Peer Review

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day school or on "bookshelf pamphlets" written by those who teach in our extinguished (or is it distinguished) institutions of supposedly higher learning. May I suggest that he and those who agree with him look into the works of those whose genius has withstood the test of time, such as Saints Thomas Aquinas, Augustine, Jerome, Gregory and Benedict, to name but a few. Only then can an informed and educated decision be made concerning the existence of God.

VINCENT D. ROMEO
Massapequa Park, New York

¶My wonder, awe and praise grow greater when I put aside the idea of God's direct creation and marvel that physical law alone brought mind from matter, pine trees from seas, these hands from the rocks. Yet I do not feel that I am denying God.

ERIC NELSON
Madison, Wisconsin

¶I can assure Daniel Dennett that he and his high school chums did not invent "universal acid." In my day (the early 1930s) we knew it as the "universal solvent," able to dissolve anything and everything. I think the idea was tossed out to us by our physics teacher, Mr. Hopkins. (Spanish fly and saltpeter were also well known to us, especially from our weeks in summer camps.)

Of course, a universal solvent would eventually become saturated and could then be stored in anything. A universal acid in any finite quantity would likewise eventually lose its chemically reactive power.

Thus Mr. Dennett's analogy is not quite apt. There is no limit to the absorptive or reactive power of an idea.

JACOB BRODZINSKY
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Daniel C. Dennett replies: It had not occurred to me before that publishing an excerpt from a carefully reasoned book is a kind of experiment, but it is, and thanks to the fine job of excerpting done by the editors Peter G. Brown and Robert J. Coontz Jr., the results in this case are more interesting than they might otherwise have been.

Let me explain. Among the many decisions made by an author are those about which objections must be met head-on, and which can be safely ignored. The temptation to try to take on all comers is hard to resist, and *Darwin's Dangerous Idea* weighs in at close to 600 daunting pages. That was much too large in the eyes of my editor at Simon & Schuster, but she let me have my way, since she felt she was in no position to argue with me about which parts could be jettisoned without seriously damaging my case. Brown and Coontz, however, thought they could distill, without serious distortion, a minimal version for publication in *The Sciences*. By my lights they succeeded handsomely, deftly extracting the main themes and the skeletal arguments. Now we get to see from the readers' response whether all those "extra" chapters in the book are indeed pulling their weight.

Thomas Bicsak expresses straightforward skepticism about whether the Darwinian hypothesis really has succeeded in explaining the origin of new species, and he sees my "biases" showing in the excerpt. For such skeptics the book provides a wealth of detail, some familiar, some novel, showing just how securely the Darwinian revolution has been established in biology, and addressing Mr. Bicsak's specific challenges, among others.

Did I really need to devote a whole chapter, however, to the intricate arguments concerning the conditions under which the first self-replicating molecular forms could emerge? Yes, because as both Stuart Newman and Benjamin Gilbert point out, in different ways, the physics and chemistry of self-replication, the sine qua non of organic evolution, cannot be taken for granted. How did such fundamental features of the universe arise (or get designed)? There is a perfectly consistent Darwinian answer to those good questions, and readers tempted to agree with Messrs. Newman or Gilbert will find something to sink their teeth into in my book's chapter seven, "Priming Darwin's Pump."

Did I really need to devote six whole chapters to an account of the evolution of meaning and value? Yes, because though there is an important kernel of truth in George Ellis's assertion that *"excellence* and *worth* are words that attain meaning only when one introduces sources of values that cannot be based on a scientific viewpoint alone," the implications are not ones that he sees. He is certainly in good company, however, in thinking that the world of meaning and value must somehow have descended from on high instead of bubbling up from below.

Did I really need to devote a whole chapter to showing in considerable detail why Roger Penrose has not "demonstrated conclusively that algorithmic procedures cannot explain the origin and operation of consciousness," as Timothy Denton says? For him—and for many other readers, I learn—Penrose is the most attractive straw to cling to in the Darwinian flood, so it was important after all to show why he is deeply confused about the nature of algorithms and evolution. For these potential readers of my book, if not for all others, the dense arguments of Part III, "Mind, Meaning, Mathematics and Morality," will provide a direct challenge to the assumptions that led them to write.

Earl Davis points out correctly that not all scientists think in the terms I defend, and he provides something of an honor roll of thinkers who have sought to find some way of softening the collision between the Darwinian and the traditional visions. I think it is important to see that there really is something like a common aspiration running through Whitehead, Eccles, Pribram, Sheldrake, Jung, Prigogine, Jahn and the others. If I had put together that list, however, I would expect to be accused of insinuating guilt by association, since I doubt it is anybody's list of the clearest thinkers, or even the deepest thinkers, in science. Fulfilling their shared aspiration has proved difficult, in any case, and I dispute Mr. Davis's claim that "reductionistic materialism is being progressively abandoned," thanks to the work of such people. I do not maintain that their aspiration cannot be fulfilled—just that it has not been fulfilled. The search for skyhooks is an honorable quest, and it is conceivable that it might triumph someday. But in the meantime, it is important not to mislead people about the implications of the quite firmly established scientific tradition such thinkers are uncomfortable with.

