jects can pose challenges for reviewers, and says that the DFG has begun to assemble "study sections"—with reviewers from different fields—to listen to applicants' presentations. In an effort to shine light on the reviewing process, the DFG will soon publish the first-ever list of its outside reviewers.

Last month the DFG also expanded its roster of elected peer reviewers by 25%, to 650, tapping more representatives from specialized fields. The percentage of women reviewers increased slightly, from 4.4% to 7.7%, although the average age of reviewers remains fairly high, at 53. (Women comprise 6% of the country's full professors, few of whom are under age 40.) Although Winnacker defends the DFG review system, he agrees that the number "is still not high enough" and that it should contain "a greater percentage of women and younger scientists."

–ROBERT KOENIG

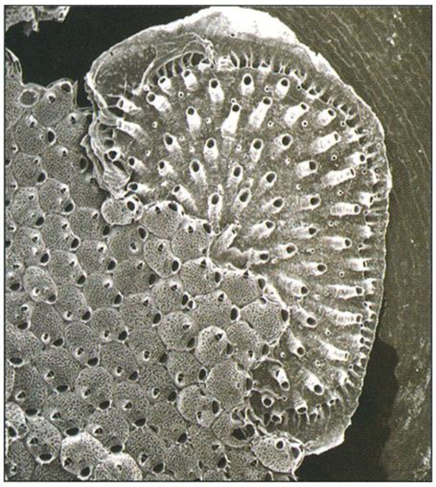
EVOLUTION

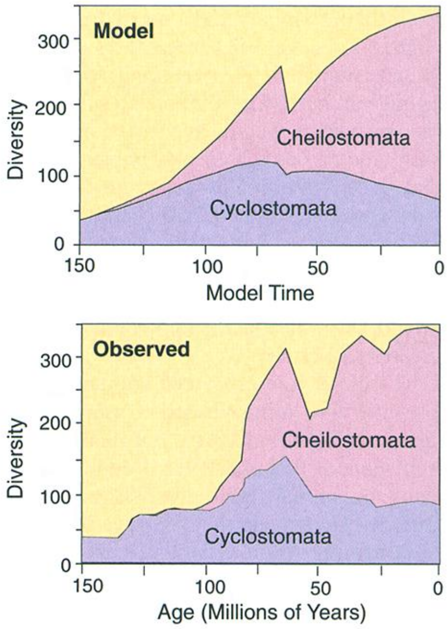
When Fittest Survive, Do Other Animals Matter?

It was a classic confrontation. The main branch of the Bryozoa family—small, coral-like "moss animals" encrusting shells and other hard surfaces of the early Cretaceous seas—had been around for more than 300 million years when a new sort of bryozoan showed up, looking for a fight. Who would prevail? Given the newcomer's ability to grow over its rival and knock it out, a simple reading of Darwin would predict a speedy victory for the newcomer. But in recent years, some prominent paleontologists have questioned whether such competition among animals has all that much to do with who wins and who loses in the evolutionary wars. High school biology lessons notwithstanding, it's been difficult to find hard evidence that interactions among animals matter, they noted, so externalities, such as the meteorite that did in the dinosaurs, might be more important. Now, three paleontologists report in the latest issue of *Paleobiology* that at least in the case of the bryozoa, competition does appear to have mattered.

The new explication of how two branches, or clades, of the bryozoans interacted is "one of the most rigorous, comprehensive looks at what happens when clades collide," says paleontologist David Jablonski of the University of Chicago. In the study, paleontologists John Sepkoski of the University of Chicago, who died last year at age 50, Frank McKinney of Appalachian State University in Boone, North Carolina, and Scott Lidgard of The Field Museum of Natural History in Chicago show how the newcomer group appears to have interacted with its rival group over 140 million years. The new arrivals did eventually rise to dominance, but failed to drive their rivals to extinction. Paleontologist Richard Bambach of Virginia Polytechnic Institute and State University in Blacksburg calls the work "truly consistent with competition being a major factor" in evolution.

The bryozoans are naturals for a starring role in the study of competition and evolution. The two groups—the original cyclostomes and the newcomer cheilostomes—have left a clear record of "battles frozen in time," as Jablonski puts it. By surveying almost 3000 fossil examples of the two bryozoan groups growing on the same surface during the past 100 million years, McKinney found that the younger cheilostome group grew over the rival cyclostomes about 66% of the time on average. Credit the cheilostomes' higher growth rate, says Lidgard, or perhaps their ability to grow a thicker layer of zooids—the individual animals that form a colony—at their encroaching edges. Thicker edges give the cheilostomes a height advantage and presumably a better chance to become large enough to reproduce.





