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A Career in the Glare of Public Acclaim

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In 1982, Steven Jay Gould and I were in England at a conference, held at Darwin College, marking the 100th anniversary of Charles Darwin's death (academics can always find some reason for a conference). Gould looked terrible, and after an ample apology for my doing to him what I hate when it is done to me, I told him so. He agreed that he did not feel very good, and said that when he got back to the States, he was going to see a doctor. He did and was diagnosed with an especially virulent form of cancer—abdominal mesothelioma. That Gould immediately went to the library to look up the latest research on his special sort of cancer reminds us that he was first and foremost a biologist, and biologists are peculiar creatures. They care about what goes on inside their bodies more than most people. If something is eating them alive, they want to know what it is and what they can do about it. When Gould went to read up on his illness, he discovered that his prognosis was not good, but it wasn't necessarily a death sentence. Gould survived his first war with cancer and, needless to say, wrote a paper on the topic.

Gould submitted his manuscript entitled *The Structure of Evolutionary Theory* to Harvard University Press in February 2001. The editors put a copy of Gould's magnum opus into his hands in March 2002. Two months later, near the end of May, Gould was dead from adenocarcinoma—metastasized lung cancer. Gould was relatively young when cancer killed him. Some people, as they approach the twilight of their life, slow down and turn to tending their garden or making stained glass windows. Even if Gould had lived another 10 or 20 years, he would not have been able to slow down. He was a compulsive writer. A day without at least a few hours at his trusty Smith-Corona was for Gould incomplete. No person working 9 to 5 could have produced the volume of work that Gould has published—300 essays, one a month for 25 years; a half dozen books, not counting his collected essays; and numerous professional papers on a variety of topics.

One would think that Gould's primary reason in writing his *Structure* was to bring together all of his work on evolutionary theory in one unified and coherent presentation. After all, he is famous in large part because of his advocacy of punctuational evolution and species selection. According to Eldredge and Gould's punctuational view of evolution, lineages remain basically unchanged for long periods of time and then undergo fairly rapid change. According to Gould's version of species selection, the same sort of selection that takes place at the level of individual organisms can also take place at the level of individual species.

Gould does go to great lengths to explain his particular version of evolutionary theory, but that is not his main goal. His book concerns *science,* but more fundamentally it concerns the *science of science,* in particular the individuation of scientific theories such as evolutionary theory. Gould begins his book with an exchange between Darwin and Hugh Falconer on the future of Darwin's theory. Falconer thought that Darwin had laid the foundations of a great edifice, but that through the course of time this superstructure might well be altered, while Darwin was sure that much of his theory would be modified, but not its general framework. It was these contrasting predictions that led Gould to write his book.

To determine the status of Darwin's theory today, Gould had to figure out how to individuate scientific theories in general. How "Darwinian" was Darwin's version of evolutionary theory? How about later versions, such as those produced by Fisher, Haldane, and Wright or Dobzhansky, Simpson, and Mayr? How about Gould's version? In its most general form, the task is to individuate individuals. The time-honored example is the ship of Theseus, which is rebuilt, plank by plank, while it remains at sea. How much change can take place while it remains the "same" ship? What if all the pieces of the original ship, one by one, were replaced? Would it still be the same ship as when it was first built? What if all the parts of the original ship are saved and later put back together again in their

Note: The Structure of Evolutionary Theory, *by Stephen Jay Gould, was published by Belknap Press of Harvard University Press in Cambridge, MA, in 2002; the book has1433 pages, with illustrations, and costs $39.95 in hard cover (ISBN 0674006135).*

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original form? Which ship is the ship of Theseus? Does Theseus now have two ships instead of one?

The example Gould uses to explicate this problem is the Milan Cathedral, begun in the late 14th century in late Gothic style. Construction slowed down for 200 years. Then in the 16th century, more work was done on it, but in the Baroque style popular at that time. Finally, in the early 19th century, Napoleon ordered that all the walls and arches be festooned with ornamental forms. The question is whether this cathedral remained the same cathedral throughout all these additions and modifications. In this case, the answer seems obvious, but what if the cathedral had been destroyed several times and rebuilt? What if, in rebuilding, the same style was used? What if successive constructions were built according to different styles?

To answer these questions, four criteria are relevant: the retention of form, the retention of matter, the continuity of change, and the maintenance of internal integrity in the face of all this change. Did the ship of Theseus and the Milan Cathedral retain the same form as they were modified through time? Were they made of the same stuff throughout, or was substantially new material introduced? Was the change continuous or did gaps interrupt this change? And finally, did both the ship of Theseus and the Milan Cathedral retain their internal integrity throughout all these changes?

One of the most contentious controversies in evolutionary biology over the past few decades has been whether species, as the things that evolve, have more of the characteristics of individuals than of traditional classes.

