

LETTERS

University Research and DOD

The anticipated increase in funding of research in universities by the Department of Defense (DOD) (News and Comment, 29 May, p. 1003) is very disturbing. There are three critical issues for the university and scientific communities as well as for the whole nation which ought to be addressed.

The first is the increasing dependence of universities on federal funding. The questions raised by Kenneth Brown (1) are relevant and deserve serious consideration and widespread discussion. The immediate budget crisis prompted by the reduction of grant money is also an opportunity for universities to lessen their vulnerability to events beyond their control and to find more secure, stable, and independent financial resources. The rush of university presidents to the DOD headline is unseemly at best and dangerous at worst.

The second issue is the appropriateness of DOD funding nonmilitary research altogether. Universities are rightly wary of any restrictions on the dissemination of research results. As citizens, scientists, and advocates for our institutions we should question why basic research is funded by DOD and not by nonmilitary agencies of the government. We should heed the warning of George Kistiakowsky who said recently, "I am very upset about this militarization of the country. I think, as President Eisenhower said in his farewell address, it is destroying our democracy" (2).

The final issue is the most important of all. That is our obligation to question the need and even the morality of *increasing* defense spending. George Kennan has just called for a 50 percent reduction in our nuclear stockpile. Kistiakowsky says our nuclear overkill capability is "beyond all concepts of common sense militarily" (2). It is narrow-minded and self-serving of universities to take their begging bowls to the Pentagon. The scientific community ought to be using its authority to speak out on the threat of nuclear holocaust and its expertise to help the human race back out of the blind alley of self-destruction into which it is rushing.

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1. K. T. Brown, *Science* **212**, 411 (1981).
2. R. Cooke, *Boston Globe*, 25 May 1981, p. 2.

Views on Evolution, Theory, and Science

R. E. Kofahl, in his letter (22 May, p. 873), tells us that Darwin "intensely hated" the dual concepts of divine intervention and special creation. Intense hatred was not known to be one of Darwin's cultural traits. Kofahl does not tell us he himself has written that "Bible-believing students of the biological sciences possess a guide for their interpretation of the available data, the biblical record of divine creation contained in Genesis" (1). Kofahl's discussion of Popper's ideas should be viewed in the light of Kofahl's own fixations.

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1. R. E. Kofahl and K. L. Segraves, *The Creation Explanation* (Shaw, Wheaton, Ill., 1975), p. 69.

It is becoming increasingly clear that the principal issue in the evolutionist-creationist debates is not scientific, but philosophical and historical. Yet one would think from recent discussions in *Science* (News and Comment, 20 Mar., p. 1331; Letters, 17 Apr., p. 281, and 15 May, p. 737) and elsewhere (1) that Sir Karl Popper is the only philosopher or historian of science in the world with anything to say on the matter. Creationists and evolutionists alike argue as if the validity of evolution by natural selection is to be decided upon the basis of Popper's pronouncements. Popper is not, however, an expert in the biological sciences or their history. His conclusions concerning evolutionary theory have been explicitly contradicted by Morton Beckner (2), who has specialized in the study of the philosophy of biology. Other philosophers and scientists have argued that a single philosophy of science based, as is Popper's, upon the study of the physical sciences is, in any case, untenable (3). Biological and historical reasoning are different from physical reasoning, these men argue. Thus, what Popper has to say about physical theories does not necessarily apply to biological ones.

The constant citation of Popper hides a more disturbing issue than just the validity of his remarks on evolutionism. Science is based upon skepticism, not authoritarianism. No matter how great Popper's authority, and no matter what Popper says—rightly or wrongly—about the issues raised by creationism, the resolution must come through independent, skeptical thinking on the part of

each individual involved in the debates.

In the first place, there is a great deal of confusion as to whether evolutionary theories can make any predictions or postdictions that can be falsified. In short, can postulated evolutionary mechanisms be tested? Kofahl (Letters, 22 May, p. 873) of the Creation-Science Research Center says no, quoting Popper's statement that "Darwinism is not a testable scientific theory." This conclusion is obviously false. Evolution postdicts certain immutable trends of progressive change that can be falsified. For example, the discovery of human bones in geological strata bearing the remains of dinosaurs would most certainly falsify the concept of evolution. So would the discovery of bird fossils in ages preceding the advent of fishes. Indeed, any inversion of the so-called "tree of life" that puts a large branch onto a twig or causes a clear discontinuity of development would clearly cause tremendous difficulties for evolutionary explanations of life. On the other hand, without such a theory, there would be no reason to consider such anomalies and discontinuities as anything other than obvious possibilities. In the absence of evolutionary theories, any chronological ordering of the fossil record would seem to be a possibility, and no means would exist to choose one order over another.

