"Of course, Exxon has some ideas on what they do and do not want done," he adds. "But then so does any funding agency. We have not found Exxon to be overbearing or second-guessing." Longwell says that the company has discouraged about 20% of the projects proposed by the lab—"some they wanted to keep internal, in a few they said their interests were diminishing, such as in emission control research." He notes that Exxon's initial interest in environmental controls faded in favor of work on manufacturing processes. "When times get tough, which they are now, things like that tend to drop out," he says.

Whether Exxon and the lab's other industrial sponsors have been "overbearing," the annual summary of research projects published by the lab indicates an overwhelming interest in topics of direct value to big business. Of 144 projects listed in the 1985–1986 edition, one was related to photovoltaics and three to biomass. None of these was funded by industry.

"Our attitude has consisted in seeking out the best-of-breed departments and identifying faculty members who have individual interests that are compatible with areas we are pursuing," says Christopher Bajorek, director of technical development at IBM, echoing a typical sentiment. "In some cases, we take a more active initiative by encouraging departments to undertake research in areas they were not very active in. But nucleating an effort is not as successful as leveraging an already strong program."

Exactly what happens to universities when multibillion-dollar corporations leverage the best-of-breed departments over many years remains to be seen. "As long as we maintain a policy against secret research, then the source of funding is immaterial," Malcom Gefter offers. "Even Hoechst's $70-million sponsorship of Massachusetts General Hospital has turned out to be pretty ordinary. The pressure on a researcher to go with the money is there whether it's the government or industry, though the government may seem farther away."

Gefter and others who have been wary about industrial funding note that it still accounts for a small fraction of total research support. According to Smith at MIT, licensing income to universities from all academic science research in 1986 was just $20 million. But if corporate money on campus continues to increase at anywhere near MIT's impressive rate of 20% per year, the issue of its effect on the direction of research will become less and less academic. ■

WAYNE BIDDLE

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AIDS and Insects

If you can get AIDS from sharing needles, why not from mosquitoes? The answer lies in the quantity of blood

IT would make a most chilling headline: BLOOD-SUCKING INSECTS CARRY DEADLY AIDS VIRUS. But there is a world of difference between harboring the virus and transmitting it.

The grim specter of insects and AIDS is in the news because of recent revelations by a Florida entomologist and Robert Gallo of the National Cancer Institute that mosquitoes can carry the AIDS virus.

Jai Nayar of the Florida Medical Entomology Lab in Vero Beach collaborated with Gallo's lab by rearing colonies of "clean mosquitoes" and encouraging them to ingest the AIDS virus, which the insects did by jabbing their stylets through a membrane of goat gut and sucking on human blood with extremely high concentrations of human immunodeficiency virus or HIV—blood that contained 1000 to 1 million times more virus than an infected person would have coursing through his body. Forty-eight hours later, the researchers in Gallo's lab were still finding infectious virus in the mosquitoes.

Reports Gallo: "Mosquitoes bite. They take blood and virus particles. It shouldn't surprise anybody that they can harbor the virus. But we have no indication that the virus replicates inside the mosquito and no evidence to show that mosquitoes can transmit AIDS."

The story was first leaked to the *Atlanta Constitution*. Neither Nayar nor Gallo knows how. Calling some coverage of the research "bizarre and irresponsible," Gallo says that television stations have run footage of him shot during the recent international AIDS conference in Washington, D.C., and made it appear as if he were giving a press conference on AIDS and mosquitoes, which he did not.

"I'm furious. I'm really, really disturbed by this," says Gallo. "All this should never have been in the media." The research results have not yet been formally published. Gallo adds that the mosquito research is "a very low priority" at the cancer institute.

Still, public concern over the matter has been piqued, and the issue is being vigorously pursued by two Florida activists who are convinced that AIDS is insect-borne. With that in mind, the Office of Technology Assessment (OTA) held a workshop 8 July to ask the question: Can the AIDS virus be transmitted by insects? The answer seems to be no, but not a completely emphatic no. Scientists want to leave the door of possibility slightly ajar. But they insist that if insect transmission is a factor in the spread of AIDS, it is an insignificant one.

For openers, epidemiologists at the OTA meeting said their data do not indicate that the AIDS virus is passed by insects. "If it's happening, it's not showing," says Harold Jaffe of the Centers for Disease Control in Atlanta.

In the United States the disease continues to plague traditional risk groups: homosexuals and intravenous drug users. If insects were a factor, says Jaffe, significant numbers of children would also be infected with the virus; but they are not, even though children get their fair share of insect bites. In Africa, where the disease afflicts men and women almost equally, AIDS remains a disease of the sexually active.

The two activists who came to the OTA meeting vehemently disagree with the assembled experts. Mark Whiteside and Caroline MacLeod, codirectors of the Institute of Tropical Medicine in North Miami, maintain that environmental factors contribute greatly to the spread of AIDS, conditions that they say explain the unusually high rate

The Miami Herald/Battle Vaughan

Caroline MacLeod. *Criticized for not substantiating her claim that mosquitoes are spreading AIDS virus.*

of AIDS infection in the town of Belle Glade, Florida, where many residents live in crowded, squalid conditions—"where 100 insect bites a day are not unusual," says MacLeod.

In 1986 the Centers for Disease Control concluded that sexual contact and shared needles are responsible for the high incidence of AIDS in Belle Glade, not swarms of mosquitoes (*Science*, 24 October 1986, p. 415). During the day-long workshop at OTA, Whiteside and MacLeod were frequently criticized for not publishing any data that could substantiate their claims that insects and cofactors such as malaria play a significant role in AIDS transmission. The two were not to be dissuaded. Their ideas, however, "are shared by very few, if any, workers in the field," says Larry Miike, the OTA official who organized the workshop.