The preceding examples may seem far removed from science, but Gould is well aware of the primary example of this metaphysical conundrum—biological species. Do species change their form as they evolve? The traditional answer is that, yes, they do. If species change their form gradually, then chronospecies are very hard to individuate. But if one accepts a punctuational view of evolution, as Niles Eldredge and Gould do, then one need not worry about how to subdivide gradually evolving lineages into chronospecies, because such gradual change is exceedingly rare. Even if evolutionary change is not as concentrated at speciation events as Eldredge and Gould once thought, speciation is still almost always punctuational (pp. 76, 798).

In evolution, do species retain the same substance as they change through time? The answer to this question is obvious and uncontroversial. Species evolve by means of organisms living, reproducing, and dying. The matter that makes up evolutionary lineages is changed over and over again. Continuity in space and time is somewhat more controversial. Assume that a species evolves exhibiting a certain array of genes and characters during a certain geological period and then goes extinct. What if, later, a species evolves that exhibits this same array of genes and characters? Do these organisms form one species or two? The usual answer is two. A species can be reduced to very few organisms and then blossom out again, but spatiotemporal continuity is essential. Species appearing in different parts of the phylogenetic tree are different species no matter how similar they may be.

Finally, the most problematic of these four criteria is maintenance of internal integrity. How well integrated must a group of organisms be to count as a species? The ship of Theseus remained well integrated while its parts were exchanged. It had to, if it were to remain afloat. The situation with respect to the Cathedral of Milan is different. Part was built. This part was well integrated. Then, after a lapse of time, a second part was built. The two parts were built so that they exhibited internal cohesion, but the nature of this cohesion changed as the size of the cathedral expanded. Species are commonly characterized as exhibiting "population structure," but the kind and amount of this structure varies from highly integrated to almost nonexistent.

All of the preceding discussion concerns individuals—individual ships, cathedrals, or species. One of the most contentious controversies in evolutionary biology over the past few decades has been whether species, as the things that evolve, have more of the characteristics of individuals than of traditional classes. If they are viewed as classes, then all that matters is form. Do a certain set of genes and traits characterize this species? Retention of substance, continuity through time, and internal integrity are of no consequence. If species are viewed as individuals (not organisms, but individuals in the generic sense), then all four criteria are relevant.

Gould sides with those who would interpret species as individuals, because that view fits in nicely with his advocacy of species selection. A common belief, from Darwin's day to the present, is that organisms are the primary focus of selection. Thus, if species are to be selected in the same sense that organisms are, they must be the same sort of thing, in this case individuals. Gould does *not* argue that because species are individuals they *must* be units of selection in the same sense that organisms are, but that, if species are viewed as individuals, then at least they *might* on occasion function as units of selection. Individuality and selection are closely connected. Can trait groups function in selection? The answer in part turns on whether they are really "groups" or externally constrained "individuals."

All of the preceding is contentious enough, but the general issue that concerns Gould in this book is scientific theories. He describes evolutionary theory "as a genuine 'thing'—an entity with discrete boundaries and a definable history" (p. 6). Do the four criteria listed above apply to Darwin's theory? If so, what conclusions follow for Mayr's version of evolutionary theory or Gould's version? Are they all essentially the same? Darwin set out versions of his theory from its earliest

form in 1838 until his death. He added here, deleted there, and introduced numerous transformations. Did Darwin's theory remain essentially the same theory through time?

Then, at the turn of the century, Mendelian genetics was combined with the evolutionary theory of the day, and later Lamarckism was expunged. Then along came the neutral theory of evolution, which was incorporated into Darwinism—or neo-Darwinism, if you prefer. Then, molecular biology had to be included in the mélange. Gould would like to add to evolutionary theory a more hierarchical, punctuational view of evolution as well as development. One common refrain in the history of evolutionary theory is that every change, when it was first introduced, was claimed to be incompatible with Darwin's theory—Darwin's theory has to be rejected. Then, to the extent that some substance was found in these new views, they were incorporated into the highly plastic boundaries of Darwinian evolution. The chief exception is Lamarckism. It began as a minor force in Darwin's theory, was elevated to greater prominence in some later versions, and finally was totally excluded, periodic ill-conceived claims to the contrary notwithstanding. The general issue, however, is how much change can be incorporated within this protean theory while it remains the same theory.

In the early days of Eldredge and Gould's punctuational theory, Gould published some remarks that raised the hackles of some of his contemporaries. For example, he claimed that Mayr's characterization of the synthetic theory was "effectively dead." Since Mayr claimed that his version of evolutionary theory was Darwin's theory, Gould was widely interpreted as saying that Darwin's theory was effectively dead. The creationists made the most of that! The prevalence of such misunderstandings is what led Gould to write his book. Certainly he spends a lot of time expounding his biological views, especially when these views differ from those of his contemporaries, but his primary goal is to show what his positions on particular biological topics imply for his theory being "Darwinian" or not.

