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Concerning the Ethics and Accuracy of Scientific Citations

The Institute of Medicine of the National Academy of Sciences,* Harvard University,† and the journals *Nature,*[1] *The New England Journal of Medicine,*[2] and *Science*[3,4] all have issued recent exhortations and guidelines concerning our responsibility to educate young investigators and authors about the fundamental concepts of research and publishing practices. Record-keeping in research, accuracy of data books, and responsibilities of co-authorship have been topics of major discussion in recent investigations of scientific misconduct. Healy, National Institutes of Health Director, has recently suggested that academic scientists could learn a lesson from industry about good laboratory practices.‡ Attention to detail, and the prevention of slovenly practices, both in the laboratory and in literature research preceding investigation and scientific writing, are essential features that should be demonstrated by all role models to young scientists in all our research endeavors. Garfield has appealed for the need preventively to instruct young researchers on the ethics and etiquette involved in complete referencing§ and emphasized that "acknowledging prior research and intellectual debts is of crucial ethical importance." The omission of pertinent references or "citation amnesia" is an important form of bibliographic misbehavior.§

In this issue of ANESTHESIOLOGY, McLellan *et al.* address errors in bibliographic citation in four journals in the anesthesia literature.[5] The error rate that these authors identified in a randomly selected number of all 1988 references ranged from 44% to 56%. This error rate in our journals is both impressive and distressing. Authors have a responsibility to refer readers accurately to the sources of their citations, and the journals certainly have a responsibility to publish the truth. The research community has tried to define and group problems in the scientific literature under the headings of scientific fraud, misconduct, and honest error. Stewart and Feder[1] have characterized "lapses from generally accepted standards" as "Type A" and "Type B" errors. They suggest that their Type A errors are explicable simply by carelessness and excessive haste, whereas their Type B errors appear to be more serious in some sense. Deliberately misleading citations or missing citations (failure to acknowledge the source) both are included in the Type B errors. Naturally, any such classification is entirely subjective, but it indicates the potential seriousness of a lack of a meticulous approach to the preparation of scientific papers for publication. It is probable that most of the bibliographic errors found in the study by McLellan *et al.*[5] fall into the category of "honest errors."

However, such errors are still a cause for concern, because they indicate a lack of discipline that also might reflect the investigator's approach to the research protocol, data management, and laboratory practices in general. The major concern is that bibliographic inaccuracies can often be traced to several previous publications in which they were cited. This type of perpetuated error clearly demonstrates that the authors have never examined the original data, have never examined the original context of the citation, and might well have drawn the

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* Institute of Medicine/Division of Health Sciences Policy: The responsible conduct of research in the health sciences. (Report of a Study by a Committee on the Responsible Conduct of Research.) Washington, DC, National Academy Press, 1989, pp 1-97.

† Harvard Medical School: Guidelines for Investigators in Scientific Research. 1988.

‡ Healy B: Academic scientists could "learn a little bit" from industry about good lab practices. Comment in: The Blue Sheet:F-D-C Reports (May 1), 1991, p 4.

§ Garfield E: Bibliographic negligence: A serious transgression. The Scientist 1991, November 25, p 14.

incorrect conclusions from another source, three or four times removed. As Hirschmann has characterized this phenomenon, "the author makes some unsupported statement and uses as his reference the same unsupported statement made by a previous writer. Repeated often enough, it begins to assume the stature of demonstrated fact."[6] A lack of careful scrutiny of the original paper cannot be condoned. In addition, such sloppy practices by authors may also become suspect in a climate of scientific misconduct that is often associated with insufficient attention to detail in the laboratory and research environment in general.

The purpose of scientific citation is at least 3-fold: to credit the original workers in the field; to relate to the authors methods and findings; and, importantly, to enable readers to locate and consult the referenced materials. Schecter *et al.*[7] point out that "it would be virtually impossible today for an investigator to pursue successfully a research question from its inception to fruition, without reference to undistorted and complete records of the work of other scientists. Thus, the avoidance of contamination is as important in channels of scientific communication as it is in the laboratory." The authors' responsibilities are absolutely clear: first, to consult the original paper; second, to quote the original material correctly and in context; and third, to present the bibliographic reference accurately.

What is the responsibility of the journal? Some publications, including *The New England Journal of Medicine* and *The Journal of the American Medical Association*, apparently examine the original papers for every reference cited in a submitted manuscript.§ Most journals do not have the staff to do this, nor does such a practice by the journal, commendable as it is, in any way ensure that the author has consulted the original paper. An alternative suggestion[8] is that the journal audit a sample of references from each paper submitted for publication. As soon as any error is found the paper could be returned with an instruction to check all citations again. Perhaps the threat of such delays would encourage authors to improve bibliographic accuracy and integrity. Finally, referees and reviewers could be "required to check a sampling of the literature cited—a task that electronic devices can now aid."§

Senior investigators, mentors, research advisors, academic departments, and journals in our discipline certainly have the responsibility to establish and disseminate expectations for the ethical conduct of research and publication. Mishkin[9] suggests that "today, senior scientists sometimes assume supervisory responsibilities that exceed their inclination or capacity to fulfill. As a result young researchers may lack the close relationships essential for learning by example." Be that as it may, it is only realistic that primary authors and editors should be held responsible for the accuracy of all published papers. Ingelfinger[10] has suggested that perhaps all reference lists should be "cut in half" to weed out citations that are inaccurate, invalid, irrelevant, or misleading! Finally, St. Leger[11] has exhorted authors to "allow many potential references to rest in obscurity" in view of the fact that the medical literature is so large and of such uneven quality.

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