

"The Extinction of Darwinism"

Review of David M. Raup,
Extinction: Bad Genes or Bad Luck
(Norton 1991)

by Phillip E. Johnson

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David Raup's new [1991] book *Extinction: Bad Genes or Bad Luck?* is something more than the usual scientific journalism. Raup, a senior paleontologist at the University of Chicago, is a leading figure among the scientists who have made "catastrophe" a respectable concept once again in the scientific study of the earth's history. His book is a very readable but state-of-the-art account of what scientists know about why dinosaurs and all those other fossil species aren't with us any more. By concluding that species become extinct because of bad luck rather than because they are unfit, Raup inadvertently raises some awkward questions about how those species got there in the first place.

Scientific thinking about extinctions has strayed far from the Darwinian principles that still define orthodoxy in the life sciences as a whole. According to Raup, the Darwinian theory that extinctions result from the slow and steady effects of biological competition is "appealing, and has been learned by generations of biology students." Nonetheless, "its verification from actual field data is negligible." Raup goes on to say, without really arguing the point, that abandonment of the Darwinian explanation of extinctions does not discredit Darwin's theory that today's species evolved from earlier species through natural selection. To explain what lies behind that disclaimer -- and why it can't be accepted at face value -- I need to explain something about the place of extinctions in Darwinian theory.

Darwinian evolution is best known as a theory about the origin of species, but it is equally a theory about how species become extinct. The most influential interpreter of fossil history before the triumph of Darwinism was the great French sage Cuvier, forgotten in the English-speaking world today but in his time renowned as the "Aristotle of Biology." Cuvier reported that there had apparently been profound catastrophes in the earth's history. Entire groups of ancient creatures disappeared abruptly from the rocks, and were replaced just as abruptly by new groups which repopulated the earth.

Catastrophic extinctions and sudden creations are outside the normal range of human experience, and hence may be elusive to scientific investigation. It would be much more convenient for science if the important changes in the earth's history resulted gradually, from the uniform operation over immense time periods of natural forces which we can observe in operation today. The motto of uniformitarian science is that "the present is the key to the past." It is a triumphant

motto because, with such a key in its possession, science can in principle unlock all the secrets of nature. Scientists thus had a strong professional motivation to reinterpret the geological evidence according to rules that disallowed both catastrophes and sudden creations as scientific explanations.

The lawyer/geologist Charles Lyell established a rigorous uniformitarianism as the basis of geology, and Darwin extended Lyell's logic to biology. Species did not either appear or disappear suddenly, according to Darwin's classic *The Origin of Species*. Rather, they evolved step by tiny step from earlier forms, due to the accumulation of tiny favorable variations through natural selection. Species declined to extinction equally gradually, as they were supplanted by modified descendants or by competing species that were more proficient at surviving and reproducing. If Darwin was right, both the origin and the extinction of living forms occurred through the slow and steady action of forces -- reproduction, inheritance, and competition -- which we see operating in everyday life.

It is important to understand that creation by natural selection and extinction by natural selection are not two separate processes, but two aspects of the same process. In Darwinian terms, superior fitness *means* superior capacity at leaving descendants. If evolution has furthered the development of capabilities like strength, or vision, or intelligence, it is only because organisms possessing these (inheritable) qualities consistently left more descendants than competing organisms which lacked them. The more fit crowd out the less fit by definition, and there is no such thing as natural selection unless they do. In Darwin's words, "The theory of natural selection is grounded on the belief that each new variety, and ultimately each new species, is produced and maintained by having some advantage over those with whom it comes into competition; and the consequent extinction of less favored forms almost inevitably follows."

Darwin cited this logical relationship between evolution and extinction to refute one of the most formidable objections to his theory. "Evolution" implies a continuous process of change, but nature is organized in discrete groups which seem isolated from each other. How could (say) an insect become a vertebrate except by a miraculous transformation? Where were the intermediate links that ought to exist if continuous change had occurred? The answer, Darwin explained, was that

"As natural selection acts solely by the preservation of profitable modifications, each new form will tend in a fully stocked country to take the place of, and finally to exterminate, its own less improved parent or other less favored forms with which it comes into competition. Thus extinction and natural selection will, as we have seen, go hand in hand. Hence, if we look at each species as descended from some other unknown form, both the parent and all the transitional varieties will have been exterminated by the very process of formation and perfection of the new form."

If extinction and natural selection did not go hand in hand, some of the parent forms ought to have survived to the present. It is therefore an essential element of Darwinism that species continually became extinct **because** they were less fit than their descendants or other rivals. And because superior fitness itself emerges very gradually, extinction of a competing species should

also proceed gradually. What is true of individual species should be still more true of *groups* of species -- families, orders, classes, and so on.

Because of this logic Darwin insisted that Cuvier's theory of periodic catastrophes had been thoroughly discredited, and that, on the contrary, "there is reason to believe that the complete extinction of the species of a group is generally a slower process than their production." That judgment was based entirely on theoretical grounds, rather than on fossil evidence. In fact, the only evidence Darwin cited in the relevant passage was the extermination of the ammonites (ancient mollusks) at the end of the Cretaceous, which he acknowledged to have been "wonderfully sudden." According to Darwin, the struggle for existence is so finely tuned that "the merest trifle would often give the victory of one organic being over another. Nevertheless so profound is our ignorance, and so high our presumption, that we marvel when we hear of the extinction of an organic being; and as we do not see the cause we invoke cataclysms to desolate the world...." In short, Darwinian ideology maintained that earlier geologists had attributed extinctions to catastrophes not because that was a reasonable interpretation of the fossil evidence, but because they were ignorant of the higher law of natural selection.

