er, Werb says, "there are people who worry that if you give something out to a big lab, they will put several postdocs on it" and grab the discovery as their own. "With PCR, all you need is to see a sequence at a meeting," she adds. As a result, says Richard Losick of Harvard, some people have taken to revealing only partial data while still trying to "stake their claim." "I would insist," he adds, "that they provide the entire DNA sequence."

In a world where authority rests on prestige and there are no laws or courts of appeal, the rule of sharing can sometimes be tricky to enforce by peer pressure. Consider an alleged case of nonsharing by Shyh-Ching Lo, until recently an obscure researcher at the Armed Forces Institute of Pathology.

In 1989 Lo published an article describing a "virus-like" organism (later confirmed as a mycoplasma) associated with cases of AIDS (*Science*, 28 April 1989, p. 416, and 11 May 1990, p. 682). The first reaction of some colleagues was to grumble that the tests must have been contaminated. Robert Gallo, perhaps the government's best funded and best known scientist, demanded Lo's materials through a colleague in Gallo's lab. Lo stalled, in part, he says, because the agent was not yet fully characterized, in part because "we were one small group, and we didn't think we could afford too much effort preparing it." Also, he was trying to get other papers published. He suggested that Gallo become a collaborator.

Gallo phoned Lo's superior—Captain Robert Karnei—and, according to Lo, said, "Get all the specimens ready; we'll come get them right now." There was an argument. Karnei declared he was not taking orders from Gallo. Articles appeared in the press challenging the credibility of Lo's work. Then Karnei and Lo arranged for a network of collaborators to get the material and confirm their findings. Now, Lo says, "We try to give reagents to any people who are credible. Lo finds the charge of nonsharing ironic, for he considers Gallo reluctant to share himself. Gallo responds: "That's utter nonsense. We made no demands. . .I just wanted to get at the truth." He says Lo's refusal to share reagents with him, which continues to this day, is "outrageous" and "unprecedented in my experience."

Given that no one really wants a central arbiter for these matters, what is the best way to ensure that the data-sharing ethic will be applied broadly and fairly to all nonprofit labs? One step—already being taken—would be to define more clearly what's expected of grant recipients and federal employees. Agencies like the National Aeronautics and Space Administration, the Environmental Protection Agency, and the National Institute of Justice have for years required that grantees make raw data fully available after publication. The NSF and NIH have formally adopted this principle recently. Another technical step that might smooth reagent transactions would be to adopt a single format for the "materials transfer agreement" that university licensing offices use in sharing research products.

But rules governing data sharing have not generally had much bite—at least not till now. Take the cases of crystallographic data and genetic sequences. A group of crystallographers criticized their peers last year for publishing articles in which they report the structure of a molecule but fail to give all the spatial coordinates (*Science*, 15 September 1989, p. 1179). The critics lobbied about 40 journals to require that authors deposit coordinate information in a public data bank at the time of publication. A handful, including *Science*, agreed, though generally they accept the author's word on this without double checking. Meanwhile, the International Union of Crystallography formally recommended in 1989 that all authors should deposit data in a public file, and last month, the National Institute of General Medical Sciences at NIH sent word to researchers that grant applications will "be examined for compliance with the IUCr recommendations." Funding may be restricted "until the situation is remedied."

There is a similar problem with DNA sequence data, according to Paul Gilna, biology domain leader at GenBank, the U.S. depository for genetic information maintained at the Los Alamos National Laboratory. Many journals want to report the substance of a new DNA discovery without printing the long sequence itself. They ask that the author send the details to GenBank so that they will be publicly available when the article comes out. But Gilna says that quite often he has not received the data when an article comes out stating that the details are on file at GenBank. A simple way to enforce the deposition requirement, he says, would be to publish the official GenBank accession number with the article. It only takes a week at most to get one.

