Most people would not expect a scientist to speak of love, except perhaps in terms of endorphins or pheromones. And who would want to hear love reduced to that? Is the heart but a pump and not the seat of the soul? Though science may clock the beats of a racing pulse, such a sterile accounting of the muscle in our breast is cold and, well, bloodless. Isn’t such a heartless picture of the world always what science leaves us with after it has explained (or explained away) some previously mysterious miracle of nature?

Such antipathy toward science and its purported effects is probably more common than scientists would like to admit. The German sociologist Max Weber was the best-known figure to articulate this worry about science. In his 1918 lecture “Science as a Vocation,” for instance, Weber spoke of the “disenchantment of the world,” which he suggested is the result of its modern worldview. He thought that the scientific idea that everything in nature can, at least in principle, be explained in natural terms effectively drains the world of mystery and thereby of transcendent purpose and meaning as well. For many, the world as science explains it is a bleak and unfeeling place.

Of course, given the often exaggeratedly impersonal way in which many scientists have described the goals of objectivity and quantification, there is a sense in which science has brought this plague upon itself. The German sociologist Max Weber was the best-known figure to articulate this worry about science. In his 1918 lecture “Science as a Vocation,” for instance, Weber spoke of the “disenchantment of the world,” which he suggested is the result of its modern worldview. He thought that the scientific idea that everything in nature can, at least in principle, be explained in natural terms effectively drains the world of mystery and thereby of transcendent purpose and meaning as well. For many, the world as science explains it is a bleak and unfeeling place.

Once More, with Feeling

Robert T. Pennock


Evolution—Once More, with Feeling

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Of course, given the often exaggeratedly impersonal way in which many scientists have described the goals of objectivity and quantification, there is a sense in which science has brought this plague upon itself. In the past, physics, especially, contributed to this malaise in its insistence on reducing the world to the interactions of matter, but another discipline is most often singled out for blame: With the familiar references to the “uncaring” Darwinian struggle, and the “mechanical” and “pitiless” action of natural selection, evolutionary biology has long been the obvious whipping boy for those who are uncomfortable with scientific naturalism. It is not just fundamentalist religious beliefs that motivate creationists’ attacks on evolution; they are also driven by a deep existential angst—a fear that evolution renders the world pointless, emptying it of purpose, meaning and morality.

George Levine’s book Darwin Loves You confronts Weber’s problem of the loss of enchantment head-on. Levine’s thesis is that this all-too-common view of science in general and evolution in particular is dead wrong and that, in fact, Darwinian evolution provides a model for what he calls “secular re-enchantment.” The aim of the book, in his words, is to enlist Darwin on the side of the angels. In keeping with the bumper-sticker comparison of Darwin to Jesus in the title of the book, Levine doesn’t hesitate to use religious language, sometimes for its shock effect, to get his point across. He says he will argue for “a redeeming Darwin” who is “an apostle of secularism.” Some readers will find the periodic insertion of such indirect, unnecessary jabs at religion off-putting, but I hope they can ignore them and focus on the emotionally uplifting view of science with which Levine aims to inspire those who are open to the idea. Evolution, he argues, if properly portrayed, is not only perfectly compatible with meaningfulness but provides a new basis for it.

Levine makes the important point that at the same time that evolution pulls the rug out from under anthropocentrism (which is not only a smug but ultimately a dangerous attitude), it provides a foundation for a justifiable form of anthropomorphism. Darwin showed that humans are not the apex of creation but are one with the rest of the biological world, related to all living things through our common ancestors. This discovery allows us to find common ground with other animals without denigrating our humanness, Levine argues, permitting us
to legitimately attribute human characteristics (albeit in simpler or incipient forms) to them. This provides an avenue to the re-enchantment of the world, for it shows we are not wrong to find in it a recognizably human notion of meaningfulness. It is wrong to see nature as cold and unfeeling; for those who understand evolutionary processes and relationships, the biological world becomes a warm and caring network of mutual interactions that are suffused with meaning. Levine is a romantic, but not a naive one; he does not close his eyes to those aspects of nature that are “red in tooth and claw,” but shows how these need not negate the positive vision.

