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What Do We Know About Fraud and Other Forms of Intellectual Dishonesty in Science? Part 1. The Spectrum of Deviant Behavior in Science

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Several recent issues of the ISI® newspaper *The Scientist*™[1,2] contain articles on ethical issues in science. One is a review[3] of a book entitled *False Prophets: Fraud and Error in Science and Medicine*,[4] by virologist Alexander Kohn, Tel Aviv Medical School, Israel. Two[5,6] discuss the controversial, recently published study on coauthorship by Walter W. Stewart and Ned Feder, National Institutes of Health (NIH), Bethesda, Maryland.[7] Another discusses the Piltdown Man hoax;[8] still another is an interview with William F. Raub, deputy director, NIH, concerning many issues, including misconduct in science.[9] Raub touches on several notorious cases of fraud, including those involving John R. Darsee, formerly of the Harvard Medical School, Boston, Massachusetts,[10] and Robert Slutsky, who was affiliated with the University of California, San Diego (UCSD).[11]

But these are just a few of the instances of scientific misconduct that have recently come to light; other instances of intellectual dishonesty have long since been identified and interpreted by social scientists, such as Columbia University sociologists Robert K. Merton[12] and Harriet Zuckerman.[13] It's not necessary to repeat details of individual cases that have already been well reported elsewhere. But these instances raise a number of questions: What do we know about the causes and incidence of misconduct in science—especially fraud? What are its effects, both on scientists and on society? And how do we deal with it? In this essay, we discuss the range of behaviors one encounters in defining misconduct in science and some of the difficulties involved in estimating its frequency; in Part 2, we focus on the causes of scientific misconduct and its effects on the scientific community.

In researching these issues, we examined ISI's database and learned that the current literature on fraud is largely informal or anecdotal. Moreover, many authors seem to be largely unaware of the continuing tradition of interest among social scientists in patterns of deviant behavior in science. The 1984 and 1985 research fronts on fraud ("Problems of fraud and deceit in science" [#84-3489] and "Misconduct, fraud, and other social aspects of science" [#85-3243]) contain "core" documents—that is, often-cited publications—that consist primarily of letters, editorials, commentaries, and opinion pieces. These items present no data based on rigorous, controlled studies. A core publication for the 1985 front, for instance, is an editorial on the Darsee affair by Arnold S. Relman, editor, *New England Journal of Medicine* (*NEJM*).[14] Even the books that lead us to some of the current literature through their subsequent citation in the *Science Citation Index*® are not based on scientific research—including *Betrayers of the Truth* by science journalists William J. Broad and Nicholas Wade.[15]

What Constitutes Scientific Fraud and Intellectual Dishonesty?

Intellectual dishonesty in science takes a number of forms, some more serious than others. The most common form is plagiarism or slanderous charges—or insinuations—of plagiary, according to Merton in his paper on deviant behavior in science, published 30 years ago.[12] Edward J. Huth, editor, *Annals of Internal Medicine*, has in-

veighed against "salami science," the slicing of one study into a series of papers.[16] D. Emerick Szilagyi, Department of Surgery, Henry Ford Hospital, Detroit, Michigan, has pointed out that self-delusion and simple errors also contribute to the "mismanagement of reporting scientific data."[17] I have addressed some practices myself, such as the underacknowledgment of one's intellectual predecessors.[18,19]

Merton states that "the extreme form of deviant behavior in science" is the fabrication of data, which is properly labeled "fraud."[12] Zuckerman has made a distinction among types of fraud,[13] drawing upon categories set forth by the mathematician Charles Babbage more than a century ago.[20] Besides outright data fabrication, she identifies as fraudulent the practices of fudging and suppressing data (or "trimming" and "cooking" it, as Babbage described it[20] [p. 178-83]). Both Merton[12] and Zuckerman[13] distinguish fraud from other forms of intellectual dishonesty, and Merton has criticized the tendency, among both scientists and others, to lump a range of deviant behaviors under the undifferentiated rubric of fraud: "This practice is much like indiscriminately describing a parking violation, embezzlement, and homicide as 'crimes' and thereby implying that they are much the same."[21] This tendency seems to have been exacerbated by the flurry of attention to recent cases of misconduct. For instance, Broad equates such practices as gratuitous coauthorship, premature publication, and duplicate publication with fraud.[22]

