Paleobiology

Richard Monastersky reports from Chicago at the Fifth North American Paleontological Convention

Tropical diversity: Evolutionary cradle

Compared to the cold polar regions and the temperate middle latitudes, Earth's tropics teem with life. Zoologists who catalogue the millions of organisms living today know that the richest assortment of plants and animals resides along the planet's warm-weather waistband. But those who study the record of past life have long wondered how the tropics grew so diverse. Does that region naturally favor the evolution of new organisms, or have plants and animals accumulated in the tropics after originating elsewhere? In short, are the tropics an evolutionary cradle or a museum? A new study by David Jablonski of the University of Chicago favors the cradle analogy.

To probe the origination question, Jablonski turned to a vast data set, compiled by himself and a colleague, concerning the 42 marine invertebrate orders known to have appeared in the fossil record sometime in the Mesozoic, the most recent 250 million years of Earth's history. Factoring in the movement of Earth's continents over that time, he analyzed the location of the oldest known examples of each order.

Of the 26 orders known by well-preserved fossils, the number that originated in the tropics roughly equaled the number that originated elsewhere, a finding that might seem to suggest the tropics were no different from other regions. But that conclusion fails to take into account one important fact: Paleontologists have spent much more time collecting fossils in the middle latitudes than they have working in the tropics. Evidence for that collection bias comes from a study of 16 orders that do not form well-preserved fossils: Jablonski finds that these orders appear overwhelmingly for the first time in areas outside the tropics. Pulling the data together, orders appear to originate more frequently in the tropics, he says.

Jablonski suggests three possible explanations. The tropics may have served as an evolutionary cradle because they had a greater area of shallow sea than other areas, providing a place for new organisms to evolve. The sheer number of species present in the tropics could have allowed for prodigious evolution. Or each tropical species may have more evolutionary potential than species in less favorable environments, he says.

Trilobites: Not forced off the block

A scuba diver exploring Earth's oceans during the late Cambrian period, 520 million years ago, would have found the waters filled with trilobites — small, oval arthropods that are a favorite of fossil collectors. Eventually though, the trilobites faded in importance, while mollusks and other creatures spread throughout the oceans. On first look, it appears those new arrivals outcompeted the trilobites, but preliminary evidence from four sites in North America suggests trilobites were not pushed out by their new neighbors.

Stephen R. Westrop of Brock University in St. Catharines, Ontario, and his colleagues investigated fossil sites in Newfoundland, Wisconsin, New York state, and Canada's Northwest Territories. The rocks at these sites formed in the shallow waters near the shores of ancient seas, providing a look at trilobite history in the nearshore environment from the late Cambrian through the mid-Ordovician periods (about 460 million years ago). As expected, the researchers found trilobites declining in relative importance. Although trilobite species accounted for about two-thirds of the total species at the beginning of this time period, that percentage dropped to one-third by mid-Ordovician times. But the number of trilobite species in the nearshore did not decline over that period. Rather, the number remained constant, whereas the number of other types of organisms grew. Instead of being driven out by competition, trilobites were passive bystanders, says Westrop. Much later, the trilobites left the nearshore for the offshore, apparently because of environmental changes, he suggests.

Physics

Voting against the Super Collider

On June 17, the House of Representatives voted to cut funding of the Superconducting Super Collider (SSC) from $483.7 million to $34 million for fiscal year 1993. That action provides just enough funds to shut down construction of what was to be the world's most powerful particle accelerator. More than $1 billion has already been spent on the $8.25 billion project — on activities ranging from the development of special superconducting magnets to the acquisition of land and the start of construction of the accelerator's 54-mile, circular tunnel and other facilities near Waxahachie, Texas.

"The House vote to kill the SSC turned entirely on one issue: money," says Rep. George E. Brown Jr. (D-Calif.), one of the SSC's strongest supporters. "A majority of the House decided that we can no longer afford this project and can no longer afford U.S. leadership in high-energy physics."

The fate of the SSC now rests with the Senate, which conducted a hearing last week on the project's status. If the Senate restores funding for the SSC, then House and Senate representatives will have to negotiate a settlement. With the SSC nearing its peak in annual funding requirements, such a settlement is unlikely to provide sufficient support to continue the project at its present pace.

The action by Congress added to the sense of unease underlying the Third International Symposium on the History of Particle Physics, held at the end of June at the Stanford Linear Accelerator Center in Palo Alto, Calif. This symposium — focused on the experimental and theoretical work that led in the 1960s and 1970s to the rapid development of the remarkably successful standard model of particle physics — should have been a celebration of what several participants described as a great triumph of the human intellect. Instead, it mirrored the gnawing uncertainty within the high-energy physics community concerning its future.

Despite the standard model's great success in accounting for the interactions of fundamental particles and forces, theorists see it as incomplete (SN: 9/29/90, p.204). But they have few clues as to how they should modify the model. "At this point, our progress seems to have come to a stop," Steven Weinberg of the University of Texas at Austin told the symposium audience.

Physicists had hoped that experiments at the SSC would help settle the issue of which way to proceed toward a deeper understanding of the fundamental nature of matter. The House vote showed that "this hope may not be fulfilled," Weinberg added. "Congress has needlessly discarded years of our work as well as $1 billion for the pettiest of political motives."

Nudging ions into strings and spirals

High-energy physicists have long sought ways of packing more ions into accelerator beams and narrowing the range of velocities at which these ions travel. Now Herbert Walther and his colleagues at the Max Planck Institute for Quantum Optics in Garching, Germany, have demonstrated that nearly stationary ions trapped in a storage ring and bathed in low-energy radio waves can be made to organize themselves into distinctive patterns. This suggests that it may be possible to generate carefully ordered, precisely defined ion beams in accelerators.

Walther and his colleagues found that as they increase the number of positively charged magnesium ions in their doughnut-shaped electrical trap, the ions first form a line, then buckle into a zigzag pattern, and eventually arrange themselves into a set of interwoven spirals along the trap's circular central axis. Finally, with thousands of ions in the trap, they settle into an array of concentric shells. These observations fit with theoretical predictions of the patterns that should arise under such circumstances. The researchers report their results in the May 28 NATURE.