



NEW BIOLOGICAL BOOKS

The aim of this section is to give brief indications of the character, content and cost of new books in the various fields of biology. More books are received by *The Quarterly* than can be reviewed critically. All submitted books, however, are carefully considered for originality, timeliness, and reader interest, and we make every effort to find a competent and conscientious reviewer for each book selected for review.

Of those books that are selected for consideration, some are merely listed, others are given brief notice, most receive critical reviews, and a few are featured in lead reviews. Listings, without comments, are mainly to inform the reader that the books have appeared; examples are books whose titles are self-explanatory, such as dictionaries and taxonomic revisions, or that are reprints of earlier publications, or are new editions of well-established works. Unsigned brief notices, written by one of the editors, may be given to such works as anthologies or symposium volumes that are organized in a fashion that makes it possible to comment meaningfully on them. Regular reviews are more extensive evaluations and are signed by the reviewers. The longer lead reviews consider books of special significance. Each volume reviewed becomes the property of the reviewer. Most books not reviewed are donated to libraries at SUNY Stony Brook or other appropriate recipient.

The price in each case represents the publisher's suggested list price at the time the book is received for review, and is for purchase directly from the publisher.

Authors and publishers of biological books should bear in mind that *The Quarterly* can consider for notice only those books that are sent to *The Editors*, *The Quarterly Review of Biology*, 110 Life Sciences Library, State University of New York, Stony Brook, NY 11794-5275 USA. We welcome prepublication copies as an aid to early preparation of reviews.

THE TALENTED MR. WELLS

KEVIN PADIAN

*Department of Integrative Biology and Museum of Paleontology,
University of California*

Berkeley, California 94720-4780 USA

E-MAIL: KPADIAN@SOCRATES.BERKELEY.EDU

ALAN D. GISHLICK

National Center for Science Education

Berkeley, California 94707-0477 USA

A review of
ICONS OF EVOLUTION: SCIENCE OR MYTH? *Why
Much of What We Teach About Evolution Is Wrong.*

*By Jonathan Wells; illustrated by Jody F Sjogren. Wash-
ington (DC): Regnery Publishing; distributed by Na-
tional Book Network, Lanham (Maryland). \$27.95.
xiv + 338 p; ill.; index. ISBN: 0-89526-276-2.
2000.*

When we first meet the protagonist of the film *The
Talented Mr. Ripley*, he is playing piano at a rooftop
party in New York City. As the song finishes, an

older man approaches and, observing Ripley's
Princeton blazer, remarks that Ripley must have
been at school with his son, Dickie. Sensing an op-
portunity, Ripley does not mention that the blazer
is borrowed from another guest, nor that he did
not attend Princeton, but only worked there. He
merely asks, "how is Dickie?"

This kind of distortion, misleading by the omis-
sion of important information, is the basis of *Icons
of Evolution*. Its author, Jonathan Wells, appears to
come from an unusually strong academic back-

ground, but the truth is more complex. Wells is a follower of the Reverend Sun Myung Moon, and explains on his website (<http://www.tparents.org/library/unification/talks/wells/DARWIN.htm>) that “Father” views “Darwinism” as one of the “evils” of the world. Wells states, “Father’s words, my studies, and my prayers convinced me that I should devote my life to destroying Darwinism,” indicating that when Father chose him to enter a PhD program in 1978, he welcomed the opportunity to “prepare myself for battle.”

Wells wrote a theological dissertation at Yale on the “Argument to Design” and how Darwin allegedly mistook it. He then received a PhD in Molecular and Cell Biology at Berkeley on the effect of gravitation on the 8-cell embryo; two multi-authored papers were produced from that laboratory’s work. He followed this with a 5-year postdoctoral position sponsored by a retired professor in the same department at Berkeley, during which time he seems to have performed no experiments and to have received no grant support from his sponsor. He was simultaneously a “postdoc” at the antievolutionary Discovery Institute in Seattle, where he remains. No peer-reviewed publications resulted from Wells’s 5-year stint, but *Icons of Evolution* appeared shortly after its term limit expired. Antievolutionists hope that Wells’s apparent academic credentials will help establish him as the new “inside expert” on the scientific shortcomings of evolution, a role Wells encourages. The book jacket to *Icons of Evolution* features congratulatory blurbs from Wells’s fellows at the Discovery Institute (without identifying them as such), including Phillip Johnson, Michael Behe, and William Dembski.

