Paleontology

Tragedy found in Cambrian carnival

Paleontologists have come to view the early Cambrian period as an evolutionary field day – a time when the first complex animals exploded onto the scene, filling the seas with a rich assortment of life. But new research reveals that a wave of extinctions may have hit right in the middle of this evolutionary binge, decimating the ranks of the newly evolved creatures.

Philip W. Signor of the University of California, Davis, discovered the extinction evidence while compiling a global database of more than 850 genera living in the early Cambrian period, roughly 530 million years ago. As he looked at the individual stages of the period, Signor was surprised to find that a vast variety of animals had died out at the end of the Botomian stage, about 10 million years after the Cambrian's start. More than 80 percent of the genera present during this stage failed to survive into the next one, Signor reported in late June at the Fifth North American Paleontological Convention in Chicago. In terms of extinction rates, the early Cambrian die-offs rank as even more severe than those at the end of the Permian, which have been considered the greatest of the five known mass extinctions in Earth's history.

A confirmation of Signor's findings would make the Cambrian event the earliest known mass extinction and perhaps one of the worst. Like all such extinctions, the early Cambrian example would have redirected the course of evolution. In this case, Signor says, the die-offs wiped out most of the major groups, making possible the ascendancy of that most famous group of extinct invertebrates – the trilobites.

Earliest sign of evolutionary arms race

When the curtain opened on Earth's Cambrian period, many of the newly evolved animals sported an unusual dress not seen in earlier times. This was when animals first began wearing hard shells, fashioned from calcium carbonate and other minerals in the oceans. Paleontologists have proposed many theories to explain why mineralized exoskeletons came into style so quickly at that time (SN: 8/25/90, p.120). Now, two researchers say they have found hard evidence that addresses the question.

Stefan Bengtson of Uppsala University in Sweden and Yue Zhao of the Chinese Academy of Geological Sciences in Beijing studied a tube-like animal called *Cloudina* that lived right before the start of the Cambrian period and was the earliest known animal with a mineralized exoskeleton. From the exterior, the shell of *Cloudina* looks a bit like a stack of ice-cream cones. Scientists have yet to determine what kind of animal lived inside these tubes.

Of the more than 500 specimens recently found in China's Shaanxi province, 17 are tubes with holes in their sides, Bengtson and Yue report in the July 17 SCIENCE. The two researchers propose that predators bored these holes. Bengtson and Yue also described their work at the Fifth North American Paleontological Convention, held in Chicago in late June.

Some researchers have proposed that exoskeletons may have served as a detoxification mechanism, allowing animals to rid their bodies of potentially lethal calcium that may have accumulated in the seas at that time. Other researchers have suggested that exoskeletons helped animals develop body shapes efficient for moving and feeding. But the borings in *Cloudina* support the theory that exoskeletons appeared as a shield against the world's first predators, say Bengtson and Yue.

If so, the tactic apparently worked in some instances. Bengtson and Yue found several *Cloudina* specimens with holes going only partially through their shells, perhaps indicating that predators had abandoned their efforts to find a tasty meal inside.

Physics

Brown's 'Brownian motion' revisited

It's microscopes at 10 paces. Two independent researchers have taken opposite sides in a duel over whether Scottish botanist Robert Brown really saw in 1827 what is now called "Brownian motion" – the ceaseless, jiggling movements of microscopic particles suspended in a liquid, caused by the impact of fluid molecules surrounding the particles.

Daniel H. Deutsch of Pasadena, Calif., sparked the controversy last year when he contended that the vigorous motion Brown had observed through his microscope resulted largely from causes other than bombarding molecules. In particular, Deutsch emphasized that because Brown's samples remained uncovered during observation, effects such as evaporation and vibration could induce the movements he saw (SN: 5/4/91, p.287).

This salvo caught the attention of Brian J. Ford of Eastrea, England, an expert microscopist who has actually worked with several of the microscopes that Brown himself used. "These microscopes are all beautifully made brass instruments," Ford says. "They're about 5 or 6 inches tall. They screw into the lid of the mahogany box . . . in which the components are housed. Their high-power lenses are well capable of [resolving] a living bacterium – but only if you use them properly."

Last month at INTER/MICRO-92, held in Chicago, Ford presented a 25-minute videotape showing the erratic movements of tiny carbon particles in diluted India ink, microscopic oil droplets in milk, and minuscule particles inside a pollen grain – as viewed through one of Brown's microscopes. "It [presents] an instantly recognizable and highly detailed portrayal of Brownian movement," Ford says. "If you just showed it at a student lecture and said, 'This is what Brownian movement looks like through a modern microscope,' nobody would even stop to question the fact."

Ford took particular care to duplicate Brown's observations of pollen grains from a plant known as *Clarkia pulchella*. Each grain, about 50 or 60 microns wide, contains a thick liquid held in place by translucent walls. When Brown looked inside the pollen grains with his microscope, he could see tiny particles, each about 1 micron across, suspended in the liquid and constantly in motion.

Deutsch readily concedes that both Brown and Ford were seeing some kind of movement. But he insists that neither saw true Brownian motion. In a letter in the June 4 NATURE, Deutsch states: "I doubt the interpretation, not the observation. Particle motion in Brown's methodology is too vigorous by orders of magnitude to be proper Brownian motion."

Deutsch argues that for Brown's pollen grains, the presence of water alone causes a variety of effects, including rupture of the grains, that Brown didn't take into account. "There's a whole series of physical and chemical processes that take place," he says. "It all happens rather rapidly, and unless you're aware of these things . . . you miss them."

He adds, "If you were to compare what you see under Brown's microscope using his conditions and take the same solution and put it under a modern microscope, using modern techniques, then you would see something quite different."

"Deutsch is acting as if people from an earlier era were too dumb to know what they were doing, but Brown was a most precise investigator," Ford replies. Indeed, according to Ford, Brown carefully checked into and discredited just the kinds of confounding effects that Deutsch mentions.

Last year, Ford offered Deutsch a wager. "If he were willing to take the bet, I gladly offered to eat my hat if I couldn't [succeed in getting the images]," Ford says. "I did write to him to say that I had now done it and that I hoped they make hat-shaped *gâteaux* in Pasadena."

But Deutsch isn't ready to concede yet. He's hard at work preparing a paper to present his own views in more detail.