Signs of a struggle. Competition among two types of bryozoa (left) may have led to divergent fates both in life (above) and in a model including competition (top).

Given those advantages, says Jablonski, from a simple Darwinian perspective, "you might expect the superior group would wipe out the inferior group"—and quickly. But what the bryozoans actually did appears to have been more complicated. The cheilostomes languished for 40 million years after their first appearance, even as the number of genera of cyclostomes grew. Then about 100 million years ago, the cheilostomes took off, adding new genera far faster than the cyclostomes until the impact-induced mass extinction 65 million years ago knocked down the diversity of both groups. The cheilostomes, however, bounced back and reached new heights of diversity while the cyclostomes stagnated and slowly declined.

To tease out the role of competition, if any, in the rise and fall of these bryozoans, Sepkoski, McKinney, and Lidgard tried to predict, in hindsight, how the two clades would fare assuming competition mattered. They used two "coupled logistic equations" developed by Sepkoski. Assuming that the world can hold only so many genera of each clade—that is, each clade has its own diversity limit—the equations predict a clade's change of diversity over time given its current diversity, its innate rate of diversification in the absence of the competing clade, and a factor that includes the diversity of the competing clade. The higher the diversity of its competitor, the more a clade's diversification is damped, as might happen if members of the two clades were going head to head for the chance to grow large enough to reproduce and pass on their genes.

When Sepkoski and his colleagues extracted the required numbers from the fossil record and plugged them into their mathematical model, it produced "a remarkable fit between the model and the empirical data," says Paul Taylor of the British Museum of Natural History in London. In the model, much as in life, the newcomer cheilostome clade expands slowly at first under the burden of the more diverse cyclostomes, which were already occupying many ecological niches and therefore denying them to the cheilostomes. But the cheilostomes eventually win out as the clade's diversity rises toward its natural limit, which the fossil record suggests is larger than that of the cyclostomes. The mass extinction hits both groups hard, but the cheilostomes bounce back thanks to their innate ability to diversi-

CREDITS: (PHOTO) FRANK MCKINNEY, APPALACHIAN STATE UNIVERSITY; (FIGURE SOURCE) SEPKOSKI *ET AL., PALEOBIOLOGY* fy faster. The cyclostomes can't rebound under the weight of their more diverse competitor, but neither do they collapse, thanks to their lower rate of extinction, a handy attribute of uncertain origin. This match between model and fossil record, plus the obvious competition recorded in bryozoan overgrowths, is consistent with "competition as a significant influence on diversity histories" of bryozoans, the group concludes.

The study represents "the most persuasive analysis yet of an apparent competitive displacement" of one clade by another, says paleontologist Alan Cheetham of the Smithsonian Institution's National Museum of Natural History in Washington, D.C. However, "they don't claim they've proven what happened." Indeed, "the model is a description rather than an explanation," notes Bambach. Although competition looks like a promising explanation, he says, others are possible. Taylor agrees, offering the possibility that a new type of cheilostome larval stage, rather than overgrowth of the competition, may have given cheilostomes an edge.

To strengthen the case for competition in evolution, paleontologists agree, researchers must learn more about all the ways bryozoa compete today. In the meantime, although Sepkoski's "death was hard for a lot of us," says paleontologist Arnold Miller of the University of Cincinnati, "he left us some things to think about."

–RICHARD A. KERR

COLLABORATIVE RESEARCH

Plans for Mars Unite Cancer, Space Agencies

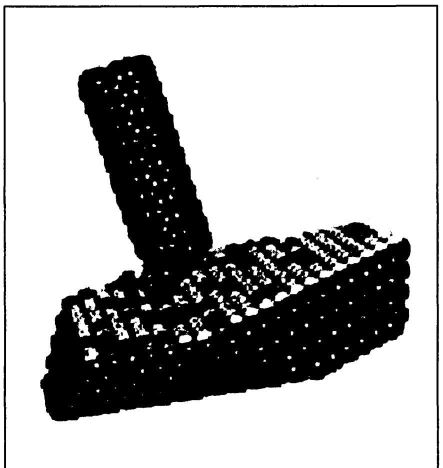
Cancer research and sending humans to Mars may seem light-years apart, but technological advances have put them on the same flight path. Last week NASA and the National Cancer Institute (NCI) announced that each intends to spend $10 million a year for the next 5 years in a coordinated effort to develop devices that could both speed detection of cancer on Earth and keep astronauts healthy during long sojourns from home.