THE GREAT EVOLUTIONARY CONSPIRACY

Wells’s thesis is that biology textbooks misrepresent classic, but flawed, examples (his so-called “icons”) that purport to support evolutionary concepts (this is hardly news: scientists have been complaining about all kinds of textbook errors for decades; commercial publishers, not scientists, determine what goes into K–12 books). Because these examples are wrong, Wells infers that there must be no evidence for the concepts themselves. He does not attempt to find better examples, nor does he show how the examples could be explained more correctly. He also does not explain that coverage in most pre-college textbooks is necessarily brief and usually simplified. His job is to sow doubt in the minds of those who do not know the examples or concepts first hand. Wells’s primary audience is the antievolutionists, for whom he hopes to provide ammunition; he also hopes to

reach those uninformed about evolution, whom he wishes to make new allies. To rally these troops, Wells concludes his book with the broad accusation that evolutionary biologists have committed what amounts to scientific fraud on the public. He exhorts his readers to complain to their Congressmen in order to prevent further evolutionary research from being funded. Wells’s “fatal” objections are a mix of the cinematic Ripley and the one who wrote *Believe It or Not!* Here we have space only to discuss three of the most egregious examples. More detailed refutations of Wells’s “icons” can be found at the National Center for Science Education’s website, <http://www.ncseweb.org>.

THE MILLER-UREY EXPERIMENTS

These well-known experiments asked whether complex biomolecules could have been produced spontaneously on a primordial Earth. As originally performed in the 1950s, the experiments were conducted using an atmospheric composition that subsequent research suggests was unlikely to have existed. To Wells, this news is not a sign of scientific progress; rather, it can only mean that the entire field of research on the origin of life is bogus. Wells sidesteps the fact that recent experiments have synthesized amino acids under what are now understood to be more likely primordial atmospheric and oceanic compositions (Rode 1999). Wells wrongly denies that molecular synthesis occurs in these alternate atmospheres; the rate of synthesis may be lower, but it still occurs.

Wells also misrepresents research on primordial atmospheric oxygen. Misreading current studies, he claims that because there was “free” oxygen in the early atmosphere, the spontaneous origin of life would have been impossible. He is consistently vague about what he means by “significant amounts” of oxygen in the “early” atmosphere. Fossil and geochemical evidence indicates that life likely arose between 4.0 and 3.8 billion years ago (GA); the earliest fossils are 3.5 GA, so the critical period for atmospheric chemistry is around 3.8 GA. Contrary to Wells’s claims, geochemists generally agree that there was little free oxygen at that time (Copley 2001). The question is whether it was “low” (0.25–0.5%) or “significant” (1–2%) compared to present levels (20%). Wells neglects to clarify this for readers, who might conclude that “significant” levels at 3.8 GA approached today’s 20%. But even levels up to 2% do not preclude the origin of life or slightly reducing atmospheres: amino acids could be synthesized even if small amounts of oxygen were present (Rode 1999). Wells equally ignores any extraterrestrial sources of organic molecules (Oró 1994; Orgel

1998). He then suggests that the “RNA world” hypothesis was proposed to salvage the Miller-Urey paradigm failure, but the link is fallacious. This hypothesis suggests how a less complex hereditary molecule than DNA might have preceded it. A “peptide world” hypothesis further narrows the gap between organic molecules and RNA (Orgel 1998; Rode 1999), but once again Wells is silent on anything that runs counter to his goal of destroying evolution.

THE “TREE OF LIFE”

Wells claims that the fossil record does not support a tree of life, and that even molecular evidence cannot save the tree from being uprooted. This should surprise evolutionary biologists, paleontologists, and molecular biologists. His central claim against the pattern of the fossil record is that the “Cambrian Explosion”—the relatively sudden appearance of many of the major animal body plans—is incompatible with Darwin’s prediction of evolution by the gradual accumulation of small differences. Because these differences occur “suddenly” in animal body plans of the Early Cambrian, he says, gradual evolution and thus the tree of life itself are disproven. But the tree of life merely shows the relationships of organisms; the timing of the first appearance of metazoan body plans does not determine the configuration of the tree (they are independent lines of evidence).