Throughout his career, Gould has been strongly disposed to pluralism. Thus, it should come as no surprise that he is a pluralist with respect to scientific theories, particularly Darwin's theory. Various evolutionary biologists have set out versions of evolutionary theory. To be genuinely Darwinian, however, these formulations must be part of the Darwinian lineage, but more than that, they also must exhibit the essential features of Darwinian evolution. The first section heading of Gould's first chapter is "Theories Need Both Essences and Histories." Essentialism has had such bad press in the past few decades that Gould urges us all to say aloud "essence," "essence," "essence," until the "fear evaporates and the laughter recedes" (p. 10). Very few authors, the author of this review included, can get along without essences. The point of contention is whether or not Darwinism has an essence, and if so, what is it.

As the title of Gould's book might imply that he should, Gould spends considerable space in determining the *structure* of evolutionary theory. Darwin toyed with the metaphor of the "coral of life," but eventually the notion of the "tree of life" took over. Gould prefers the "coral of life," because it portrays the temporal dimension of evolutionary change more appropriately than does the tree of life. He uses a drawing of a coral to illustrate both biological and conceptual evolution (pp. 18, 97). He also uses it on the dust jacket of his book. In conceptual evolution, at the base of this coral is natural selection, which can be characterized in terms of three undeniable facts—overproduction of offspring, variation, and heritability. This fundamental base of evolutionary theory then splits into three principles—agency, efficacy, and scope. Agency concerns the locus of action in a hierarchical world. For Darwin, this locus of action is the level of organisms—not God, not genes, not species. Darwin also argued for the efficacy of natural selection. Although natural selection is not the only causal mechanism involved in the evolution of species, it is the primary cause. Finally, Darwin maintained that his microtheory has a wide scope. It can be expanded to include all relevant phenomena. No additional macrotheory is required.

Anyone familiar with Gould's work might conclude that, on the principles he himself sets out, his theory is not in the least Darwinian. For Gould, no one level of selection is good enough. Selection wanders up and down the organizational hierarchy. Gould acknowledges that natural selection has a role to play in evolution, but not as pervasive a role as many of his contemporaries maintain. Finally, Darwin thought that we could extrapolate from his microlevel theory to all of evolution. Gould clearly disagrees. Thus, it would seem that Gould is urging a decidedly non-Darwinian version of evolutionary theory. He certainly belongs in the Darwinian tradition, but his theory is different in its essentials from any of the versions set out by Darwin himself, let alone later Darwinians.

Gould disagrees. With respect to each of the three branches of Darwinian logic, Gould thinks that his revised structure of evolutionary theory is best characterized as expansion and revision, not rejection. If Gould had to present a one-sentence description of his intent in writing his *Structure,* it would be this:

> This book attempts to expand and alter the premises of Darwinism, in order to build an enlarged and distinctive evolutionary theory that, while remaining within the tradition, and under the logic, of Darwinian argument, can also explain a wide range of macroevolutionary phenomena lying outside the explanatory power of extrapolated modes and mechanisms of microevolution, and that would therefore be assigned to contingent explanation if these microevolutionary principles necessarily build the complete corpus of general theory in principle (p. 1339).

Gould insists that the "Darwinian framework, and not just the foundation, persists in the emerging structure of a more adequate evolutionary theory" (p. 3). The changes that have been introduced since, however, have resulted in a structure so expanded and enlarged beyond the original Darwin-

ian core that the "full exposition, while remaining within the domain of Darwinian logic, must be considered as basically different from the canonical theory of natural selection, rather than simply extended" (p. 3).

The trouble with evaluating Gould's conclusion is that he does not unpack such key terms as "framework," "foundation," "core," "premises," "principle," "traditions," and "Darwinian logic" in sufficient detail. How does a framework differ from a foundation? Also, I did not find his metaphor of cutting up a coral to be very helpful (see p. 19). Here, I think that Gould's essentialism has led him to define his criteria so generally that just about anything can be included.

Gould was a highly controversial figure throughout his career. Many of his fellow biologists and paleontologists loved to hate him. One reason for this antipathy is all too familiar. As much as professionals complain about the general public seriously misunderstanding their work, anyone who dares to popularize technical science runs the very real danger of being "Saganized." One of Paul Ehrlich's colleagues once remarked to me that Ehrlich turned to popular work because he did not have what it takes to do real science. One reason why Gould kept reminding his readers that he does hard empirical work on the genus *Cerion* was to shore up his professional status. He does more than popularize science, he does more than contribute to theoretical science, he does real get-your-hands-dirty science.

