

Biology Departments Restructure

Many U.S. biology departments are splitting according to level of study—molecules versus ecosystems. But some biologists warn that such reorganizations divide the hottest research areas

Independence Day came late last year for ecologists and evolutionary biologists at Yale University. For nearly 2 decades, faculty members in this minority wing of the biology department had yearned for autonomy, tired of playing second fiddle to their more numerous—and better funded—colleagues in molecular and cellular research. They got their wish last October, when Yale President Richard Levin announced that the Yale Corp. had ended the long faculty feud by agreeing to split the old unified biology department into a Department of Molecular, Cellular, and Developmental Biology (MCDB) and a Department of Ecology and Evolutionary Biology (EEB). “Finally, we have independence,” says Yale environmental biologist Jeffrey Powell, one of many who had feared that his wing of the department would wither unless it gained sovereignty over new faculty hires. “If we blow it now, at least we blow it by ourselves.”

Yale biologists are not alone in redrawing the academic boundaries of their discipline. University biology departments seem more prone than nation-states to periodic political and cultural revolutions. Even so, this may be remembered as an especially tumultuous year for U.S. universities. Last month at Duke University, faculty members met to debate a controversial proposal to merge the botany and zoology departments into a unified department. This week, the University of Illinois, Urbana-Champaign, is expected to name interim directors for two new schools of biology, one for molecular, cellular, and physiological biology and another for “integrative” or whole-organism biology, with each school absorbing three of the six existing biology departments. And at a meeting to be held in May at Michigan State University (MSU), faculty, administrators, and students will discuss reorganizing nearly a dozen units into a few large departments organized along similar lines.

All of these institutions are seeking the best way to structure faculty research groups and prepare the next generation of biologists—but there’s no undisputed answer. “The experiment is still under way, with lots of

different trials,” says Michael Hadfield, a marine biologist at the University of Hawaii. Still, amid all the experiments, it’s clear that many departments such as Yale’s are continuing a long-term trend to discard taxon-oriented divisions, such as zoology versus botany, and divide instead according to level of analysis: molecule and cell versus organism and ecosystem. Says Günter Wagner, an evolutionary biologist and chair of Yale’s new EEB department: “Twenty or 30 years ago, departments based on taxonomic distinctions were fused into biology departments. Now, they are splitting again, but the plane of splitting is a different one.”

Yet, there’s also a growing backlash against such division. Critics fear the eclipse of fields such as botany and entomology.

And much of the fissioning runs counter to one of the most exciting trends in biology: Some of the hottest areas tend to encompass several levels, from genomic analysis as a tool in wildlife conservation to the evolutionary implications of developmental mutations. Says Hadfield: “The unifying principles in biology are far greater than the dividing principles.” From this standpoint, the ideal structure might be a single, unified department, but many biologists say it just doesn’t work in practice, as tensions over career standards, funding, and research methods drive biologists apart.

A house divided

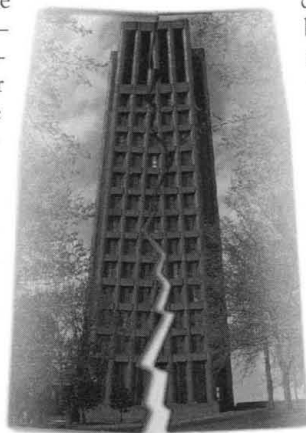
That was certainly the case at Yale. Although long one of the nation’s most prominent, comprehensive biology departments, its very breadth became a source of conflict, Yale faculty say. And the chief flash point was that hottest of hot-button academic issues: faculty appointments. Every recent faculty opening in molecular and cellular biology drew hundreds of applicants, including dozens who were highly qualified, so faculty members were sure they were getting the pick of the litter among young Ph.D.s. Openings in ecology and evolutionary biology attracted just as many applicants overall, but molecular biologists regarded only a handful as highly qualified, says Yale cell biologist Joel Rosenbaum. That triggered quarrels that polarized the en-

tire faculty. As Wagner puts it, “Some hires that we felt strongly about didn’t resonate with many of our colleagues.” In his view, the molecular biologists applied “very limited” standards such as sheer numbers of publications—criteria that “are not adequate for building a good group in this area.” Rosenbaum acknowledges that “there has to be a separate set of expectations” for applicants in ecology and evolutionary biology, where publication records are often shorter. “That was hard for the rest of us to come to grips with.”

