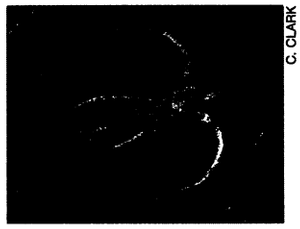
LETTERS

Markings

The technology for "quick and precise" analysis of airborne particles may, or may not, be at hand. The "vast majority" of public debates about evolution are said to decrease public support for it. Despite new information provided by genetic analysis, is this "the best time" to reorganize the classification of living things? Altering cotton genetically so that it can resist pests has allowed thousands of farmers to "entirely eliminate insecticide spray treatments," according to the Monsanto Company. And do fossil stromatolites provide evidence that animals originated on Earth at least 1 billion years ago? (Right, the arthropod *Marrella*, approximately 19 millimeters long, lived about 530 million years ago.)



C. CLARK

Linnaean Categories

Solomon W. Golomb (Letters, 8 Nov., p. 902) suggests introducing the rank of "empire" to denote the highest division(s) of the living beings. I hope that any sympathetic attitude toward this proposal will be checked against the following considerations:

1) Carl Woese's divisions of life on Earth are not "categories." *Bacteria*, *Archaea*, and *Eukarya* are "'taxa," as are *Aves* (the birds), *Coleoptera* (the beetles), or *Homo sapiens*. Categories are those things (for example, the species, the genus, the phylum) to which Golomb would like to add another term (the empire).

2) These Linnaean categories, in spite of their long traditional use, are not unquestionable. An increasing number of students are arguing for abolishing them as arbitrary and, in one opinion, even nonsensical and overtly misleading (*1*). These matters are admittedly controversial, but this does not seem the best time for introducing new formal ranks.

3) The threefold basal split of living beings that seems to be "gaining acceptance" so as to require introducing this highest rank of "empire" has two obvious weaknesses: (i) it corresponds to an incompletely resolved phylogeny, and (ii) it takes for granted the monophyletyic character of each and all of the three taxa, that could be true (as assumed in the archea theory) but might not be so (as assumed by the eocyte theory).

4) The term "*imperium*" is all but new. Linnaeus (*2*) used the term "*Imperium Naturae*" as the whole embracing his three kingdoms (animals, plants, minerals), and the same term has been recently revived, more or less intentionally, by a few modern authors (*3*).

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References and Notes

1. A modern critic of the Linnaean hierarchy is G. C. D. Griffith [*System. Zool.* **25**, 168 (1974)].
2. C. Linnaeus, *Systema Naturae* (Holmiae, ed. 10, 1758), p. 5.
3. D. L. Lipscomb, *Cladistics* **1**, 127 (1985).

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Debating Creationists

Paul R. Gross (Letters, 6 Sept., p. 1321), Michael J. Erpino (Letters, 8 Nov., p. 904), and David Edge (Letters, 8 Nov., p. 904) all take issue with my position against formal debates with creationists. I find the "duty to defend science" argument pales next to that of "above all else, do no harm."

Our goal in such debates is quite different from *creationists'* goal to inspire their adherents to proselytize teachers about how evolution is a "theory in crisis" and how it would be great if we could introduce this new "science" of creationism into our schools. More people will come to a debate than to a lecture in a church basement so, of course, creationists will try to get a scientist to oppose them. After the debate, citizens influenced by the creationist position proceed to write letters to the editor, talk to their kids' teachers, and so forth. This intimidates many teachers, who then may be tempted to "skip evolution this year." Hardly our side's goal.

My position is not to ignore creation science, but to confront these ideas in the

proper forum, which is not a formal debate.

I have had many productive exchanges with creationists on radio, television, or panels, where it is possible to stop my opponent and correct errors before they pile up uncontrollably. This accomplishes Erpino's goal of educating the general public in science and evolution, but a formal debate does not. The vast, vast majority of formal debates decrease public support for evolution, which discourages teachers from teaching it. I suggest that we put our egos aside and, above else, do no harm.

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Bollgard Cotton Performance

Assertions that resistance management strategies for Bollgard cotton—which expresses the natural insecticidal protein *Bacillus thuringiensis* (Bt)—are inadequate or that the product "failed" to provide cotton growers control of the bollworm (M. Mellon, Letters, 1 Nov., p. 703) are simply not correct.

The facts speak for themselves. More than 1.8 million acres of Bollgard cotton were planted by more than 5700 growers across the United States in 1996 (nearly 13% of the entire cotton crop). Approximately 60% of these growers were able to entirely eliminate insecticide spray treatments for tobacco budworms, bollworms, or pink bollworms. For those growers that did spray some of their Bollgard cotton acres because of unusually high bollworm pressure, a single spray generally controlled the insect pests. That single spray—when combined with the season-long, in-plant protection provided by the Bollgard gene—represents a significant improvement over adjoining non-Bollgard fields that may, in the past, have required four, five, or even six traditional insecticide spray treatments.

The insect resistance management plan for Bollgard cotton was initiated and implemented by Monsanto with the full support and concurrence of the U.S. Environmental Protection Agency. This plan always accounted for the bollworm and its unique characteristics.

The adoption of Bollgard cotton in 1996 saved the equivalent of the application of more than a quarter of a million gallons of formulated insecticide products, hardly a "failure" for the environment.

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Japanese Science

Concerning Hiroo Imura's editorial about Japanese science education (4 Oct., p. 15), from a Japanese student's point of view, there is a more serious problem than the number of graduate students or university facilities and budgets. Scientists at my university teach us mostly practical issues, like how to produce data and write papers. But they seem to rarely discuss philosophical matters or the social consequences of scientific activities. Science education in Japan should provide opportunities for students to learn about social responsibility and the quality of scientific research in a uniquely Japanese way. Then we could stop mimicking or pursuing the Western way of thinking and make a unique Japanese contribution to the international scientific community.

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