On even a superficial level, Wells fails to understand that in Darwin’s day the word “gradual” remained connected with its Latin origin, “stepwise.” For example, when Darwin witnessed the earthquake in Chile that destroyed hundreds of buildings and lifted the coastline several meters in an instant, he described it as a “gradual” change in his *Journal of Researches*. But more importantly, Wells entirely overlooks the explosive field of evolutionary developmental biology when he ignores the fact that evolutionary theory does not require the slow accumulation of small changes to produce body plan differences. Relatively early-acting, small, genetic changes in genes that affect features of body plans such as axis orientation, segmentation, and appendage formation can have substantial and immediate phenotypic effects. This is especially surprising because Wells wrote his PhD dissertation on embryology.

Starting from his incorrect assumption that evolution must occur gradually, Wells then tries to show that the Cambrian explosion was a “sudden” appearance of complex life forms that could not have been produced by evolution. Specifically, Wells asserts that there is no evidence for the existence of multicellular life until “just before” the

Cambrian explosion, thereby denying the necessary time for evolution to have acted. But Wells remains vague, perhaps deliberately so, about what he considers “just before.” As he must know, metazoan eggs, embryos, and bilaterian trace fossils—which demonstrate the presence of at least an ancestral lineage of all Bilateria—are present at least 40 (and maybe as many as 70) million years before the Cambrian “explosion” (Valentine et al. 1999). A similar stretch of time was enough for the entire present-day mammalian fauna to evolve after the Age of Dinosaurs had ended. How can Wells call this length of time “just before”?

The Cambrian opens with the “small shelly faunas” that contain archaic members of some living animal lineages, as well as some forms that soon became extinct when the full-blown post-Tommotian faunas of the Cambrian “explosion” later appeared (Valentine et al. 1999). In these later faunas, too, not all component lineages appeared at once. So there is nothing “sudden” about metazoan appearances in the Cambrian, except perhaps in fossilization potential. For Wells, it is enough to ignore the latter question and simply make the astonishing claim that the Precambrian fossil record is sufficiently complete to prove that no transitional fossils existed. To support this, he cites Benton et al. (2000) on the completeness of the fossil record. The final sentence of this paper does literally conclude that the “early” parts of the fossil record are adequate for studying the patterns of life. But the talented Mr. Wells leaves out a critical detail: the sentence refers not to the Precambrian, but to the *Cambrian and later times*. Ironically, the conclusion of their article directly contradicts Wells’s claim that the fossil record does not support the tree of life. Benton et al. assessed the completeness of the fossil record by showing that the *sequence of appearance* of the major taxa is indeed consistent with the independently derived patterns of *phylogenetic relationships* of the same taxa, using both molecular and morphological analyses of phylogeny. It makes one wonder if Wells actually read the whole paper or hopes that his readers will not.

In the same chapter, he also attacks genetic phylogenies, claiming that the genetic data that place whales within artiodactyls (the even-toed hoofed mammals) are “bizarre.” We agree that molecular analyses can sometimes give jarring results—especially if they are built on short sequences of single molecules that may not evolve on time scales appropriate to the question. Further studies generally correct this problem. Yet whales were comfortably lodged within artiodactyls long before the supporting data of biochemistry became available. They are known to be related to a mesonychian stem group of artiodactyls over 55 million years

old. At present the question is not whether whales are artiodactyls, but whether the molecular evidence that hippos are their closest relatives can be reconciled with the fact that there is no evidence of hippo-like animals until at least 25 million years later. Evolutionists are quite frank about this current lack of resolution, but Wells is far less frank about the general degree of consilience between molecules and fossils.