Along these lines, Levine does miss one important opportunity to extend his argument. He accepts the common view that evolution removes teleology (the characteristic of being directed toward an end or shaped by a purpose) from nature, and he fails to see that, by making a move similar to his anthropocentrism/anthropomorphism distinction, it might be possible to elucidate an evolutionarily legitimate notion of teleology. This could allow a human notion of purpose in nature that is not at odds with the requirements of science. But no matter; the thesis he does defend is correct and important even by itself. When properly understood, scientific research is not passionless but filled with excitement and wonder. With unabashed emotion that is entirely appropriate to his project, Levine again and again shows how evolutionary science can allow one to view the world with awe and reverence.

The book is erudite and wonderfully interdisciplinary. In making his case, Levine weaves together a narrative that features the work of not only biologists, but also sociologists such as Weber, historians of science such as Janet Browne and Adrian Desmond, and philosophers from René Descartes, John Stuart Mill and Jean-Jacques Rousseau to William James, Hilary Putnam and Daniel Dennett—not to mention literary figures, including William Shakespeare, John Milton, William Blake, Percy Bysshe Shelley, William Wordsworth, George Eliot and Thomas Hardy.

An emeritus professor of English at Rutgers University, Levine reads Darwin—not only the Origin of Species and the Descent of Man, but also The Expression of the Emotions in Man and Animals, the H.M.S. Beagle research journals, Darwin’s correspondence and even The Formation of Vegetable Mould, through the Action of Worms—with a keen eye on his language. The book is especially good in pointing out subtleties in Darwin’s choice of words and metaphors and in noting revealing uses of alliteration, personification, passive voice and so on. Levine also highlights the poetry that may be found in Darwin’s prose, such as in his precise and yet “literary” description of the amazing thread-aided leaps of the shipboard spiders he observed while aboard the Beagle.

Levine’s contention that science can engender awe and reverence is certainly right, and his

531 GLORIFIED DINOSAURS: The Origin and Early Evolution of Birds. By Luis M. Chiappe. Reviewed by Paul M. Barrett. In this accessible, well-illustrated book, Chiappe first summarizes the evidence supporting the close relationship of birds and theropods and then guides readers through recent advances in understanding the sequence of evolutionary changes in early birds

532 TALKING HANDS: What Sign Language Reveals about the Mind. By Margalit Fox. • THE GESTURAL ORIGIN OF LANGUAGE. By David F. Armstrong and Sherman E. Wilcox. Reviewed by Michael C. Corballis. Both of these books bear on the question of whether language evolved from manual gestures and then shifted to a vocal mode: Fox makes the case that the hands provide a more natural signaling system than the voice, and Armstrong and Wilcox propose that speech itself is a gestural system

533 THE ART OF MATHEMATICS: Coffee Time in Memphis. By Béla Bollobás. Reviewed by James Propp. This collection of puzzles, which range from clever to fiendishly difficult, is not for the faint-hearted, says Propp, but like potent espresso, the problems should have a stimulating effect on the mathematically prepared reader

534 THE SUN KINGS: The Unexpected Tragedy of Richard Carrington and the Tale of How Modern Astronomy Began. By Stuart Clark. Reviewed by Alex Soojung-Kim Pang. Amateur astronomer Richard Carrington—who in 1859 witnessed the first solar flare on record—is placed by Clark at the fulcrum of a century-long debate over the effects of sunspots

535 WHY BEAUTY IS TRUTH: A History of Symmetry. By Ian Stewart. Reviewed by David W. Farmer. Stewart provides an entertaining historical account of mathematical symmetry from ancient Babylon to modern string theory, and of the people who did the math along the way

536 MATHEMATICS AND COMMON SENSE: A Case of Creative Tension. By Philip J. Davis. Reviewed by Dan Rockmore. The 33 essays in this book offer a bird’s-eye view of professional mathematics and reveal the subject to be not just useful but a source of mystery, beauty and pleasure

537 THE GREAT LEAD WATER PIPE DISASTER. By Werner Troesken. Reviewed by David Rosner. The widespread introduction of lead-pipe water systems in the 19th century was one of the greatest environmental disasters of the past 200 years, suggests Troesken, who uses statistical analysis to show that lead poisoning from the water pipes likely killed or harmed large numbers of people

538 EVOLUTIONARY DYNAMICS: Exploring the Equations of Life. By Martin A. Nowak. Reviewed by Carlos Castillo-Chavez and Carlos Castillo-Garsow. This hands-on account of the contributions of mathematics and simulation to the understanding of evolution covers topics ranging from quasispecies theory, fitness landscapes and game dynamics to disease progression, the virulence of infectious agents, and linguistic fitness

539 CHILDREN’S BOOKS. Short takes on three books: Beetle Bop. By Denise Fleming • Cold Light: Creatures, Discoveries, and Inventions That Glow. By Anita Sitarski • Living Color. By Steve Jenkins
book is best when it makes salient observations to illustrate that point. However, I must note two small but pervasive weaknesses that prevent the book from making its case as well as it might have.

