BOOKS: MEDICINE

The Benefits of Selective Thinking

Mark Pagel

One can imagine Darwin sitting in heaven with a smug grin as yet another field of inquiry falls to the Darwinian juggernaut. Dobzhansky had clearly glimpsed the juggernaut when he said "nothing in biology makes sense except in the light of evolution." Perhaps he hadn't realized that such diverse fields as psychology, genetics, economics, anthropology, and medicine would come to be similarly illuminated by Darwinian thinking. Stephen Stearns' edited volume *Evolution in Health and Disease* reveals just how far the evolutionists have progressed into medicine.

Evolution in Health and Disease
Stephen C. Stearns, Ed.
Oxford University Press, Oxford, 1999. 344 pp. $95, £55. ISBN 0-19-850110-2. Paper, $45, £23.50. ISBN 0-19-850445-4.

As with so many other important ideas in evolutionary biology, George Williams was in at the beginning of Darwinian medicine. In 1957 he showed how natural selection might favor genes that are harmful when you are beyond reproductive age so long as they are helpful during your reproductive lifetime (*1*), thereby giving rise to evolutionary studies concerned with senescence and theories of aging. Later, although their efforts were never labeled evolutionary medicine, population biologists offered profound insights into vaccination strategies and the evolution of disease. But the field remained quiescent until 1991, when Williams teamed with psychiatrist Randolph Nesse to write an article modestly titled "The Dawn of Darwinian Medicine" (*2*).

What followed was a flurry of research attempting to use evolutionary principles to explain everything from depression to conflicts between mothers and their fetuses. Some of it was profound, but there was enough pure quackery that the still-young field acquired a tarnished reputation. This volume, based on an April 1997 conference Stearns organized at Sion, Switzerland, should restore the field's luster. The book's list of authors is a who's-who of evolutionary medicine, and *Evolution in Health and Disease* is likely to set a benchmark for the many contributions that will certainly follow.

A persistent theme in much evolutionary medicine is that humans are fundamentally adapted to a hunter-gatherer lifestyle, the lifestyle we presumably led for the roughly 2.5 million years leading up to the dawn of agriculture about 10,000 years ago. Many of our modern ills are claimed to arise from the discrepancy between this Paleolithic "environment of evolutionary adaptedness" (EAA) and our modern circumstances. A penchant for potato chips, for example, may derive from humans having evolved in environments that were poor in salt. The increasing occurrence of reproductive cancers in women is attributed to cultural changes that date to the origin of agricultural subsistence practices.

In a refreshing treatment, Strassman and Dunbar expose some amusing shortcomings of the EEA concept. One is that most of our genes are far older than the Stone Age. Another is that bipedalism, which long antedates the Stone Age, still contributes to some of the most chronic of modern problems. As for women's reproductive health, Strassman and Dunbar point out that many women in traditional agricultural societies have not changed the timing or number of pregnancies (compared to women in contemporary forager populations, which are used as surrogates for pre-agricultural conditions) and do not suffer from increased incidences of cancer. Thus, it is not the transition to agriculture that matters. As alternative sources of disease from maladaptation, they suggest more recent changes, such as the demographic transition (to the growth rates and age structure of developed societies), air pollution, and loss of kin support. Indeed, there is scant reason to believe that there ever was a single EEA. Human populations have long been adapted to a range of physical environments, practices, and behaviors; one might even say that adaptability (both genetic and cultural) has been the hallmark of our species.

In the EEA view, diseases reflect the clash of modern lifestyles with stone-age genes, but others see the genes per se as the problem. Heart disease is usually attributed to smoking, poor diet, sedentary lifestyles, and chronic stress. So it is surprising that these risk factors explain little of the variability in the incidence of the disease—everyone knows somebody in their nineties who has smoked three packs a day since age 15. Kardia, Stengård, and Templeton suggest that heart disease susceptibilities might best be studied as arising from unavoidable mutations to one or more of the large numbers of genes involved with normal heart function and metabolism. Theirs could become a model approach for investigating disease susceptibilities and will surely be contentious for many years to come.