On a positive note, Lederberg thinks that the key is to provide more incentive for sharing. "We don't have a good system for giving credit," he says. For example, "Some fairly famous cell lines were generated by obscure people." If people were rewarded for contributing to data banks or making reagents available—perhaps if review committees gave extra credit to grant proposers with a record of generosity—it would enhance "the scientific ethos."

■ **ELIOT MARSHALL**

Information Decontrol Urged

Recent discussions on how to liberalize the Western export control system have concentrated on the complaints of American industry. But last week a panel of technology experts warned Congress that scientific progress in the United States could still be constrained by burdensome information controls unless the government acts to improve the situation.

John Shattuck, a vice president for government, community, and public affairs at Harvard University, told the House Science, Space, and Technology Committee that concerns about the strategic and commercial importance of scientific information have led to "an extensive system of export controls" over categories of technical data, communications between scientists, and "sensitive unclassified" information.

Most of these controls were placed on scientific and technical information during the Reagan Administration. They caused a furor in the mid-1980s, when they were used to deny visas to Soviet scientists planning to attend a scientific conference and prompted papers to be withdrawn at a few scientific meetings. Though the issue has receded into the background in the past few years as the number of heavy-handed attempts to control information have declined, some of the restrictions remain on the books.

For instance, current interpretations of the 1979 Export Administration Act have made scientists wary of foreign contacts, Shattuck said. Government agencies, such as the Department of Defense, have restricted attendance at scientific conferences where unclassified papers were presented, leading some scientific and technical societies to informally bar foreign scientists from their meetings. And in areas such as cryptography and nuclear energy, the government has regulated the dissemination of "sensitive" but unclassified information.

Shattuck recommended changing two regulations that hamper the free exchange of scientific information. The first, a Department of Defense exemption from the Freedom of Information Act, allows the Pentagon to bar publication of unclassified government-funded research that it deems militarily sensitive—as it did at the March 1985 conference of the Society of Photo-Optical Instrumentation Engineers (SPIE). The second, more insidious, regulation is a national

security directive issued by President Reagan in 1985 which forbids restrictions on the distribution of unclassified research except as provided in "applicable U.S. statutes"—such as existing export laws. Shattuck said this exception should be deleted, and added that the National Security Council should undertake "a thorough review of the current system of export controls and related restrictions on the communication of unclassified scientific and technical data."

In a similar vein, Robert L. Park, public affairs director of the American Physical Society, called for a narrower definition of classified information and the reversal of a 1982 executive order which expanded the scope of classifiable material. "We recommend higher fences around less information."

In addition, Park said the government should extend First Amendment protection to electronic information. In 1986, then national security adviser John Poindexter issued a memorandum detailing controls on some types of information in electronic databases, but the memo sparked a barrage of protest and was withdrawn the following year. "We are fast approaching the day electronic databases will supplant conventional libraries as the repositories of scientific and technical information," said Park. "Any attempt by the government to restrain this electronic revolution . . . is to ensure that other nations will take the lead in shaping the future."

Gerald Dinneen, foreign secretary of the National Academy of Engineering, told the committee that international scientific exchange programs have already become easier to coordinate over the past year, thanks to a reordering of U.S. priorities. "In several cases, proposed exchange visits and scientific workshops which were rejected by the U.S. government just 1 year ago as being in militarily sensitive areas have now been endorsed by the U.S. government as being very important in fostering scientific linkages between East and West."

All three panelists welcomed the upcoming liberalization of export controls, saying they expected both science and industry to reap benefits from a freer exchange of information. As for safeguarding proprietary information, Shattuck argued that Western nations should ensure that Eastern European nations agree to the Berne Convention on patents and copyrights so that "Western intellectual property rights are not unintentionally compromised by the new openness of technological communication."

■ DAVID P. HAMILTON

David Hamilton is a reporter-researcher at The New Republic.

