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SUMMARY:

The Scientific Controversy Over Whether Microevolution Can Account For Macroevolution

When Charles Darwin published *The Origin of Species* in 1859, it was already known that existing species can change over time. This is the basis of artificial breeding, which had been practiced for thousands of years. Darwin and his contemporaries were also familiar enough with the fossil record to know that major changes in living things had occurred over geological time. Darwin's theory was that a process analogous to artificial breeding also occurs in nature; he called that process natural selection. Darwin's theory was also that changes in existing species due primarily to natural selection could, if given enough time, produce the major changes we see in the fossil record.

After Darwin, the first phenomenon (changes within an existing species or gene pool) was named "microevolution." There is abundant evidence that changes can occur within existing species, both domestic and wild, so microevolution is uncontroversial. The second phenomenon (large-scale changes over geological time) was named "macroevolution," and Darwin's theory that the processes of the former can account for the latter was controversial right from the start. Many biologists during and after Darwin's lifetime have questioned whether the natural counterpart of domestic breeding could do what domestic breeding has never done -- namely, produce new species, organs, and body plans. In the first few decades of the twentieth century, skepticism over this aspect of evolution was so strong that Darwin's theory went into eclipse. (See Chapter 9 of Peter Bowler's *Evolution: The History of an Idea*, University of California Press, revised edition, 1989).

In the 1930s, "neo-Darwinists" proposed that genetic mutations (of which Darwin was unaware) could solve the problem. Although the vast majority of mutations are harmful (and thus cannot be favored by natural selection), in rare instances one may benefit an organism. For example, genetic mutations account for some cases of antibiotic resistance in bacteria; if an organism is in the presence of the antibiotic, such a mutation is beneficial. All known beneficial mutations, however, affect only an organism's biochemistry; Darwinian evolution requires large-scale changes in morphology, or anatomy. Midway through the twentieth century, some Darwinian geneticists suggested that occasional "macromutations" might produce the large-scale morphological changes needed by Darwin's theory. Unfortunately, all known morphological mutations are harmful, and the larger their effects the more harmful they are. Scientific critics of

macromutations took to calling this the "hopeful monster" hypothesis. (See Chapter 12 of Bowler's book.)

The scientific controversy over whether processes observable within existing species and gene pools (microevolution) can account for large-scale changes over geological time (macroevolution) continues to this day. Here are a few examples of peer-reviewed scientific articles that have referred to it just in the last few years:

- **David L. Stern, "Perspective: Evolutionary Developmental Biology and the Problem of Variation," *Evolution* 54 (2000): 1079-1091.**

  "One of the oldest problems in evolutionary biology remains largely unsolved… Historically, the neo-Darwinian synthesizers stressed the predominance of micromutations in evolution, whereas others noted the similarities between some dramatic mutations and evolutionary transitions to argue for macromutationism."

- **Robert L. Carroll, "Towards a new evolutionary synthesis," *Trends in Ecology and Evolution,* 15 (January, 2000): 27.**

  "Large-scale evolutionary phenomena cannot be understood solely on the basis of extrapolation from processes observed at the level of modern populations and species."

- **Andrew M. Simons, "The continuity of microevolution and macroevolution," *Journal of Evolutionary Biology* 15 (2002): 688-701.**

  "A persistent debate in evolutionary biology is one over the continuity of microevolution and macroevolution -- whether macroevolutionary trends are governed by the principles of microevolution."

It should be noted that all of the scientists quoted above are believers in Darwinian evolution, and that all of them think the controversy will eventually be resolved within the framework of that theory. Stern, for example, believes that new developmental studies of gene function will provide "the current missing link." (p. 1079) <u>The important point here is that the controversy has not yet been resolved, precisely because the evidence needed to resolve it is still lacking.</u> It is important for students to know what the evidence does or does not show -- not just what some scientists hope the evidence will eventually show.

Since the controversy over microevolution and macroevolution is at the heart of Darwin's theory, and since evolutionary theory is so influential in modern biology, it is a disservice to students for biology curricula to ignore the controversy entirely. Furthermore, since the scientific evidence needed to settle the controversy is still lacking, it is inaccurate to give students the impression that the controversy has been resolved and that all scientists have reached a consensus on the issue.