Earth Sciences

Distinctions between extinctions

Organisms that have settled comfortably into their evolutionary niches, having survived millions of years of normal, or "background," extinction forces, could suddenly find that the evolutionary tables have turned on them during the relatively brief and rare episodes of mass extinction that punctuate the history of the earth. According to David Jablonski at the University of Chicago, adaptive traits that enhance survival and diversification of species during times of background extinction tend to have little in common with those traits that increase the chances of survival during mass extinctions.

Current evolutionary theory is based almost exclusively on patterns of background extinctions, Jablonski says; scientists have assumed that mass extinctions simply accelerate or emphasize trends of background extinctions so that the same kinds of organisms are wiped out by a mass extinction, only in much greater numbers. But Jablonski's finding that the two extinction regimes differ *qualitatively* as well should inspire a new view of the evolutionary forces that shape life.

Jablonski arrived at his conclusions by comparing the evolutionary patterns of marine organisms that lived during the background extinctions in the last 16 million years of the Cretaceous period to those of marine life at the very end of the Cretaceous, 65 million years ago, when a mass extinction event killed off a large portion of species. He found that during background times, traits such as a broad geographic range and mobile larvae enhanced chances of species survival, and having many species in a clade (group of related species) increased the odds of clade survival. But these same traits were "ineffectual" during the mass extinction, which instead favored clades having wide geographic range, regardless of the number of member species. During mass extinctions, "evolution is channeled in directions that could not have been predicted on the basis of patterns that prevailed during background times," writes Jablonski in the Jan. 10 SCIENCE.

Who believes in death by asteroids?

Some of the more interesting aspects of the debate over whether a mass extinction 65 million years ago was triggered by an asteroid slamming into the earth are the scientists themselves. A few of those involved have become celebrities of sorts at geologic meetings, where sessions on the subject draw large audiences and often sizzle with emotion.

Recently, Antoni Hoffman of Lamont-Doherty Geological Observatory in Palisades, N.Y., and Matthew H. Nitecki of the Field Museum of Natural History in Chicago, Ill., became interested in how the cultural and academic backgrounds of scientists might shape their attitudes toward the asteroid theory. In the spring of 1984 — just after SCIENCE and NATURE published a number of papers supporting or exploring the asteroid idea — Hoffman and Nitecki sent surveys to paleontologists, geophysicists and other earth scientists in the United States, Britain, West Germany and Poland. In general, they report in the December GEOLOGY, U.S. scientists tended to be more interested in the issue than those in Europe. Moreover, they say, the U.S. geophysicists were more likely to think that the issue had been resolved and that an extraterrestrial body had indeed caused the extinctions, while British paleontologists tended to hold opposite views on both counts. Europeans, especially West Germans, were less inclined than U.S. scientists to believe that an asteroid hit the earth 65 million years ago and German and British paleontologists were more likely to reject the notion of a catastrophic mass extinction.

While cautioning that they cannot be sure that their results are truly representative of the scientific communities surveyed, the researchers conclude that "informed judgments" may vary from country to country.

Technology

Lighting up alcohol drops

The jiggling of a raindrop as it falls is often difficult to capture in a photograph (SN: 3/2/85, p. 136). The problem is even trickier when the liquid droplets are only a few microns across. Yet knowledge of the static and dynamic properties of these microparticles is important in atmospheric science, biology, combustion studies and other fields. In the Jan. 31 SCIENCE, a team of researchers now reports the development of a laser technique for showing changes in the size, shape and orientation of these droplets as they fall.

The technique, developed by Richard K. Chang and his colleagues at Yale University in New Haven, Conn., uses an intense, green laser pulse to irradiate ethanol droplets doped with rhodamine, a fluorescent dye. The excited droplets emit red and orange light. A filter screens out the green radiation, allowing the droplets to be photographed. The technique works because the laser emissions tend to highlight the interface between the liquid and the surrounding air, neatly outlining the droplets.

Finding a second site for radwaste

The Department of Energy (DOE) last month identified 12 potentially acceptable sites in seven states for a second high-level radioactive waste repository. These sites, all in granite or crystalline rock formations, are in Georgia, Maine, Minnesota, New Hampshire, North Carolina, Virginia and Wisconsin. DOE's screening process was based largely on a survey of national and regional geological data. The department now plans to do field studies at each potential site.

Detailed studies are already under way at three sites in Nevada, Texas and Washington to determine which one will be used for the first repository, scheduled to be ready in 1998 (SN: 1/5/85, p. 6).

Meanwhile, President Reagan signed into law a bill that heads off a threatened closure of the nation's three low-level radioactive waste landfills (SN: 1/11/86, p. 22).

Racing transistors

A semiconductor switch that turns on and off in only 5.8 picoseconds has been built by scientists at AT&T Bell Laboratories in Murray Hill, N.J. It now takes the lead as the world's fastest electronic device, at least when cooled to 77 kelvin, the temperature of liquid nitrogen. In such a short time, light travels less than 2 millimeters.

The device, made up of transistors arranged in a simple circuit, is essentially a stack of gallium arsenide and aluminum gallium arsenide layers. Some layers are heavily doped with impurities (in this case, silicon atoms), while the others are as pure as possible. To further speed up the device, the active area (gate) within each transistor is as short as possible, much less than a micron across.

"We use silicon impurities to provide the electrons," says Bell Labs' Nitin J. Shah. In conventional gallium arsenide materials, the electrons sit in the same volume as the impurity atoms. As the electrons move, they often strike the impurities and scatter. "Whereas, for our structures, simply because of the way the layers are built up," says Shah, "you separate the electrons from the impurities." The electrons, once released, move about in an adjacent, undoped layer. With much less scattering, especially at low temperatures, the electrons travel faster.

"I'm sure there are ways to increase the speed further," says Shah. "But I think that what we have is about as far as we can go with the present technology. We're very close to the physical limits." He adds, "It's not just a freaky, odd research device." This work is part of a long-term project to develop faster circuits for computers, telecommunications and other applications.