We are regularly subjected to media reports of ultra–drug-resistant pathogens, poised to visit the next plagues on society. Hospitals, by harboring such pests, have become dangerous for the young or infirm. The acquisition of drug-resistance by bacteria and viruses is a wholly expected consequence of natural selection. Malarial parasites developed resistance to quinine within a decade of its first widespread use, and reports are circulating of HIV evolving in response to triple-drug therapies. These threats have been addressed in a growing number of popula-

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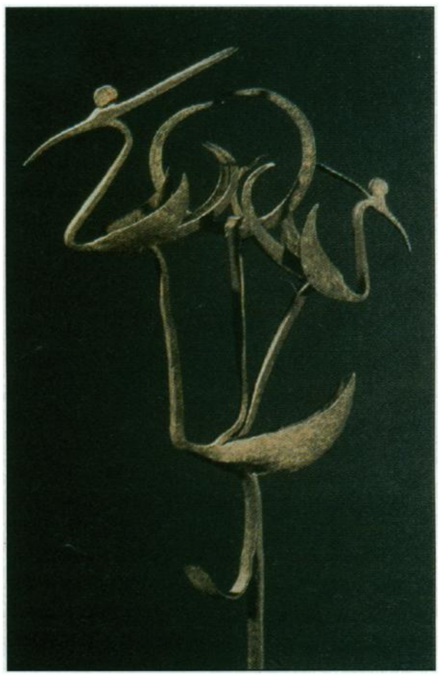
BROWSINGS



CREDIT: MARIAN AND DANIEL MALCOLM

To Cure and Protect. Sickness and Health in African Art. *Frank Herreman.* Museum for African Art, New York, 1999. 64 pp. $24.95. ISBN 0-945892-022-6.

This catalog accompanies an exhibit at the National Museum of Health and Medicine, Washington, DC, through 23 August. The iron staff decorated with birds, from the Yoruba of Nigeria, is a symbol of the herbalists' battle against insanity and disease.

tion-biology models, and four chapters explore issues of virulence, vaccination strategies, and drug resistance. One intriguing finding is that drug-taking regimes themselves, and not simply the drugs, may substantially influence the evolution of drug-resistance. For example, theoretical models suggest it is better to use two different drugs simultaneously than in succession. Applying population biological theory could greatly prolong the useful life of some drugs.

Stearns and his over 60 contributors provide many more examples of the still incipient discipline of evolutionary medicine. In the coming years, the field will be given abundant opportunities to prove its worth. The old scourges of polio and smallpox have been defeated. But the new challenges—the health of an aging population and pathogens that have shown greater cleverness in outwitting our best vaccines and antibiotics—may not be so easily overcome. Perhaps now is the right time for the new ways of thinking that *Evolution in Health and Disease* so effectively presents.

References

1. G. C. Williams, *Evolution* **11**, 398 (1957).
2. ______ and R. M. Nesse, *Q. Rev. Biol.* **66**, 1 (1991).

BOOKS: CELL BIOLOGY

Seeing Is Believing, But What Do We See?

Manfred D. Laubichler

Christian Gottfried Ehrenberg's 1838 book *Die Infusionsthierchen als vollkommene Organismen* (Infusoria as Complete Organisms) was accompanied by an atlas of magnificent colored drawings (*1*). These detailed illustrations depict a diverse group of animals—including bacteria, single-celled animals, rotifers, and many "worms"—as fully developed organisms, complete with nervous, vascular, and digestive systems; muscles; and sexual organs. Ehrenberg, an accomplished naturalist, drew what he believed he had seen. Succumbing to an optical illusion common at magnifications of less than 300, he interpreted whatever he saw as evidence for his ideas regarding the "completeness" of lower animals and the prevalence of sexual reproduction among them. Today we can easily see how Ehrenberg's ideas in turn reflected his opposition to the conception of a *scala naturae* (a linear and directed ordering of life from the simple to the complex) and the possibility of spontaneous generation.