THE PEPPERED MOTH

A particularly egregious example of Mr. Wells's talents is his treatment of the peppered moth, an "icon" of industrial melanism and natural selection. Voluminous data (not just from Kettlewell's classic experiments) show that the frequencies of light and dark *Biston betularia* (and several other moths with multichromatic morphs) change with pollution levels, that light and dark moths are differentially camouflaged against light and dark backgrounds, and that birds eat moths. Most lepidopterists, even Kettlewell's critics, conclude that although there may be subsidiary causes, bird predation is the major cause of the changes in color frequency (Majerus 1998), a clear result of natural selection.

Wells picks through the literature in search of studies where even a single detail of the original story may not hold, and implies that such anomalies refute the vast amount of confirmatory data in support of natural selection. He notes a study in which light moths did not increase in frequency after air pollution was reduced, but fails to mention the role of migration and gene flow among populations, or that the light colored morph has now recovered in all populations (Grant et al. 1998). He cites research that claims that lichens are not always present on tree surfaces, but forgets that the color of the substrate is critical, not the presence or absence of lichens. He counters with research on industrial melanism in ladybird beetles that does not follow the peppered moth pattern, as if the lack of selective predation in one species precludes it for another.

Wells implies that field biologists have overinterpreted and misrepresented the situation by affixing light and dark moths to light and dark tree trunks, and recording which ones got picked off by birds in these field experiments. Wells erroneously claims that moths do not rest on tree trunks, although research has shown that moths rest on trunks 26% of the time, and on trunk/branch junctions 43% of the time (Majerus 1998, p 123). In addition, Wells infers that Kettlewell relied entirely on the staged experiments to conclude that bird predation causes color changes. But, once

again, Wells misses the mark. The experiments were conducted to establish whether birds eat peppered moths at all, and if so whether they *differentially* select moths that contrast with their backgrounds. The bird predation hypothesis is inferred from the statistical data on *observational* release and recapture experiments conducted by Kettlewell and others. Combined with *experimental* evidence that birds differentially select prey from contrasting backgrounds, the inference of bird predation is doubly strengthened. Wells then pretends righteous indignation about "fraudulent," "staged" textbook photographs of light and dark moths against light and dark backgrounds. But these photographs merely illustrate the differential camouflage that field experiments tested—a reasonable and expected part of science. Can Wells be so ignorant of this investigative tradition or the purpose of an illustration?

BOOKMARKS, STICKERS, AND POLITICS

These are only three examples of Wells's "icons." Elsewhere in the book, he pretends that homology is both evolutionary similarity and evidence for that similarity. He appears not to know the difference between direct and collateral ancestry. He completely mistakes scales of time in Darwin's finches and other natural examples of selection rates. He rails against artists' drawings of ape-like humans that, in his view, "justify materialistic claims that we are just animals," as if the drawings were evidence. In discussing mutant fruit flies, he argues that changes in DNA have nothing to do with the expression of new features—which should surprise the professors in the department that gave him his PhD. At lectures given by evolutionary biologists, his acolytes pass out bookmarks with Wells's supposedly fatal objections to evolution in an obvious attempt to fluster speakers who have not prepared for hostile distortions and specious questions. The National Center for Science Education has mounted answers to Wells's "Ten questions to ask your biology teacher about evolution" at their website.

In a related tactic, Wells's website (<http://www.iconsofevolution.com>) and the second appendix of his book provide a template of stickers to download and paste into textbooks that discuss concepts that he does not like. The thought that anyone would encourage others to deface textbooks for ideological reasons is chilling. Wells concludes with an exhortation to activism, including organizing Congressional hearings to stop "supporting dogmatic Darwinists that misrepresent the truth to keep themselves in power" (p 242). Is this really about science or politics?

THE WHINE EXPERT

Wells reminds us of those kids who used to write to the letters page of *Superman* comics many years ago. "Dear Editor," they would write, "you made a boo-boo! On page 6 you colored Superman's cape green, but it should be red!" Okay, kid, mistakes happen, but did it really affect the story? Wells cannot hurt the story of evolution; like a petulant child, he can only throw tantrums. Detailed reviews (see http://www.don-lindsay-archive.org/creation/icons_of_evolution.html for links) expose Wells's Ripleyesque distortions; they do not conclude that the evolutionary concept in question is nonsense.