There are two ways in which a blood-sucking insect can spread disease: biologically and mechanically. Biological transmission occurs when an insect ingests blood infected with virus, which then replicates inside the host, eventually finding its way to the insect's salivary glands. Saliva may then be secreted by insects during feeding to keep blood from coagulating. Unlike some particularly nasty viruses—yellow fever, dengue, and encephalitis—there is no evidence to suggest that the AIDS virus replicates inside insects, and thus biological transmission of AIDS is impossible.

It is more difficult to categorically state that mechanical transmission of AIDS does not happen. Mechanical transmission of virus could theoretically occur if a mosquito, for example, was interrupted while feeding on an infected host, then flew to another person and injected a tiny portion of tainted blood. Says Leon Rosen, a virus specialist from the University of Hawaii at Manoa: "The question the layman is asking is 'if you can get AIDS from sharing needles, why can't you get it from mosquitoes, which are just tiny needles?' "

The answer is volume, the scientists say. Biology is quantitative. The proboscis of a mosquito or the mouthparts of a bedbug apparently do not hold enough residual blood to give an infectious dose.

Charles Bailey, an entomologist with the U.S. Army Medical Research Institute of Infectious Diseases in Fort Detrick, Maryland, sketched this scenario: Assume a person infected with AIDS virus had a concentration of 1000 units of free virus per milliliter of blood. Bailey estimates that a mosquito interrupted during feeding on this host could inoculate a second person with approximately 0.0000000001 milliliter of infected blood. "Thus the chances of inoculating a single unit of virus would be 1 in 10 million," Bailey says. "That's what I call a remote possibility."

Such arithmetic, though, can raise as many questions as it answers. "Part of the problem is we don't know how much virus a person must get to be infected," says Thomas Monath of the Center for Infectious Diseases in Fort Collins, Colorado. In fact, researchers are not sure how much virus an AIDS patient has in his blood at different stages of the disease.

Perhaps the most puzzling, and morbidly fascinating, unknown came from Jean Claude Chermann of the Pasteur Institute in Paris. Chermann and his colleagues have found genetic material in African insects that is remarkably similar to that of the AIDS virus. Using nucleic acid probes, Chermann detected HIV-1–related sequences in a number of insects collected in Zaire and the Central African Republic. The genetic material is found in cells in tissue throughout the insects' bodies. It is also found in male mosquitoes as well as females, although male mosquitoes do not feed on blood. More bizarre, insects that are not even blood-sucking species have turned up with genomes having sequences very similar to the AIDS virus, insects such as cockroaches and ant lions.

Chermann is at a loss to explain how the genetic sequences are getting into the insects. Blood-sucking insects could be getting them from infected blood, then passing them to mates and offspring. But cockroaches? "Maybe they are feeding on soiled bandages or sores? I don't know," says Chermann.

Chermann points out that he has found no free virus in the insects and no HIV-related proteins or RNA. The virus is not replicating in the insects, he says.

Most workshop participants agreed that scientists need a better idea of how concentrated the AIDS virus is in infected persons. They also suggested finding good animal models to test the possibility of mechanical transmission of AIDS virus from insects.

Several participants, though, took the position that further research is not warranted. "Everything we heard was theoretical or parallel. There's no evidence the virus replicates. No evidence it is transmitted mechanically. No evidence it is transmitted biologically. The urgency is not there," says Donald Burke, a virologist with the Walter Reed Army Institute of Research in Washington.

Bailey put it this way: "I'm a medical entomologist. Nothing would enhance my career more than for there to be a link between AIDS and insects. But there is not a shred of evidence to indicate that HIV is being transmitted by insects. Not a hint." ■ **WILLIAM BOOTH**

Some Refuseniks See No *Glasnost*

American scientists returning from visits to the Soviet Union report that some Soviet refuseniks feel that their position has actually deteriorated in the atmosphere generated by General Secretary Mikhail S. Gorbachev's reform initiatives.

Refusenik is the term given Soviet citizens of Jewish background who have applied to emigrate and been refused permission to leave. The refuseniks are said to feel that they no longer receive the support from scientists abroad that they regarded as effective in their behalf. Changes in Soviet law on emigration and travel are also said to have made matters more difficult for some.

Americans returning recently say that refuseniks appear to be receiving differential treatment from the government. Long-term refuseniks, those whose applications for emigration date from the 1970s, continue to be denied visas while many who applied more recently are granted permission to emigrate. A number of scientists, engineers, and others with technical backgrounds are included in the former group.

In the Soviet system that classifies ethnic groups separately, Soviet Jews are the only "nationality" that has been permitted relatively large-scale emigration. Jewish emigration built to a peak in the middle 1970s after U.S.–Soviet détente, but has been tightly restricted in recent years. Comments by Gorbachev have been interpreted as signaling a prospect of increased emigration. Morris Abram, chairman of the National Conference on Soviet Jewry, said recently, however, that although 3092 Jews had been permitted to emigrate so far this year, the number falls far short of the large-scale emigration that Soviet officials indicated would occur.

Changes in the law governing emigration and travel outside the Soviet Union seem to be a mixed bag in respect to liberalization. The new law includes specific provisions for what has previously been handled administratively and that is regarded as a step toward the rule of law.

Physics professor Kurt Gottfried of Cornell, however, says that refuseniks in Moscow told him that "while the new law looks better, it is, de facto, much worse." Gottfried and physicist Andrew M. Sessler of Lawrence Berkeley Laboratory, who are active in the Scientists for Sakharov, Orlov, and Shcharansky (SOS) organization formed by American scientists to promote human rights, visited Moscow in May.

They report that a particular concern for