Divergent classifications of the misbehavior of scientists contribute to difficulty in arriving at a consensus definition of fraud in individual cases. Works that contain some irregularities but have not actually been fabricated can cause heated debate, with some scholars arguing that fraud has been committed, while others argue against such a conclusion. This subject was addressed by Zuckerman, who described in 1977 the concept of "reputable and disreputable errors in science."[13] The former she defines as errors that "occur in spite of investigators having lived up to the prevailing methodological rules of the game and of having taken the...accepted procedural precautions against error.... [They are the] unavoidable hazards of research." Disreputable errors, on the other hand, result from "sloppy craftsmanship...the neglect or violation of methodological canons and procedural precautions." Such mismanagement constitutes a deviation from the methodological norms of science, as opposed to data fabrication, which violates both methodological and ethical norms. Zuckerman points out that disreputable error nevertheless breaks what she says is "perhaps the first commandment of science...that 'thou shalt not mislead thy colleagues.' "[13]

One controversy that seems to involve the concept of disreputable error concerns a study of controlled drinking in alcoholics by Mark B. Sobell, Vanderbilt University, and Linda C. Sobell, Dede Wallace Center and Vanderbilt University, Nashville, Tennessee.[23] Although it is conventional wisdom among alcoholism researchers that the only cure for physically dependent alcoholics is abstinence, the Sobells reported that a group of 20 alcoholics taught to drink moderately functioned significantly better in day-to-day living than a control group whose treatment was total abstinence.

But a follow-up study by psychiatrist Mary L. Pendery, San Diego Veterans Administration Medical Center and UCSD; psychologist Irving M. Maltzman, University of California, Los Angeles (UCLA); and L. Jolyon West, Department of Psychiatry and Biobehavioral Science, UCLA School of Medicine, found that the 20 experimental subjects had in fact fared poorly.[24] A special committee investigating allegations of fraud against the Sobells found that they had not fabricated their data and that, with the exception of one instance of careless record keeping, they had reported their procedures and results accurately.[25] However, critics charge that, while the Sobells' methods may have been accurately reported, their data were inadequate to support their conclusions. They also say that sloppy record keeping is tantamount to fraud and continue to press for further investigations into the Sobells' work.

Another example of work that has caused a storm of controversy involves the highly disputed claim of the existence of the virus-

like particle of protein dubbed a "prion" by Stanley Prusiner, University of California, San Francisco. According to a report in *Discover*,[26] Prusiner coined the term, loosely defined the characteristics of the prion, and secured millions of dollars to fund his team's research, but he has yet to actually isolate the particle. Critics also say that Prusiner has failed to acknowledge previous work that bears a striking resemblance to his, that his conclusions are far afield from his data, and that he has improperly circumvented conventional scientific practices, such as publishing in reputable, refereed journals before announcing findings to the popular media. But they have stopped short of accusing him of plagiarism or fraud.

The Frequency of Fraud in Science

The popular media abound with reports of corruption and incompetence in public office, malfeasance in business, malpractice in medicine, and misconduct in the legal profession. The statistics are staggering. In 1986 a US House of Representatives Subcommittee on Health and Long-Term Care found that "upward of 10,000—or 1 in every 50—doctors now in hospitals and private practice...either stole or paid for their degrees, or stole or paid for a copy of an exam which had to be passed before they could practice medicine."[27] According to Henry B. Hine, then a graduate student studying law and business, St. Louis University, Missouri, the US Department of Health and Human Services estimates that Medicare and Medicaid fraud—such as overcharging for procedures performed, charging for procedures not performed, and substituting generic drugs for more expensive brand-name pharmaceuticals and then charging the brand-name price—cost the federal government $1 billion in 1982. In the same year, the cost of such practices to state governments was $3 billion.[28]

The list goes on. Of the 97 percent of the 681 undergraduate students responding to a questionnaire on scholastic dishonesty, only 37 percent said they had *not* cheated during the course of their college careers.[29] Over 2,100 federal, state, and local officials were awaiting trial, or had been indicted or convicted, on charges of public corruption in 1984 alone.[30] (p. 175) In the same year, almost 8,000 of the 36,000 defendants convicted of some crime in US District Courts were convicted on charges of embezzlement and fraud; along with drug-related offenses, fraud and embezzlement was the largest specific crime category.[30] (p. 179) The American Insurance Association estimates that fraudulent claims exceed $11 billion annually. Underreporting of income or falsifying charitable contributions and other deductions by US taxpayers is conservatively estimated to have cost the federal government $100 billion in 1983 alone.[31]