A principle aim of my book is to show that those implications are actually quite beautiful and inspiring, that the search for skyhooks is not as well motivated as its many fans suppose. That puts me more in agreement, I suspect, with Eric Nelson than he realizes. He does not feel his "wonder, awe and praise" of ultimate reality to be denying God. Yet the object of my affections is the same as his, I am quite sure: the universe itself, as demystified by science, and thus revealed in all its glory. This is a universe of complexities and beauties unimagined by Saints Thomas Aquinas, Augustine and the rest of the authors recommended to me by Mr. Romeo, a fact I bear in mind when I read their works.

Finally, although I agree with Jacob Brodzinsky that there is no limit to the absorptive or reactive power of an idea—especially an idea as wonderful as Darwin's—I would urge caution about his conclusion that my school chums and I did not invent (that is to say, reinvent) the idea of universal acid. The better an idea, the more likely it is to be reinvented, time and again. Historical precedents for universal acid go back at least to the ancient myth of the philosopher's stone, but there need be no transmission path from that early meme (or Mr. Brodzinsky's 1930s meme of universal solvent) to the memes of my youth in the 1950s, any more than there must be a genetic transmission path from the good idea of insect wings to the good idea of bat wings. •

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piece, it seems to me a reasonable first effort to relate the two. It certainly has not been the basis of objections quoted everywhere, as Mr [illegible] puts it; there is a rich literature on [illegible]pic, some of which he mentions. It is also not dramatically different from the rates estimated in *Extinction Rates*, edited by John H. Lawton and Robert M. May, in which three methods converge on rates 10,000 times normal.

THOMAS E. LOVEJOY
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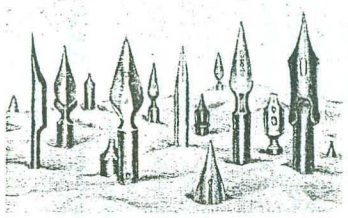
DISSECTING DARWIN

In "Darwin's Dangerous Idea" [May/June] Daniel C. Dennett uses the metallurgical annealing process as a paradigm



Fanny Brennan, Beach Party, *1994*

for evolution. But though the process of annealing can be observed and its details learned, no one has ever observed evolution. By evolution, I mean the genesis of one species from another, not the relatively small changes that arise from mutation but that never give rise to completely new species. Mr. Dennett's biases also show when he cites "hard-to-classify intermediate creatures" as one of the problems in understanding creation pre-Darwin. But the existence of the duck-billed platypus, for instance, in no way provides evidence for an evolutionary process; it is just as conceivable that such an organism arose independent of any apparently "related" species. Moreover, the fossil record is devoid of any of the true intermediate forms that would be required to confirm the Darwinian hypothesis.

THOMAS A. BICSAK
Neshanic Station, New Jersey

¶Daniel Dennett's discussion of Darwinism demonstrates a remarkable disregard for the history of biology and for the nature of biological and physical systems. The "controversy" in which he enlists Darwin, about whether complex creatures could have emerged from the physical world without the intervention of conscious design, has long been resolved in the scientific culture in favor of materialism, and its solution—organic evolution—was proposed by Lamarck before Darwin was even born. Indeed, the resistance of the wider culture to evolutionary ideas can partly be laid at the door of Darwin and his followers. By maintaining that the morphological, functional and behavioral diversity of the living world arose by an algorithmic process (that is, by natural selection) completely indifferent to the materials in which it is carried out (what Mr. Dennett calls "substrate neutrality"), Mr. Dennett and other unregenerate Darwinians show that they are out of touch with the remainder of modern scientific thought. It is little wonder that creationism still exerts its grip on a public that is told that that is the only way to view evolution.

Forms and patterns emerge from the dynamics of particular systems, and those dynamics are tied to the specific nature of the systems themselves. There is no substrate neutrality in the real world. The only thing dangerous about Darwin's idea (at least as characterized by Mr. Dennett) is that it is incorrect.

STUART A. NEWMAN
New York Medical College
Valhalla, New York

¶When I was a student of chemistry in the late 1940s, much of the biochemistry now known was only beginning to be discovered. Nevertheless, it was substantially clear then, and it has become only too clear more recently to those of us who try to develop drugs to combat "primitive" microorganisms, that there is not really such a large difference between their biochemistry and ours. In fact, many microorganisms have chemical abilities we lack. I was unable as a student of both chemistry and mathematics to draw any conclusion other than that the accidental occurrence of the basic biochemical system of living beings was not reasonably possible within the mass of the then known universe or its time span, then estimated at five billion years.

The problem arises out of the complexity of proteins and nucleic-acid polymers and the fact that, as far as one can see, a large assortment of them has to appear in one confined location at one moment in time and not be spread out over the universe at varying times.

