CD4s, two groups of promising drugs that are in the early stages of safety and efficacy testing in humans. As early as 1975, it was learned that TNF can inhibit tumor growth by triggering the deployment of immune cells that damage tumor-nourishing blood vessels. Now Genentech, Biogen, and Knoll Pharmaceuticals are all testing recombinant TNFs to treat cancer in humans. The problem is that this work strains the limits of the hottest researchers, because it still isn't clear exactly how TNFs work. And the FDA has a tough time recruiting the scientists it needs to review these drugs.

Nor are they likely to make quick intellectual work of CD4s, recombinant copies of the cellular receptor that the AIDS virus binds to. Two companies, Genentech and Biogen, have just started testing genetically engineered CD4s in humans, where they hope the drugs will act as decoys to bind the virus, protecting white blood cells from infection. Although the method copies nature through the use of CD4 receptors, it isn't using CD4 in the way that nature intended—and large quantities of the molecule circulating in the blood could have a wide variety of unintended consequences, since CD4 is a key element in immune system regulation.

Is anyone besides the manufacturers worried? In a report earlier this year, the Vice President's Council on Competitiveness said—in what might be taken to be a bit of hyperbole—that it is concerned that regulatory delays at all agencies could jeopardize the nation's lead in the international biotechnology industry. And beyond the fashionable buzzwords like competitiveness, there is a hard, underlying reality in the potential biotech bottleneck: Delays keep drugs from dying patients.

At least eight of the monoclonal antibodies in the pipeline are intended to treat life-threatening diseases. Genentech's president, G. Kirk Raab, says the most powerful argument for speedy approval is "to get the drugs to the people who need them. The FDA's role is not to protect small industry or American competitiveness."

The FDA responds that drugs for life-threatening diseases—particularly AIDs—are already fast-tracked. Says Miller, "The argument that the agency is in big trouble just doesn't hold water." Nonetheless, he is concerned about the growing workload for those at the FDA who approve new biotech drugs. More than two-thirds of all active investigational new drug (IND) applications to one FDA center are for biotech products, and that number is expected to grow from 2600 this year to 3250 during 1992.

Although a large infusion of new resources for the FDA may not be a realistic possibility, Grant, an M.B.A. who was on the Edwards Commission, has some suggestions that might help avoid a bottleneck without too much new cost. One would be to convene an outside group of expert medical and scientific authorities who would help the FDA "rethink the whole process" of how it reviews drugs. In particular, it should consider new ways of streamlining the way it measures the safety and efficacy of new biotech products, Grant says.

"One glance into the future shows a biotech research pipeline on the brink of a bottleneck."

—Thomas L. Copmann

New FDA head David Kessler apparently is listening to such ideas. Earlier this week, in a speech to 100 biotech company leaders, he said he had hired a new senior science advisor, and had set up an in-house committee to reconcile differences between the two main FDA centers that approve biotech products to help speed up the review time. Changes also are being made in the agency's management, including better computer systems to track and evaluate the approval of drugs. Whether Kessler, with his limited resources divided among many congressional mandates, can reduce the bottleneck that so many industry insiders fear won't be known for a while. But the answer will determine whether the 1990s is to be a decade like the 1980s for the biotech industry—a time full of promise but only moderate hard payoff—or a decade that sees the promissory notes, for the first time, redeemed in a big way. ■ ANN GIBBONS

They'd Rather Switch Than Fight

The huge number of college students who choose science, math, or engineering majors only to drop out is alarming the National Science Foundation (NSF), and members of the scientific community generally. As NSF calculates it, the attrition rate is as high as 60%. Just why it's so high is a puzzle. Faculty members often blame the students, arguing that the dropout rate is due to educational weaknesses among the students who switch. Alternatively, they cite factors over which teachers have little control, such as large classes or inadequate lab facilities. But maybe it's time to focus on the quality of teaching itself—at least that's the conclusion of a preliminary study by two sociologists at the University of Colorado at Boulder.

Switch analysts. *Nancy Hewitt* (left) *Elaine Seymour.*

Work by Nancy Hewitt and Elaine Seymour, research associates at the university's Bureau of Sociological Research, takes issue with the "weak students" hypothesis. The two researchers interviewed 149 students at four colleges and universities, including 61 switchers and 88 nonswitchers, and found that "the switchers and the nonswitchers are essentially not two different kinds of people," as Seymour puts it. "They're not the untalented versus the talented or the lazy versus the hard-working or people who have problems of some kind versus people who don't have problems."

What all share are problems with the science faculty at their schools, the sociologists discovered. The chief complaints were poor teaching and unapproachability on the part of the faculty members, who didn't seem to have much time for undergraduates. And here came a pointed difference between the two groups: The switchers didn't find any way to cope with these difficulties; the persistent nonswitchers did. Yet even among those who stuck it out, a telling 40% reported being "turned off" to science by the experiences they had as undergraduates.

A quarter of the nonswitchers added another telling observation to their complaints about faculty laissez-faire: They had come to believe, they reported, that other majors were intrinsically more interesting than sci-

ence and engineering. And a slightly smaller but still significant percentage cited an aversion to the lifestyle associated with careers in science and engineering.

