

## INTRODUCTION

A famous legend (perhaps even true) from the early days of Darwinism provides a good organizing theme for understanding the centrality and importance of evolution both in science and for human life in general. A prominent English lady, the wife of a lord or a bishop (yes, they may marry in the Church of England), exclaimed to her husband when she grasped the scary novelty of evolution: “Oh my dear, let us hope that what Mr. Darwin says is not true. But if it is true, let us hope that it will not become generally known!”

Scientists invoke this familiar story to laugh at the recalcitrant stodginess of old belief and breeding—especially the risible image of the upper classes keeping a revolutionary fact of nature in the Pandora’s box of their own private learning. Thus, the lady of this anecdote enters history as a quintessential patrician fool. Let me suggest, however, if only to organize the outline of this introduction, that we reconceptualize her as a prophet. For what Mr. Darwin said is clearly true, and it has also not become generally known (or, at least in the United States, albeit uniquely in the Western world, even generally acknowledged). We need to understand the reasons for this exceedingly curious situation.

## EVOLUTION AS TRUE

The task of science is twofold: to determine, as best we can, the empirical character of the natural world; and to ascertain why our world operates as it does, rather than in some other conceivable, but unrealized, way—in other words, to specify facts and validate theories. Science, as we professionals always point out, cannot establish absolute truth; thus, our conclusions must always remain tentative. But this healthy skepticism need not be extended to the point of nihilism, and we may surely state that some facts have been ascertained with sufficient confidence that we may designate them as “true” in any legitimate, vernacular meaning of the word. (Perhaps I cannot be absolutely certain that the earth is round rather than flat, but the roughly spherical shape of our planet has been sufficiently well verified that I need not grant the “flat earth society” a platform of equal time, or even any time at all, in my science classroom.) Evolution, the basic organizing concept of all the biological sciences, has been validated to an equally high degree, and may therefore be designated as true or factual.

In discussing the truth of evolution, we should make a distinction, as Darwin explicitly did, between the simple *fact* of evolution—defined as the genealogical connection among all earthly organisms, based on their descent from a common ancestor, and the history of any lineage as a process of descent with modification—and *theories* (like Darwinian natural selection) that have been proposed to explain the causes of evolutionary change.

Three broad categories of evidence best express the factuality of evolution. First, direct evidence of human observation, guided by an explicit theory since Darwin’s publication in 1859, but buttressed by data on longer periods of breeding for improved crop plants and domesticated animals, provides hundreds of exquisitely documented examples of the small-scale changes that our theories anticipate over such geologically brief periods of time. These include the familiar cases of changing pigmentation in moth wings as an adaptive response to substrates darkened by industrial soot, altered beak shapes in Galapagos species of Darwin’s finches as climates and food resources change, and the development of antibiotic resistance by numerous strains of bacteria. No one—not even among creationists—has denied this overwhelming weight of evidence in the small, but we also need proof that such minor changes can accumulate through geological time into the substantial novelties that build the history of life’s expanding diversity.

We must therefore turn to a second category of direct evidence from transitional stages of major alterations found in the fossil record. A common claim, stated often enough to merit the label of “urban legend,” holds that no such transitional forms exist and that paleontologists, dogmatically committed to

evolution, have either withheld this information from the public or have claimed that the fossil record is too imperfect to preserve the intermediates that must once have existed. In fact, although the fossil record is indeed spotty (a problem with nearly all historical documents, after all), the assiduous work of paleontologists has revealed numerous elegant examples of sequences of intermediary forms (not just single “in between” specimens) joining ancestors in proper temporal order to very different descendants—as in the evolution of whales from terrestrial mammalian ancestors through several intermediate stages, including *Ambulocetus* (literally, the walking whale), the evolution of birds from small running dinosaurs, of mammals from reptilian ancestors, and a threefold increase in brain size during the last 4 million years of human evolution.

