More active engineering role for NSF

For years there has been a growing movement within the engineering community to push for development of a technological analog to the National Science Foundation (NSF) — largely owing to a suspicion that engineering was never likely to rise above its stepchild status in an agency whose primary responsibility was a fostering of basic research in the pure sciences. Acknowledging that it might not always have been as nurturing of applied research as it could be, NSF has just embarked on a total revamping, expansion and rejuvenation of its engineering responsibilities. With its Jan. 28 reorganization of its engineering directorate, NSF aims to assume an active — even trend-setting — role in the support of both academic engineering research and industrial engineering excellence.


NIH

Biotechnology is a new area where special core-research programs will be sponsored.

Many of its changes reflect the ideas of Nam Suh, who has been in charge of the directorate since last October. Says Suh, "We are in some ways acting as an investment banker, generating new knowledge and manpower." Since any investment made today cannot be expected to pay off in benefits for a long time — perhaps before the year 2000 — he says, "our policies at NSF cannot be based on what the university community needs today." Rather, says Suh, NSF's investments must be directed toward future needs and engineering weaknesses.

Toward that end he has established a new interdisciplinary division for fundamental research in emerging and critical engineering systems. Some of the "emerging" areas — defined as offering promise for enhancing the nation's economy and security — include biotechnology, bioengineering and light-wave technology. "Critical" systems are those deemed essential to the nation's safety and health, including earthquake engineering, environmental engineering, toxic waste hazards mitigation and the systems engineering for large structures such as bridges.

Suh says universities have had trouble getting into these critical and emerging areas in the past for a number of reasons that NSF has only recently begun to appreciate. For example, solutions to these problems tend to be multidisciplinary. Yet university professors usually collaborate little, and when they do, only within departments. That's why, Suh says, NSF won't wait for biotechnology proposals for interdisciplinary research collaboration; the wait would be too long. Instead, his agency will actively solicit interest in developing university centers for biotechnology, offering to help create the infrastructure that will encourage such collaboration. He suggests that NSF's aiding in development of program curricula might even spur creation of a new breed of engineer, the biotechnologist.

Moreover, Suh points out that solutions to many of these problems require teamwork on a scale not usually encountered in universities. To prepare students for the scale of collaboration representative of the real world, NSF will encourage creation of university-industry centers to focus on critical large-scale problems, such as innovation in the design of bridges or a restructuring of the nation's highway arteries. This is an important area for NSF, Suh believes. Because it is the public that pays for developments in these areas, there has been little incentive for the commercial civil engineering sector to fund research or adopt cost- or resource-saving innovations, he says. The centers themselves may be funded out of his new Office of Cross Disciplinary Research.

Suh believes he was chosen for his new post in part because of his experience with such industry-university collaboration. The Massachusetts Institute of Technology's Laboratory for Manufacturing and Productivity, which he directed before coming to NSF, was such a center. "When I started our lab we had only a few students; it's become an organization of 150 people spending over $3 million of industrial money," he told Science News.

Another Suh strategem was the creation of an NSF division to develop a science base in design, manufacturing and computer engineering. Unlike pure science, which is based largely on knowledge systematized into collections of generally applicable principles, much of engineering is based on empirical knowledge — what one learns by experience. Each programmer, for example, develops his or her own approach to software design by trial and error, Suh notes. The same is true for welding and product design. However, attempts can be made to distill the experience base in many areas to scientific paradigms. In fact, Suh believes that's one of NSF's primary missions. This science of engineering, he explains, is essential research seldom tackled by industry.

Three other divisions complete Suh's organization: Chemical, Biochemical and Thermal Engineering, which deals with the transformation and transport of energy and matter; Mechanics, Structures and Materials Engineering, including geotechnology and building systems; and Electrical, Communications and Systems Engineering, related to basic electrical phenomena and the synthesis and analysis of devices.

Suh considers the $150 million engineering budget he has for this fiscal year "totally inadequate" — perhaps by a factor of 3 or 4. However, he says his reorganization may help him plead for more "where it matters, namely in the Congress and Office of Management and Budget." Explaining that it's hard to argue that mechanical engineering, per se, needs more money, he says he has no trouble justifying more for the priority programs he has given greater visibility through his reorganization.

