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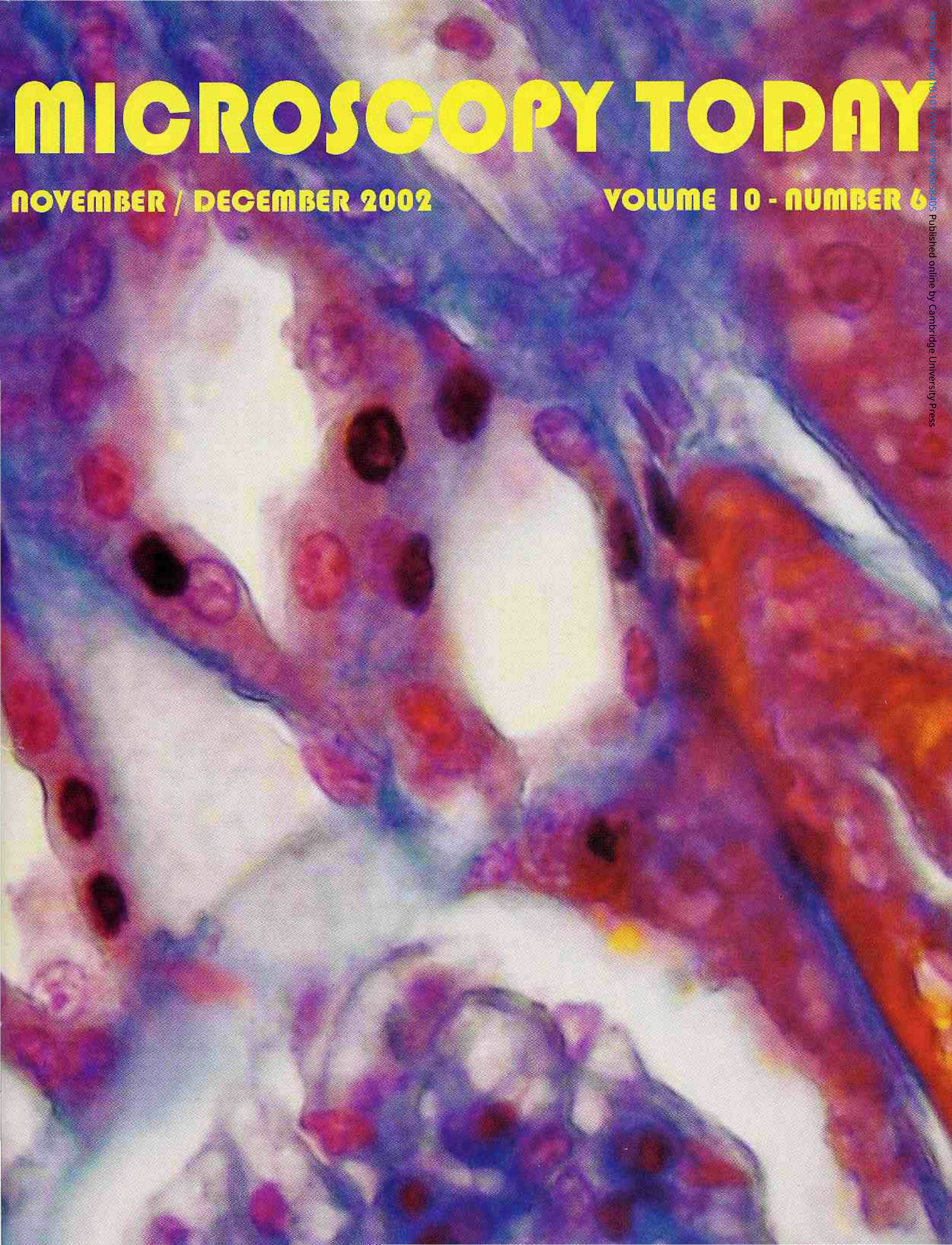

When Dinosaurs Became Extinct, What Happened to the Insects?

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It is widely accepted that approximately 65 million years ago, an extraterrestrial object slammed into the Yucatán Peninsula of Mexico, creating a worldwide climatic shift that wiped out the dinosaurs, and many other terrestrial and marine species. But what happened to the insects? They undoubtedly represented a larger biomass than the dinosaurs, but it's fair to say they haven't captured the public's imagination in the same way. The reason the fate of the insects has not been adequately explored is due to the paucity of the available fossil record of the insect bodies. There are a few records of insects embedded in amber or fossilized, but practically none are available from the time of mass extinction referred to as the Cretaceous-Paleocene boundary. Recently, Conrad Labandeira, Kirk Johnson, and Peter Wilf found an ingenious way to examine indirect evidence and show what happened to the insects during this time.[2]

Whereas the insect fossil record is sparse, there is an abundance of plant fossils. For those of us who are weekend gardeners, we are all too familiar with the damage that insects can do to plants. We also recognize that some of this damage is general (a nibbled leaf can be caused by several different insects) to specific (a leaf miner leaves a distinctive trail within a leaf of a particular species of plant). Labandeira *et al.* had the clever idea to examine plant fossils for insect damage.

At a site in North Dakota known for plant fossils that spanned the Cretaceous-Paleocene boundary, the team used 10X or 20X hand lenses to examine specimens *in situ*. In all, 13,441 fossil plant specimens (9,292 from the Cretaceous period, 4,149 from the Paleocene) were examined back in the laboratory with a standard stereomicroscope at magnifications ranging from 14X to 80X, with particularly interesting insect damage patterns examined at higher magnifications. In contrast, only five insect body fossils have been found within the same collections. Labandeira *et al.* took advantage of the statistical robustness of the large sample size to document the trophic associations between plants and their insect herbivores.

Each specimen was examined for damage from insects, and the damage was assigned to one or more of 51 insect damage types, ranging from general to very specific. Each damage type was classified into one of four functional feeding groups (external foliage feeding, galling, mining, and piercing and sucking) or non-feeding damage due to deposition of eggs. After extensive use of sophisticated statistical methods, Labandeira *et al.* showed significant variations of insect-plant associations during the latest Cretaceous Period, with a dramatic decrease at the boundary and into the earliest Paleocene Epoch. Their observations are consistent with a genuine extinction of many herbivorous insect species at the same time the dinosaurs disappeared. They proposed two nonexclusive scenarios. First is an outright extermination of insects caused by adverse environmental conditions. Alternatively, a secondary extinction of insects occurred after the demise of plant hosts.

Whereas this study is limited to a single site, it nevertheless presents compelling evidence for the extinction of a large number of insect species after a historically important event. Labandeira *et al.* are to be congratulated for taking a shrewd and indirect approach to providing a definitive answer to a perplexing question.

Footnotes

1 The author gratefully acknowledges Dr. Conrad Labandeira for supplying information on the use of microscopy in this study and reviewing the manuscript.

2 Labandeira, C.C., K.R. Johnson, P. Wilf, Impact of the terminal Cretaceous event on plant-insect associations, *Proc. Nat. Acad. Sci.* **99**(4):2061-2066, 2002.

INDEX OF ARTICLES

ABOUT THE COVER

By Gregor Overney
Agilent Technologies Inc., California, USA.

See his article on photomicrography with a consumer digital camera on page 10. Photomicrograph of a healthy human kidney section is shown. The tangential section goes through renal corpuscles of the cortical zone. A modified Masson's trichrome stain is used. The digital image is obtained with a SONY DSC-S70 digital camera connected with a Nikon Eclipse E200-F microscope with a 40x CFI_{60} Plan Achromat objective.