Levine mentions that there are hundreds of examples in Darwin’s writings that could illustrate and support his thesis. Anyone who has read Darwin carefully knows this is so, but others do not, and they are the ones Levine needs to reach. Hoping to see more of this enchantment of science revealed, I found myself disappointed that Levine didn’t multiply his examples and flesh out his analysis more fully. He might have profitably spent less time saying what he was going to do and more time actually doing it.

This fault relates to the book’s second weakness, which is the author’s self-consciousness. Levine worries aloud that he will be seen as preaching, as trying to turn evolution into a religion, as assuming the easy middle-class lifestyle and forgetting the dis-enchanting hardships of poverty, as writing hagiography or as sentimentalizing his subject. He does none of these things, but his fretfulness about them calls attention to what ought not to have come up as a problem in the first place. Academic writing cannot help but cover itself with caveats—woe to one who would offer a naked generalization—but the habit risks obscuring important insights. (For instance, Levine refers in many places to the scientific notion of a world governed by laws and to the evolutionary laws that Darwin discovered, but then near the end speaks of “natural law,” whatever that might mean,” a flippancy that risks undermining his previously serious use of that very concept.) And he spends an inordinate amount of time justifying the “quirky” bumper-sticker title he gave the book; if one is going to take such a risk, it would be better to do so boldly and without apology.

Such weaknesses do not mar David Sloan Wilson’s excellent book Evolution for Everyone, which tackles some of the same issues (and more besides) in quite a different way. In a brief first chapter that grabs one by the lapels, Wilson states his ambitious goals: that his audience should come to see that evolution can become attractive for everyone to learn and so uncontroversial that even evolution and religion can be brought together harmoniously. By the third chapter he has already plunged readers into working out on their own how evolutionary thinking might explain patterns of infanticide in nature. The book is chockablock with examples, data, thought experiments and, tellingly, stories—stories about how scientists think and what wonders such thinking can reveal about the world. Moreover, they are stories told with feeling.

A professor of biology and anthropology at Binghamton University, Wilson often draws here on his own evolutionary research, which ranges from the provision of a sound theoretical basis for group selection, to behavioral studies of burying beetles, to the evolutionary value of cooperation and forgiveness. In the service of finding harmony between evolution and religion, he discusses some of the evidence for his evolutionary hypothesis that religions are adaptive at the group level, providing practical benefits relating to the specific conditions the group is confronted with. Throughout the book, as when he talks about bacterial morality, he conveys an infectious enthusiasm for his subject.

Given the central importance of evolution in biology, the most extraordinary thing about the public’s view of evolution, Wilson says, is not that 50 percent don’t believe in it, but that nearly 100 percent haven’t connected it to anything of importance in their lives.

A natural teacher, Wilson also Seizes every opportunity to highlight both the ordinary and the distinctive ways in which scientists gather data, test hypotheses and reach conclusions. For instance, a chapter about his research on understanding religion from an evolutionary perspective begins with an obvious concern: Might not any conclusions he draws be biased by which religions he picks to examine? Of course they might. This leads to a discussion of selection bias and how scientists use random sampling to help avoid it. He then explains how he wrote a computer program to pick page numbers at random from the 16-volume Encyclopedia of World Religions as a way to get a sample set of religions for his students to examine, rather than make the selections himself and perhaps inadvertently stack the deck. There is scarcely a page that doesn’t exemplify, either explicitly or implicitly, the way a scientist works on the basis of evidential reasoning.

