# Did Disease Indeed Destroy the Dinosaurs?

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## DID DISEASE INDEED DESTROY THE DINOSAURS?

**What Bugged the Dinosaurs? Insects, Disease, and Death in the Cretaceous.** George Poinar Jr. and Roberta Poinar. Princeton University Press, 2008, 264 pp., illus. $29.95 (ISBN 9780691124315 cloth).

As an entomologist, I am usually thrilled when people are reminded about the ecological preeminence of insects as pollinators, consumers, and vectors of diseases. In *What Bugged the Dinosaurs?* George Poinar Jr. and Roberta Poinar explore how dinosaurs may have competed with insects for plants, how insects provided food for dinosaurs, and, most significantly, how dinosaurs very likely were meals for blood-feeding and parasitic arthropods. In fact, they propose that diseases spread by arthropods contributed to the end-Cretaceous extinction of nonavian dinosaurs. George Poinar, a retired parasitologist and courtesy professor at Oregon State University, has a sizable personal collection of amber, which is the basis for his many taxonomic descriptions of diverse life forms in amber and for the popular works he produces with his wife, Roberta.

This book fits the formula of the authors' previous ones (e.g., *The Amber Forest,* Princeton University Press, 2001): it's 6 by 9 inches; falls within 250 to 350 pages; and has basic drawings, black-and-white photos of amber inclusions, a central octavo of color plates, a checklist of families in the back, and a text rife with errors and overstatements. There are 23 short chapters that roughly fit into four subjects: an introduction to fossils and the Cretaceous, the roles of insects in Cretaceous ecosystems, Cretaceous insects as disease vectors, and extinctions. Most chapters are prefaced with a two-page scene from the Cretaceous, the descriptions of which come across as corny: "This verdant jungle was teeming with life," "climbing ferns that festooned the limbs of mighty trees," "lianas and epiphytes festooned every layer in the forest," "a cloud of sanguinary mosquitoes alighted unobtrusively on its body," "an old, infirm dinosaur took a final breath and slowly sank to the ground, leaving his body to the whims of nature." The text is festooned also with simplistic passages like the following: "Within each ecosystem there are a variety of habitats with specialized niches. The animals compete within these for food, space, and shelter" (p. 44). In describing how they supposedly discovered trypanosomatids and blood cells in amber, the authors inform the reader that it was "an amazing discovery!" (p. 163). Even if one could overlook the scientific errors, sophisticated readers would find the writing obtrusive.

Before getting to the serious problems, some obvious errors need to be pointed out. I saw at least four misidentifications among the photos: figure 10 is not the tip of a fern leaf, but rather the tip of a conifer shoot; the photograph in plate 1E is not of a scarab beetle but of a scolytine bark beetle; photograph 4B is not a "long-horned grasshopper" but a nymphal mantis; and those are not "club mushrooms" in photograph 12C but—as a colleague pointed out to me because I had made the same mistake—the borings of ancient "shipworms" (pelecypod molluscs) into the surface of the amber. On page 102, the authors state that all hematophagous insects pierce their hosts with stylets, which is not true. The calyptrate flies, such as stable flies (*Stomoxys*) and Pupipara (tsetse, bird flies, and bat flies), use sharp, scalelike prestomal teeth on the labella to scrape the skin. Cholera is caused not by a virus (as the authors say on p. 133) but by the bacterium *Vibrio cholerae.* There are many groups of insects the authors portray as existing in the Cretaceous, when in fact definitive fossil and phylogenetic evidence—references to which are excluded—indicates they are much younger. These include gall-forming cynipoid wasps, mealybugs (Pseudococcidae), foliage-feeding caterpillars, ambrosia beetles, periodical cicadas, mound-building termites and ants, and higher flies (the Schizophoran).