Gould, more than his opponents, thinks that such extrascientific considerations as politics play a more important role in science and are harder to uncover and uproot than we are willing to admit.

Another source of the antipathy that some of Gould's colleagues express toward him is his implication that they make certain mistakes that they are sure they do not make. Adaptationism is an example. Who in their right mind ever thought that "all aspects of organismal phenotypes, even the most trivial nuances, could be fully explained as adaptations built by natural selection" (p. 40)? The young Steven Jay Gould, that is who. But, in addition to Gould in his youth, how many evolutionary biologists now totally ignore exaptations? None, I suspect. After a pugnacious beginning, adaptationism, like punctuationalism, has boiled down to matters of degree. Gould thinks that exaptations and punctuational speciation are much more prevalent than do many of his contemporaries.

No one likes to be told that they harbor in their intellectual makeup some beliefs and attitudes of which they are totally unaware, but which nevertheless influence their conscious efforts. If these beliefs are sociopolitical, the allegations are even more galling. Gould spent a lot of his time working in the history of science, in particular the history of evolutionary theory. Looking back at the work of our intellectual ancestors, we can see that science has not always been narrowly "scientific." Features that we think should not influence scientists nevertheless did in the past. For example, scientists today irritate creationists by refusing to include appeals to God in their professional publications. In Darwin's day, such references, though not as widespread as some might think, were acceptable. Not anymore.

But if scientists in the past were influenced by what we take to be nonscientific considerations, what makes us think that we are totally free today from societal taint? As Gould observes, "Many scientists fail to recognize that all mental activity must occur in social contexts, and that a variety of cultural influences must therefore impact all scientific work" (p. 121). Nor need these social impacts always be negative. Sometimes they facilitate science. Nor need these influences remain eternally opaque. Sometimes, with great effort, they can be uncovered and dealt with accordingly. Nor does Gould think that he himself is immune to such influences. He does think, however, that scientists who are aware of the effect of social contexts on science are in a better position to discover and evaluate these effects than those who think that science proceeds in pristine isolation from all else.

Gould himself was raised on academic Marxism. If only we could order the whole world on Marxist principles, we would have Heaven on Earth. Unfortunately, before we get the benefits of Marxism, the whole world must become Marxist. Right now, no country is purely anything. Some countries exhibit a mishmash of economic elements that are sort of capitalist (e.g., the United States), while others exhibit a more Marxist mishmash (Cuba). For some reason, we do not have to wait around for ideal capitalism to materialize before we get the benefits of capitalism. For Marxism, we do. Many of Gould's contemporaries objected to his introduction of politics into science. They think that politics has no place in science (except such sciences as political science) and that scientists have been and continue to be very good at keeping it out. Once again, what began as a difference in kind has now become a difference of degree. Gould, more than his opponents, thinks that such extrascientific considerations as politics play a more important role in science and are harder to uncover and uproot than we are willing to admit.

Gould published his early work during the Vietnam War and its aftermath. Students and teachers alike were radicalized. I was against the war then, but, looking back at this period, not as against it as I should have been. I wish that I had been as active as Gould and his colleagues, even if my professional reputation suffered. Gould was also a strong opponent of sociobiology and its descendant, evolutionary psychology, in which the connection between science and politics is closer and more apparent. Looking back at the history of sociobiology, I think that Gould overreacted and I underreacted.

Sociobiology is, like all such programs, a hodgepodge. It stretches from narrow, careful empirical studies to casual, highly general asides. Probably the most questionable re-

search program that operates under the umbrella of sociobiology is memetics, the attempt to explain conceptual change as involving selection. Needless to say, Gould opposes memetics. It is too speculative and closely identified with gene selectionism. He has no truck with such reductionist claptrap. But Gould and the memeticists overlap in one respect: They are both attempting to find a general way to individuate such conceptual entities as scientific theories. For Gould, scientific theories are akin to species. They may not evolve in exactly the same variety of ways that species do, but they are both punctuational (p. 25).

I began this review with a personal aside. I hope that I may be excused if I end it with another. When my lover of 25 years was dying of AIDS, Gould wrote me a letter urging me to learn as much about the disease as I could. I was puzzled. What good would that do? I had bedpans to empty. But I figured that if anyone knew how to handle a serious illness, he did. I went to the science library every couple of weeks to read everything I could find on the subject. Of course, that was the right thing to do. It busied my mind while the disintegration characteristic of AIDS gradually ground its way through to inevitable death. I suspect that Gould once again turned to the science library at Harvard when he was diagnosed with his second cancer. One might think that one kind of cancer per person would be enough, but it is not. In any case, this cancer developed so rapidly that Gould probably did not have time to learn much about it, but I am sure that he tried.