BENJAMIN GILBERT
Instituto de Tecnologia em Fármacos
Rio de Janeiro, Brazil

¶The problem with Daniel Dennett's approach is that he attempts to apply his viewpoint, characterized as an algorithmic approach, to everything, without exception. He builds his view on the basis of "guaranteed results": the supposition that an algorithm is a foolproof recipe. Major parts of computer science, however, are concerned precisely with the issue of when algorithms do or do not work (the halting problem). His supposedly secure foundations are built on sand.

More important, he fails to tackle both the metaphysical issues underlying cosmology and the crucial issue of the origin of values. Thus he seems unaware of the debate about how physical laws and the universe [illegible] have the highly restricted nature [illegible]d for the existence of life. Furthermore, he states that through Darwinian evolution, excellence, worth and purpose can emerge out of mindless, purposeless forces. But *excellence* and *worth* are words that attain meaning only when one introduces sources of values that cannot be based on a scientific viewpoint alone. Thus, in professing to give a view on the evolution of values, he introduces concepts that can have no place in a purely scientifically based world view.

Strangest of all is his belief that undermining a childish caricature of religion can make a serious contribution to the modern debate between science and religion. He is apparently unaware of the current sophisticated level of that debate, and even seems ignorant of Immanuel Kant's contribution to arguments about the existence (or nonexistence) of God.

GEORGE F. R. ELLIS
University of Cape Town
Cape Town, South Africa

¶When Daniel Dennett couches his argument about the evolution of ideas as the development of memes, and proposes that algorithms are sufficient to explain the products of our minds, he falls into much greater difficulties than he knows.

Roger Penrose has demonstrated conclusively that algorithmic procedures cannot explain the origin and operation of consciousness. The inadequacy of algorithms flows directly from Kurt Gödel's incompleteness theorems, which state that any formal deductive system operating from a fixed set of axioms must be either internally contradictory or incomplete. Hence if, as Mr. Dennett says, evolution is fully algorithmic in nature, the solvent of Darwinism is contained by the fact that it is necessarily incomplete, and by the fact that consciousness engenders a change in the order of being. You cannot get to fundamental aspects of consciousness from algorithmic procedures. Calling ideas memes is not going to get materialism out of its difficulties.

If aspects of consciousness are noncomputable, the philosophical materialists have some more work to do.

TIMOTHY DENTON
Ottawa, Ontario

¶It is Daniel Dennett's ideas that are dangerous. He seriously misleads his lay audience by presenting his own self-consistent materialist world view as having been firmly established by science.

Although natural selection is obviously a primary evolutionary algorithm, it is still far too early to view it as the sole source of life's creative diversity. Mr. Dennett's conclusions concerning the theoretical implications of Darwinian theory for other disciplines are equally premature. It is both disturbing and puzzling that a philosopher of Mr. Dennett's caliber remains so wholly unaffected by the enforced humility felt by so many biologists and physicists as they confront the ever expanding circumference of their own ignorance. Rather, in the grand tradition of the European explorers, Mr. Dennett swaggeringly asserts that the entire terra incognita of nature's unexplored continent is subject to the laws of his own linear intelligence. He then falsely leads his readers to imagine that the only alternatives to his model are variations on creationism or other such disproven hypotheses that require some kind of skyhook.

Reductionistic materialism is being progressively abandoned at the fore of almost every field of scientific investigation. It has simply become inadequate as a way of describing the complex dynamical systems that seem to interpenetrate everything. Instead, investigators are developing pictures of organisms and deep reality that have profoundly interconnected and self-reflexive global structures. Amid countless other areas of study, such fundamental subjects as the nature of memory, instinct, the unconsciously maintained coherence of consciousness, the processes of embryological and evolutionary morphogenesis and so forth are further from explanation and more incredibly mysterious than ever.

To counterbalance Mr. Dennett's overarching but narrow views, I would recommend that readers consider the rich mix of more organic proposals in the works of such eminent thinkers as Alfred North Whitehead in philosophy, Wolfgang Pauli and David Bohm in quantum physics, John C. Eccles and Karl H. Pribram in neurology, James Lovelock and Rupert Sheldrake in biology, Carl Jung and Stanislav Grof in depth psychology, Ilya Prigogine in chemistry and Robert G. Jahn with Brenda J. Dunne's most recent and best-documented research into areas of anomalous human–machine interaction. And I would recommend that Mr. Dennett consider taking some of his own "universal acid" or, perhaps, some magic mushrooms, in the hope of dissolving some of the rigid categories of his own "submerged" psychology and his general proclivities to clean up the messiness of life.

EARL DAVIS
Leonia, New Jersey

¶I feel rather sorry for Daniel Dennett and all those other scientists of his ilk. They have become totally deluded by secular materialism and humanism into the twisted belief that God is a myth of childhood. I strongly recommend that Mr. Dennett spare himself the embarrassment of basing his conclusions about the existence of God on a song learned as a child at Sun-

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