TELEOLOGY IN BIOLOGY: WHO COULD ASK FOR ANYTHING MORE?

by Lyman A. Page

Abstract. Teleological thinking permeates biology and is useful in pondering unanswered biological questions. Such thinking differs from the usual sense of teleology in that "purpose" in biology carries no imputation of causation. A few examples are given. The teleological system of biology is every bit as elegant a construct of the human mind as any other teleological system and in no way precludes spirituality. I argue that it provides a firmer foundation for moral guidance than supernatural systems.

Keywords: biology; brain; causation; ethics; evolution; human constructs; religion; teleology; transcendentalism.

The word *teleology* carries an aura of supernatural final purpose or causation that, when I was a student, seemed to make science teachers teleophobic. Forgetting that Charles Darwin was heavily into teleologic reasoning in his great works, they would cringe if one asked "why" such and such was so. The definition of teleology in Webster's *New World College Dictionary* (2002) is:

1 the study of final causes 2 the fact or quality of being directed toward a definite end or of having an ultimate purpose, esp. as attributed to natural processes 3 a) a belief, as that of vitalism, that natural phenomena are determined not only by mechanical causes but by an overall design or purpose in nature b) the study of evidence for this belief 4 *Ethics* the evaluation of conduct, as in utilitarianism, in relation to the end or ends it serves.

Unlike many definitions, this separates the opposition of purposeful versus mechanical causation into a discreet definition, but the retention of

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"purpose" in definition 2 still leaves some uncertainty over the appropriateness of applying the word to purely biological thinking. Definition 4 seems to involve the use of teleology in a nonsupernatural sphere. Emboldened by Darwin's example, I argue that teleological thinking is appropriate in biology and very helpful.

It is worth noting that any teleological system may be considered inherently "transcendental" in the Kantian sense of being the product of organizational thought of the human mind. I try to avoid confusion between this sense of transcendental and the sense of the word as a synonym of supernatural. I *am* proposing a Kantian transcendental unity among the teleological systems of religions and that of naturalism. In the latter, however, conclusions are testable, and the "purpose" is a posteriori. The purpose does not imply purposeful causation.

In the next section I give five examples of what I call teleological reasoning that predicted or led to productive answers in biology. I argue that natural teleology is logically and ethically as valid as teleology transferred to the supernatural, has the same source, and can serve as well or better as a foundation for understanding good and evil and the amazing rhythms of the universe without sacrificing any of the beauty that the search for this understanding has produced through religion, the arts, mathematics, philosophy, and science.

Teleology in Nature

1. Darwin uses teleology throughout his works, particularly *The Descent of Man* ([1871] 1952). Despite the deistic philosophy expressed at the end of *The Origin of Species* ([1860] 1952, 243), Darwin's use of teleology is always encompassed by the world of nature. In "the case of the peacock" ([1871] 1952, 477–99) he reasons that the beautiful tail must carry survival advantage that outweighs the disadvantages of its energetic excessiveness and its dangerous interference with efficient escape from predators. He concludes that sexual selection by peahens is that advantage and is in keeping with observation. The power of sexual selection as a mechanism of natural selection occupies two-thirds of *The Descent of Man*, with concluding emphasis on its importance in the characteristics of primates and humans.

2. The discovery in 1977 that much of the messenger ribonucleic acid (RNA) copied from a gene is chopped out of it in pieces (called introns) and the remaining pieces (exons) that code for the protein to be synthesized are then rejoined in a process called splicing was a landmark in molecular biology (Gilbert 1978). Teleologically, though, the question was, Why? This is very energy-consumptive. Each of the phosphodiester bonds between polynucleotide bases costs two of the high-energy phosphate bonds of adenosine triphosphate (ATP), the main "battery" of the cell, and this seems to throw away a lot of that energy. Furthermore, splicing must be

done with great precision and requires elaborate cellular machinery. Even more shocking, as genetic information accumulated, was the recognition that most deoxyribonucleic acid (DNA) did not code for proteins, i.e. as "genes." This DNA came to be called "junk" DNA, and its existence led to statements such as "Nearly 99% of the DNA in your cells has little or nothing to do with the instructions that make you *you*" (Raven et al. 2005, 350).[1] The teleologist would say that this prodigality is not acceptable. A sparrow in the northern winter may have to consume seeds at the rate of one every twenty seconds of its waking hours simply to survive. Certainly *its* cells aren't throwing away 99 percent of the energy of making DNA every time a cell divides! Introns must have some function, or the process of splicing has redeeming value, or both. All that noncoding DNA *must* be doing something. Nature would simply not carry on that kind of energy wastage over the millennia of evolution.