—*J. Raloff*

Cereus bacteria go for the gold

For centuries prospectors have relied on plants, dogs and even bees to home in on mineral deposits. Now a group of researchers at the U.S. Geological Survey (USGS) in Denver reports that a spore-forming bacterium, *Bacillus cereus,* has a particular liking for topsoils overlying deposits of gold, copper and other ores that may be buried several hundreds of feet deep. While microorganisms have been used in oil exploration, this is the first indication that a bacterium might be a useful guidepost for mining, say the scientists.

Geomicrobiologists John Watterson and Nancy Parduhn presented their findings in Denver last week at the USGS-sponsored McKelvey Forum on Mineral Resources. Watterson outlined research done over the last two and a half years at a big copper deposit in Montana in which the count of *B. cereus* can run up to 100,000 times that of surrounding soils. Parduhn, following up on these studies, described recent soil surveys near gold deposits in California, Colorado and Nevada. She too discovered that *B. cereus* bacteria living over mineralized bedrock outnumbered their counterparts in unmineralized terrain.

Except for a few brazen plants and microorganisms, *B. cereus* is uniquely adapted to these kinds of deposit areas. Most other bacteria wouldn't dare enter Watterson's copper deposit, for example, because they would be killed either by the copper or by the penicillin and other antibiotics produced by metal-tolerant fungi that live in the soil. But *B. cereus,* the researchers believe, has learned to survive by stealing a water molecule from each penicillin molecule, leaving a gap in the penicillin that traps a copper molecule before either can hurt the bacterium. In this way, the bacteria continually detoxify the copper molecules migrating away from the ore site. (Penicillin is commonly used to treat copper toxicity in humans.) Watterson has found that the penicillin resistance of *B. cereus* increases the closer one gets to the deposit. The bacteria are also unusual because they feed on the metal-tolerant fungi, unlike other members of their genus.

Parduhn and Watterson suspect that *B. cereus* may have devised other survival mechanisms at different mineral sites and that it may respond differently to different minerals, but more study is needed. It is possible, says Parduhn, that the microbe is really keyed to an element associated with gold, such as arsenic, and not so much to gold itself. The researchers also think that *B. cereus* is not the only microorganism that prefers metal-rich areas. "We may well find there are others," says Watterson. "We're just looking at the tip of the iceberg."

Because each *B. cereus* seems to be genetically coded to survive in its particular soil, Parduhn believes the microbes may provide a much more sensitive way of searching for mineral deposits than conventional geochemical techniques. The researchers have yet to do extensive testing of their microbe method in areas previously untested for mineral deposits. But Parduhn expects that in a couple of years they will be out of the research phase and into an exploration mode. —*S. Weisburd*

New lead guidelines

The Centers for Disease Control (CDC) in Atlanta has revised its 1978 guidelines for the prevention of lead poisoning in young children. The 1985 standards, which appear in the Feb. 8 MORBIDITY AND MORTALITY WEEKLY REPORT, are much more stringent than those in the former version, particularly regarding dangerous levels of blood-lead concentration. The guidelines state that a concentration of 25 micrograms per deciliter ($\mu g/dl$) constitutes "an excessive absorption of lead" (down from 30 $\mu g/dl$ in the 1978 report). Lead toxicity has been redefined as 35 $\mu g/dl$ (formerly 50 $\mu g/dl$).

The CDC also strongly recommends that all children between the ages of 9 months and 6 years be screened, as this group suffers the most detrimental effects of lead toxicity. "To be successful," states the agency, "a screening program ... requires not only an acceptable and cost-effective screening procedure, but also medical follow-up and means of preventing the child from future exposure to lead."

The majority of lead poisoning cases in young children are linked to the lead-based paint used in pre-World War II housing. Although it is no longer used, the agency states that "27 million households in this country remain contaminated by lead paint." Other sources of lead poisoning can be found in lead-soldered food cans and airborne lead from car exhaust (SN: 6/16/84, p. 373). □

Vaccine for cats' number one killer

The first vaccine to prevent feline leukemia — the number one killer in domestic cats — is being distributed to veterinarians this winter. The vaccine, developed by Richard Olsen, professor of veterinary pathobiology at Ohio State University in Columbus and marketed by Norden Laboratories, Inc., in Lincoln, Neb., is the first vaccine against any cancer in mammals. Anticancer vaccines for chickens and other birds are already in use.

