Reply to "Forever Tentative"

David H. Bailey

I WISH TO THANK CHARLES BOYD for bringing to light some additional material relevant to the topics discussed in my article on science and Mormonism. I will briefly respond to some of the issues he raises. I will include, where possible, references to recent articles in *Scientific American*, since for many readers the original scientific papers may be either inaccessible or excessively technical.

Boyd appears to make several claims in his letter. One of these is that the real world of active scientific research is far from the serene, polite image popularly held. He claims that in fact the scientific world is roiled with controversies, that the ranks of scientists include pugnacious characters who propose dissident theories and demand incontrovertible experimental evidence for even the most widely held theories, and that even the foundation rocks of science are regularly questioned and reexamined. How does the scientific community plead to such claims? "Guilty as charged!"

Indeed, the history of any well-established theory is one of repeated demands from skeptical scientists for experimental proof. In the case of relativity, most scientists were reluctant to take Einstein's theory seriously until impressive experimental evidence began to accumulate. Even then, some scientists continued to advance alternate theories that agreed with relativity for experimentally verified phenomena, but that made different predictions for untested phenomena. Relativity is well-established today precisely because it has withstood these challenges for eighty-five years. For example, recently Einstein's general theory of relativity received impressive verification by the observation of "gravitational wave" effects (Schramm and Steigman 1988; Jeffries 1987) and "gravitational lenses" (Turner 1988).

While I am speaking of Einstein, I should mention that he staunchly maintained a dissident position about the random indeterminancy inherent in

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quantum theory. He simply could not believe that "God plays dice with the universe," and until his death he disputed experimental evidence that indicated otherwise, proposing "hidden variables" to account for these phenomena. Unfortunately for Eintsein, his view has now been soundly refuted by recent experimental evidence (Shimony 1988), which dramatically confirms the most fundamental (and "spooky") notions of quantum theory.

However, Boyd seems to be alluding to more than just significant debate within the scientific community regarding these scientific theories. He suggests that these controversies might upset some of the fundamental scientific notions on which I based my article. However, I feel that a careful examination of these dissident theories shows that this is not the case—these alternative theories either differ only in sophisticated details from the orthodox theories (and the basic notions are not at issue), or else their experimental support is still somewhat weak.

For example, Boyd mentions the work of John W. Moffat, who has proposed what is known as the nonsymmetric gravitational theory, an alternative to the standard general relativity theory of Einstein. As Boyd has pointed out, some recent experimental evidence appears to confirm Moffat's theory. What are the facts here? Is Einstein's work about to be repudiated?

Moffat's theory is simply a mathematical extension of general relativity. Even in those highly exotic circumstances where the predictions of relativity significantly differ from those of classical Newtonian mechanics, Moffat's theory usually predicts the same results as general relativity. Only in some highly unusual circumstances, for instance in certain binary star systems, does Moffat's theory give rise to results significantly different from those of general relativity. By the way, Moffat's theory has recently received an additional experimental boost (a discrepancy similar to that of DI Hercules has now been observed in another binary star system), and so it is possible that one day Moffat's theory will supplant Einstein's. But Moffat's theory does not upset the basic notions of either special or general relativity. For example, black holes and the big bang can be derived from Moffat's theory as well as from general relativity.

An even more dramatic example of this point is Boyd's mention of the fact, which has long been known, that the current mathematical formulation of general relativity is not completely compatible with quantum theory. What Boyd did not mention, however, is that a revised "quantum theory of gravitation" would only affect phenomena that occurred in the first 10^{-40} second following the big bang (Schramm and Steigman 1988, 69).

The public disagreement between Richard Leakey and Donald Johanson over the ancestry of modern humans, mentioned by both Boyd and myself, is another case in point. Some creationists, and even the likes of Hugh Nibley, have cited this case to show that the study of human evolution is far from settled. This may be true. However, even a brief review of the issues involved in the Leakey-Johanson debate makes it quite clear that the notion of humans evolving from hominids over millions of years is hardly in doubt. Certainly neither side of this debate can offer the slightest comfort to those who cling to a fundamentalist interpretation of creation scriptures.

What of the plasma theory of Hannes Alfven, which Boyd lists as an alternative to the standard big bang cosmology? Here again, there may be some substance to Alfven's ideas. Indeed, many scientists now agree that these plasma effects may be more widespread and important than previously thought. But Alfven's claims that the big bang never happened, and that these plasma effects are the dominant force shaping the large-scale structure of the universe, are at present not very well substantiated. Similarly, Arp's data is simply not yet compelling enough for his theory to seriously compete with the established theory. Indeed, neither of these theories is able to account for some of the most important experimental facts of cosmology, such as the observed abundances of light element isotopes in the universe today. By contrast, a straightforward application of the big bang theory correctly predicts these abundances, even though they span nearly ten orders of magnitude (Schramm and Steigman 1988, 66). Also, the number of lepton families observed in particle accelerator experiments is entirely consistent with the big bang cosmology but is not easily explained by other theories (Cline 1988). In short, the big bang theory simply explains too many things too well to be casually discarded in favor of theories that still have only limited theoretical and experimental support.

