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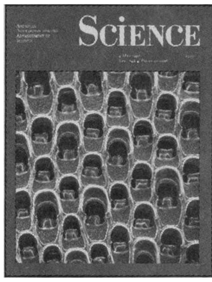

COVER Skeleton of a colony of the cheilostome bryozoan *Steginoporella magnilabris*. Features of individual modules (zooids, each about 1 millimeter long) that are preservable in the fossil record are sufficient to discriminate between morphospecies that breed true and are genetically distinct. Thus paleontologists can study evolutionary patterns at the species level in this group. See page 579. [Scanning electron micrograph by Susann Braden, National Museum of Natural History SEM Lab, Smithsonian Institution]

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Wiring the Campuses

The rapid evolution of computing technology in the last decade has presented higher education with a number of challenges. In the coming decade, there will be even greater challenges, particularly in connecting computers to one another and to information servers of all kinds. Without a plan to deal with these new challenges, the productivity of U.S. universities will suffer.

The key ingredient in the spread of computing in higher education during the 1980s was the introduction of the personal computer. The per unit cost of the personal computer was low enough that purchase decisions could be made by heads of departments or by principal investigators. Trade-offs could be made within local budgets, often without the campus administration realizing how fast things were changing. In the coming decade the computing revolution will continue as hardware costs come down, speeds go up, and, software takes more advantage of the hardware. Computers will cease to be merely a useful tool for scholarship but will become a principal tool. Access to library materials, to protein databases, and to specialized software and hardware will all be necessary for scholars to function effectively by the mid-1990s.

If universities are going to take advantage of the technology, they will have to plan now and invest now. Although it was painful for departments to discover that the campus administration was not going to provide new money for microcomputers, it was still possible for them to achieve a fair amount of computerization on their own. Networks are common goods; their value increases with the number of people and resources interconnected. Like highways and phone systems, they require central planning, management, and financing. The capital requirements for campus networks are quite high. At the University of California, San Diego, we are preparing a proposal for a new network that would require $1.4 million for the fiber optics portion. Network management and building-level electronics will bring the cost up to $2 million, exclusive of end-user electronics. If we had not put in a new phone system and local area networks, trenching costs and building modifications would have doubled the costs. Campuses that are older and more congested than ours will find the cost for trenching and retrofitting buildings much higher.

In the 1980s, higher education in the United States has managed to keep up with the computer age without an overall plan. This will not do in the 1990s. Already, the National Science Foundation has realized that scientists and engineers will need access to specialized computing facilities, and it has installed a national backbone network for this activity. Further, NSF has encouraged groups of colleges and universities to form regional networks that connect people to the backbone. It has done this by providing funding for the initial stages, particularly for the acquisition of hardware and installation of fiber.

The NSF's program in data communications is a good model, but it does not go far enough. Just as there is no point in building a national backbone if there are no regional networks to connect people to it, there is no purpose in having regional networks if the campus networks are inadequate to the task. At present, campuses are holding back from installing the needed fiber optics that will be required to take advantage of the national networks during the 1990s. Until universities see that there is a national policy regarding higher education data communications, they will continue to hold back.

NSF can further its good work by establishing a program to help "wire" the campuses with fiber optics. To encourage universities to formulate plans and to initiate project, the federal government should be prepared to provide matching funding—perhaps as much as 50% of the required costs for wiring campuses. A competitive grants program should be established to evaluate proposals, with first priority going to those that have the most innovative plans and are most likely to make effective use of the network. The new program should be established with add-on funds; it should not be implemented at the expense of individual investigators. If incentives are provided by the federal government to speed up the wiring of campuses, great progress can be made in both the quality and productivity of university-based research and teaching. Without some kind of federal help, universities will be slow and uncertain in their efforts to install fiber optic networks and will gradually lose the competitive edge they now enjoy over universities in other parts of the world.

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