There's a New Offering on Campus: Global Change 101

Climatologist Stephen Schneider is a hot property these days—so hot that at least four universities have been trying to recruit him. They want Schneider to help them move into a trendy—and well-funded—area of science: the study of global change. A well-known climate modeler who is head of interdisciplinary climate research at the National Center for Atmospheric Research (NCAR), Schneider is in demand because he is a rare breed of researcher: a scientist comfortable with straddling disciplines to take on the urgent problems threatening the planet. "Right now, we don't have global changeologists running around," says Stanford University geologist Gary Ernst, dean of the Earth sciences school.

But that may be changing, as more and more universities launch the kinds of programs now courting Schneider, who will be at Stanford next year to help run its new Earth Systems Program but is also a candidate for the directorship of centers at the University of California, Santa Barbara, the University of Michigan, and the University of California (UC), Davis. At least six other universities are in various stages of opening and operating new centers and programs for global studies, and many more are considering the idea. These new programs are meant to foster the cross-cutting research needed to cope with the interrelated problems of climate change, ecological shifts, and human activity—and to train a new generation of researchers to tackle those problems.

"By all means it's a trend," says sociologist Gayl Ness, who is part of a faculty group launching the Michigan center. It's driven, he notes, by both a funding shift and an intellectual awakening. "Part of it is there's new money out there, and academic entrepreneurs are always going where the new money is." But that new money, which is part of a 4-year-old presidential initiative that this year is pumping $1.18 billion into global change research, became available just as researchers in fields as diverse as ecology and oceanography realized that they were interested in the same problems—and that those problems couldn't be solved from the vantage point of just one discipline. "Global change problems rarely fall within intellectual boundaries traditionally associated with university departments," says Schneider.

That was what UC Santa Barbara oceanographer Ray Smith found when he started research a few years ago to see whether phytoplankton in the Antarctic ocean were being damaged by ultraviolet radiation seeping through the ozone hole (*Science*, 21 February, p. 952). Answering the question meant coordinating data on the ozone hole with shipboard measurements of plankton populations, the ecology of their predators, and the chemistry of the ocean. And it took an interdisciplinary team of atmospheric scientists, biologists, and chemists to do so. Likewise, a Pennsylvania State University project to model how climate change might affect the global water cycle ended up involving 15 scientists from different departments, recalls Eric Barron, a climatologist who is director of the Earth System Science Center there.

Breaking down disciplinary boundaries has never come easy in academia, however. Some faculty in traditional disciplines look down on interdisciplinary work as lacking in rigor; others, mainly department heads and deans, are threatened by the loss of funds and bright, young scholars to the new cross-cutting programs. And still others view the new interdisciplinary initiatives as a fad, doomed to fade away like many of the interdisciplinary environmental studies programs of the 1970s. "A lot of this is just hype," says isotope geochemist Wallace Broecker, who has long been crossing disciplinary boundaries himself in his studies of past climates at Columbia University's Lamont-Doherty Geological Observatory. "I think every university got the message that 'global change is going to be an important thing, so we better get into it.' A lot of it's just on paper, with no real substance."

BRENDEN BUCKLEY

Sampling the climatic past. Lamont-Doherty researchers extract a tree-ring record from a Huon pine in Tasmania.

Programs whose impetus comes from the top seem to draw the most skepticism. Such top-down programs often get started when university administrators—enticed by the funding available in the global change initiative—hop on the global change bandwagon, or when outside funding agencies, such as the Department of Energy or the National Aeronautics and Space Administration, offer startup funds to establish closer ties with academia. These initiatives can falter if there's no groundswell of support on campus. That has reportedly been the problem at the University of Maryland, where the director of the new policy-oriented Center for Global Change—attorney Alan Miller—has been seen as an outsider and, perhaps symbolically, has been located off campus.

Grassroots global change. The global studies centers that seem to be doing best are those that originated among faculty members who were already doing interdisciplinary research. The pattern is emerging at Stanford, Michigan, UC Santa Barbara, UC Davis, Rice University, and the Massachusetts Institute of Technology (MIT), and advocates say it's the only way to create a vital program. "Our 3000 faculty are 3000 prima donnas. Nobody tells them what to do," says Ness at Michigan. "The way to build an interdisciplinary group is to capture our researchers and students where their hearts and minds are"—by nurturing and building on interdisciplinary research already under way. Any grassroots movement, of course, runs the risk of getting torn apart in turf battles between department heads or key researchers in different departments—as is said to have happened at the University of Washington and the University of Wisconsin. "A number of universities that could have superb programs are having trouble getting them approved," says Barron.

Even after winning broad support, most global change programs have faced heated debate on whether they should have their own faculty and degrees. Should there be professors of global change, supervising interdisciplinary Ph.D. projects? Few programs go that far; most start out as umbrella centers, drawing upon faculty who remain in various academic departments where they still must meet stringent standards for tenure and promotion. Instead of offering graduate degrees, they insist that students get a doctorate in a particular discipline and, as icing on the cake, take a range of broader courses and engage in some interdisciplinary research.

