

Theory of Diving

"Papa Topside"

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I would reckon that a word should be said about the theory of diving. Be assured that what will follow comes strictly from the brain of "Papa Topside", and does not necessarily relate to any given and acceptable concepts of diving practices.

Commencing with JS Haldane, we have been confronted with, and have abjectly acceded to, a purely mathematical concept of tissue gas containment. By virtue of experimental work involving JS, his oxygen-intolerant wife, and his son, plus a handful of edible pigs. Haldane developed his theory of half-time gas-tissue residuals. The concept was fabulous but quite fragile. Over the years, it simply did not hold up. As we laboriously examined the uptake and elimination gas curves so carefully derived by Dr Al Behnke and his associates, it became clear that the intake and outflow of inert gases were not at all mirror images. Technical roadblocks at that time did not permit further inspection of the most critical problems of gas transport, which is the essence of calculating decompression requirements.

For a long time, several of us in the field of diving medicine had wished to examine the concept of multiple-inert gas usage for shallow dives. We reasoned that, since each inert gas has its own individual pattern of uptake and elimination, perhaps we could put together a mixture of inert gases which, if treated separately by the diver's body, might greatly improve decompression times. The weight of world scientific opinion was against us since it was accepted doctrine that the human body, for purposes of decompression, cares only for the total partial pressure of any single inert gas of many such. We could not accept this dogma, but had no safe or reliable tools to measure elimination curves of the gases we would like to use in combination. In effect, our hands were tied.

In about 1972, however, we were given access to a new tool, which combined the miniaturized mass-spectrometer "Med Spect-8" with a specialised flexible teflon-tipped intravenous probe capable of instantaneous readout of as many as five inert blood gases, plus O<sub>2</sub> and CO<sub>2</sub>.

In 1974, we took off at our tiny facility at NCSL. After 18 human exposures to quintimix gases, we achieved several dives to 60 feet for a duration of 240 minutes. All of this with no decompression, and no bends symptoms. At this point we were stopped by order of the US Navy Surgeon General, and so never reached our 360 minutes/60 feet goal, which I believe possible with out magic-mix-5. No matter, it will ultimately come to pass.

(Virtually no animal subjects are acceptable for high-pressure experimental work. Small rodents are nearly unbendable; rabbits are extremely susceptible to O<sub>2</sub> toxicity; apes of any kind tend to have congenital lung disorders; and horses, the best choice, are too big for chambers. Let's face it, man if our best research subject.)

I guess that the main point of this discussion would simply be that although the basic laws of physics are perhaps immutable, these laws can occasionally be manipulated to our advantage. And that's the bottom line of the diving game.