



## Let's examine both sides of coin of human understanding

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By RICHARD D. ALEXANDER

In his **July 12 letter**, Ronald G. Larson is correct that evolution is primarily "postdictive." However, this is no shortcoming, or flaw, of evolution as a science, but an inevitable consequence of life on earth being by far the most complicated phenomenon known in the universe long before we got around to trying to understand it.

There are tens of millions of species, each having potentially uncountable individuals, every individual with up to tens of thousands of genes, and composed of trillions of body cells, each with a complete set of genes and functioning as a more or less complete machine in itself. It is predictable that we would learn the most about life by figuring out how existing living creatures came to be. But our methods are the same as those of any other science.

The science of evolution can be astonishingly predictive. My colleague, Thomas E. Moore, and I predicted the existence of a peculiar species of 13-year cicada - its geographic location, habitat, general appearance, and behavior, including the structure of the male's song, having no direct information about it, except knowing about five other such cicada species with 17- and 13-year life cycles.

Others, such as the late U-M botany professor, Warren Wagner, have told me that they have similarly predicted the existence of unknown species. Incidentally, contrary to Scott Nelson (in his June 13 Other Voices), numerous successive laboratory hybridizations of species that never hybridize in nature have shown repeatedly that species differences are precisely the same as differences between genetically different individuals within species: They are what Darwin (1859) referred to as "numerous, slight, successive modifications," and they give no evidence of requiring supernatural explanations.

More startling is the result of an effort to understand how insects and other animals evolve the kind of social behavior (eusociality) that involves reproductive queens and non-reproductive workers, and soldiers - as in ants, termites, wasps and bees. I used the traits of eusocial insects to predict a hypothetical eusocial mammal so completely and accurately that the set of 15 or so traits I put together apparently match only one species in the world - the African naked mole-rat. This first-known eusocial vertebrate was correctly predicted to be a small rodent that lives in East Africa, dwells almost completely underground, lives on large underground tubers, has specific kinds of snakes as enemies in its burrows that promote the heroic defenses of worker-soldiers, a large queen that outlives the smaller non-breeding castes, and so on. Concerning this evolutionary

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prediction, the mathematical ecologist, Karl Sigmund, of Vienna, Austria, said in his 1993 book, "Games of Life": ". . . this splendid feat of theoretical biology ranks with the prediction of the planet Neptune by astronomers " - for the reason that astronomers similarly lacked direct knowledge of the existence of Neptune.

I agree with Larson that the earlier **Other Voices essay** by Patrick Julius was an admirable defense of evolution, but I would say, as science and not merely as theory. I suggest, however, that to be so dramatic and ferocious as Julius in adversarializing religion and science misses the point that there are adaptive reasons for the tenets of religion as well as for other traits and tendencies of humans; the answers to religion's questions were developed centuries ago, before the existence of formal sciences such as evolution. They obviously have worked, whether or not we like all the reasons today, and that too deserves scientific analysis. We are well-advised to examine both sides of this particular coin of human understanding rather than claim that either "side" is irrelevant.

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