Neglected Neurotoxicants

When young people started exhibiting classic symptoms of Parkinson's disease a few years ago, researchers quickly nailed down the cause: exposure to tiny amounts of a chemical called MPTP that is sometimes produced during the illicit manufacture of synthetic heroin. The discovery, says a new report by the Office of Technology Assessment (OTA), provided dramatic evidence of how a toxic chemical can poison the nervous system, and it has helped fuel concerns that a variety of neurological disorders might be linked to exposure to neurotoxicants. But the report says the federal government has not yet come to grips with these concerns.

Research on neurotoxicants is chronically underfunded, the report says, and regulations are fragmented and poorly coordinated. The regulatory agencies have focused largely on the carcinogenic potential of toxic substances, but "the adverse effects [of such chemicals] on organs and organ systems, particularly the nervous system, may pose an equal or greater threat to public health."

The true extent of the health hazards posed by neurotoxicants is unknown, the report points out, because very few chemicals have been tested to determine if they affect the nervous system. But OTA notes that a large percentage of the 600 pesticide ingredients registered with the Environmental Protection Agency (EPA) are known to be neurotoxic to varying degrees. Potentially neurotoxic substances are also found in industrial chemicals, food additives, cosmetic ingredients, abused drugs, therapeutic drugs, and naturally occurring substances such as lead. Moreover, OTA cites evidence that environmental agents may play a role in the recent increases in the incidence of amytrophic lateral sclerosis (ALS, or Lou Gehrig's disease) and Parkinson's disease in the elderly.

One major problem in devising regulations to limit exposure to neurotoxicants is that their effects can vary widely and the biochemical and physiological changes that link exposure to the development of neurological disorders are not well understood. Take the problems in regulating exposure to lead, one of the oldest known neurotoxicants. Over the past five decades, as new evidence has accumulated, the maximum blood lead level deemed safe has steadily decreased. And "lead poisoning in the United States still occurs in epidemic proportions," OTA writes.

Lack of knowledge of the mechanisms of neurotoxicity is also a barrier to screening new commercial compounds because there's no firm basis to predict from a compound's structure whether it is likely to damage the nervous system. Indeed, current screening practices, which rely on structural comparisons with known neurotoxicants, are "a game of chemical Russian roulette"—a dangerous gamble based on shaky assumptions—says neurotoxicologist Peter Spencer of the Oregon Health Sciences University, who chaired OTA's Neuroscience Advisory Panel. Furthermore, adds Spencer, until tissue cultures can be used for testing, different animal species "must be selected to test specific classes of neurotoxicants." Nevertheless, the regulatory agencies could do much better, OTA says. They "have not widely adopted or applied neurotoxicity test protocols," and there is "little coordination of regulatory efforts."

To Spencer, the most immediate concern is "to build a solid base to understand the mechanisms of action" of neurotoxic chemicals. OTA reports that the federal government is spending a mere $67 million on research on neurotoxicants. Its conclusion: "Given the threat the neurotoxic substances pose to public health and the lack of knowledge of the mechanisms by which these substances exert adverse effects . . . federal research programs are not adequately addressing neurotoxicity concerns." EPA, for example, has no extramural grants program in neurotoxicology, and when the Office of Management and Budget made across-the-board cuts in the agency's 1991 budget, a $1.5-million research initiative had to be nixed.

If, as Senator Albert Gore, Jr. (D–TN), puts it, "chronic neurotoxicity presents a health risk every bit as large and as tragic as cancer," should funding for neurotoxicity research approach that for cancer? Yes, says Spencer. If neurotoxicants play a role in Alzheimer's, ALS, and Parkinson's disease, the early onset of these diseases may be preventable. That, he suggests, is at least worth rigorous investigation.

OTA concludes ominously, "available neurotoxicity data are insufficient" to ensure the safe use of many commercial pesticides, industrial chemicals, food additives, and drugs. Spencer says: "More research is needed to fill this chasm of biomedical ignorance."

■ SARAH WILLIAMS

Sarah Williams is a Science *intern.*