Theories must not only be predictive (or postdictive) and falsifiable; they must also limit what data are possible a priori. Evolutionism is a theory according to these criteria. It could be falsified by evidence that its predictions indicate should not exist. Yet, in more than 100 years of research, no such data have been discovered. Thus, the validity of the theory has been established by its historical record. It is this historical record of research, in turn, that gives the theory its important epistemological status in science.

Theories must do even more than predict and limit, however; they must also provide criteria for the evaluation of data. As any scientist knows, not all observed data are valid. Some can be interpreted as factual (that is, they fit the theory); some are artifactual (that is, the result of secondary or accidental influences not covered by the theory); and some are anomalies (that is, demonstrably not due to secondary influences, but also at odds with predictions from theory). Evolutionism provides such criteria for data evaluation. A perfect example is the case of Piltdown "man." Evolutionary theory predicted a "missing link" between the apes and man. Piltdown "man" was thought at first to be

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that desired link until it was demonstrated to be an artifact (due to human conniving) because it did not meet the anatomical criteria predicted for the missing link according to theory. Thus, while evolutionary theory calls for a "missing link"—or more accurately, a series of such links—it also specifies the criteria by which any suspected link may be evaluated as factual, artifactual, or anomalous. In short, a theory must incorporate means for self-correction. Evolutionary explanations qualify as theories on these grounds.

But whether evolutionary theory is valid or not is only half the question in the present debates. For some reason most scientists are so busy defending their own discipline that they fail to see that the crux of the matter lies in the creationist camp. Can creationist accounts of life qualify as scientific theories? No—on no account. They are neither predictive nor postdictive. They do not limit what is possible in history; or, if they do (as in stating the age of the earth), they fail to do so in verifiable or falsifiable ways. Neither do they set criteria for the evaluation of data as fact, artifact, or anomaly. These creationist explanations have not even accrued epistemological validity through a history of accumulated research. Indeed, quite the opposite. And worst of all, creationist accounts are authoritarian, based primarily upon revelation rather than reason. Creationism is therefore not science; it is dogma.

It is time that the cards be placed on the table. The creationists are playing a nasty game of double standards. They use Popper to argue that evolutionism is not a theory; they do not point out that according to Popper's criteria, creationism is not a theory either. Indeed, according to Popper's criteria, creationism is not even science. Popper at least grants evolutionism *that* status (4). Thus, whether or not Popper's ideas are truly applicable to the present case, the creationists bear the brunt of the criticism which they wish to redirect at evolutionism.

It is time to stop the nonsense. Scientists and creationists alike need to start thinking more deeply about just what science is. This may be a philosophical and historical issue, but a little common-sense thinking by all concerned would not hurt. In fact, careful thought is needed very badly, for, as Alfred North Whitehead said, "When we consider what religion is for mankind and what science is, it is no exaggeration to say that the future course of history depends upon the decision of this generation as to

the relations between them" (5). At least let us not be blind to their differences in making that decision.

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2. M. Beckner, *The Biological Way of Thought* (Univ. of California Press, Berkeley, 1968), especially pp. 159-172.
3. R. D. Carmichael, *Logic of Discovery* (Open Court, Chicago, 1930); D. Hull, *Philosophy of Biological Science* (Prentice-Hall, Englewood Cliffs, N.J., 1974); A. Szent-Györgyi, *Introduction to Submolecular Biology* (Academic Press, New York, 1960), pp. 3-4.
4. K. Popper, *New Sci.* 87, 611 (1980).
5. Quoted from I. G. Barbour, *Issues in Science and Religion* (Harper and Row, New York, 1966), p. 12.

Applied Social Science

Mazur (Letters, 22 May, p. 875) observes that social scientists have not constructed better social systems than laymen have. . . . Our failure to design improved social systems is due as much to our failure to esteem social scientists who do applied research as it is to the general lack of social scientific progress which Mazur implies. When applied social research and the development of social theory are done well, they become complementary processes. We need to hone the methodological tools and analytical skills that facilitate dovetailing of theory construction with social research which has an applied orientation. In fact, the feedback between theory and application is inadequately understood and is itself in need of further study (1).

