Some Styles of Thought in Science: Examples Applied to the History of Evolution

by Erik Rau

In the vastly cluttered secondhand shop of philosophical ideas, there is a large but somewhat empty cardboard box labeled 'SCIENCE.' A few terms rattle around inside, some of which look very similar to each other. When these terms are unpacked and tried out on a few actual theories, however, we begin to see how they might work. What follows is a short discussion of some often-used but little-identified epistemological terms in the philosophy of science, and their roles illustrated through part of the history of evolution.

Cautious realism and cautious inductivism can be unsatisfying scientific paradigms. Since both exclude stark ultimate causes, their organic natures leave us feeling a little unsure of our footing, walking on a frozen lake. This lack of absolute conviction doesn't imply any lack of scientific progress, however. Cautious inductivism, such as that discussed by Sir John Herschel in *Familiar Lectures on Scientific Subjects* is a generalization that sharply limits the gathering and sorting of knowledge whereas cautious realism is milder--a sort of reluctance to overreach on the same topic. As new scientific information is developed and theories are proposed, cautious realists will craft theories using new information but hesitate to force the universe to fit inside those theories, preferring instead to use the most predictive theory of a given moment without asserting anything about the true nature of the universe. One of the classic examples of cautious realism is found in the astronomy of the late 16th and early 17th centuries. At a point after the work of Brahe, Kepler, and Copernicus but before Galileo's telescope observations, a cautiously realistic astronomer could use a heliocentric model of the Cosmos without discarding two thousand years of physics. Cautious inductivists take this a step farther and give theories of *vera causa* wide berth, for good reason. They are leery of any attempt to extrapolate causes from observations, confining themselves to laws and the extraordinarily rare causal theory.

The 1859 publication of Darwin's *On the Origin of the Species* is a watershed event, in the neutrally geographic sense of that word—recognized regardless of how you feel about it. Subsequently, scientists established functionalism, based on the adaptation of critters to their niches via natural selection, as the dominant paradigm in evolutionary biology for virtually all of the 20th century and still going strong into the 21st. Functionalism explains diversity among species of critters through adaptation to either the tasks those critters perform or the environment they live in or both. Though he wasn't the first to do so, Darwin clearly propounded the supremacy of adaptation over conservation of structure in natural selection: 'Hence every detail of structure in every living creature (making some little allowance for the direct action of physical conditions) may be viewed, either as having been of special use to some ancestral form, or as being now of special use to the descendants of that form,' (Darwin 200) and this supremacy was then taken up as inevitable by subsequent researchers.

One of the main criticisms of functionalism is that while newly generated causes of traits supplant old ones in endless succession, there is no examination of whether functionalism is the best way to explain these traits. The definitive tactic of functionalism is to atomize a critter into traits, all of which are optimized to their fullest extent, except where more optimization would compromise some other function. The only limit to natural selection's power under functionalism is the trade-off between one trait and another.

Structuralism is an alternative theory for explaining changes in critters and species, which uses a different approach to that of functionalism, above. Structuralists see features of critters as both the things that are optimized through natural selection (traits), and the unselected byproducts of those optimizations. Thus some things are not traits as such: the human chin being one example that is rather a byproduct of two other separate traits: an articulated lower jaw and a respiratory canal separate from our feeding tube.

The headlining debate of biology in the late 18th century—between Geoffroy and Cuvier with their slogans of 'Unity of Type,' and 'Conditions of Existence,' respectively—opened in a not-always-

civil discussion about structure and function in Europe at the Institut in Paris. In England fifty years later, Richard Owen espoused structuralism when his expertise with comparative osteology led him to propose somewhat obscure correspondences in the bones of bats, moles, horses, and humans. Owen held to cautious inductivism with these varieties of cohesion to an archetype, even going so far as to say flat out that, 'To what natural laws or secondary causes the orderly succession and progression of such an organic phenomena may have been committed we are as yet ignorant' (Owen 86). Owen was responding in part to a competing theory involving an ultimate cause: the metaphor of animals designed to their purpose by their Maker as are vehicles such as a hot-air balloon, a locomotive, and a sailing ship designed to their purpose by their maker.

Owen's cautious inductivism contrasted sharply with the full-throated adaptationism and theological ultimate cause popular in other publications of the time. The Bridgewater treatises (commissioned in the early 19th century for the purpose of showing off the intricacy of God's creations) and other works kept adaptationism closely linked to creationism, so Owen tried to divide and conquer. Salting many references to Christian doctrine throughout his text, he emphasized religious solidarity while criticizing adaptation. Owen's tour de force of explication with limbs from widely disparate vertebrates leaves little doubt that while adaptation does play a role in making a bat look different from a horse, the fact that the body plans of the bat & the horse cleave to a common archetype doesn't allow for totality of adaptation.

On the third hand in this discussion about causality, Darwin was not shy about touting natural selection both as a mechanism for the change of one species to another, and as an ultimate cause for adaptation. Organizing these preceding authors into divisions by their style of epistemology can place Darwin together with the natural philosophers, since both he and they have ultimate causes, and casts Owen into another camp of cautious inductivists like Von Baer and Geoffroy. Owen's stance on the change in critters with time is unequivocal in the last paragraph of 'On The Nature of Limbs.' The two main points on that change are: first, it happens, and second, we don't know why it happens. He then goes a step further: we don't know why it happens, but it doesn't have to be God. Not only is Owen a cautious inductivist, he is also a cautious realist. Like some other controversial scientific authors, Owen may have used cautious realism to ease the passage of his ideas among criticism both collegial and religious.

Stephen Jay Gould used very different rhetorical devices when he made his critique of adaptationism. Gould published his paper *The Spandrels of San Marco and the Panglossian Paradigm* in 1979, and attacked the same certainty of adaptation that Owen contested 150 years earlier. Neo-Darwinists ossified the adaptationist paradigm with an unending sequence of discarded hypotheses; Gould offered simpler structuralist explanations instead. Unlike Owen's use of repetitive arguments to establish structural similarities, Gould dissects the adaptationist paradigm itself, and then proceeds point by point. As discussed above, he argues against the tactics of atomizing every critter into traits and viewing each trait as optimized. The prior example of the human chin is taken directly from Gould. His analysis of the chin is that it is not a trait unto itself, but a byproduct of two overlapping growth fields that coincidentally makes us more like Dudley Doright.

Gould also cites as a flaw the frequent changes of tack amongst adaptationist arguments—if one argument fails, another will serve just as well. His abundant examples of about-face maneuvers in adaptationist research papers cover Eskimo face shapes (described first as adapted for cold weather and second for chewing tough stuff like muktuk) and mollusk shell patterns (as camouflage, or perhaps as structural reinforcement). The next step in Gould's deconstruction is the claim of imperfect understanding of a critters ecological niche as a cure for a paucity of adaptive explanations for traits. This also leads to a paradigm where a lack of immediate utility in a trait renders it totally inexplicable. And indeed, due to the influence of Gould and others, adaptationism is beginning to yield pride of place to structuralism in evolutionary biology.

Gould's critique carries issues into the modern arena that have been debated since Galileo tried to sell his telescope as signal intelligence technology. But as science exists as much in the context of society now as then, we can expect that the demesnes of scientists are shaped by similar winds of thought and change. The tools we have examined need not go back into their dusty box—they can be useful, if kept in good order.