Amber-trapped creatures show timeless form

Throughout the history of life on Earth, the unseen hand of natural selection has molded, reshaped, and then swatted into extinction countless species of living creatures.

Now, the discovery of 220-million-year-old microorganisms preserved in hardened tree resin, or amber, confirms that some of Earth's smallest land dwellers have remained in a state of evolutionary suspended animation since the dawn of the age of the dinosaurs, according to a report in the Jan. 8 SCIENCE.

Genetic studies of present-day microorganisms have suggested that the overall physical design of some simple, soft-bodied creatures – single-celled protozoans that haunt stagnant freshwater ponds, for instance – may have changed little for eons, although some alterations have undoubtedly occurred at the genetic level.

This phenomenon, called morphological stasis, is akin to changing the type of engine in a certain model of automobile from year to year but maintaining the same basic chassis, body shape, and number of doors.

A resident of Schliersee, Germany, Ulf-Christian Bauer, found the rare Triassic period amber in sandstone deposits on Mount Leitnernose in Bavaria. He sent it to paleontologist George O. Poinar Jr. of the University of California, Berkeley, who exhumed the amber-entombed creatures and photographed them. Based on the shape, size, and anatomy of the microorganisms, graduate student Benjamin M. Waggoner determined that some strongly resemble modern species.

The amber also contains a snapshot of protozoan behavior. One well-preserved victim, similar to members of the genus *Nassula*, was engulfed by tree sap in the middle of a meal. A photograph of the bulbous little creature shows it sucking up a colony of bacteria joined end to end "just like a strand of spaghetti," says Poinar. Modern members of this group also digest bacterial filaments in this manner, he notes.

In the past, scientists have discovered in the fossil record many traces of microorganisms, some dating back nearly to the beginning of life on Earth. However, the new specimens – including freshwater protozoa, algae, branching bacterial colonies, pollen, and fungal spores – contain the oldest examples ever found of soft-bodied creatures preserved well enough for comparison with their descendants, Poinar says.

These microorganisms probably lived as a self-sufficient colony in rainwater-filled bark crevices or in crooks between tree branches, say the researchers. A sudden flow of sticky sap from the host tree – possibly the extinct tree fern *Pterophyllum jaegeri* – engulfed the colony and eventually hardened into amber.

Animals preserved in amber often display remarkable three-dimensional detail, including cellular structure. This plastic-like gemstone protects soft remains from air and moisture and guards against attack by bacteria and other microbes (SN: 10/24/92, p.280).

Poinar is best known for his studies of insects and other animal remains preserved in amber. Last year, he and others recovered intact DNA from 40-million-year-old fossil insects. Poinar says he would like to do the same with the ancient microorganisms, which might contain salvageable strands of genetic code. However, the technology is not yet sensitive enough to mine DNA from single-celled organisms embedded in amber, he notes.

Why would these creatures remain relatively static as nature created such great diversity in other forms of life?

Poinar speculates that single-celled organisms must have developed successful body plans by the time of the dinosaurs. Living in small, isolated habitats, they had little incentive to change markedly.

"Once an organism reaches that point, things tend to get static," he explains.

– D. Pendick

Spilled fuel oil: A toxic indoor threat

Six years ago, Marjorie B. Kaplan reviewed a log of emergencies that the New York City fire department's hazardous-materials division responded to in its first 30 months of operation. She recalls her surprise at how many incidents involved residential fuel-oil spills – 5.3 percent, or an average of one every three weeks. But her review of the scientific literature turned up no estimates of the health risks that indoor oil fumes might pose. So Kaplan, then a graduate student at Columbia University, decided to address the omission.

Findings of her research, reported in the January AMERICAN JOURNAL OF PUBLIC HEALTH, suggest that vapors from small basement spills – perhaps involving as little as 21 gallons of fuel oil – might pose neurological and reproductive risks to a building's residents.

Some 15 percent of U.S. residential structures – almost 12 million households – depend on fuel oil for heat. "Our conclusion is not for people to run out and remove the oil tank in their basement," says Kaplan, now an environmental toxicologist with the New Jersey Department of Environmental Protection in Trenton. Rather, she argues, these findings underscore the importance of homeowners' taking a few routine precautions, such as inspecting oil tanks for leaks and overseeing oil deliveries.

Kaplan simulated a basement spill by pouring about one-half gallon of No. 2 fuel oil into each of three pans. Over 12 days, she calculated the evaporation from the oil of xylene, which she focused on because it was the lightest aromatic hydrocarbon reliably found in these oils that posed a significant health risk. Using a dispersion model for gases in a multistory structure, she estimated xylene's passive flow into the upper floors of a three-story townhouse.

Human and animal data suggest the main health concerns for adults arising from low-level inhalation of xylene are reversible central nervous system (CNS) effects – from confusion to impairment of balance and reaction time.

Of potentially greater concern, however, are possible reproductive risks, which animal data suggest could include miscarriage and birth defects.

Together with colleagues at Columbia University and the Massachusetts Institute of Technology, Kaplan calculated acceptable daily intake (ADI) levels for short-term inhalation episodes: 0.20 milligram per kilogram of body weight to prevent CNS changes, and 0.018 mg/kg to protect a fetus.

For individuals spending an estimated 115 hours in the home each week, even a 21-gallon basement spill might exceed both ADIs for seven or eight days, the new study indicates. Moreover, Kaplan and her coauthors point out, these estimates do not account for an individual's exposure to xylene from other sources, such as gasoline, or to synergistic effects of other toxicants evaporating from spilled oil.

"There's no doubt that if you spill [heating] oil you're going to contribute to indoor air pollution," acknowledges Robert T. Drew, director of health and environmental sciences for the American Petroleum Institute in Washington, D.C. But "I'm a little skeptical of the [study's] conclusions," he says, since the modeled xylene dispersion may not account for "nonideal" evaporation, and xylene fumes were not measured directly.

What's more, he argues, xylene emissions from the hypothetical spills should be large enough to smell, making immediate cleanup of the spill – before significant exposure occurs – likely.

Not necessarily, Kaplan counters. With a 21-gallon spill, her calculations indicate, upstairs concentrations would fall below xylene's odor threshold. Moreover, she adds, leaks may precede a tank's catastrophic rupture, leading to long-term exposure.

– J. Raloff