tion to integrating these devices into larger assemblies.

One problem is that no one company or academic group typically makes all of the different components needed for a complete system. And researchers in need of a particular component often have no idea whether other research groups have already built such devices. JOP's architects hope to address this need by setting up brokers in the United States and in Japan, funded by the RWCP. American researchers looking for a particular device, for example, would simply contact the U.S. broker, who would then work with the Japanese broker to find all of the R&D labs producing that device.

To many researchers in the field, the effort to link devices into working systems is long overdue. "The need for prototyping of optoelectronic [systems] is very obvious to a lot of people in the community," says Stephen Forrest, an electrical engineer at Princeton University. "We want to work in the applications, and the field is ready for it."

The most recent of the three agreements, the Civil Industrial Technologies Cooperation Plan (CITCP), may confer the same benefits on other high-tech areas. The agreement, which was proposed by Commerce Department officials in the fall of 1992 and was signed in June, differs from its predecessors in that it isn't restricted to specific technological applications; instead, says Phyllis Genther Yoshida, the director of the Japan Technology Program at the Department of Commerce, "[CITCP] is an overall framework agreement for conducting cooperative research." For now it includes such areas as synthetic membranes for chemical separations, and chemical vapor deposition, used for manufacturing electronic components. Besides laying ground rules for cooperative research, the agreement calls for an active government role in organizing joint R&D projects and researcher exchange programs.

Administration officials concede that because the new agreements don't provide any money to jump-start collaborations, the first few projects may be slow in coming. But by encouraging companies and government funding agencies to invest in international partnerships, says Elliot Maxwell, the Commerce Department's director of international technology policy and programs, "we hope the agreements will encourage first-rate research activities." If so, competition through collaboration is likely to become Washington's next high-tech policy mantra.

–Robert F. Service

BIODIVERSITY

Ecologists Draft Plan to Dig in the Dirt

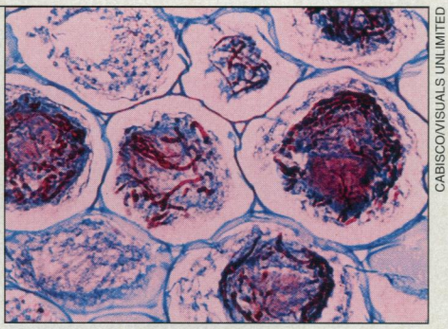
LONDON—For the past few years, tropical ecologist Dan Janzen of the University of Pennsylvania has been touting a big idea: Take a chunk of habitat, say 50,000 hectares of tropical rain forest, and document every single species in it (*Science*, 30 April 1993, p. 620). Most of Janzen's colleagues agree that such an All Taxa Biodiversity Inventory (ATBI) could help achieve many goals, from teasing out interactions among species to prospecting for new drugs. But skeptics point to a major obstacle: Taxonomists have so far identified just a few percent of the millions of species of bacteria, fungi, and other microorganisms that populate the soil. And because these organisms play key roles in important ecological processes such as nitrogen fixation, decomposition, and carbon cycling, that's a serious problem.

Last week, however, at London's Natural History Museum, some 30 leading U.S. and British taxonomists and soil ecologists took the first step toward tackling that problem. After 3 days of debate, they emerged with a rough outline for an international multisite soil biodiversity survey, and their mood was distinctly upbeat. The paucity of data on soil fauna and flora, participants agreed, doesn't reflect any intractable technical difficulties. On the contrary, it's due to nothing more than a lack of cash for soil biodiversity studies. "We've got to get going with the soil," says nematode expert and soil ecologist Diana Freckman of Colorado State University, who led the U.S. contingent. "We can do it."

Maybe so, but none of the attendees underestimates the magnitude of the task. "The soil leaps out as being problematic," says workshop organizer Steve Blackmore, associate director of life sciences at the Natural History Museum. Traditionally, biologists have identified soil microorganisms by culturing washings from a soil sample on a standard nutrient medium. "What you get out are things that like those isolation methods," rather than ecologically significant species, says David Hawksworth, director of the International Mycological Institute in Egham, west of London. Hawksworth says it's easy, for instance, to obtain cultures from spores of fungi like *Penicillium* that are lying in the soil; it's very difficult, in contrast, to culture mycorrhizal fungi, which grow around plant roots and are involved in nutrient uptake. But ask a taxonomist if it's feasible to develop techniques to isolate organisms from his or her chosen group, says Janzen, and the answer is: "If you give me enough money… yes."

The plan mapped out at last week's meeting would focus initially on organisms involved in two key ecological processes: carbon flux through the soil, and decomposition. The idea would be to understand the links between biodiversity and ecosystem function. By treating soil with chemicals that kill a particular group of organisms, ecologists have already gained a rough picture of some groups' ecological functions. But they have been unable to determine how such plots are recolonized over time, and how the addition of each recolonizing species affects ecological processes. "We know what they do, but we don't know who does what," says Colorado State's Freckman.

Freckman says a firm proposal for funding to develop the necessary methods and conduct a multisite soil biodiversity survey should be ready within a year—probably aimed at the U.S. National Science Foundation and Britain's Natural Environment Research Council, which co-sponsored the London workshop. These studies could begin at existing well-studied sites, such as those of the U.S. Long Term Ecological Research network (*Science*, 15 October 1993, p. 334).



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Root of the problem. Mycorrhizas (*stained red*) on plant roots are hard to culture.

Ideally, this survey would be conducted alongside several ATBIs. This, however, is a much more expensive proposition—each ATBI will cost a minimum of $80 million over more than 5 years, according to Janzen. That kind of money has never before been lavished on a single biodiversity study, but Janzen is optimistic that at least one ATBI could soon be under way. On 25 July, the Costa Rican government agreed to conduct an ATBI in a national park called the Guanacaste Conservation Area, working with Costa Rica's National Biodiversity Institute (INBio). Costa Rican President José María Figueres has now applied to the World Bank's Global Environment Facility for a $6-million grant to fund a 2-year planning and setup phase. And given the positive tone of last week's workshop, claims Janzen, the message to the World Bank and other funders is that all that's missing is the money to turn the ATBI concept into reality. "It's not as if we're up against a great intellectual black hole," he argues.

–Peter Aldhous