# The Growing Threat to Research:
## Scientific Misconduct

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In the past year, the news that a Bell Labs scientist performing Nobel-quality experiments engaged in scientific fraud sent shock waves through the scientific community. The work of 32-year-old physicist Jan Henrik Schön came under suspicion after he published two papers with an identical figure, including noise patterns. The papers indicated the figures to be measurements of two different phenomena from two different pieces of equipment. One of the papers was published in *Science*, the other in *Nature*. Schön had previously been publishing at the astonishing rate of roughly one paper per eight days, gathering extraordinary results. "He discovered everything in condensed matter physics in the last sixty years" in organic materials, said Lydia Sohn of Princeton University. Later, an independent committee led by Stanford physics professor Malcolm Beasley investigated Schön's work and found Schön guilty of data falsification in sixteen separate instances. [1,2,3] His many co-authors were absolved of all charges, and nearly all of the questioned papers have since been retracted.[3,4,5] With the reproduction of his results having become a "minor industry," others' careers are also at stake.[2] Perhaps most importantly, however, Schön's high-profile case has led to further discussion of the troubling but prevalent issue of scientific fraud and misconduct and the measures necessary to prevent and punish them.

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### Schön Not Alone

Schön's case is hardly an isolated example. In the past five years, instances of questionable scientific research ethics at universities and other research institutions have been numerous. In 2002, physicist Victor Nirov was fired from Lawrence Berkeley National Laboratories (LNBL) in California after his computer analysis of the discovery of elements 116 and 118 was found to be fabricated. Nirov's co-authors, like Schön's, were cleared of any misconduct. The news of his data fabrication also cast a shadow over the discovery of

elements 111 and 112, to whose discoveries he had contributed. The discovery of those elements, however, has not been refuted.[6]

Following are still more examples of American scientists engaging in scientific misconduct. Biochemist Robert Liburdy, also at LNBL, had won more than $3.3 million in federal money for his research on a possible connection between electromagnetic fields and cancer. In 1999, he was found to have fabricated data. He retracted his findings and accepted as punishment the loss of federal funding for three years.[7] In 2001, Harvard medical researcher Evan Dreyer was handed a ten-year ban from receiving National Institutes of Health (NIH) grant funding because of false data reported in papers and grant applications.[8] William Simmons, formerly of the University of Texas Southwestern Medical Center, left his job in 1998 to seek employment elsewhere, only to be called back the following year because the postdoctoral fellow who replaced him could not duplicate his results. When redoing his experiments to prove their validity, he was spotted inserting material into the vials that would alter the results in his favor. His former collaborator, Derry Roopenian, noted that people in his laboratory "wasted a lot of time and money trying to reproduce results that weren't real to begin with," a common complaint of scientists who have based their research on others' fraudulent results.[9]

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Yet recent scientific misconduct has not been confined to the United States. Overseas, allegations of misconduct are also common. In the field of medicine, Neil Marshall of Britain's General Medical Council (GMC) notes that "we have seen enough complaints to warrant action among the whole profession." In Britain, an article in the *Journal of Bone and Joint Surgery* contained photographs stolen from another author's work. When the author of the article submitted a replacement picture, claiming it as a correction, the new picture was then found to be a combination of two photographs, only one of them from the author's own work.[10] In China, a translator of a 1998 American anthropology textbook decided to publish it in Chinese as well—under his own name.[11] Researchers from two German universities, Professor Friedhelm Hermann of the University of Ulm and Professor Marion Brach of the University of Lübeck, were accused in 1997 of manipulating data in more than thirty biomedical papers. Hermann was later suspended from the university, and Brach lost her position entirely.[12] In Poland, author Marek Wroñski, while writing a book about scientific misconduct in 1997, discovered scientist Andrzej Jendryczko was guilty of more than twenty acts of direct plagiarism. Wroñski claims that an "old guys' network" in Poland protects scientists like Jendryczko from prosecution or defamation. In fact, Wroñski was told that questioning Jendryczko's work "was going to destroy Polish science."[13] Clearly, the problem of scientific misconduct is widespread.