Applicants’ funding prospects also drew sparks, because government and foundation grants for research in ecology and evolutionary biology tend to be both sparser and smaller than those for biomedical research. “You don’t see the Howard Hughes Foundation supporting people in ecology and evolution,” says Rosenbaum. “Does that have any effect on whom we hire? Theoretically not, but if you were a cynic, you’d say it’s probably in part the case.”

Differences in the ways researchers approach their subjects defined yet another cultural divide. Says Wagner: “What were considered interesting and uninteresting research questions had become very different” between the two factions. The molecular and cellular faction, for example, has long viewed with skepticism the burgeoning effort in computational ecology—the mathematical simulation of ecosystems—pursued by several of the department’s ecologists, including Wagner. “In organismal biology, evolution, and ecology, mathematical modeling plays a very central role, but it has no importance and is not well understood [among molecular biologists], so there is a lot of resistance,” Wagner says.

After years spent edging toward the hatch, Yale’s ecologists and evolutionary biologists finally found their parachute—in the form of a \$20 million donation from Yale alumnus Edward Bass, backer of the controversial Biosphere 2 project in Arizona. Part of the money went to create the Institute for Biospheric Sciences in 1991, and some will now go toward making the EEB department independent and hiring five to seven new faculty—nearly doubling the new department’s current size. The ecologists’ “intense concern” that the Bass funds be used primarily to benefit their side helped drive the breakup, according to Tim Goldsmith, a neurobiologist in the MCDB department, which includes 26 faculty members, most of the old biology department.



Crack-up. Ecologists will leave Yale's Kline Biology Tower.

Split levels—and split views

At universities whose biology departments divorced years or decades ago, many faculty members predict both new Yale departments will be better off. One of the first schools to restructure according to level of analysis, for example, was the University of Colorado, Boulder, which in the 1960s created both an MCDB department and a Department of Environmental, Population, and Organismic Biology (EPOB). "We feel it has been a very successful model," says ecologist Carl Bock, who chairs the EPOB department. Echoing Yale's ecologists, Bock says that research opportunities for faculty members in the two departments are very different because of the uneven funding available—and required—for different sorts of science. That "makes it very hard to make fair comparisons about the accomplishments of faculty members in our two departments," he says. So, when hiring and tenure decisions come up, being a separate department "makes it easier for us to work as a group and make the right decisions."

In the 1980s, a bevy of taxon-based biology departments at the University of California, Berkeley, realigned themselves according to the Boulder model. While the change was bitterly opposed by some, it proved popular among prospective graduate students, who have been applying in record numbers ever since, says Berkeley biochemist Randy Shekman: "That has definitely been a plus." Adds Guy Bush, an MSU zoologist who a decade ago organized an interdepartmental graduate program in ecology, evolution, and behavior, "Everybody realizes the old taxonomically oriented departments were too narrowly focused." Today, MSU is also bowing to fashion: Its zoology department will likely be renamed as ecology, evolution, and behavior later this year, and may also take part in a major reshuffling of the university's biomedical science departments, depending on the outcome of a "visioning" meeting among faculty, staff, and students, scheduled for this May.

The no-new-taxa trend goes beyond departments. Last year, the American Society of Zoologists renamed itself the Society for Integrative and Comparative Biology, and the U.S. National Research Council (NRC), in a change designed "to reflect more accurately current campus conditions," dropped botany, microbiology, and zoology as department cat-

egories in its rankings of doctorate programs, replacing them with molecular and general genetics, neurosciences, and ecology, evolution, and behavior. Of course, that left traditional taxon-based departments such as Duke's homeless. Says NRC study co-chair Marvin Goldberger: "There's no question that there were [departments] that were hurt by being forced to place themselves in one category or another that was not consistent with their own structure." But given the turmoil in departments these days, he says, "it was impossible to define the compartments in biology in a way that was compatible with all institutions."

To some, however, the "split-level" model has its own drawbacks. "It works against having truly integrative research" built around hierarchy-spanning themes such as development and evolution, says Jim Hanken of Boulder's EPOB department. Developmental biologist Rudy Raff, a member of the still-unified biology department at Indiana University, Bloomington, seconds that notion. "The

will also mean a narrower curriculum, as undergraduate majors in molecular and cellular biology are freed from required courses in ecology and evolution, other faculty members fear the split's effect on the next generation of scientists. "We've prided ourselves on our good teaching—not only how we teach, but the breadth of what we teach," says Rosenbaum. "That's a loss."