Finally, a third major category of more indirect, but ubiquitous, evidence allows us to draw a clear inference of change from a different historical past by observing the quirks and imperfections, present in all modern organisms, that make no sense except as holdovers from an otherwise altered (that is, evolved) ancestral state—that is, except as products of evolution. This principle governs the analysis of all kinds of historical series, not just biological evolution. We can infer that an abandoned railroad line once linked a group of well-spaced and linearly ordered towns (that would have no other reason for such an alignment). We can also identify social change from a more rural past by the etymological evidence of many words now used in very different meanings in our modern industrial world (“broadcast” as a mode of planting by throwing out seeds by the handful; or “pecuniary” advantages, literally measured in cattle, from the Latin *pecus*, or cow). In the same manner, all organisms carry useless remnants of formerly functional structures that make no sense except as holdovers from different ancestral states—the tiny vestiges of leg bones, invisibly embedded in the skin of certain whales, or the nonfunctional nubs of pelvic bones in some snakes, surviving as vestiges of ancestors with legs.

## **EVOLUTION AS NOT GENERALLY KNOWN OR ACKNOWLEDGED**

No scientific revolution can match Darwin’s discovery in degree of upset to our previous comforts and certainties. In the only conceivable challenge, Copernicus and Galileo moved our cosmic location from the center of the universe to a small and peripheral body circling a central sun. But this cosmic reorganization only fractured our concept of real estate; Darwinian evolution, on the other (and deeper) hand, revolutionized our view of our own meaning and essence (insofar as science can address such questions at all): Who are we? How did we get here? How are we related to other creatures, and in what manner?

Evolution substituted a naturalistic explanation of cold comfort for our former conviction that a benevolent deity fashioned us directly in his own image, to have dominion over the entire earth and all other creatures—and that all but the first five days of earthly history have been graced by our ruling presence. In evolutionary terms, however, humans represent but one tiny twig on an enormous and luxuriantly branching tree of life, with all twigs interconnected by descent, and the entire tree growing (so far as science can tell) by a natural and law-like process. Moreover, the unique and minuscule twig of *Homo sapiens* emerged in a geological yesterday, and has flourished for only an eye-blink of cosmic immensity (about 100,000 years for our species and only 6-8 million years for our entire lineage since our branchlet split from the node of our closest living relative, the chimpanzee. By contrast, the oldest bacterial fossils on Earth arose 3,600 million years ago).

We might mitigate the challenge of these basic facts if we could espouse a theory of evolutionary change that remained congenial to our old comforts about human necessity and inherent superiority—as in the common misconception that evolution implies predictable and progressive pathways of change, and that human origins (however belated) may therefore be viewed as both inevitable and culminating. But our best understanding of how evolution operates—that is, our preferred *theory* for the mechanism of evolutionary change (as contrasted with the simple *factuality* of evolution, discussed in the last section)—does not even grant us this ideological comfort. For our favored and well-attested theory, Darwinian natural selection, offers no solace or support for these traditional hopes about human necessity or cosmic

importance.

Hence, when I ask myself why evolution, although true by our strongest scientific confidence, has not become generally known or acknowledged in the United States—that is, nearly 150 years after Darwin’s publication, and in the most technologically advanced nation on earth—I can only conclude that our misunderstanding of the broader implications of Darwinism, in particular our misreading of his doctrine as doleful, or as subversive to our spiritual hopes and needs, rather than as ethically neutral and intellectually exhilarating, has impeded public acceptance of our best documented biological generality. Hence, I treat the meaning of Darwinism, or the implications of evolutionary theory (rather than the mere understanding of evolution’s factuality), as my major theme in trying to explicate why such an evident fact has not become generally known.