To drum up enthusiasm for the idea, NASA Administrator Dan Goldin and NCI director Richard Klausner brought together two dozen molecular biologists, geneticists, pharmacologists, and chemists to discuss how nanotechnology and bioengineering can revolutionize health care on Earth and in space. "We're bringing medicine out of the hospital," says David Baltimore, president of the California Institute of Technology in Pasadena and chair of the NASA-NCI working group on biomolecular systems and technology. "It's a terrific opportunity." However, he warned that interagency efforts are "the most cumbersome activity on Earth."

Goldin and Klausner hatched the idea for a collaboration 3 years ago at a dinner party hosted by Bruce Alberts, president of the National Academy of Sciences, and shepherded it through their agencies. Last year, as part of a pilot program in unconventional innovations, NCI awarded five grants, worth $11 million, for technologies to detect and diagnose cancer that involved nanoscience, near-infrared optical techniques, and new polymers. One went to a scientist at NASA's Ames Research Center in Mountain View, California. Last June, a joint NASA-NCI meeting at Ames drew 150 investigators to examine advances in sensors to detect the signature of specific biomolecules.

Under the new agreement, the agencies will disburse grants separately but be free to supplement one another's projects. Klausner gains access to the space agency's expertise in building small and lightweight hardware, while Goldin bolsters the scientific credibility of NASA's human space flight program and strengthens ties to the burgeoning biological community. Astronauts bound for Mars may be in space for more than 4 years, bombarded by dangerous radiation and facing situations where even minor accidents—such as a rip in a space suit—could prove disastrous. Combating such threats may call for machines that can screen for genetic damage at a very early stage, robotic sensors injected into astronauts that continuously monitor their health, and a self-repairing space suit. Such innovations have revolutionary implications for improving health care on Earth, adds Klausner.

Of course, the health issue could be moot if humans don't take any long trips in space. "Why not learn to build robots to do business on Mars?" asked Stanford geneticist David Botstein at a 13 April public panel discussing the new collaboration. Even Baltimore noted



Tiny helpers. Nanoscale sensors would collect health data during long trips in space.

CREDITS: (TOP TO BOTTOM) R. ERGENBRIGHT/CORBIS; CISM

ScienceScope

Science in the Parks Canadian biologists are welcoming a new plan for making ecological science the foundation for managing the country's 39 national parks. But they have mixed feelings about another proposal to protect endangered species.

Two years ago, in the wake of public debate over proposed development in the parks, the Minister of Canadian Heritage appointed a scientific committee to examine park management. Last month, the panel recommended making "ecological integrity"—preserving intact assemblages of native organisms—managers' "first priority." The panel's report also calls for adding C$328 million to the Parks Canada budget over 5 years and hiring more staff to supplement the present team of 51 scientists. The ambitious proposal parallels a similar effort in U.S. national parks (*Science*, 7 April, p. 34) and has won support from politicians. "I think the political mood is there [to implement the plan]," says panel member Tom Nudds, an ecologist at the University of Guelph, Ontario.

But many biologists are less enthusiastic about a plan to protect threatened species. Introduced by the government last week, the Species at Risk Act would impose stiff penalties for killing protected plants and animals. Critics are unhappy that the bill leaves final listing decisions to the Cabinet rather than scientists and doesn't make protecting habitat mandatory. But after 7 years of debate, even some skeptics are hoping the bill will pass this year, warts and all, so Canada will finally have an endangered species law.

Metric Mandate Complaining that NASA's approach to projects is "faster, cheaper, worse," Representative Vern Ehlers (R–MI) says he is drafting legislation requiring government contractors, scientists, and engineers to use exclusively metric measures. That's in response to the 1999 failure of the Mars Climate Orbiter due to a mix-up between English and metric units (*Science*, 7 April, p. 32). "He wants to send a clear message ... that we won't tolerate mistakes like this again," says an aide.

Contributors: Govert Schilling, Jeffrey Mervis, Jocelyn Kaiser, Andrew Lawler