Seeking the perfect compromise, Duke is planning to combine its old taxon-specific departments into one—but to subdivide that megadepartment along disciplinary lines. With separate departments of botany and zoology, biologists have long lacked a coordinated hiring plan, says plant biochemist Jim Siedow, Duke's new dean for faculty development. Moreover, he says, Duke's biology majors must negotiate a Byzantine multidepartmental web in order to graduate. And a splinter group of developmental, cell, and molecular biologists has already formed its own de facto department, taking up residence in a new building

halfway between the botany and zoology departments. When a nine-member faculty task force chaired by Siedow met last fall to consider possible solutions, it "looked at the notion of spinning off into several new departments ... but didn't see that as a viable option," he says, in part because the botany and zoology departments have only 40 faculty members between them.

The draft plan therefore aims for the best of both worlds, with a single department of biology containing four roughly equal-sized and semi-autonomous subgroups focused on different sub-

fields. The whole structure would be overseen by an executive committee with members from each subgroup. Says Siedow: "At the end of the day, the groups would keep the essence of a department—the ability to hire faculty—but the executive committee would also have the perspective of unifying long-term hiring plans."

Taxonomy at risk?

But this plan, which is to be evaluated in the next few months by a new faculty working group, has its critics, too. Such mergers tend to extinguish taxon-specific disciplines such as botany, entomology, and mycology, says mycologist Rytas Vilgalys, Duke's director of graduate studies in botany. "At several schools where botany and zoology have merged, botany has gone into eclipse" or lost clout, Vilgalys

School	Date	Change
UC Santa Cruz	by 1999	Unified department discussing splitting along levels of analysis—ecology/evolution and cell/molecular
Duke University	1997	Botany, zoology discussing merging into unified Biology Dept.
U. of Illinois	1997	Six departments in one school will split into two schools—one molecular, one organismal in focus
Michigan State U.	1997	Discussing consolidation of 10 departments into level-oriented groups
Yale University	1996	Biology department split in two along levels of analysis—ecology/evolution and molecular/cell/developmental
UC Los Angeles	1995	New department focused on molecular/cellular biology split off from unified one; remaining department has organismal focus
Harvard University	1994	Molecular, cellular biology merged into a single department; organismal remains in a separate department
U. of Pennsylvania	1993–94	Biology considered dividing according to levels of analysis but decided to stay unified
Princeton University	1990	Biology split into two along levels of analysis—ecology/evolutionary and molecular
UC Berkeley	1989	Numerous departments consolidated into two—molecular/cell and integrative (evolutionary/organismal)

molecular revolution is beginning to reunify biology," he argues. "It's now becoming possible to attack classical problems in phylogeny using molecular tools. And you can do it a lot better if you run a unified department."

Surprisingly, several Yale faculty members contacted by *Science* share Raff's views. "We live at a time when the growing unity of the biological sciences is plainly apparent," says biological chemist Peter Moore, a member of Yale's biochemistry department who 2 years ago served on a university task force examining the biology department's future. "There were a lot of people inside and outside the [Yale] biology department who questioned the intellectual rationale for taking a subject which is essentially all one piece and splitting responsibility for it between different departments." And because the divide

notes, citing the University of North Carolina, Chapel Hill, the University of Michigan, and even Indiana University as examples. Indeed, plant taxonomist James Rodman, a program officer at the National Science Foundation (NSF), says there is "declining expertise on various taxa—particularly poorly known groups of organisms—resulting in part from shifts of emphasis by academic departments." NSF takes the problem seriously enough that in 1995 it established a special grant competition, overseen by Rodman, entitled PEET—Partnerships for Enhancing Expertise in Taxonomy. Of course, funding is not distributed evenly at NSF either: PEET provides about 20 annual awards of up to \$150,000 each—good money in evolutionary biology, but no jackpot in cell and molecular fields.

The concern for taxa has even reached Berkeley, where the College of Natural Resources' Plant Biology Department recently acquired a new microbiology division, becoming the Department of Plant and Microbial Biology, says Berkeley biologist Robert Tjian. And misgivings similar to NSF's recently halted a plan at the University of Illinois, Urbana-Champaign, to consolidate six biology departments into two—ecology and molecular biology. Led by entomologist and National Academy of Sciences member May Berenbaum, the entomology department vetoed the plan. "We felt our successful formula was going to be sacrificed for some vague, ill-defined organizational principle," says Berenbaum. Their proposed alternative, which is being evaluated this month by two external review committees, splits the differ-

ence between the taxon-oriented and level-oriented models. Plant biology, vertebrate biology, and entomology will be preserved as separate departments but will merge some of their administrative functions in a new School of Integrative Biology, while the remaining departments make up a new School of Molecular, Cellular, and Physiological Biology.