But Wilson’s tone is never pedantic or preachy. With only a few exceptions, the writing is light, conversational and filled with apt metaphors and felicitous turns of phrase. In explaining the ubiquity of groups-as-individuals, for instance, he writes of how “life emerged as tiny molecular fellowships.” He compares an ant colony forcing out the smaller competition as it moves into a rotten log to “a Wal-Mart moving into your neighborhood.” The copying of DNA during cell division occurs with the care of “a monk transcribing a holy text.” And although Wilson aims for a down-to-earth way of talking about science, to emphasize it as an approachable “roll-up-your-sleeves” kind of activity that anyone might learn to do, at times one finds a hint of the poetic in his language and images. He describes, for instance, one scientist who studies social insects as having been originally inspired by “the aroma of wax and honey and the spectacle of thousands of bees crisscrossing the summer sky.”

To contemplate and appreciate that not only our bodies but also our minds and our thoughts are the result of the same evolutionary sculpting action that formed hemlocks, wood turtles, burying beetles and cellular slime mold, Wilson says, is both “awesome and humbling.” These are the same words Levine uses to express the enchantment that Darwinian evolution makes possible. But Wilson has conveyed this enchantment with the world, and with the
scientific way of thinking that leads to it, so dramatically throughout his book that by the time he puts the words to page in the last paragraph, readers can’t help but understand the point, for he has allowed them to get a sense of the feeling for themselves.

Both Levine and Wilson leave one with an important take-home message: that science is by no means incompatible with finding joy, meaning and purpose in the world. Moreover, it may even contribute to such emotional richness, not by divorcing reason and feeling but by yoking them, and an understanding of evolution provides one of the best ways of seeing how this link can be made. The heart may be a pump, but that fact need not prevent one from also seeing it as the seat of the soul. More scientists need to follow Levine’s and Wilson’s lead in expressing, with feeling, the heart-stirring emotions of awe, beauty and wonder to be found in the scientific view of nature. Then, perhaps, the general public might come to no longer associate science with loss of meaning and to no longer think it incongruous that a scientist might speak of love. It’s an enchanting possibility.

Robert T. Pennock is a professor in the Lyman Briggs College, the Department of Philosophy, the Department of Computer Science and Engineering, and the Interdepartmental Graduate Program in Ecology, Evolutionary Biology and Behavior at Michigan State University in East Lansing. He is the author of Tower of Babel: The Evidence against the New Creationism (The MIT Press, 1999). In 2005 he testified as an expert witness in the Kitzmiller v. Dover Area School Board case regarding the teaching of intelligent-design creationism in public schools.

PALEONTOLOGY

The Mesozoic Aviary

Paul M. Barrett


Charles Darwin famously declared that the origin of flowering plants was an “abominable mystery”: The highly modified structure and reproductive habits of the angiosperms set them apart from all other plants and, until recently, confounded attempts to identify the common ancestor of roses, grasses and oak trees. However, Darwin’s adage might equally well have been applied to many other plant and animal groups with specialized and idiosyncratic anatomy or an incomplete fossil record.

In 1860, just one year after publication of On the Origin of Species, a 150-million-year-old fossil—a finely detailed impression of a single feather (shown on page 532)—was found in Solnhofen, Germany. The following year the same strata yielded a nearly complete skeleton of a feathered animal that would become an icon of evolution—the earliest known bird, Archaeopteryx lithographica. The origins of birds were particularly mysterious: Warm blood and the ability to fly could potentially unite them with mammals, whereas certain skeletal features and the possession of scales linked them with reptiles. The discovery of Archaeopteryx provided a definitive “intermediate form” that indicated the strong evolutionary relationship between birds and reptiles, offering 19th-century biologists much-needed support for Darwin’s arguments. But even though Archaeopteryx demonstrated the link between birds and reptiles, there was little consensus about which particular group of reptiles was closest to birds. This uncertainty, in turn, was a major obstruction to meaningful discussions on the origin of key avian features, including flight and feathers.

Over the past 150 years, numerous candidates have been proposed in the search for the closest reptilian relatives of birds, including crocodiles, pterosaurs, various primitive Triassic archosaurs (“thecodonts”) and the enigmatic Triassic reptiles Longisquama (a tiny creature with very long, superficially featherlike scales fanning out from its back) and Protoavis (proposed as the oldest known bird, a claim that has been vigorously disputed by most paleontologists). However, an overwhelming amount of evidence now shows that, beyond reasonable doubt, the...