But even taking Wells's arguments at face value, if all the evidence for evolution is wrong, what is his alternate explanation? Special creation of each natural entity? A little divine intervention here and there? An admission that we should not be researching natural causes of biological evolution? That there can be no natural processes that govern biological patterns, unlike the sciences of physics, chemistry, and astronomy? Wells and his colleagues refuse to say. Instead, they prefer the role of the naysayer, presenting only limited argumentation to a sympathetic and scientifically unsophisticated audience in an effort to undermine confidence in evolution—at least enough to throw open the door to Intelligent Design theory. And please, pay no attention to the man behind the curtain. For more on the intellectual paucity of Intelligent Design, see Ruse (1998), Miller (1999), and Pennock (1999)—or peruse Hume's (1779) *Dialogues Concerning Natural Religion*, which refuted this version of "Natural Theology" over two centuries ago.

Wells's book is aimed at a public that is largely ignorant of scientific issues, and it is being marketed aggressively. His arguments, however spe-

cialous, are well funded and publicized. *Icons of Evolution* is being pushed on state and local textbook adoption committees as a supplementary volume, although its use would result in considerable mis-education—and not just about evolution. Scientists should counter that evolution is a noncontroversial scientific theory that explains the patterns of biology, and that dovetails with the evidence from geology, astronomy, physics, and chemistry. It also continues to be central to biomedical, agricultural, and ecological research. But it is just as important to focus on what *they* assert. Ask how Wells and his colleagues will replace evolution with Intelligent Design, and where the peer-reviewed research for it is. Have them explain exactly who the Intelligent Designer is, exactly when and where He (She? It? They?) intervened in the history of the Earth and its life, and exactly how this can be shown to everyone's satisfaction. Nobody here but us scientists? Then let us make Intelligent Design a testable hypothesis and see how robust it is.

We can all agree that textbooks should represent science more currently and more accurately, and that scientists should have a stronger role in textbook production and adoption; but this is not Wells's conclusion. He implies that those who, in his view, are silent about the alleged weaknesses of evolution are guilty of fraud, citing Louis Guenin: "The pivotal concept here is candour . . . the attribute on a given occasion of not uttering anything that one believes false or misleading. We describe breaches of candour as deception" (p 233). Considering how silent Wells is on the real evidence and arguments for evolution, his citation of Guenin is the pot calling the Kettlewell black. In our view, regardless of Wells's religious or philosophical background, his *Icons of Evolution* can scarcely be considered a work of scholarly integrity.

REFERENCES

- Benton M J, Wills M A, and Hitchin R. 2000. Quality of the fossil record through time. *Nature* 403:534–537.
- Copley J. 2001. The story of O. *Nature* 410:862–864.
- Grant B S, Cook A D, Clarke C A, and Owen D F. 1998. Geographic and temporal variation in the incidence of melanism in peppered moth populations in America and Britain. *Journal of Heredity* 89:465–471.
- Majerus M E N. 1998. *Melanism: Evolution in Action*. New York: Oxford University Press.
- Miller K R. 1999. *Finding Darwin's God: A Scientist's Search for the Common Ground Between God and Evolution*. New York: Cliff Street Books.
- Orgel L E. 1998. The origin of life—a review of facts and speculations. *Trends in Biochemical Sciences* 23(12):491–495.
- Oró J. 1994. Early chemical stages in the origin of life. Pages 48–59 in *Early Life on Earth: Nobel Symposium No. 84*, edited by S Bengtson. New York: Columbia University Press.
- Pennock R T. 1999. *Tower of Babel: The Evidence Against the New Creationism*. Cambridge (MA): MIT Press.
- Rode B M. 1999. Peptides and the origin of life. *Peptides* 20(6):773–786.
- Ruse M. 1998. *Taking Darwin Seriously: A Naturalistic Approach to Philosophy*. Amherst (NY): Prometheus Books.
- Valentine J W, Jablonski D, and Erwin D H. 1999. Fossils, molecules and embryos: new perspectives on the Cambrian explosion. *Development* 126:851–859.