Whatever fences universities erect between departments—or schools—researchers say they need plenty of gates. To facilitate idea exchange and coherent education, departments will need more interdisciplinary and interdepartmental programs, something funding agencies have been encouraging for years, says the University of Colorado's Hanken: "There is no perfect structure—but there are ways of getting around the liabilities."

—Wade Roush

SPACE STATION

Science Slides to Bottom of Schedule

U.S. and Russian officials are bickering over whether the first pieces of the international space station will be launched this year or next. But whatever they decide, don't expect much science to be done on the \$30 billion orbiting laboratory until after the turn of the century. Delays and cost overruns in the program have forced NASA to abandon most of its plans to conduct research on the station until it is nearly complete.

NASA officials delivered this bad news last week to the National Research Council's Space Studies Board (SSB) in the shape of a new plan that would result in a virtual 3-year hiatus in studies of the effects of weightlessness on humans, other animals, and plants, as well as on a variety of fluids and materials. "There will be no community left to do any experiments," warns Mary Jane Osborn, a microbiologist at the University of Connecticut and an SSB member.

NASA originally had encouraged science aboard the station during the early years of construction, between 1998 and 2001. But cost overruns have led the agency instead to borrow nearly half-a-billion dollars designated for the necessary science facilities such as glove boxes and furnaces. That leaves "a very, very thin program," admits NASA's Mark Uhran, who oversees science payloads planned for the station. Uhran said his office lost control of the \$2.1 billion facilities budget after authority was transferred to Johnson Space Center in Houston. But he says he is hoping that the agency could set aside at least one shuttle flight during the station's construction to keep the science program afloat. Even then, however, it is not clear whether there will be enough time—and money—to plan a successful mission, he adds.

Speaking last week before the House Science Committee's space panel, NASA Administrator Dan Goldin painted a bright picture at odds with the fiscal reality. He dodged concerns about the issue raised by several lawmakers, saying "we will not skimp on our commitment" to do good science aboard the station. Other Administration officials say they had little choice but to draw on the \$2.1

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—Simon Ostrach

billion scientific facilities fund to build the modules, power arrays, and environmental systems that will make up the station (*Science*, 26 April 1996, p. 478). "It was the only thing we could do," says Steven Isakowitz, a White House budget official.

NASA managers intend to take \$235 million out of the fund in 1998 after tapping \$177 million this year and \$50 million in 1996. Agency managers say they will pay the money back but offer no firm repayment schedule. As a result of these "loans," the majority of station science facilities won't be ready for launch until early in the next century. The U.S. laboratory module is slated to go up at the end of 1998, but only two science-related shuttle flights are planned in 1999 and none in 2000. Even that schedule is an optimistic one: Russian financial woes are expected to cause launch delays of 6 months

to a year, an effect that would ripple through the entire construction schedule (*Science*, 14 February, p. 921).

Members of the academy's space science board attacked NASA's current plan as wasteful and shortsighted. "These communities are going to dissipate," warns Martin Glicksman, a materials scientist at Rensselaer Polytechnic Institute in Troy, New York. And Simon Ostrach, an engineering professor at Cleveland's Case Western Reserve University, says there may be "no meaningful experiments [to conduct] ... when this gorgeous hotel is ready." He adds: "We have built up a world-class community, and now we have to sit for 6 or 7 years and not do anything."

Uhran says that the Russian space station Mir could offer a temporary home for some of the experiments, but other NASA and Russian officials say the aging facility is on its last legs. In the meantime, Uhran's office is drawing up a list of the physical requirements needed to do science aboard the station to aid researchers in making their case to NASA.

They could use the help. So far, researchers have made little headway in winning allies for their cause. Representative George Brown (D-CA), the former head of the science committee and a longtime advocate for space science, expressed concern about the situation at last week's hearing but did not pursue the issue. And House staffers told the academy panel that they have logged few complaints from life and microgravity scientists. "Maybe you have just not been lobbying enough," remarked SSB member Bill Green, a former congressman. Osborn agrees: "I think we have been remiss in not getting more proactive." For the time being, however, science aboard the space station appears likely to remain on NASA's back burner.

—Andrew Lawler