# Data Sharing: A Declining Ethic?

*Commercial pressures and heightened competition are testing the notion that scientific data and materials should be widely shared. The following five articles explore this issue*

WHEN IT COMES TO SHARING DATA and reagents, Paul Berg of Stanford has a "straightforward rule." After publishing, Berg says, "I make the material available to anyone who asks, whether they are industrial or academic or whatever." That's the classic way of doing science, and it makes life simple.

But the notion that scientific data and materials are, in effect, common property is under pressure these days. Many scientists feel tugged in two directions: on one hand they want to follow the wide-open ideal Berg espouses, but on the other, they may limit their cooperation to retain dominance in a field, to protect an investment, or merely to comply with university rules. Academic licensing staffs often get involved in "materials transfer agreements" and put conditions on what goes out.

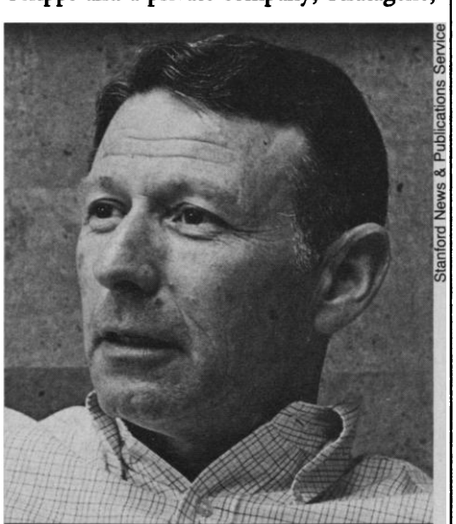
Practices have always varied from lab to lab, and there's no solid evidence that the percentage of hoarders (or sharers) is any greater now than, say, 30 years ago. But a few research leaders say they feel there has been an erosion of the sharing ethic. Of special concern, some said, is the new drive by universities and federal agencies like the National Institutes of Health (NIH) to forge patents from the research done by their staffs. This is the explicit goal of the U.S. Technology Transfer Act of 1986, which encourages federal grantees and employees to profit from their discoveries.

Another source of tension is the decade-old boom in commercial biotechnology. Walter Gilbert, a Harvard biochemist, says companies have continued to publish descriptions of new strains or genetic discoveries, but, beginning in 1978 or so, they sometimes declined to give out all the information or material. The aim was to guard proprietary interests—staking a claim while keeping competitors at least partially ignorant of the details. Before that, Gilbert says, the rule was considered "absolute" that everything must be made available after publication. "That's how the entire field of immunology developed—through the free exchange of material," he says. Joshua Lederberg of Rockefeller University also has spoken out, saying it may be necessary to reinforce the old standards because people seem to be neglecting them.

There are no universally accepted rules, although a number of institutions—including NIH, the National Science Foundation (NSF), scientific societies, and a few journals—have adopted policies recently (see box on p. 954). Scientists themselves are reluctant to play cop, but they have been quite willing to use informal sanctions to enforce the data-sharing ethic. Peer pressure and ostracism have been effective in the past and still seem to work pretty well.

Consider, for example, the current tussle between research universities and the Scripps Clinic of La Jolla, which has a hot new property that many biochemists want to use. Scripps, which gets 75% of its funds from federal grants, wants to share data but also wants to protect the interests of its private partners and licensees.

Richard Lerner and his colleagues at Scripps and a private company, Stratagene, Inc., announced 5 months ago that they had invented a new way to use *Escherichia coli* bacteria as a factory to produce highly specific antibodies (*Science*, 8 December 1989, pp. 1250 and 1275). The discovery promises a huge gain in efficiency. Many think it may entirely replace the old, labor-intensive monoclonal antibody technology in which balky hybridoma cells must be raised first in vitro and then in mice. This method takes months; Scripps's, a matter of days. The question at the moment is how broad the application will be.



