

Invited editorial

What if Darwin had been a diver?

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This issue of *Diving and hyperbaric medicine* carries the fascinating review by Newman *et al.* of therapeutic agents from the sea.¹ Quite rightly the authors place their subject into the context of 2009 being the 200th anniversary year of the birth of Charles Darwin and the 150th anniversary of the book *On the origin of species by means of natural selection*;² but what if Darwin had been a diver?

Firstly we must assume that Charles Darwin was not a diver. Search *On the origin of species* or Darwin's account of his voyage of the *Beagle*³ and there is no mention of diving. His grandfather, Erasmus Darwin, worked with engineers, physicians and scientists who were involved in the fledgling diving industry of the late 1700s,⁴ but the scientific possibilities of using this new technology obviously passed his grandson by and there is no record of diving equipment being on board the *Beagle*.

Given his fascination with biology and biodiversity, the inability to go underwater must have been incredibly frustrating for Darwin; especially as you consider that, previous to *On the origin of species*, Darwin's main scientific contribution had been the publication of the book, *The structure and distribution of coral reefs*.⁵ Imagine how Darwin, possessing a highly inquisitive mind, must have felt as he travelled for weeks on the *Beagle* between countless untouched Pacific coral atolls in clear blue seas but without any means of getting underwater to view the life on them? *The structure and distribution of coral reefs* did, however, contain some observations that supported the idea that the Earth was not static but was filled with change. Darwin was fascinated by how coral atolls came to be. These atolls invariably rose from deep waters but were made from the skeletons of animals that could only survive in shallow water.⁶ Darwin's theory was that they formed around basalt spikes, which had been forced upward in the water column by volcanic activity but later sank back into the Earth's crust leaving the distinctive central atoll lagoon. It would take over a century to prove his theory,⁷ but his mind was already made up and what we now refer to as plate tectonics underwrote in part at least five of the 14 chapters of *On the origin of species*.

In *On the origin of species*, Darwin first observes how man, through processes such as domestication and selective breeding, had produced animals that were distant variants of their origins in only a few thousand years (e.g., the domestic dog coming from the wild wolf) and different species in decades (there were 15 designated species of dog in Darwin's childhood, but over 50 by the time *On the origin of species*

had been published.⁸ Darwin was aware that this had been achieved through selection and that man had accelerated the process by being able to be quite ruthless in that selection process. His main question from this observation was 'could nature be influencing variation through a similar process of selection?' and his main driver for this question was his fascination with the diversity of existence. However, increased diversity had to have its limits and selection could be affected by fitness. The process termed 'natural selection' by Darwin outlined how inherited differences in the ability to survive in conditions of limited or diminishing resources caused the species to evolve and vary. Darwin's theories of how changes in global stability could have affected geographical distribution added to the selection pressures. It was not just physical variation; Darwin also considered how behaviour could change within the process of natural selection. Darwin was, no doubt, aware of the controversy that would be caused by the publication of *On the origin of species* and he dedicated a significant part of the book to arguing against what he saw as the main criticisms of evolution as a theory and why he considered it to be fact. Sadly, 150 years later, the overwhelming scientific evidence that evolution accounts for the diversity of the world we live in is still not accepted by many, but, rather, attributed to fundamental creation.⁹

Evolution is a theory that provides the intellectual framework to describe organic diversity, change and fitness. So, could examples of this have contributed to *On the origin of species*, had we been able to give Darwin a scuba set all those years ago? I am sure that Darwin would have targeted his diving on the coral reefs because they held a special fascination for him. He would immediately have been struck by the huge biodiversity supported by the reefs. What evolutionary clues would have been living amongst the diversity? He may have examined the prawns, shrimps, crabs, lobsters and crayfish and observed that, even though they were distinctly different species, the body plan was exactly the same with identical arrangements of the segments and limbs but with different proportions, shapes and uses.⁹ Darwin may well have concluded that these species had evolved from a smaller number of ancestral 'crab' species. He may have been attracted to the cleaning behaviours of wrasses and shrimps and used diving to separate the cleaners from their hosts to observe how both suffer as a result. His conclusion may have been that cleaning behaviour had evolved through a process of mutual dependence. Watching an angler fish luring its prey using a modified dorsal spine, Darwin may have pondered if the complexity of the spine had evolved through a process of selective breeding whereby mate selection is influenced by the 'beauty and size' of the lure.⁹

Battling with his own buoyancy control (because all great scientists are poor divers!), Darwin may have wondered how the thousands of fish in front of him were maintaining their buoyancy. Being careful to catch a bony (teleost) fish, Darwin could have dissected his specimen to reveal a gas-filled swim bladder. But more than this, he may have worked

out that the fish was able to regulate the amount of gas in the bladder, the bladder was a modification of part of the gut and, in some cases, it helped the fish to hear better underwater as well. While he was performing the dissection, it would have been a shame not to examine the basic physiology of the blood of the fish; he would have discovered that the plasma was a slightly diluted version of full seawater. A more detailed investigation of marine and freshwater animals would have shown him a trend whereby the more advanced the animal was in evolutionary terms, the further the ionic composition of its blood plasma was removed from that of seawater.¹⁰ By maintaining and regulating its internal physiology, an animal will benefit as it will be more able to contend with environmental change.

Once fishes had more control of their physiology, then the next step may have been to leave water altogether. The movement from water to land would obviously have been a major evolutionary step, and Darwin may have been thinking about this as he surfaced from his dive and caught a glimpse of amphibious blennies 'walking' on the foreshore. After a few large rums that night on the *Beagle*, Darwin would doubtless have come up with theories as to why fish would leave water and what adaptations allowed them to do so.^{11,12} But confusion could have set in on his next dive, when the turtles he had seen earlier laying eggs on the beach were now grazing underwater at depth. Surely this must be an example of land animals evolving back to an aquatic habit? He would no doubt have made similar conclusion about the mammals while watching a whale or dolphin swim by, although he may not have necessarily noticed that the nearest terrestrial family related to whales are the African *Hippopotamidae*. What would he have made of the sea snakes that have evolved the ability to excrete nitrogen across their skin to avoid getting the bends?

Being able to dive would have certainly added to Darwin's knowledge and wonderment of the natural environment. But what would he have thought about the divers themselves? Would they show any evolutionary trends with time? Putting aside the possibility of a slight shift in the sex ratio of the offspring from couples where at least the male is a diver, any evolutionary shift is unlikely as there are few associated selection pressures. It could happen though if, for example, human survival ever depended on having to eat a particular food which can be obtained only by freediving to depths greater than 20 m thirty or more times a day.

It is extremely disheartening to conclude that the main present-day association between Darwin and diving is with the awards that carry his name. It is only by dying in a spectacularly stupid way that a diver can advance the fitness of the human species in an evolutionary fashion by ensuring that their 'stupid genes' are not passed on to future generations.¹³ It is only by getting a 'Darwin award' that a diver can truly contribute to evolutionary theory – perhaps this should be a consideration in any hyperbaric treatment algorithm?

References

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All of Darwin's original texts are available to download in text or pdf formats at *The complete works of Charles Darwin online* (<<http://darwin-online.org.uk>>).

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The front page photo of a barrel sponge, *Xestospongia testudinaria*, was taken by Martin Sayer at Kimbe Bay, Papua New Guinea during the SPUMS 2008 ASM.