As significant as the factors that led undergraduates to choose other majors, say Hewitt and Seymour, are some of the problems that, while mentioned by both groups, were not cited by the switchers as reasons for dropping out of their major. Poor teaching by graduate teaching assistants (TAs) was one, language difficulties on the part of foreign faculty and TAs another, and large class size and poor laboratory or computer facilities yet others. Many of these complaints will sound familiar because they are frequently seized on by institutions and professional associations brainstorming on how to explain student attrition. But study coauthor Seymour points out that "we've not had one single switcher tell us yet that those problems were part of the set of reasons [for leaving science]."

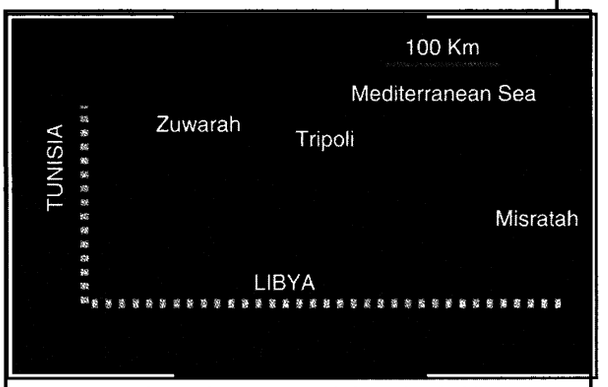
There is an optimistic side to the Colorado work: Because both of the main factors that distinguish switchers from their nonswitching peers are amenable to change, according to the authors, universities can take some important steps to stop the science "brain drain." For example, the authors observe that those who stay in science seem to develop a study "support network—people who are in the same boat who are willing to work with them"—that helps them get through the rough parts. Universities, Seymour concludes, can take steps to encourage the development of such groups early in the students' careers.

As to complaints about lack of faculty support, the Colorado sociologists posit that many science departments intentionally scrimp on the kind of course and career advising that helps students survive because of a "weed-out" mentality that assumes attrition is actually a good thing, because it leaves them the best and most dedicated students. That outlook, the authors note, is mistaken. As one professor told the authors: "We're not just weeding people out, we're ripping out half the garden."

Of course, institutions will never reduce to zero the attrition rate of undergraduates leaving science for other subjects—nor should they. "They will still have people who are not up to it, and they will still have people who don't work hard enough," notes Seymour. But, she adds, institutions can eliminate the waste of students who are talented enough and willing to work, but who are put off by the institutional barriers. Which is why the Colorado sociologists have plans for a nationwide sampling on this topic. But, they point out, teachers and university officials needn't wait for the larger sample: They can begin listening to students now. ■ BARRY CIPRA

UN Claims Victory in Desert War

Shortly before noon on Thursday, 7 February, four planes carrying United Nations insignia flew low over a large, predominantly Islamic nation, opened their cargo bays, and unleashed a potent biological weapon. If this sounds like recent world history turned on its head, it is no fantasy. The nation being "attacked" was Libya, and the biological weapon being employed was 40 million sex-starved-but-sterile male screwworm flies, whose larvae feast on living flesh. With the world distracted by the Gulf war, forces of the Food and Agriculture Organization (FAO) of the United Nations had started a war of their own, not against Libya's leader Muammar al-Qaddafi but against a cattle pest that had long plagued South America, occasionally killing people as well as livestock, and that had only recently established its first beachhead in Africa. The battle plan was to shower Libya with sterile impostors that would mate with native flies—indeed, mate themselves into oblivion.



Biological weapon and target zone.

Seven months and 1.3 billion flies later, FAO last week declared victory. Screwworms apparently have been wiped off the face of North Africa, more than a year ahead of schedule. No new cases of screwworm infestation in Libyan livestock have been reported since April. Moreover, the FAO's campaign to eradicate the pests cost only about $65 million (Libya kicked in $27 million)—a little over half the originally estimated $117 million.

The sterile insect technique employed by FAO was developed by U.S. entomologists in the 1950s to eradicate screwworms from the United States and Mexico and is currently being used successfully in Central America as well. The strategy is simple: Overwhelm fertile female flies—which mate only once, then die—with an abundance of sterile males. The females don't produce offspring and after about 10 lifecycles, the population dies out.

The pest first showed up in Libya 3 years ago, apparently having hitched a ride on imported South American sheep. It began to spread rapidly. In September 1990 alone, 2932 new cases of screwworm infestation were reported among Libyan livestock and computer models predicted that the pest might migrate south. If that happened, "you could essentially kiss goodbye a great deal of the livestock south of the Sahara," says Patrick Cunningham, director of FAO's screwworm emergency center for North Africa. Even a small number of sub-Saharan livestock lost to the parasite could have crippled the African food supply and might have wiped out some endangered species, says Cunningham. Which is why the FAO began to mobilize last year.

Some deft political maneuvering was needed to enable the U.S. Department of Agriculture (USDA) to supply FAO with the sterile flies, which are bred at a USDA laboratory in Tuxtla Gutierrez, Mexico (see *Science*, 5 July, p. 28). The department is prohibited by law from providing high technology to Libya, but legislation signed by President Bush in March 1990 specifically exempted sterile screwworms from export controls. The idea for the legislation began quietly at the cabinet level and included Secretary of Agriculture Clayton Yeutter and Secretary of State James Baker, says Paula Henstridge of USDA's legislative office. "They realized there was a potential for a very serious problem" spreading through Africa, she says. No longer. But despite its spectacularly successful air war, FAO hasn't planned any parades to celebrate the rout of its opponent, even though, unlike in the other desert war, victory seems complete. ■ RICHARD STONE