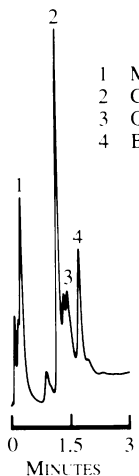


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Anomalies in Sociobiology

Kudos to Alan Lightman and Owen Gingerich (Articles, 7 Feb., p. 690) for their enlightening discussion of anomalies in science, which not only taught me some needed physics and cosmology, but also stimulated a fresh look at my own field of sociobiology. In particular, much of the "paradigmatic revolution" in sociobiology during the last 25 years was stimulated by the consequences of W. D. Hamilton's identification of inclusive fitness theory (1), which provided a way to interpret animal altruism as—in Lightman and Gingerich's terminology—"reasoned facts" that are amenable to analysis as opposed to the often unrecognized "facts-in-themselves."

In my own textbook (2), I had stated that "evolutionary biologists, beginning with Darwin, have been troubled by the fact that animals often do things that appear to benefit others, often at great cost to themselves" (2, p. 67); and I, like most sociobiologists, then proceeded to demonstrate how the kaleidoscopic array of animal altruism, previously so bothersome to evolutionary theory, has now been normalized by Hamilton's insights into the genetics of kinship. Darwin himself had indeed been troubled by what he saw as the anomaly of altruism, especially among the eusocial insects. However, stimulated by the Lightman-Gingerich thesis, I have reviewed numerous pre-1964 textbooks of animal behavior and evolutionary biology and have discovered that, in fact—and contrary to my own above-cited assertion—before Hamilton's insight, evolutionary biologists were *not* very much troubled by the occurrence of apparently altruistic behavior among animals (at least, they did not devote much theoretical or empirical attention to the phenomenon). Since then, the biology of altruism has become one of the cornerstones of modern sociobiology, whose very emergence and prominence are often attributed to its success in resolving this heretofore anomalous aspect of animal (and human) behavior.

I sometimes think that one regrettable aspect of teaching science is that, typically, we simply instruct our students in what we have learned about the natural world, such that science courses become a recitation of known facts and principles, implying that we know and understand just about everything. I have joked that it might be interesting to attempt to teach a course in what we *don't* know about, say, animal behavior. Maybe, with a wink toward Lightman and Gingerich, we should attempt to teach

(Continued on p. 79)

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 19. In the error analysis we used a random selection of values for each measured parameter based on their respective means and standard deviations. A large number, for example, 1000, of calculations of the calculated parameter, S_{oc} , were made with the randomly selected values for each measured parameter. Then the mean and standard deviation of S_{oc} were determined from the 1000 calculated S_{oc} values; see B. Efron, *Biometrika* 68, 589 (1981).
 20. The ^{14}C activity is expressed as $\Delta^{14}\text{C} = [(A_s/A_{ox}) - 1]1000$ in per mil, where A_s is the activity of the sample and A_{ox} is the age-corrected activity of the oxalic acid standard after ^{13}C normalization [M. Stuiver and H. A. Polach, *Radiocarbon* 19, 355 (1977)].
 21. We thank the group at NOAA-Pacific Marine Environmental Laboratory, in particular D. Feely

and P. Murphy, and M. Dudley for sample collections. J. Zhang helped with sample collection and extraction. S. Moe, M. Knox, and L. Lu helped with sample extraction, and D. Wilbur oversaw the mass spectrometer measurements. P. Kroopnick provided tabulated $\delta^{13}\text{C}$ data from SCAN and ANTIPODES cruises. T. Brazunias, U. Siegenthaler, S. Smith, and P. Tans provided helpful reviews. The U.S. work was supported by NOAA's Climate and Global Change Program (NA90AA-D-AC828) and the Canadian work was supported by the Department of Fisheries and Oceans and the Panel of Energy Research and Development (Project 48115).

3 September 1991; accepted 27 January 1992

(Continued from p. 14)

what we know, or are troubled by, but don't know that we know (or don't admit that we are troubled by) because we don't have a satisfying explanation.

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The Search for Eve

Marcia Barinaga's article " 'African Eve' backers beat a retreat" concerning the debate about modern human origins (*Research News*, 7 Feb., p. 686) contains many examples of the kind of thinking that still

plagues the study of human evolution. It was clear by 1987 that new methods of phylogenetic analysis for reconstructing human history would be necessary, and not just new DNA sequences from more people or a 4.0 version of some existing software package that violated present knowledge of the system (unequal sample sizes and varying rates of evolution).

Breakthroughs in extraction of DNA from human fossils must now be accompanied by better methods to absorb large data sets for analysis of variance and clustering. DNA sequences from actual fossils, not reconstructed hypothetical ancestors, are the key. Further arguments are tedious and wasteful of limited resources and predispose observers to equate evolutionary biology with street theater.

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Corrections and Clarifications

The News & Comment article "Wilson slashes spending for antismoking effort" by Marcia Barinaga (13 Mar., p. 1348) erroneously stated that the California legislature approved the shut-down of California's antismoking ad campaign. The legislature approved the removal of \$29 million from the smoking-initiative budget, but those funds do not influence the ad campaign. The ad campaign funding was removed by an action of the governor that did not have legislative approval.

In Joseph Palca's News & Comment article "AAAS in Chicago: Dawn of a new era?" (21 Feb., p. 918), University of Miami philosopher Kenneth Goodman's name was inadvertently misspelled.

The name of the associate vice chancellor for research at the University of Illinois, Tina Gunsalus, was inadvertently misspelled in the News & Comment article "What's left on the table" by David P. Hamilton (13 Mar., p. 1345).

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