Research into fundamental social processes continues to be needed. However, the substantial drop in federal monies available to social research requires that we seek alternative sources of funding in a marketplace which can be expected to demand that practitioners' concerns be taken into account. If we meet the challenge, the social sciences may benefit more than they are harmed.

LAURENCE CHALIP

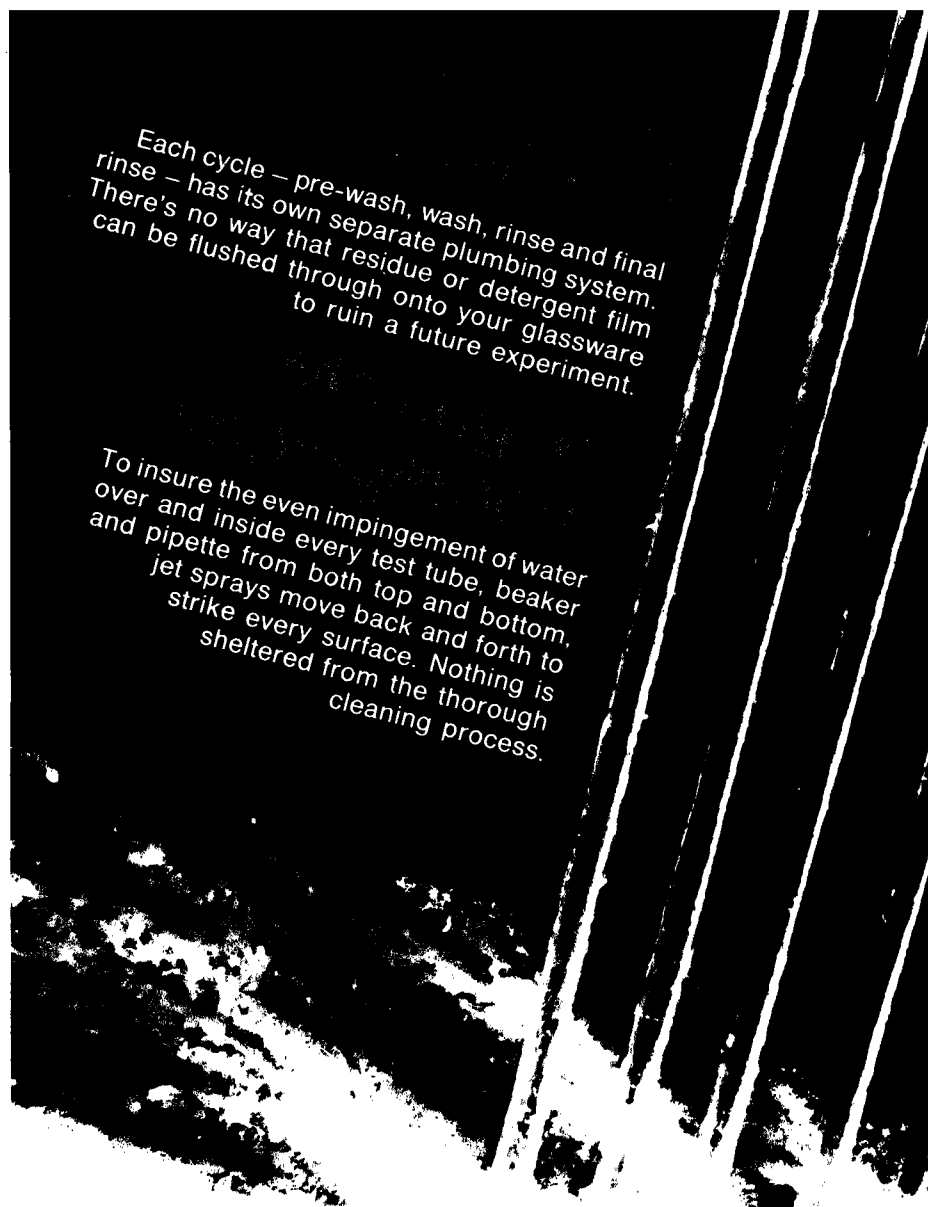
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Erratum: The legend to the photograph of spoil from strip mining (News and Comment, 15 May, p. 759) incorrectly reads: "Kentucky argued to bar this completely, but only after a fight." The caption should have read, "Kentucky agreed to bar this completely, but only after a fight."

Erratum: In the article "New A-bomb studies alter radiation estimates" (News and Comment, 22 May, p. 902), the reference to C. P. Knowles' research should have read: "power of the Little Boy bomb," not "Fat Man bomb."



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