By comparison with these numbers, one might argue that scientists have exhibited a relative degree of immunity to misconduct. Daniel E. Koshland, editor, *Science*, points out in an editorial that "some newspaper reporters have used recent fraud cases to imply that the structure of science is crumbling or that there is a cover-up, forgetting that the extent of the scientific enterprise has grown a thousandfold since the 1800s. We would expect a greater number of cases of fraud today, but there is no evidence of an increased percentage."[32] As noted by Merton in the latter 1950s, "the annals of science include very few instances of downright fraud, although, in the nature of the case, an accurate estimate of frequency is impossible."[12] In fact, Broad and Wade list only 34 cases of "known or strongly suspected fraud in science" from the second century BC through 1981[15] (p. 225-32)—"an extremely small number for such a long period of time," say sociologists H. Kenneth Bechtel and Willie Pearson, Wake Forest University, Winston-Salem, North Carolina.[33] Mary L. Miers, Office of Extramural Research and Training, NIH, reports that between 1982 and 1984, although instances of "*reported* misconduct...increased dramatically," the NIH received an average of just "two reports per month of possible misconduct.... About half of those reports have proven to be factual." Out of the 20,000 awards that the NIH has active at any given instant, Miers notes, the number of reported cases of fraud is "almost insignificant."[34]

But as encouraging as these statistics may sound, the fact is that we simply do not know the extent of scientific fraud. Merton has pointed out that "there are no statistical series on the extent of [deviant] practices and hence no epidemiology of fraud in science."[35] Zuckerman had also noted that the dearth of rigorous studies in this area makes "empirical evidence on various forms of deviance in science...hard to come by."[36] Indeed, as stated in her analysis of the incidence of deviant behavior in science, "no comprehensive, quantitative data have been collected on the extent of deviant behavior in science or its distribution."[13] She speculates that this lack of systematic data may partly be due to the lack of an institutionalized arrangement for detecting and dealing with misconduct; correcting deviance has been mostly a matter of private, informal activities. Daryl E. Chubin, former director, Technology and Science Policy Program, School of Social Sciences, Georgia Institute of Technology, Atlanta, and now at the Office of Technology Assessment, Washington, DC, agrees. But he, among many others, has voiced the opinion that this information gap is due at least in part to the difficulties in collecting rigorous data on such a sensitive subject.[37]

Thus, as Raub asserted in his interview in *The Scientist*, "I don't think anybody, including me, is in a position to give any kind of an estimate as to how widespread it [fraud] is."[9] At this point, therefore, it continues to be extremely difficult—if not impossible—to say authoritatively whether fraud is on the rise, on the wane, or about the same as it ever was. And despite the statistics on fraud in other walks of life, it is difficult to compare the problem of misconduct in science with the rate in other professions, since these, too, lack rigorous data.

Nevertheless, opinions and speculation on the incidence of scientific fraud are plentiful. According to Patricia Woolf, Princeton University, New Jersey, the late Philip Handler, former president of the National Academy of Sciences, expressed the view of the majority of scientists concerning the frequency of fraud.[38] Woolf reports that Handler told the Subcommittee on Oversight and Investigation of the US House of Representatives Science and Technology Committee that "the matter of falsification of data... need not be a matter of general societal concern. It is, rather, a relatively small matter which is...normally effectively managed by...the scientific community."[38] Raub also believes that scientific fraud is "extremely infrequent" and that recent cases, while not all of the problem, represent "a large part of the...wrongdoing."[9]

A similar conclusion was reached by Warren O. Hagstrom, University of Wisconsin, Madison, who surveyed over 1,700 scientists in 35 specialties concerning the effects that competition had on their professional behavior. While acknowledging that extreme competition can tempt some scientists to fudge their data, he considers such behavior unlikely. Instead, he found that competition most commonly induces some scientists to become secretive about their work until their results are published; another, less common response was to shift to less competitive specialties.[39]

But other evidence, while flawed, is nevertheless disquieting. For instance, Ian St. James-Roberts, University of London, UK, writes that 92 percent of the 204 scientists who responded to a questionnaire published in *New Scientist* said they had knowledge of "intentional bias" in science.[40] A very informal poll reported by Lawrence Altman, medical correspondent, Science News Department, *New York Times*, and Laurie Melcher, research associate, Cornell Medical College, New York, may indicate that the problem of scientific misconduct may be severe. Members attending a Council of Biology Editors meeting in 1981 were asked whether they knew of recent, unpublicized instances of fraud; over one-third raised their hands.[41]

Altman and Melcher admit that it is impossible to say what those raised hands represent.[41] How many knew of more than one fraud? Were they all thinking of the same case, or did each have a different example in mind? What did those who responded construe the word "fraud" to mean? Similar objections can be raised to the *New Scientist* "poll." The unsatisfactory nature of this evidence emphasizes the need for rigorous studies.

In Part 2 of this essay, we will examine in detail the current thinking on the causes of misconduct in science, its consequences, and how best to deal with it.

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