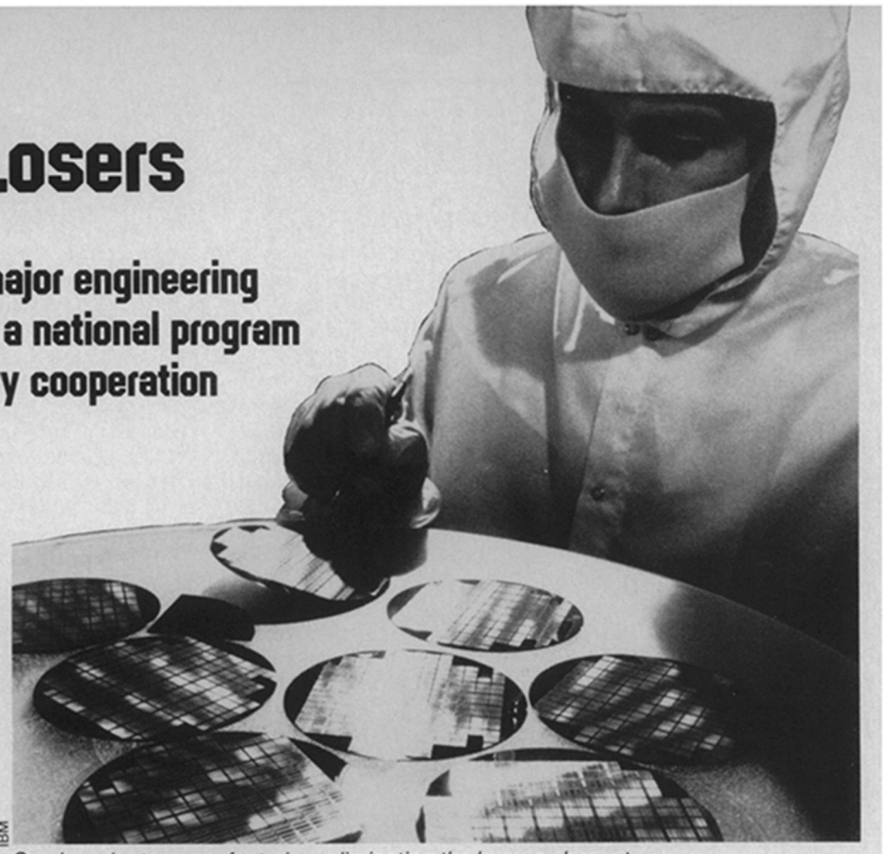
Winners and Losers

The establishment of six major engineering research centers is part of a national program to foster university-industry cooperation

By IVARS PETERSON



IBM

Semiconductor manufacturing: eliminating the human element.

"The good news is that you've survived what may have been the toughest grant competition in NSF history; the bad news is that now you have to do all those things you promised in the proposals."

With those words, Presidential Science Adviser George A. Keyworth II congratulated the people connected with the first six engineering research centers to be established at universities with funding from the National Science Foundation (NSF). Speaking at a recent symposium at the National Academy of Sciences (NAS) in Washington, D.C., he described the founding of these centers as the beginning of a major effort to develop closer ties between universities and industry — to speed the flow of new knowledge into possible applications and to provide the trained talent that industry needs for the future.

But the 300 or so symposium participants weren't there just to listen to theory. With millions of dollars at stake, almost every engineering school in the United States had submitted a bid in the original competition, and the losers wanted to do better in the next round. They were taking notes on how to write more enticing proposals.

The criteria that cut 142 proposals down to just six had to be stringent. The National Academy of Engineering had recommended that each center get enough funds "to make a noticeable difference in its area of research." And NSF had only $10 million available for fiscal year 1985. With this in mind, a special panel, composed largely of representatives from major industries, early this year began its review of the most highly recommended proposals.

"In a number of cases, the evidence of industry participation was weak," says Eric A. Walker, panel cochairman and president emeritus of Pennsylvania State University. "And, in a number of other cases, proposals were so broad that they were sort of a potpourri of research without focus. But a significant number of the proposals were on target."

Visits to the 14 finalists provided a sharper picture of each university's commitment to the idea of an interdisciplinary research center. Then came the "orals," at which the principal investigators associated with each of the proposals had a last chance to defend their plans. The panel selected six winners, and NSF followed its recommendations.

One winner was the University of California at Santa Barbara, which will receive up to $14 million over the next five years to set up a center for automating the manufacture of semiconductor devices. As the features on such chips get smaller and smaller, contamination, especially from human workers who have to handle the materials, becomes a serious problem. "You want to get rid of people as much as possible," says center co-director Susan Hackwood.

Columbia University in New York will get up to $20 million over five years to study the integration of data, graphics, voice and video transmissions into a telecommunications network. Unlike the Santa Barbara program, which is starting from scratch, this one already has a long history. But center director Mischa Schwartz faces a problem often encountered in work involving researchers from different disciplines. "How do you get these characters to work together?" he asks.

"Chemical engineers who know something about mechanics, and mechanical engineers who know something about chemistry," says Byron R. Pipes, will have plenty to do at the center for the manufacture and design of composite materials at the University of Delaware in Newark. About $7.5 million will go into designing new composite materials and automating the fabrication of high-performance materials now largely handmade. Ceramics research will be handled by Rutgers University in New Brunswick, N.J. Pipes says more than 50 companies have already signed up to support the work.

