Time Machines, by Peter Ward

Virtual Ammonites

Some structures or proteins evolved by organisms early in their history stay with them throughout time and may play a large role in how they and their ancestors are eventually made. My favorite example of how historical factors affect the design of organisms comes from the study of the octopus. Octopuses are among the smartest creatures in the ocean (much more intelligent than fish, for example), and one wonders why their brains did not continue to enlarge until thy, like us, became truly sentient creatures. Instead, they dwell in the nether world of semi-consciousness. In a classic account worked out by my friend Martin Wells of Cambridge University, it was shown that the octopus suffers the ill effects of a choice made half a billion years earlier by its hoary cephalopod ancestor, the first nautiloid. This creature and its ilk evolved a copper-based rather than an iron-based blood pigment to carry oxygen. Nautilus (and hence, we presume, the earliest nautiloids as well) is quite a stupid beast with a very small brain. A copper-based blood pigment carries more than enough oxygen to meet the needs of the nerve cells and brain of a nautilus. However, copper cannot carry as much oxygen in blood as iron can. With the evolution of a larger cephalopod brain, oxygen availability became an issue for the first time. Because of its large size, the poor octopus's brain is nearly always on the brink of oxygen starvation, for nerve cells above all others need a constant supply of oxygen. The octopus cannot evolve a larger brain, because its blood supply will not support more nervous tissue. Worse yet, so basic is the type of blood pigment that the cephalopods cannot redress this wrong by evolving an iron-based pigment at this time. It is too late. This wrong choice offers an example of the historical aspect of functional morphology at work.

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