If one wanted to subject Darwin's theory to empirical testing, one way to do it would be to examine the history of extinctions. Does the evidence confirm that biological competition was frequently the cause of extinctions? Can the occurrence of a Darwinian extinction -- by competition from a closely related rival -- be confirmed in even a single case? To put the point the other way around: Have the paleontologists, despite their best efforts to see fossil history in a Darwinian light, found that Cuvier was much closer to the truth after all? The answers couldn't be clearer.

The story starts with the famous "K-T" (Cretaceous-Tertiary) extinction of 66 million years ago. The K-T is not the biggest of the "Big 5" mass extinctions which mark the close of various geological ages, but it is the most recent and the most fascinating from an anthropocentric point of view. It eliminated the dinosaurs, the ammonites, and a lot else, clearing the way for mammals to dominate the planet.

Geologist Walter Alvarez (with his famous physicist father Luis Alvarez and others) startled the world in 1979 by attributing the mass extinction to a meteor or comet impact, which caused a worldwide environmental disaster that disrupted the food chain. As Raup puts it, the first reaction of paleontologists schooled in Lyellian and Darwinian concepts was horror and disbelief: "It was like suggesting that the dinosaurs had been shot by little green men from a spaceship." Hardly more than a decade later, so much confirming evidence has piled up that Raup predicts that soon "it will be difficult to find anyone who ever doubted the impact-extinction link." In science as in war, victory has a thousand fathers; defeat is an orphan.

Was the K-T extinction (or the Big 5 as a group) an exception to a generally Darwinian pattern of gradual extinctions by competition? Raup thinks that environmental disasters triggered by large meteor impacts may have caused most extinctions (other than those caused by humans). There is some evidence of a connection between major extinctions and known meteor impacts, but Raup concedes that the evidence is far from conclusive. What inclines him to the meteor theory is primarily the difficulty of attributing extinctions to more mundane causes.

It turns out to be very difficult to kill off a numerous and wide-ranging species unless a catastrophic "first strike" has severely depleted its numbers and restricted its range. Even the spectacular environmental stress induced by the last great Ice Age produced only a relatively modest number of extinctions, although the casualties included such popular favorites as the mammoths and sabre-tooth tigers. It seems that something far outside the ordinary run of environmental hazards is needed to kill enough individuals to threaten a widely distributed species with extinction, and meteor impacts may be the least unlikely of the known alternatives.

Maybe most extinctions were triggered by giant meteor impacts and maybe they weren't. If it is difficult to determine what did cause the bulk of extinctions, it is much easier to determine what didn't. There is no hard evidence that any observable extinctions were caused by competition from closely related species. Raup notes that evolutionary biologists long emphasized competition as a cause of extinctions because the explanation "seemed self-evident," but when they actually tried to test the effect of competition the results were negative. The only reason for attributing extinctions to Darwinian competition remains the theory itself.

Some groups survived mass extinctions while others did not, but this does not mean that the survivors were more fit in any Darwinian sense. Characteristics that would aid survival under normal circumstances would not necessarily be of any use under the extreme conditions of a catastrophe. For example, there is nothing to identify mammals as more fit than dinosaurs other than that some mammals happened to survive the K-T extinction. When a prominent Darwinist attributed the survival of some groups in a mass extinction to their possession of the quality of "resistance to extinction," his statement added nothing to the bare fact that they had survived.

But then what becomes of Darwinism? Raup answers that attributing extinctions to bad luck rather than bad genes does not discredit Darwin's theory of evolution by natural selection, because

Natural selection remains the only viable, naturalistic explanation we have for sophisticated adaptations like wings and eyes. We would not be here without natural selection. Extinction by bad luck merely adds another element to the evolutionary process, operating at the level [of] species, families, and classes, rather than the level of local breeding populations of single species. The trouble with that disclaimer is that in Darwin's theory survival of the fittest and extinction of the less fit are the same thing, not two separable processes. Does natural selection produce variation only *within* the local breeding populations of single species? Then it doesn't produce new species -- much less new families and classes, or innovations like wings and eyes. Does natural selection continue to produce its creative effects *beyond* the species boundary? Then it does so by selecting the less fit species for increasing rarity and eventual extinction, just as Darwin said. A natural selection that only creates and never destroys is a logical impossibility, because it wouldn't be doing any selecting.

There is a way out of this logical impasse, but it is one I think Raup or any other empirical scientist would be reluctant to take. Only a minority of species are fossilized and hence only a

minority of extinctions are recorded. Approximately 250,000 fossil species have been cataloged. According to Raup's figures (based on estimates of average species longevity and standing diversity over the age of the earth), between 5 and 50 *billion* species may have lived during earth's long history, of which at most 40 million or so exist today. Who can say what may have extinguished the billions of species which apparently lived and vanished without leaving a trace?

Perhaps only the visible extinctions went according to Cuvier, and the invisible ones were Darwinian. Withdrawing a subject from empirical investigation in order to protect a theory from falsification is hardly the scientific thing to do, however. Raup says that the study of extinctions was long neglected: perhaps the influence of Darwinism kept it off limits.