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Anyone who has ever looked through a microscope is, of course, familiar with the problems Ehrenberg faced. We also know how difficult it is to resist the temptation to see what we believe to be there. What exactly do we see when we focus on the objects of our investigation? What is an artifact and what is real?

Questions such as these guide Henry Harris in this excellent history of cell biology. Through the eyes of a practitioner skilled in the field of cellular pathology, Harris (regius professor of medicine emeritus at Oxford University) has closely examined the original scientific literature from an interval of more than 300 years. The result is a major accomplishment. It is also a notable exception to the historian's claim that the history of science is too important to be left to aging scientists. Harris follows the development of the modern concept of the cell from its origins in a corpuscular view of the world to the discovery of similarly corpuscular determinants of inheritance (genes) inside cells. Spanning these two moments, which mark significant conceptual innovations in the history of biology, *The Birth of the Cell* tells the story of how the cell became established as the central building block of organic life.

The Birth of the Cell
by Henry Harris
Yale University Press, New Haven, 1999. 224 pp. $30. ISBN 0-300-07384-4.

Harris scrutinizes each contribution to the cell doctrine by asking the following two questions: What could the authors have seen with the available instruments and preparation methods? How is what they described related to what they could have seen? Harris thus analyzes the scientific literature in a manner resembling retrospective diagnosis in medical history. Such "presentism" is frequently derided by historians. But, in the hands of a polymath like Harris, who combines technical knowledge of the scientific problems with a sense for history, it can lead to important insights—not only into the history of cell biology, but also into the practice of science in general. Focusing mainly on biographical material, Harris places the development of cell biology within the changing cultural, intellectual, and national contexts. And his scientific competence allows him to distinguish the factual basis of individual discoveries from the cultural and technological resources that enabled them.

Harris' approach traces the multiple interactions between theories, experiments, observations, instruments, and beliefs so characteristic of the development of every scientific discipline. For instance, after binary fission of cells was accepted, the division of the cell nucleus became an issue. Before mitosis had been observed and the chromosomes were identified, all that was known was that both daughter cells also have a nucleus. Furthermore, it had been established that the fission of cells proceeds through an *Abschnürung* of the cell membrane, a process now known as cleavage. Consequently, a variety of models were proposed that suggested (without direct evidence) a similar mechanism for the division of the nucleus.

Because Harris pays close attention to the original literature, he is also able resolve many priority disputes. The extent of stolen credit, willful neglect, and outright distortions that he uncovers in the history of cell biology is unsettling, even to those who pride themselves on having a realistic view of science in action. The Belgian Barthélmy Dumortíer, who was the first to discover binary fission in multicellular organisms, was denied recognition of his accomplishment in the German scientific literature. Suffering the same fate were the Czech Jan Evangelista Purkyně and his school in Breslau, whose ideas about the similarity of animal and plant cells were ignored by Theodor Schwann, a member of the powerful Berlin school of Johannes Müller (who championed Schwann as the creator of the cell theory). As expected, competition in its various forms—between individuals, research schools, and nations—stands out as a main reason for these distortions. But ignorance, quite often of foreign languages (German for 19th-century French scientists; Czech for the Germans), also played a significant role.

The problem of how our expectations shape what we see is not confined to areas of observation or experiment. As Harris demonstrates, initial misrepresentations of a competitor's research by fellow scientists often become the received wisdom of the standard historical accounts that, in turn, shape our understanding of the history of science. By going back to the original sources in many different languages, Harris succeeds admirably in the task he set for himself: "to present a less schematic version of events and to show how, out of a sea of error and confusion, an approximation of the truth finally emerged."

References

1. C. G. Ehrenberg, *Die Infusionsthierchen als vollkommene Organismen* (Voss, Leipzig, 1838).