Public difficulty in grasping the Darwinian theory of natural selection cannot be attributed to any conceptual complexity—for no great theory ever boasted such a simple structure of three undeniable facts and an almost syllogistic inference therefrom. (In a famous, and true, anecdote, Thomas Henry Huxley, after reading *Origin of Species*, could only say of natural selection: “How extremely stupid not to have thought of that myself.”) First, that all organisms produce more offspring than can possibly survive; second, that all organisms within a species vary, one from the other; third, that at least some of this variation is inherited by offspring. From these three facts, we infer the principle of natural selection: since only some offspring can survive, on average the survivors will be those variants that, by good fortune, are better adapted to changing local environments. Since these offspring will inherit the favorable variations of their parents, organisms of the next generation will, on average, become better adapted to local conditions.

The difficulties lie not in this simple mechanism but in the far-reaching and radical philosophical consequences—as Darwin himself well understood—of postulating a causal theory stripped of such conventional comforts as a guarantee of progress, a principle of natural harmony, or any notion of an inherent goal or purpose. Darwin’s mechanism can only generate local adaptation to environments that change in a directionless way through time, thus imparting no goal or progressive vector to life’s history. (In Darwin’s system, an internal parasite, so anatomically degenerate that it has become little more than a bag of ingestive and reproductive tissue within the body of its host, may be just as well adapted, and may enjoy just as much prospect of future success, as the most complex mammalian carnivore, wily, fleet, and adept, living free on the savannas.) Moreover, although organisms may be well designed, and ecosystems harmonious, these broader features of life arise only as consequences of the unconscious struggles of individual organisms for personal reproductive success, and not as direct results of any natural principle operating overtly for such “higher” goods.

Darwin’s mechanism may sound bleak at first, but a deeper view should lead us to embrace natural selection (and a variety of other legitimate evolutionary mechanisms from punctuated equilibrium to catastrophic mass extinction) for two basic reasons. First, truthful science is liberating in the practical sense that knowledge of nature’s actual mechanisms gives us the potential power to cure and to heal when factual matters cause us harm. When, for example, we know how bacteria and other disease-causing organisms evolve, we can understand, and find means to combat, the development of antibiotic resistance, or the unusual mutability of the AIDS virus. Also, when we recognize how recently our so-called human races diverged from a common African ancestry, and when we measure the minuscule genetic differences that separate our groups as a result, then we can know why racism, the scourge of human relations for so many centuries, can claim no factual foundation in any real differences among human groups.

Second, and more generally, by taking the Darwinian “cold bath,” and staring a factual reality in the face, we can finally abandon the cardinal false hope of the ages—that factual nature can specify the meaning of our life by validating our inherent superiority, or by proving that evolution exists to generate us as the summit of life’s purpose. In principle, the factual state of the universe, whatever it may be, cannot teach us *how we should live* or *what our lives should mean*—for these ethical questions of value and meaning belong to such different realms of human life as religion, philosophy, and humanistic study. Nature’s facts can help us to realize a goal once we have made our ethical decisions on other grounds—as the trivial genetic differences among human groups, for example, can help us to understand human unity

once we have agreed on the unalienable rights of all people to life, liberty, and the pursuit of happiness. Facts are just facts, in all their fascination, their pristine beauty, and, sometimes, their unfortunate necessity (bodily decline and mortality, as the obvious example), and ethical rectitude, or spiritual meaning, reside within other domains of human inquiry.

When we thought that factual nature matched our hopes and comforts—all things bright and beautiful, and all things made for our superior selves—then we easily fell into the trap of equating actuality with righteousness. But when we sense the different fascination of evolution's naturalistic ways, and of life's astonishingly rich diversity and history of change, with *Homo sapiens* as but one contingent twig on the most luxuriant of all trees, then we finally become free to detach our search for ethical truth and spiritual meaning from our scientific quest to understand the facts and mechanisms of nature. Darwin, in defining the factual "grandeur of this view of life" (to quote the last line of *Origin of Species*), liberated us from asking too much of nature, thus leaving us free to comprehend whatever fearful fascination may reside "out there," in full confidence that our quest for decency and meaning cannot be threatened thereby, and can emerge only from our own moral consciousness.

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