New Analysis Affirms Life Sharing Universal Common Ancestry

The notion of a universal common ancestry (UCA) for all species, which traces to Charles Darwin, has “rarely been subjected to formal quantitative testing,” says Douglas Theobald of Brandeis University in Waltham, Mass. His recent effort, which he calls “the first, to my knowledge, formal, fundamental test of UCA,” is based on a close look at 23 highly conserved proteins taken from groups that span the three domains of life—eukaryotes, bacteria, and archaea. That test “overwhelmingly supports UCA, irrespective of the presence of horizontal gene transfer and symbiotic fusion events,” he concludes. “These results provide powerful statistical evidence corroborating the monophyly of all known life.” Details describing that analysis appear in the 13 May 2010 Nature (465:219–222). In an accompanying commentary, Mike Steel of the University of Canterbury in Christchurch and David Penny at Massey University in Palmerston North, both in New Zealand, point out: “The results give firm quantitative support for the unity of life.” Even if life arose “more than once,” they add, it appears that only one original life form survived. Theobald’s “claim is simply that all known life has at least one common ancestor...”

Rutherford said, “In science there is only physics; all the rest is stamp collecting.” The subsequent involvement of physicists in the early development of molecular biology, although unpopular in some circles, helped to overcome that earlier antagonism. Even if rivalries persist between the disciplines, cooperation once again is on the rise.

“Physicists have a bad habit of saying, ‘This is an interesting problem, I’m going to study it,’ and it’s kind of annoying to other people,” says physicist Herbert Levine of the University of California, San Diego, who chaired a session on microbial evolution during the APS meeting. Yet when researchers from these two very different scientific disciplines cooperate, he says, they can “understand things at a deeper level than possible by one discipline alone.” Levine’s general interest in soft-condensed matter led him to focus on polymer networks, which can be studied in purely physical terms or in the context of cell biology, he says. “People have learned that [polymers in] cells are the same but more interesting.”

Notwithstanding traditional rivalries, relations between microbiologists and physicists can be outright cordial these days, says ASM president Roberto Kolter, professor of microbiology and molecular genetics at Harvard Medical School in Boston, Mass. Kolter, who often collaborates with physicists, finds their perspective invaluable in his current work on biofilms. His postdoc Hera Vlamakis presented recent findings from their research on multicellular bacterial biofilms during the APS meeting this past March. “I thought it was fantastic that physicists are inviting us to present at their meeting,” Kolter says.

Long interested in biological materials and phenomena, some physicists admit to being fascinated with living microorganisms for their own sake. Further, new tools enable the study of forces “over a small scale and at very short distances,” says physicist Alex Levine of the University of California, Los Angeles. For example, his interests in microchemistry, the study of how fluids and soft matter flow, and in particle-tracking microscopy, which uses video to follow moving molecules, are yielding new microbiological insights. Those analytic approaches are suited for investigating the cytoskeleton, which enables cells to maintain or change their shape, as well as how biofilms are structured.

Chemical physicist Sean Sun at Johns Hopkins University in Baltimore, Md., is collaborating with microbiologists to study mechanical influences in bacterial cell walls and during cell division. Compared to physics, he says, “biology takes advantage of a highly nonlinear type of thinking.” An important exception is genetics, which appears to have some biologists thinking that once they identify a gene they understand the system, he adds. “It’s more interesting than that.”

A physicist would think he understood a system only “if he could identify all the variables,” Sun continues. “It’s not like when you’ve found the engine you understand how a car works.” However, on the plus side, the “free exchange of information is quite good in the microbiology world—much better than the eukaryotic cell community.”

Physicists and microbiologists need to do more to develop a common language, Kolter says. “Microbiologists of the future should have physics training [and] physicists should make the attempt to talk in a language that’s understandable.”

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Insights into Airborne Pathogens from Fluid Dynamics

Even with sophisticated heating, ventilation, and air conditioning (HVAC) systems, circulating pathogens may cross-infect building occupants, especially in hospitals. Now physicists are studying how temperature gradients and turbulence influence airborne...
Federal Laws Tied to Drop in Research Efficiency Involving Ebola, Anthrax

Following passage of the Patriot Act in 2001 and the Bioterrorism Preparedness Act the next year, the efficiency of research on Ebola virus and *Bacillus anthracis*, both considered “weaponizeable” microorganisms, dropped, according to Elizabeth Casman of Carnegie Mellon University in Pittsburgh, Pa., and her collaborators. Although the numbers of papers being published on these microorganisms and related topics increased after 2002, there was a two- to fivefold increase in the cost of doing research on these and other select agents as measured by the number of research papers published per millions of U.S. research dollars awarded, they report, noting: “The decreased efficiency is likely due to the increased costs of and bureaucratic hurdles to conducting such research.” Details appear in the May 25, 2010 *Proceedings of the National Academy of Sciences* (107:9556–9561).

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