Stanford News & Publications Service

***"I don't want to be driven by concerns of patenting, so I just ignore them."***

—Paul Berg

But there is a difference between the old and new methods in legal status. The hybridoma technique won a Nobel Prize for its inventors, Georges Köhler and Cesar Milstein, but it is not covered by a patent. They never sought one. In contrast, Scripps's new method is already the subject of a patent application, and Scripps must honor preexisting license agreements.

How does Scripps respond to requests for material? Lerner says: "We want everyone to have it for research; it's in our best interest for everyone to get it and use it." He says he has sent material out to 30 people "all over the world," including his competitor Peter Schultz of the University of California at Berkeley. He has invited people from the Salk Institute, Berkeley, and the Swedish University of Lund to his lab for training.

And yet, behind the scenes, at least six universities are complaining that they are not getting full access to Scripps's technology. So says Lita Nelsen, associate director of the technology licensing office at the Massachusetts Institute of Technology (MIT). She and Neils Reimers, Stanford's licensing director, have objected to a letter Scripps sent out early this year to academics. It offered material on condition that recipients (i) not share the material or by-products with anyone else, (ii) notify Scripps 60 days in advance of any publication, and (iii) yield to Scripps and Stratagene first rights on any improvement of the vector or products made with it.

Reimers says the conditions are "unconscionable" coming from a non-profit institution that receives public grants. The contract implies that "we will all be beavering away for Scripps."

Nelsen objects to the vagueness of the terms, which she calls "a perpetual tag with an unknown price." The worry is that a faculty member may be committing himself or partners to ill-defined obligations. Thus, MIT and some others have advised faculty not to sign the form.

Many researchers don't care about such niceties and sign quickly. Some, like Schultz of Berkeley, dislike the conditions, but sign to get the material. Paul Berg took a unique tack. "I don't want to be driven by concerns of patenting, so I just ignore them," he says. Berg received Scripps's "nine-page letter" of conditions. "I said, 'bullshit,' we've sent you all of our material; send us yours." Berg got it without signing anything.

Lerner explains: "Paul is a close friend," and besides, his contributions have been so important that "it would be a crime not to reciprocate with him," whatever his terms.

Ray Kahn, Scripps's licensing officer, says he has an obligation to protect Stratagene's half-interest in the venture and the interests

# Agencies, Journals Set Some Rules

There are no objective data on data sharing, according to Adil Shamoo, editor of a journal called *Accountability in Research*. Anecdotal information is just about the only kind you can get, says Shamoo, who thinks the government should finance more studies on the subject.

David Cordray, a Vanderbilt University social scientist who also has made an extensive survey of what's written on this topic, agrees.* "The literature is incredibly fragmented," he adds.

There are some clues in the fragments, but their interpretation depends on one's viewpoint. Shamoo says he is convinced that "the vast majority" of scientists—at least in his area of biomedicine—are not sharing data adequately. He says he has received "dozens of letters" of complaint citing cases of noncooperation, but he doesn't have permission to make them public. Cordray, on the other hand, is impressed by the volume of collaborative work being done and the amount of data being exchanged. He thinks that instances of deliberate noncooperation are unusual.

Whether the problem is large or small, it has won the attention of officialdom in recent years. This is reflected in a couple of policy statements from the Public Health Service (PHS) and the National Science Foundation (NSF), designed to clarify what the government expects researchers to do.

The PHS issued a notice on 16 September 1988 discussing "unique research resources produced with PHS funding," such as cells, viruses, cloned DNA, and DNA sequences. The bulletin says the PHS rule is to "make available to the public the results and accomplishments" of all activities it funds. Once a research paper has been published or a contract completed, PHS expects that material produced in the course of the work "should be made readily available for research purposes to the scientific community." DNA sequences and crystallographic coordinates should be submitted to data banks.

The National Institutes of Health issued a separate set of guidelines on 21 March 1990 covering intramural research. The document, though slightly more philosophical than the PHS treatise, is just as prescriptive. Raw data are to be "carefully recorded in a form that will allow continuous access for analysis and review." Data and reagents both belong to NIH, but investigators may make copies to take with them if they leave. After publication, research data should "be made available promptly and completely to all responsible scientists seeking further information." Special materials such as mutant cell lines or monocolonal antibodies also must be made available if they are "essential for repetition of the published experiments."

