contretemps* the supply could be varied according to depth.

A further complication is that at great pressure too highly compressed oxygen becomes in its turn a poison and beyond a certain depth the dosage has to be reduced.

It was only after taking all the precautions suggested by the above considerations that two record depth performances were set up.

In 1945 the Swedish engineer Arne Zetterstrom reached a depth of 525 feet using air down to 130 feet and then a rapid "rinsing" with nitrogen followed by hydrogen with a small admixture of oxygen. Unfortunately the breaking of a cable on the return journey cost him his life.

Three years later, in 1948, an Englishman named William Bollard set up the record of records to date, reaching a depth of 538 feet with a mixture of helium and oxygen.

But the complications involved in such artifices condemn them. With such methods man will never be able to achieve anything but exceptional exploits. They are for "records" only; they will never be a means of seriously opening up the new underwater world.

I am afraid that we must now face it: round about 300 feet is the limit for free dives, and only then for fit, well-trained men.

FLIRTING WITH DEATH

However, man has never felt inclined to accept any limits. Someone is always sufficiently daring and determined to try again. And again and again.

Thus, for example, the Americans have taken the Cousteau-