Well, of course, if you wait a bit, that kind of skepticism turns out to have value. Splicing allows a single gene to be organized in many ways to form different gene products, magnifying the value of the information transfer from DNA (see Raven et al. 2005, 313–14). Major functions of introns are still elusive, but some may be appearing. Most important, "non-gene" DNA is anything but junk. It codes for RNAs that have all kinds of important regulatory functions in the cell and will likely ultimately prove to be as important as traditional gene products (Riddihough 2005). Indeed, many of these regions of the genome are "conserved" evolutionally, meaning that they persist through long periods and much evolutional branching and therefore must be important for the function of a wide variety of organisms.[2] On the other hand, there are major differences in the noncoding DNA between chimps and humans, suggesting its importance in human-specific evolution (Culotta and Pennisi 2005; Chimpanzee Sequencing and Analysis Consortium 2005).

3. The function of the narwhal's "tusk" has troubled scientists for years. Observation never supported its use as a weapon or Jules Verne's assertion that it could pierce the hull of a ship. It occurs predominantly as an outgrowth of the male's left tooth and can vary from six to nine feet in length. It does not appear to be an object of sexual selection like the peacock's tail. The curiosity of a dentist, Martin T. Neewia, led him to study these "tusks," and he found them to be very untoothlike. They have tubules that open to the surface and are highly innervated, unlike ordinary teeth and tusks that are heavily protected by an enamel coat. The current thinking is that these "unicorn horns" are sensory organs that allow the narwhal to get important information on the chemical and other characteristics of the sea and possibly the weather. (Narwhals often hold their tusks vertically above the water.) Whatever the ultimate answers are, the conviction that these prominent and strange organs must serve useful functions is leading to further understanding of the narwhal (Broad 2005).

4. The effects of opiates have been known to humankind since antiquity. Only in the modern era of biochemistry, however, has thought been given to *how* they work. It was reasoned that there must be a receptor, and, of course, a receptor was found (Goldstein, Lowney, and Pal 1971; Pert, Pasternak, and Snyder 1973). That raised the question, Why? An opiate receptor must mean that there are endogenous ligands for it. Soon endogenous opiate congeners and other neuroregulatory compounds were found (Reichlin 1998, 198–99). These compounds are important to brain function, and the endorphins may prove to be particularly important to the human heritage (Balter 2005; Rockman et al. 2005).

5. The subtlety of biological teleological nets manifests in different ways. For example, the parasite *Toxoplasma gondii* matures in the cat, its feline definitive host, which excretes the *T. gondii* eggs as oocysts. These may be ingested by a rat or other mammal, which becomes an intermediate host. The parasite invades cells, replicates, and then becomes encysted until the rat is eaten by a cat. While carrying the cysts, the rat appears in every way to be normal, including having a normal olfactory sense, except that, in contrast to normal rats, he or she is not averse to cat odor and may even be attracted by it! All other scents tested produced a normal response. Thus, infected rats seem especially susceptible to cat predation, and *T. gondii* lives on (Berdoy, Webster, and Macdonald 2000).

The Natural World of Teleology

Darwin's use of teleology is best explained by his last sentence in *Origin of Species* ([1860] 1952): "There is grandeur in this view of life, with its several powers, having been originally breathed by the Creator into a few forms or into one; and that, whilst this planet has gone cycling on according to the fixed law of gravity, from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved."

Note that the Creator never appears in the reasoning after the origin of life. From a teleological approach to his prodigious observations of nature and those of others in biology, animal husbandry, farming, and from hosts of observant individuals Darwin induced his theories[3] of evolution. These theories revolutionized thinking in the world and have withstood innumerable potentially falsifying tests in many disciplines, including probably hundreds of thousands or more experiments in the science of molecular biology, which came into existence ninety years after the publication of Darwin's book. From this alone one can conclude that teleological thinking has a place in biology that is useful and powerful.

Energy orientation regarding the utility of cellular materials is a useful concept for anyone who wants to continue to understand biology. Selection over eons is a powerful tool, and most of it has occurred in conditions in which sources of biological energy were limiting. Only in recent human societies (since development of agriculture) have we seen situations

where malnutrition of excess occurred more frequently than starvation, and these situations still obtain in a small minority of the world's human population. It is a useful rule that nothing that occurs routinely in normal cells is not of use to the cell and, directly or indirectly, to the organism in which it occurs. Confidence in this rule led to the explanation of the peacock's tail, to the idea of sexual selection, to the discovery of endorphins, and to further understanding of the narwhal's tusk. The recent understanding of the potential importance of the large amount of nongene RNA in cells tends to confirm the rule. The *Toxoplasma* story is an example both of how intricately purpose in nature is woven into its web and of how "purpose" can turn out to be a relationship that develops after the fact. Some *Toxoplasma* eggs by chance carried a new potential capability of affecting rats' reactions to cat odor and immediately improved their chances of maturing into egg-laying organisms. This selective advantage quickly got established as a predominant characteristic of *Toxoplasma gondii* because of its survival value.[4] At that point the advantage looks like a "purpose" that directed the development of the characteristic, but it isn't. This fundamental distinction was perceived by Empodocles in the fifth century B.C.E. (Turner 1941, 569).