On 17 April 1989, NSF offered its entry, an "Important Notice" to university presidents and heads of grantee organizations from director Erich Bloch. In it he made a pitch for open scientific communication. The NSF "expects investigators to share with other researchers, at no more than incremental cost and within a reasonable time, the primary data, samples, physical collections . . . gathered in the course of research. . . . " Without getting specific, Bloch said NSF will "implement these policies in ways appropriate" to the field and circumstances.

While such requirements may sound novel to some, they have long been standard at such places as the Environmental Protection Agency, the National Institute of Justice, and the National Aeronautics and Space Administration. NASA public affairs officer Charles Redmond says that the agency typically expects investigators to publish a quick report 30 days after a project has been completed and a final analysis after 6 months. When the final 6-month results are out, the information goes into a public data bank, such as the one maintained by the Goddard Space Flight Center near Greenbelt, Maryland.

Cordray notes that the National Institute of Justice has had a strong data transfer rule since 1981. According to its standard, a grant recipient must turn over for public use at no extra cost, the "computer-readable copies and adequate documentation" of all databases or programs developed in the course of work. The EPA, likewise, in its "Good Laboratory Practice Standards" requires that all backup data (except for "fragile tissues and biological fluids") be retained for 5 to 10 years and be made available for reviews.

Some scientific journals also have begun to take steps to encourage data and material sharing. In his survey, Cordray found that while "the majority of journal editors" have been slow to do this, a handful have been quite outspoken. The *American Journal of Public Health*, for example, explicitly requires that primary data be shared with editors and other researchers. *Cell* now informs authors that they must be prepared "to distribute freely to interested academic researchers for their own use any clones of cells or DNA or antibodies, or other similar materials used in the experiments that have been reported."

There is one big arena where these rules don't necessarily apply—private industry. Here, it's entirely up to the owner whether to release data (and risk a loss of exclusivity) or keep them locked away. Of course, a claim not supported by details or probative material is not likely to win much credibility. And in fact, many companies share material anyway, according to a recent survey conducted by the Pharmaceutical Manufacturers' Association. According to Anthony Palmieri III of the Upjohn Company, 30 of 34 firms said they shared an unmarketed compound still under development with other researchers. However, Palmieri also detected a double standard: most companies would not agree to sign materials exchange letters they send out, because they consider them too restrictive. ■ **E.M.**

*"Sharing Research Data: With Whom, When, and How Much," by David S. Cordray, Georgine M. Pion, and Robert F. Boruch, presented at a PHS workshop, 25 and 26 April 1990, Chevy Chase, Maryland.

of licensees, Johnson & Johnson and PPG, Inc. What does he think of scientists' threats to "reinvent" the technology and avoid onerous terms? (Several labs are said to be doing this right now.) Kahn's response: "I say, go right ahead," but it is only fair, he says, for people who use Scripps's discovery for commercial gain to share the benefits.

The Scripps case is not the first in which academics have battled fiercely to protect their domain. The Cetus Corporation, inventor of the polymerase chain reaction (PCR) gene amplification technique, was hit with the same kind of criticism in 1988. Although it was sharing the technology freely with researchers, its chief executive, Robert Fildes, made an offhand comment to *Business Week* that he expected to get a "slice of the pie" if researchers used PCR to create something profitable.

A howl went up, because scientists who had purchased PCR equipment said they were unaware that in doing so they were signing away future rights. The issue, says Nelsen, was once again the lack of clarity in the technology sharing agreement. While academics considered it reasonable to ask for royalties on the use of PCR in commercial production, many thought it unreasonable to impose claims on discoveries that relied on PCR only in the R&D stage.

The protests poured in and, as Berg says, Cetus "got hooted down." According to Ellen Daniell of Cetus, the early "confusion" about licensing has now been clarified. The R&D license that comes with the machine does not bind users to pay royalties on discoveries they make with it. But Cetus has already licensed Hoffmann–La Roche for all diagnostic applications.