The feline leukemia virus (FLV), discovered in the 1950s to cause a fatal leukemia and other cancers in cats, also causes aplastic anemia, reproductive failure, respiratory infections and immune system failure. The virus's suppression of cats' immune systems can render them susceptible to many other infections that ultimately are fatal.

FLV infects about 1.5 million of the United States' 50 million pet cats and kills about 1 million of these each year. Most cats infected by the virus survive for a few years with little noticeable effect, Olsen says, but later die from immune suppression or other complications caused by the virus. Infected cats can spread the virus to other cats through saliva by grooming each other or sharing food dishes, or possibly through urine by sharing litter pans. Feline leukemia is the first cancer found to be spread by contact, but the virus apparently cannot infect humans or other animals.

The vaccine uses two viral proteins instead of killed or modified live virus to immunize cats. Using protein molecules is safer than using whole virus, Olsen says, because the whole virus risks infecting cats and causing a mild case of the disease, including the virus's suppression of the immune system.

One of the proteins protects cats from viral infection caused by FLV. The other prevents tumors caused by the virus, in case cats have already been infected and the vaccine cannot completely prevent FLV's growth. Thus, although the vaccine cannot totally protect cats already infected with FLV, it won't make the disease any worse, Olsen says, and it may even help cats that are in the early stages of the disease.

Can the feline leukemia vaccine provide clues for developing an AIDS vaccine? It's all conjecture at this point, Olsen says. Both FLV and the purported AIDS virus are retroviruses that cause immune suppression. "Conceivably," Olsen says, "the technique used to develop the FLV vaccine can be used to develop an AIDS vaccine."

—*D. D. Bennett*

Toxic pollutants in 'Chemical Valley'

West Virginia's Kanawha River tumbles through one of the most highly industrialized valleys in the United States. Almost 200 facilities, including several giant chemical plants run by major producers such as Union Carbide Corp., dot this long narrow "Chemical Valley," as it is known locally. Last week, the Environmental Protection Agency (EPA) released a study suggesting that the 220,000 people living in the valley are not adequately protected from toxic pollutants in the air and water.

This study, started in July 1983 and completed a year later, focuses on the chronic release of various hazardous substances from area plants and abandoned waste dumps. Although substantial improvement has occurred since 1977 when the last study was done by EPA's National Enforcement Investigations Center, the report says, "Toxic substances continue to be released to the environment in wastewater discharges and air emissions and are present in large volumes in hazardous waste disposal sites." Furthermore, it states, "Toxic substances in the air pose potential health risks at some locations under adverse meteorological conditions."

The EPA report, however, says nothing about episodic releases of toxic substances, which have also become a major concern in the area. Since last December, a great deal of attention has focused on the Union Carbide chemical plant in Institute, W. Va., a small town in the Kanawha Valley. This plant is very similar to the one in Bhopal, India, where a leak of methyl isocyanate vapor led to the death of thousands of people (SN: 12/15/84, p. 372).

Last month, a special EPA investigation revealed that Union Carbide employees failed to report, as required by law, at least 28 methyl isocyanate spills at the Institute plant. These spills, mostly small, took place over a five-year period. One spill, however, allegedly involved 840 pounds of methyl isocyanate, but Union Carbide officials later drastically lowered their estimates of how much material had leaked. They admitted making mistakes in compiling the information for EPA.

This and other discrepancies prompted Reps. Henry A. Waxman (D-Calif.) and James J. Florio (D-N.J.) last week to ask the General Accounting Office (GAO) to investigate EPA's data gathering methods. Their letter to GAO says that the discrepancies raise serious questions about the reliability of any data given to EPA, especially because Union Carbide has a reputation for being one of the more safety-conscious chemical companies. This spring, Congress also faces a slew of committee hearings and bills that address issues raised by the Bhopal disaster. —*I. Peterson*