So what is the bottom line of the controversies that Boyd mentions? It certainly is regrettable that in some cases solid scientific work was blocked from scientific journals, although for every case of this sort there are a hundred cases where shoddy work has been published. But as for their impact on this discussion, it appears to me that the alternative theories listed by Boyd either differ only in subtle ways from the standard theories, or else they do not yet have strong experimental support and cannot yet explain some well-established experimental facts. As far as I can see, the basic notions of the scientific theories mentioned in my article are not at present seriously threatened.

But what if they were, or what if in the future one or more of these theories is supplanted with more precise theories? Why is it so threatening to think that one's current conception of the universe may have to be revised, particularly in a Church that professes belief that "[God] will yet reveal many great and important things pertaining to the kingdom of God"? Indeed, the continuing refinement of modern scientific theories has a perfect parallel in the evolution of LDS doctrines. One need only consider the changes that have occurred in the understanding of such principles as race and the priesthood, the Adam-God doctrine, blood atonement, polygamy, the role of seventies, the temple ceremony, and the gathering of Zion to conclude that LDS doctrines are "forever tentative" also.

Certainly I agree with Boyd that it would be highly improper at the current time for Church leaders to make an authoritative pronouncement in favor of a scientific theory, particularly one as unsettled as the big bang now is. On the other hand, given the weight of evidence that now supports many of these theories, it seems to me rather unwise for a leader to blithely criticize one of them in a public speech or article. In a similar vein, while it may be unwise to base one's system of personal philosophy on a tentative scientific theory, it

would be even more foolish to adopt an inflexible personal philosophy that contradicts one or more well-established scientific principles.

Finally, I reiterate my belief that it is high time for the LDS intellectual community to consider the theological and philosophical implications of recent scientific discoveries. Granted, the possibility always exists that some of these discussions will be rendered moot by future scientific developments that may place these matters in a different light. But in the absence of such discussions, there is the susbtantial risk that the Church may one day appear much as the Catholic church of old, or as the fundamentalist Christian churches of today: forever fighting a rear-guard action against certain scientific theories that become more incontrovertible with each passing year.

BIBLIOGRAPHY

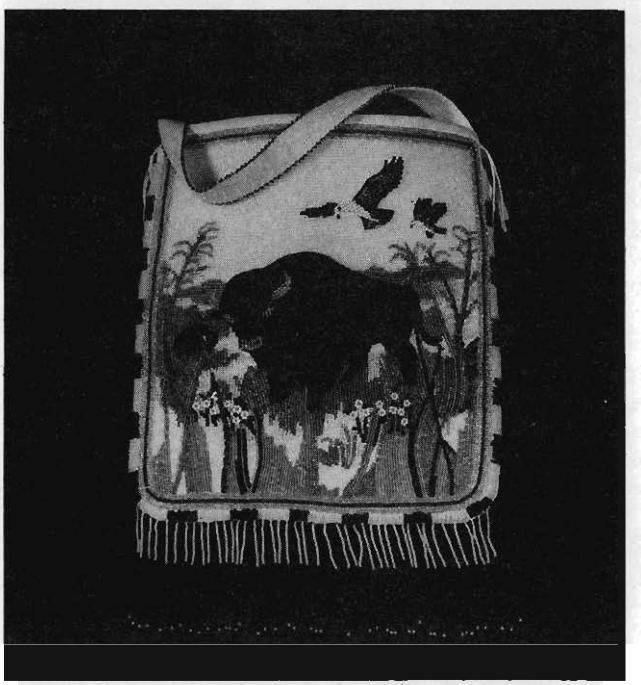
Cline, David B. "Beyond Truth and Beauty: A Fourth Family of Particles." *Scientific American* 259 (Aug. 1988): 60–67.

Jeffries, Andres D., Peter R. Saulson, Robert E. Spero, and Michael E. Zucker. "Gravitational Wave Observatories." *Scientific American* 256 (June 1987): 50–58.

Schramm, David N., and Gary Steigman. "Particle Accelerators Test Cosmological Theory." *Scientific American* 258 (June 1988): 66–73.

Shimony, Abner. "The Reality of the Quantum World." *Scientific American* 258 (Jan. 1988): 46–53.

Turner, Edwin L. "Gravitational Lenses." *Scientific American* 259 (July 1988): 54–61.



Bag, buffalo design, Mae Parry (Clearfield, Utah), 11½"×16", buckskin, fabric, glass beads, 1988; (Utah) State Art Collection.