In these cases, researchers have been vocal when they thought commercial interests were intruding on science. They may be less outspoken about the stinginess of peers in federal or academic labs, where behavior more directly reflects personal style, and the rules on sharing are less clearly defined.

There is a growing concern in biomedical research, according to Lederberg, that new technology such as PCR has made it possible to replicate other peoples' discoveries more easily, and that this, in turn, could make people more reluctant to share.

This problem is not new, says Zena Werb, a biochemist at the University of California at San Francisco. She recently conducted an informal poll of friends and concluded that 15 to 20% of offers to share materials are not completely honored. Sometimes, Werb says, people send out "second-rate material—a restriction enzyme won't cut . . . or monoclonal antibodies may be very dilute." There are others who, out of malice or indifference, simply don't respond to letters, or who promise to cooperate in a phone conversation and never do.

More subtle conditions on sharing also may inhibit free exchange, according to Werb and several others. There is the practice of sharing only with a select group of insiders, grant reviewers, or those who agree to become "collaborators" and include the sharer's name on the author line. Some labs demand to know in fine detail exactly what will be done with the material in advance, and then set limits on its use.

Lederberg has written that the "predicament is most severe for a young investigator seeking first recognition and facing competition from an established laboratory with ample resources. . . . " Since the two sides are unevenly matched in this situation, many blink at the offense when the junior scientist pauses before sending out material. According to one such young researcher, Josh Trueheart of Berkeley, "There is an unspoken principle that if it is clear someone wants to do exactly the experiment you're doing right now, you'll be very slow to send it out." He asks, if you have put 5 years into a project and the next experiment is kind of obvious, "Why should you just hand it over to somebody else to skim the cream?"

Considering the vulnerable lone research-

## Geneva on the Beltway

The "Swiss bank" of biology, as its director Robert Stevenson likes to call it, can be found in a low, red brick building in the suburbs of Washington, D.C. It is the home of American Type Culture Collection (ATCC), a nonprofit institution with two roles—one confidential and the other wide open.

As a Swiss bank, the ATCC receives deposits of biological material (cell lines, DNA probes, and so on) from researchers who are seeking a patent and are required to submit a sample, but who also want their secrets protected. In its other role, the ATCC serves as a center for standardizing and exchanging lab materials around the world. Because it has been a leader in materials sharing since 1925, the ATCC has been named in several recent policy statements—including the 1988 guidelines of the Public Health Service—as the logical agency to use when releasing a new cell line for general use.

The ATCC began accepting U.S. patent deposits in 1949 and in 1981 was recognized under the Budapest Treaty as an international agency as well. It now has more than 10,000 items in its inventory, which it keeps suspended in tanks of liquid nitrogen in the basement. For example, frozen embryos of the patented Harvard "oncomouse" are kept here. The ATCC doesn't give out samples unless explicitly told to do so by the depositor, or if a patent has been issued. After that, anyone can receive a sample of the material for a small (around $70) handling fee.

Consider, for instance, a newly isolated type of human brain cell that can be grown in the laboratory (*Science*, 4 May 1990, p. 603). Solomon Snyder, leader of the team at Johns Hopkins University that discovered the line, said when asked that he had put the material on deposit at the ATCC. But ATCC staffers were under instructions from the university to treat this as a secret and declined to say whether or not they had received any material. However, Snyder himself says he intends to share the cell line with other researchers if they contact him directly.

The regular collection at the ATCC is much larger, containing more than 50,000 strains. ATCC could become the central U.S. clearing house for all bio materials, Stevenson says, and in the past, people have suggested that every new biological discovery be put on deposit. But at present this would be impossibly expensive. Says Stevenson: "Nobody's giving us that kind of money—and we don't have it to spend." It's not clear that it would be worthwhile getting every little cell line, either. However, Stevenson says there are a few publicly funded scientists from whom he would like to receive material, but doesn't.

■ E.M.

**Biological vaults.** *The ATCC's 50,000 cultures are stored in containers of liquid nitrogen.*

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