Robotics and systems research are the focus of the new center at the University of Maryland at College Park. Working with Harvard University and with up to $16 million in funding, this new center will look at problems like integrating data from arrays of "intelligent" sensors for applications such as flight control.

The Massachusetts Institute of Technology will receive up to $20 million to "create a new breed of professional," says Daniel I. C. Wang. "To get fundamental science researchers to work with engineers is no small matter," he says. But that kind of cooperation is needed before the products of biotechnology research can be marketed. Wang's center will look at new ways of processing and purifying complex biological materials like polypeptides.

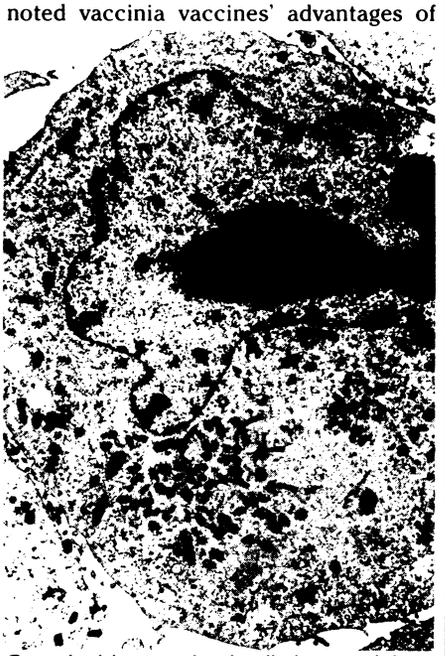
At Purdue University in W. Lafayette, Ind., a center for "intelligent manufacturing systems" will get up to $17 million to come up with machines that are capable of making independent decisions and of carrying out a manufacturing process from start to finish.

The victors, of course, were jubilant, but some researchers at the NAS meeting were concerned that this new NSF initiative could threaten other research efforts by concentrating scarce funds in the hands of a few universities and providing less for individual researchers. In fact, Keyworth predicts that funding for engineering research centers "could become

Continued on p. 382

Continued from p. 378

In a recent report, the National Research Council's Institute of Medicine noted vaccinia vaccines' advantages of



Moss

Once inside an animal cell, the vaccinia virus DNA replicates and is packaged into new virus particles (arrows) in the cytoplasm.

ease of production, low cost and use of live replicating viruses; but the report also noted some potential barriers. These include the inherent danger of potential side effects in individuals with dermatitis or immune deficiencies and uncertainties about when a vaccine has successfully "taken." The report also says that some countries might be reluctant to reintroduce the vaccinia vaccine now that the smallpox program has been dismantled.

Paoletti believes that the danger of side effects can be adequately reduced by employing standard medical screening practices to avoid vaccinating people with certain skin conditions or immune deficiencies.

A greater uncertainty, perhaps, is how the public will receive a live, genetically engineered vaccine. Some people consider it to be in the same controversy-provoking category as agricultural microbes that are to be released into the environment. Others argue that genetically engineered vaccines will be more predictable than the live vaccines already in wide use.

"To date, attenuation has been entirely empirical," says David J. Rowlands, who works on vaccine development at Wellcome Biotechnology Ltd. in Surrey, England. Viruses are just repeatedly grown in the laboratory until they become less virulent. Rowlands says the work on recombinant vaccinia virus by Paoletti and Moss is "one of the most exciting recent developments" in vaccine improvement.

According to Paoletti, "The wheel has been rediscovered." □

10 percent of NSF within a short period of time."

Larry W. Sumney, president of the Semiconductor Research Corp. in Research Triangle Park, N.C., pointed out some of the barriers to success. "Most universities are structured around discipline-oriented departments," he says, "and a faculty member's stature and rewards are strongly focused on personal achievements as determined by his peers within the discipline." Collaborative efforts run counter to that tradition. "There are case histories of faculty members whose careers have been adversely affected when they gave priority to such collaborations," he notes.

In addition, Sumney contends that universities are "not often well managed," a factor that could threaten a center's existence and success. Moreover, he says, 50 percent of academic research expenditures in engineering are concentrated in the 14 top schools. One objective should be to "elevate the research productivity of additional universities," says Sumney.

Finally, Sumney argues that "problem identification" should be a core concern so that research done is relevant to industrial needs. "History is rife with solutions to nonexistent problems," he says.

The optimistic view is that the new engineering research centers will help bridge the gap between the generation of knowledge and its application. "Today, fundamental scientific knowledge is one of our most effective forms of foreign aid," comments Roland W. Schmitt, chairman of NSF's National Science Board. "Unfortunately, it's foreign aid for our strong rivals — most notably, the Japanese." The hope is that these new centers will help strengthen the international competitive position of the United States.

For others, engineering research centers have another important role. "Imagine a medical school without a hospital," says one engineering professor. "That's the current position of U.S. engineering schools." Engineering research centers are the "hospitals" that may bring engineering research and education into the "real" world, he says.

"In some ways we are attempting to change the system, to push engineering research and education over a threshold into a new way of doing things," says H. Guyford Stever, president of the Universities Research Association in Washington, D.C. "So it is extremely important that we get it right from the beginning," says Stever, who chaired the NAS symposium.

Nevertheless, engineering research centers are still an experiment, and the results may not be known until well into the next century. "We don't expect all of these to be successful," says Nam P. Suh, NSF's assistant director for engineering. "Some are bound to fail." □