This ensures that global-change researchers have a strong grounding in a traditional discipline—and it works well for professors who already have tenure but have developed an interest in interdisciplinary research, notes Jonathan Roughgarden, an ecologist who is director of Stanford's Earth Systems Program. But young, untenured faculty and graduate students contemplating academic careers in glo-

bal change are often reluctant to join interdisciplinary centers that don't have their own tenured posts. "The bottom line is you can't be purely interdisciplinary and get tenure," says University of Michigan biologist Terry Root, who comes up for tenure next year. Although she has made a name for herself doing interdisciplinary work on how climate warming will affect North American bird populations, she has been told she will be judged primarily by traditional department standards, which call for single-author publications in traditional journals.

But at least a few of the new programs are trying to give interdisciplinarians secure status. Take the Earth System Science Center at Penn State, launched in 1985 with the hiring of Barron, who collaborated with Schneider as a postdoc. The center's eight faculty members did have to win tenure in traditional departments, but the department heads knew that the researchers' principal interest—and the source of their salaries—was interdisciplinary research. "So, we had to search for faculty together [with the departments]," says Barron. "We were looking for people who were not afraid of projects on the fringe of different disciplines, people who were not scientific snobs. The departments were looking for people with enough depth to be part of the department. What's surprising is how many people fit both categories."

The new global change center at UC Santa Barbara will have even more autonomy. After a 4-year lobbying effort by an ad hoc group of faculty and Chancellor Barbara Uehling, the UC Board of Regents recently decided to establish a new School of Environmental Science and Management, with its own independent faculty of 15 and a new 42,000-square-foot building (if a bond issue is approved by California voters in June). When the new professional school opens in 1993, it will offer both doctoral and master's degrees in Earth systems science, as well as courses and research opportunities for students in other schools on campus.

K.S. BAKER

Trolling for global change. A University of California, Santa Barbara, team samples plankton in Antarctica.

Closet interdisciplinarians. The Santa Barbara center may be the closest thing so far to a full-fledged department of global change, but the movement has been rolling across other campuses, bringing more and more interdisciplinarians out of their niches (see chart). To those who think the movement is riding on hype, that trend raises the specter of scores of global changeologists stranded with nowhere to practice their trade when the enthusiasm ebbs. But global change may prove among the most practical of academic specialties.

That's certainly the feeling at Michigan, where an institute is in the works that explicitly gears its master's degree in global studies toward students who are not planning academic careers but want to work for industry, government agencies, or non-profit organizations. "We've been talking with a lot of corporate leaders from the auto companies, utilities, and gas and oil companies," says Ness. "They are looking for people who can do environmental work but who know something about the economics, biology, and physics of global change. They can't find them."

U.S. Fish & Wildlife Service oceanographer Edward LaRoe confirms that his agency, too, is looking for interdisciplinarians. Out of 30 hires he has made in the past 5 years to fill jobs in the service's cooperative research units, 18 have been global change generalists. "In my program there definitely is a trend to hire people with broader backgrounds than in the past," he says. "I need an ecosystem biologist who can deal with broad concepts. I think that's where the profession is going."

By its very nature, it seems, global change comes with a guaranteed employment plan for researchers. "In 10 years, I'm more than 90% confident there will still be an ozone hole, global warming, the loss of biodiversity, toxic waste disposal," predicts Schneider. "We need the best brains to work on those problems." In the face of that need, "it will be a tragedy if universities don't respond."

–Ann Gibbons

Centers for Global Change

University	Year Established	Faculty	FY 1992 Budget	Degrees	Specialties
University of New Hampshire (Institute for the Study of Earth, Oceans, and Space (EOS))	1985	2 affiliates, 31 joint appts., 2 faculty researchers	$12 million research	none	Earth and space science
Pennsylvania State University (Earth System Science Center)	1985	25 affiliates, 8 hired by center as joint appointments	$4 million research	undergrad minor	Global water cycle, biogeochemical cycles, earth system history
Lamont-Doherty Geological Observatory (Center for Climate Research)	1985	n/a	$10 million research	none	Paleoclimate, paleo-oceanography, atmospheric models
University of Maryland (Center for Global Change)	1989	15 on advisory committee	$600,000 for center	none	Environmental policy
Massachusetts Institute of Technology (Center for Global Change Science)	1990	25 affiliates	$6 million research	none	Meteorology, oceanography, hydrology, satellite remote sensing
University of Michigan (Project for the Integrated Study of Global Change)	1989*	100 associates for 3-year terms (joint appts. later)	$300,000 for 2 years	master's starting 1993-1994	Remote sensing, social and health sciences, atmospheric sciences, environmental engineering
Stanford University (Earth Systems Program)	1992	15 affiliates	$305,000 for 3 years for program	undergrad starting June 1992	Ecology, economics, coastal estuarine systems
UC Santa Barbara (School of Environmental Science and Management/Global Change Program)	fall 1992	15 full-time, 5 joint appointments, 30 affiliates	$10 million research	master's & Ph.D. starting 1994-1995	Earth systems science, applied ecology, environmental policy and management

* New institute opens 1992-1993.