This last point brings up the first serious problem of the book: selective citation mostly of George Poinar's publications, with little mention and even outright dismissal of authoritative work. For example, there is no mention of the extensive research by Michael Engel, who has redefined the evolutionary history of bees, nor of the exciting work on exquisite, carbonized Cretaceous flowers that has transformed paleobotany. The authors state that the Late Cretaceous bee *Cretotrigona* is "discredited," for which they cite a book review by George Poinar! Another example regards the bizarre, two-winged scorpionfly *Parapolycentropus* in 100 million-year-old Burmese amber: Poinar and Poinar state that the scorpionfly's long, thin proboscis was used to suck blood. The original, detailed report (Grimaldi et al. 2005)—which is not cited—described that the mandibles were not serrated, and so the creature was probably not hematophagous. Moreover, the section on lice does not cite perhaps the most pertinent paper on the topic (Grimaldi and Engel 2006).

Second, the Poinars restrict their discussion to only three Cretaceous amber deposits, from Lebanon, Myanmar, and Canada. Compression deposits are largely ignored, and deposits of extremely rich and well-studied Cretaceous amber from France, Spain, Siberia, and New Jersey are barely mentioned. This is perplexing, since there are some astonishing insects in these ambers. All the scenarios in the book take place in forests of araucarian trees (relict conifers that were once nearly global), because the authors believe that Araucariaceae produced all Cretaceous ambers, which is simply false. Definitive evidence shows that New Jersey amber was produced by trees in the Cupressaceae (cedars, redwoods, etc.), and there is compelling evidence that Lebanese and Burmese amber were likewise not produced by Araucariaceae.

Recent work on the ancestry of birds from maniraptoran theropods is one of the most exciting episodes in paleontology, yet the authors adhere to the

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anachronistic concept of a bird-reptile dichotomy and cite studies on the parasites of modern reptiles as proxies for what bugged dinosaurs. This and other misinterpretations stem from a lack of phylogenetic thinking—the third fatal flaw of the book—particularly the concept of stem groups, which are basal, primitive species and lineages that possess some but not all of the specialized features of the crown group.

In chapter 8, in a strange section titled "The Cretaceous: Age of Chimeras and Other Oddities," the authors describe chimeras as creatures having "features found in two or more present-day groups...[such that] how to classify them is a conundrum. Vertebrate paleontologists have *Archaeopteryx,* a strange animal with teeth and feathered wings with claws that appears both bird and reptile." In fact, almost all serious biologists accept that *Archaeopteryx* is a maniraptoran stem group to the birds. Likewise, *Burmaculex antiquus,* in Burmese amber, is a stem-group mosquito, even though the authors dismiss it because it doesn't have all the characteristics of modern mosquitoes. Ironically, the authors repeatedly cite *Melittosphex* in Burmese amber as a true bee, but it is a very primitive stem group. Every geological era has its share of stem groups; even today there are the egg-laying platypus and echidna, monotremes that are a stem group to the therian mammals that retain primitive, synapsid features.

Given the diversity in the Cretaceous of blood-feeding arthropods, it would not be at all surprising if they were vectors of pathogens transmitted to vertebrates of that era. Chapter 20, "The Discovery of Cretaceous Diseases," is a personal account of how the authors extracted tissues from biting midges in Burmese amber and presumably found the remains of *Leishmania*- and *Haemoproteus*-like microbes, even viruses. Unfortunately, the vague, dark forms in their light micrographs fail to convince. Since cells within amber-fossilized insects are well known to have preserved organelles, identification of the putative pathogens should have been made with electron microscopy.

Assuming that arthropods did spread pathogens among dinosaurs, would this have caused or contributed to the demise of dinosaurs? The authors write, "You cannot discount the probability that diseases, especially those vectored by miniscule insects, played an important role in exterminating the dinosaurs" (p. 202, the final sentence of the book). They cite introduced vectors and diseases that wreaked havoc among native populations of plants and animals, and an array of human diseases and epidemics such as leishmaniasis, Lyme disease, malaria, plague, and yellow fever. But *Homo sapiens* on an evolutionary scale is an introduced species, which is why some native people have evolved only modest resistance to a few of these diseases, and why native animals show great immunity. Is there, in fact, any case of a native host species becoming extinct as a result of a native pathogen? This is the conceptual Achilles' heel of the book. But why take such liberty with facts? It could be argued that license was taken to appeal to the broader audience of dinophiles and fossil collectors. Popularity should not, however, sacrifice accuracy.

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