Author Responds to Comments Regarding Darwin Article

Dear Editor,

In a recent letter, Eastwell (January, 2003) offered some observations regarding the article "Scientific Knowledge of the Past is Possible" (Cooper, August, 2002). One of his observations was that my contention that "the conclusion that Darwin was correct is inescapable" (p. 431) goes too far in claiming certainty for Darwin's ideas. It was not my intention to claim absolute certainty. As I indicated in the article, "... scientists who rely on historical evidence can[not] establish their conclusions with absolute certainty. Since they have incomplete information about the past, their conclusions, [like all scientific interpretations of evidence], must always remain tentative" (Cooper, 2002, p. 431).

However, when a theory like descent with modification achieves as high a degree of consilience as it has, scientists have an equally high degree of confidence in that theory. The amount of evidence and the degree to which independent lines of evidence are mutually reinforcing warrants a very high degree of confidence in Darwin's descent with modification (Gould, 1983; Futuyma, 1999). Thus, I maintain that, given the current state of our knowledge, the conclusion that Darwin was correct is, indeed, inescapable.

However, the fact that we have such a high degree of confidence in Darwin's theory does not mean it is written in stone and cannot be revised. Theories always remain subject to modification in the light of new findings. Indeed, evidence of an extensive role for lateral gene transfer in the early evolution of microorganisms appears to be uprooting the base of Darwin's tree of life (Doolittle, 2000; Woese, 2000).

Eastwell's (2003) second point, that "both evolution and creation are indeed outside the bounds of empirical science," (p. 10) but not for the same reasons intended by creationist John Morris is subject to misinterpretation depending on how one understands the terms used. Morris (1991) clearly intended that both evolution and creation are outside the bounds of empirical science because of their inability to establish their claims demonstratively by experiment. Since Eastwell (2003) equates empirical science with experimental science, he generously concedes Morris' claim and then proceeds to argue that "Evolution is not an example of empirical science, but rather historical science, but science all the same" (p. 10).

Eastwell is correct in challenging Morris' claim that historical sciences, like evolutionary biology, lack scientific standing, and are inferior to experimental sciences. However, he does not tell us what makes historical sciences scientific. Furthermore, his use of the word "empirical" as a synonym for "experimental" is too restrictive and plays into the hands of those like Morris. As I understand the word empirical, it means, "based on observation or experiment." All science is empirical; that is, all science involves the testing of ideas against evidence. The requirement that ideas be tested against empirical evidence is one of the defining features of a scientific approach. This is true whether the problems being investigated involve historical events or whether they are open to direct experimental intervention in the present. If we allow that historical sciences are not empirical, that is, not based on evidence of any kind, then what feature makes them scientific? If scientific claims about the past are not empirically based, we have to concede that Morris is entirely correct.

As I explained in the article, sciences that focus on the present and sciences that focus on the past have some methodological differences, but they also share many similarities. Cleland (2001, 2002) argued a

similar point and explained that the root of the differences lies in a fundamental asymmetry of time. Before an event occurs, that event is underdetermined by any single cause that might be investigated by an experimenter. Experimenters try to identify as many causal factors as possible and understand their interactions and effects one at a time by manipulating them. But once an event has occurred, it is overdetermined by the traces left behind. The ability to know the past depends on our ability to find and correctly interpret these traces. This fundamental time asymmetry leads to different problems that necessitate some differences in methodology, but it would be incorrect to conclude from these differences that historical sciences are completely different, or that they are inferior in any way (Cleland, 2001, 2002; Gould, 1986).

The sharp distinction between empirical (experimental) science and historical science employed by Eastwell has the benefit of highlighting an ambiguous point in the article. I do not believe that "experimental sciences" and "historical sciences" should be viewed as two mutually exclusive categories of science; however, one may conclude that from the way in which the terms are used in the article (Cooper, 2002). Many branches of science (e.g., molecular biology) do, in fact, rely more frequently on experimental intervention than do those sciences that investigate the past; however, experiments are not unknown in historical sciences. Darwin, for example, performed experiments to test hypotheses about whether seeds could have remained viable while being carried by ocean currents to the Galapagos Islands. He placed seeds in salt water for varying periods of time to test whether they retained their viability. Clearly, there are times when an experiment may shed light on the plausibility of a hypothesis about past events.

The real source of the problem lies in the fact that many people, like creationist John Morris, do not understand science well, and equate being scientific with doing experiments. Since historical scientists don't usually do experiments and they can't observe first hand or replicate the phenomena they study, their work is considered less than scientific. The perceived inferiority of sciences that study the past is a consequence of an anachronistic and parochial view of science that is based on nineteenth century physics (Rudolph & Stewart, 1998). Textbooks contribute to this view by using controlled experiments as exemplars, and by listing the steps in The Scientific Method as if there exists only one approach to doing science. However, a look at what evolutionary biologists actually do, in practice, shows that controlled laboratory experiments are usually not the method of choice (Cooper, in press). It is time to adopt a more pluralistic view of the methods actually employed in the various sciences (Wivagg & Allchin, 2002). This will prevent creationists from making spurious criticisms based on misunderstandings of what science is and how scientists operate.

Sincerely,

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