Implications for Science and Religion

Teleology obviously implies a teleological system or systems. It is useful to reflect on what these are. I conclude that they all are constructs arising from the remarkable human brain. Religions arose, I suggest, as a response to two major cognitive perceptions: (1) recognition of the vast complexity of what is observable and a need to explain things and (2) awareness of mortality and the unacceptable nature of that thought. Perception 1 also gave rise to the arts, mathematics, philosophy, and science, which all contribute along with religion to the human quest for beauty, morality, and meaning. Teleologic systems arose in religion and science to help organize and codify the respective constructs, and these teleologies serve continuously as stimuli for exploration and debate—the why questions.

In a recent Internet discussion among members of the Institute on Religion in an Age of Science the assertion was made: "The mind did not evolve to seek truth." This statement hints that there is causative purpose in evolution, which no evolutionist would agree to. It also hints of a teleology that is outside evolution—that is, transcendental. But it leads to the fascinating issue of unanticipated side effects of evolution. The wing likely did not evolve to support flight—until it actually did support flight (Dial 2003).[5] Then it got better at it and became an important part of the life effort of many organisms. Seeking truth became a major pastime for the brain when it became advanced enough to perceive the kinds of perplexities that led to the urge to seek truths. Hence, the arts, philosophy, mathematics, and science—and religion. These disciplines born of the human

brain strove to seek the meaning of it all. What does that imply? To me it implies that any "meaning of it all" emanates from us, that there is no meaning to the inanimate cosmos unless we perceive it. And we perceive it through our animate brains, which clearly are results of evolution. With a nod to Pogo, we have met the meaning of it all, and it is us—and our understanding of our world.

Why, then, should our teleology be transported to the supernatural? Already in the twentieth century the scope of our construct in the natural world ranged from the unimaginably small and evanescent to the unimaginably vast and aged—a scope much greater than any imagined by the great religions. A teleology based on the natural world would have a universally recognizable foundation, testability, and evolution. Many of its lessons for right behavior would be direct and tangible, and all would be testable, unaffected by theological manipulation serving less lofty interests. It would in no way limit ability to imbibe the beauty and truths of arts and religions. I argue that it would even expand that ability. How much more thrilling and enlightening it is to contemplate the evolution of God as a character of Hebrew imagination (Miles 1995) than to trudge obediently through the Bible (especially Leviticus) as a literal document! It would—and here's the rub—be immune to authoritarianism.

The translocation of religion to the supernatural allows for contemplation unfettered by the constraints of the natural world. That goal can be achieved by the human imagination without such a transfer. The transcendental transfer allows mystification, authoritarianism, and the resultant establishment of priesthoods. The Judeo-Christian-Muslim tradition is based from the beginning on a condemnation of the human biological imperative—the quest for knowledge, particularly of good and evil. A wonderful recent examination of the Faust tradition by Ingrid Shafer (2005) illuminates the fascinating intellectual ramifications of this stricture and ends with a fine metaphorical fusion of traditions. A comment in the penultimate paragraph, however, serves as a focus for my defense of a naturalist teleology. Shafer worries that "the contemporary technological potential for causing irreparable harm in foreseeable and unforeseeable ways is a real and present danger" (2005, 913). This seems to blame science, and by implication secularism, for the technology and to imply that because of this they cannot deal with its threat. I argue, and think experience supports the point, that a morality based on religious naturalism[6] is more likely than scripture to lead us to understanding these dangers and finding ways to avoid them—and keeps our remarkable brains working harder.

NOTES

I thank Michael Cavanaugh for helpful review and suggestions on this essay.

1. In fairness, this excellent high school biology text later notes the emerging field of nongene RNA that may have important cellular functions (Raven et al. 2005, 494).

2. The idea that conservation through evolution of specific genetic or DNA information implies its importance is inherently a teleological concept.
3. For argument on why the "theory" of evolution should actually be thought of as five theories, see Mayr 2001, 86ff.
4. This "survival value" is relative, and evolutionarily the main mechanism is the withering in a larval state of almost all of those *Toxoplasma* that could *not* affect their host's likelihood of being ingested by a cat.
5. This reference does not answer the question "What were dinosaur feathers for?" raised by Philip Hefner in his call for papers (Hefner 2005), but it does serve as an example of an unintended consequence of their existence.
6. For a comprehensive list of references on religious naturalism see *www.religiousnaturalism.org*.

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