down at a Control Data computer terminal in any of 20 countries and enters key words for some technology he needs—say a process for preserving milk cheaply in a tropical climate. After a dialogue with the computer to exclude extraneous information, the subscriber might receive a description of how a mixture of yogurt and bulgur serves this end in the Middle East. If the technology requested is so complex that no known solution is presently available, the WORLDTECH system could supply the subscriber with the names of researchers in the specific area.

Two fundamental assumptions obviously lie behind CDC's latest gamble in a particularly tricky market—assumptions that say much about the changing status of East-West relations and the expanding role of technology in business.

First is the assumption that the usual course of attending meetings and reading journals is no longer adequate to tell an industrial engineer all he needs to know about what is going on in his particular specialty. Indeed, the most common complaint one always hears at meetings—aside from the usual grousing about the economy—is the increasing inability of conscientious professionals to "keep up with the literature." Communications experts have been predicting for years that computers will soon be needed to help scientists and engineers supplement their general reading with specific information about their narrow specialties. These predictions may now be coming true.

The second assumption is that American industry can no longer afford to "go it alone"; that international competition is now so keen that U.S. businessmen need all the help they can find—even from the Russians. Again, a common complaint concerns the decline of American productivity and competitiveness in world markets. Technology exchange with the Soviet Union is already old hat to some other countries. West Germany probably has the most extensive East-West exchange program of any nation and has apparently profited for its initiative.

The need for more American interest in technology exchange is perhaps most bluntly summarized by CDC's chief executive officer, William C. Norris. "In a crowded elevator in Moscow, Bucharest or Paris," he grumbles, "you aren't elbowing Americans, but Japanese who are looking for technology and other business opportunities." The result, he says, is a loss of American jobs.

A growing recognition of the need for more international technical cooperation—regardless of the current political "climate"—is reflected in the Soviet willingness to enter more exchange agreements, to participate in seminars and to submit their new technologies for dissemination through systems like TECHNOTEC. That may say a lot more about the status of detente than any pronouncements in Washington or Moscow. □

OFF THE BEAT

Gene-splicing research: Some safety advice from virus scientists

By now almost all have had at least their first say about recombinant DNA research. We have heard from the scientists who are and are not engaging in experiments using this tempting technique. We have heard from political groups interested in protecting public health and the environment. We have heard from drug companies eager to exploit the pharmaceutical possibilities.

Discussants have locked horns over such difficult questions as whether the speculative potential for good outweighs the speculative potential for harm, what the consequences of this research might be on evolution and how the right to free inquiry balances against a scientist's responsibility to protect the public.

While these questions certainly must be discussed, there are also some very concrete issues worth considering. Bacteria containing spliced genes are not suddenly endowed with magical powers for good or evil. They are still living organisms that will behave in familiar ways. The worst immediate disaster I can imagine from recombinant DNA experiments is an organism causing a terrible human disease. Yet there are laboratories that study viruses and other organisms known—with 100 percent certainty—to cause severe diseases. So when the topic of recombinant DNA research came up among some of these researchers at the Gustav Stern Symposium for Perspectives in Virology last week, I was interested to find out what virologists had to say.

"Until the relevant animal experiments are performed [to demonstrate whether a new hybrid will cause disease], containment is our safeguard," Thomas Weller of the Center for Prevention of Infectious Diseases at Harvard School of Public Health said in an after-lunch speech. "A common and rigorous technique must be applied."

Of the two types of containment required for recombinant DNA experiments, the more novel approach is biological containment. The DNA researchers use experimentally disabled organisms unlikely to survive outside of defined, laboratory conditions. Virologists, however, are experts at physical containment—wearing gloves, decontaminating glasswear, working in defined areas—because in their work it is all the protection they have.

Weller is concerned that in the excitement of the DNA research, the rigorous physical safety measures might not be followed religiously. "The bubbling ferment of discovery in science is a unique intoxicant that when quaffed is at once a stimulant and a depressant," he said. "The stimuli of discovery are self-replicating, induce an intensified investigative drive and a lowered threshold of irritation for interfering constraints, particularly those that impinge on intellectual freedom and the design of experiments. Meanwhile, receptors attuned to the realities of the *in vivo* [whole organism] world are depressed." The virologist's realities are tumors that develop in a newborn hamster inoculated with a virus benignly coded SV40 or the fever caused by another virus called VSV. He worries that young investigators trained only to work on cells grown in the laboratory or molecular biologists accustomed to *E. coli*, the standard research bacteria, have not been impressed with these disease possibilities. Because classical sterile techniques have not been necessary for their previous work, the young investigators pour and splatter protected only by what Weller calls "a tutor-induced psychological gown and mask."

Edwin H. Lennette of the California State Department of Public Health agreed: "Weller said with humor what I've been trying to say for years." Lennette suggested that recombinant DNA researchers be required to work in a clinical microbiology laboratory for about three months, until they learn to react correctly, without thinking, to a spill or dropped test tube.

A recently trained molecular biologist, admittedly defensive, counters that prior training in "sloppy" *E. coli* work shouldn't be considered an automatic handicap. "Individuals vary a great deal in their approach to lab safety, and that is not correlated with the area of their training, but with some more basic aspect of personality or concern for others, or general responsibility," he says.

Whether or not molecular biologists and young investigators are initially unprepared for the rigors of protective laboratory techniques, Weller believes that enforced adherence to the standards set up in the NIH guidelines will narrow the safety technique differences between investigators. "The guidelines are an operational bible, and the new commandments should be honored in spirit and in fact," Weller says.

In the meantime, Weller offered some advice from his own experience in a laboratory equivalent to the guidelines' P3 level. Even a conscientious scientist, he warned, may not notice an air filter inadvertently mislocated, a broken fan motor in a distant location, or insects and rodents in the building. Says Weller: "Until the present generation of investigators becomes skilled in the science and art of high-level physical containment, some mechanism should be developed to provide recurrent inspection and certification of facilities by experts from without, as well as within, the sponsoring institution."

—Julie Ann Miller