perhaps to support the contention that fraud really is uncommon. "An incidence of 1 in 1000 would not be a serious problem in terms of science overall, in terms of knowledge" statistician Bailar argues, "but it would be a serious blow in terms of public perception."

What if the audit turned up two or three or even ten or more papers that were not fraudulent but that were nonetheless imperfect—papers in which the authors had used inappropriate statistical techniques for analyzing their data, for instance, or in which data interpretations were ambiguous. This, Bailar speculates, is the more likely outcome of an audit, and highlights the need to make sharp distinctions between outright fraud, poor science, and honest error.

Designing a first-class protocol for an audit, if one is to be done, will be crucial. "An inappropriate study of fraud that confuses fraud with mistaken or challengeable judgment could be destructive in the long run," Bailar believes.

How much would an audit cost? Estimates vary, but it surely would cost $100 a paper, and maybe as much as $1000. Financially, it could be done with support from one or more federal agencies.

Bailar and others who tend to favor the idea of an audit think the next step is to actually design a real protocol for an audit so that the proposition can be debated and evaluated in specific scientific terms. Just who will do that remains to be seen.

■ BARBARA J. CULLITON

Authorship, Data Ownership Examined

As the research community examines the problem of scientific fraud, misconduct, and honest error, a number of issues assume importance. Two of them—ownership of data and authorship policies—are among several that have been raised at recent conferences on responsibility in science.

■ **Authorship and other credit.** Who should be listed as an author of a paper? It sounds like a simple question, but many scientists suggest that it is both subjective and complex—sufficiently complex that at several meetings on the subject during the past few months it has not been possible to get a definition everyone can agree on.

New England Journal of Medicine editor Arnold Relman, at an authorship meeting at the National Institutes of Health in May, and again at the Institute of Medicine (IOM) and Council of Biology Editors meetings this fall, sketched the following definition. To qualify as an author, a person must fulfill two of four requirements:

1) Conception of idea and design of experiment.

2) Actual execution of experiment; hands-on lab work.

3) Analysis and interpretation of data.

4) Actual writing of manuscript.

Response has varied. Edward Huth, editor of the *Annals of Internal Medicine*, said at the IOM conference that to qualify as an author, one should fulfill three (not just two) of Relman's postulated requirements. Others take the position that appropriate decisions about who is an author cannot be based on a checklist.

And, although virtually everyone states that "honorary authorship"—for instance, the practice of putting the lab chief's name on the paper even though he made no substantial contribution to the work—is deplorable, it has been difficult for scientists to reach an agreed upon definition of honorary.

Although certain bounds are clear, conferees debated whether strict authorship guidelines would unfairly exclude postdocs from papers. And one said that credit for an idea is sometimes hard to pin down in retrospect.

Various observers have suggested that the authorship problem could be resolved by establishing categories of authorship and other credits which would separate full authorship from other contributions. Relman suggests categories such as "with the assistance of" or "with the collaboration of."

Constance C. Conrad of Emory University says science might look to television and the movies for inspiration. The cameraman is listed as cameraman; the makeup artist is recognized for his specific talent; the set designer gets his due. So, Conrad suggests, why not give lab chiefs credit for assistance in grant-getting and in providing a good research environment, without calling them authors if they are not? To meet the need all researchers have for credit when it comes to promotion and tenure, she suggests that "credit" be accepted as a legitimate category of professional contribution that can be listed on one's résumé. Were this accepted, she believes, "authorship would be restored to meaning."

Existing attempts by various professional groups, including the biology editors, are ripe for study. Says Huth, the first step to a solution would be wider dissemination of editors' definitions of authorship and a requirement that authors indicate at the point of submission of their paper how their contributions fit the definition.

■ **Who owns the data?** Ownership of research data has, until recently, never been much of an issue. It is a question nearly all academic scientists could answer with confidence and consensus. The researcher owns the data. That may not be so, or not exclusively so. It is a point that requires resolution; recent comments illustrate the complexity of the question.

At an IOM meeting in September, Linda Lorimer, a lawyer who is president of Randolph-Macon Woman's College was rapporteur for a panel on institutional oversight, comprised of attorneys, deans, and administrators. "The institution, not the investigator, is probably the ultimate owner," she reported, adding that there should be written policies about who keeps data and for how long.

Carl Djerassi of Stanford, taking the more traditional position, replied: "I object to the view that institutions own the data. That's not correct. Universities might not even want them."

Harvard Medical School recently had this to say on the subject in its new policy on guidelines for research (*Science*, 29 July, p. 525): "Custody of all original laboratory data must be retained by the unit in which they were generated"—a virtual assertion of institutional ownership or, at least, coownership. The new policy also states that "An investigator may make copies of the primary data for his/her own use."

At a Council of Biology Editors conference 2 weeks ago, a legal perspective on data ownership was offered by Richard Riseberg, chief counsel of the Public Health Service and former chief counsel to NIH. In the academic sector, he noted, the researcher usually is free to keep the data because the "university rarely asserts ownership rights." In industry, ownership is defined by contract; data usually belong to the company. And in government, well, said Riseberg, "What a government scientist produces on government time belongs to the government. But that is hard to tell young NIH researchers who do not view themselves as government employees."

Within NIH, Riseberg made it plain, the rights of access to data are broad. "Clearly a supervisor has a right of access. The Secretary of HHS probably does too." In any lab with NIH funding, the inspector general has a right of access. Congressional oversight committees have subpoena power, and in cases of dispute, so do the courts. "The courts have a right to every person's evidence," Riseberg reminded the editors.

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