## What Exactly Is Scientific Misconduct?

One difficulty in prosecuting scientific fraud often is the lack of a precise definition of the term. The United States has adopted a definition produced by the Office of Science and Technology Policy (OSTP), which states: "Research misconduct is

defined as fabrication, falsification, or plagiarism in proposing, performing, or reviewing research, or in reporting research results." This definition, though quite narrow, goes on to pinpoint specific acts that violate good scientific practice, clearing up some confusion in the previous definitions provided by the National Science Foundation (NSF) and Health and Human Services (HHS).[14]

Abroad, some countries also struggle to define misconduct, while others merely focus on how to prevent it. Graeme Catto, vice principal of the University of Aberdeen, claims "there is little value in lengthy discussions about a definition of scientific misconduct as done in the U.S. A better approach seems to be an emphasis on implementing good research practice guidelines."[15] The Wellcome Trust, the largest biomedical charity in the United Kingdom, created its own definition, which recipients of its grants must follow. The definition largely mirrors that of the OSTP but is slightly broader. It is criticized for not providing adequate protection for whistleblowers, but this is partially due to the United Kingdom's strict libel laws. Wellcome hopes that its actions "can become the template for guidelines in other fields of science."[16]

## What Measures Have Been Taken to Combat Scientific Fraud?

In 1989, the United States created the Office of Research Integrity (ORI), a branch of the Department of Health and Human Services, to investigate claims of fraud.[17] The ORI receives more than 1,500 complaints a year and often requires ten to twelve months to investigate an allegation, resulting in what Barbara Mishkin, a Washington attorney who specializes in dealing with scientific misconduct, calls a "black-hole effect."[18] More often than not, only lower-level researchers are convicted. The ORI claims a 92 percent success rate, but it has failed several times in high-profile cases. These failures have included false accusations, as in the case of a publication in *Cell* by former MIT professor Thereza Imanishi-Kari, who was supported by Nobel Prize-winner David Baltimore, now president of the California Institute of Technology. Imanishi-Kari was accused of falsifying important data, and her case required a full decade to resolve before she was cleared of wrongdoing.[18,19] Nearly all universities and research institutions also conduct internal reviews whenever a scientist comes under fire. In addition, in the United States, the NIH now requires medical schools to provide training in research ethics, and some universities have expanded such classes to all graduate students.[20,21]

In Europe and Asia, methods of dealing with scientific misconduct have also been discussed at length. The Chinese Association of Science and Technology has issued a number of rules for science journalists, requesting journals not to publish multiple submissions or papers of poor quality and forbidding the publication of papers dealing with confidential information.[22] In the early 1990s, Denmark created the Committee of Scientific Dishonesty (CSD), which has considerable power over scientists because the Danish government funds more than 90 percent of the country's research.[15] Rather than develop a national body to investigate misconduct, other countries have preferred to simply tie funding by national organizations to compliance with misconduct procedures. In Australia, the National Health and Medical Research Council has

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guidelines to which grant-receiving research institutions must adhere.[23] The German Deutsche Forschungsgemeinschaft, the nation's largest source of grants for basic research, has proposed ways to promote research ethics and deny funding to those who do not comply. Among their recommendations are requiring the storage of original research data for ten years, offering protection to whistleblowers, and eliminating the practice of honorary co-authorship. In addition, prominent research institutions all over the world, such as the Max Planck Society in Germany, have been preparing their own procedures for dealing with misconduct. President Hubert Markl hopes "universities or other institutions will look closely at our new rules and perhaps use them as an example."[12] The only question that remains is how successful these agencies can be at finding and punishing misconduct, as well as preventing it.

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## Why Would Anyone Commit Scientific Fraud?

In the words of Stephen Lock, a past editor of the *British Medical Journal*, "Many researchers think that a high IQ goes hand in hand with high moral values." However, he continues, this correlation "is, of course, absolute nonsense."[15] The high-pressure environment that today's young researchers enter can often tempt them to practice poor ethics. More than 1 percent of scientists report direct knowledge of an instance of misconduct.[21] The "publish-or-perish" mindset of research institutions that often base promotions on the volume of research published can lead a young researcher astray, particularly in the extremely competitive and lucrative biomedical industry.[17,24] Because of the huge volumes of research produced in a year, many also believe their questionable activities will escape notice. Computer programs can make falsifying images such as X-rays easy and indiscernible from genuine ones.[10] A person who successfully passes off small data manipulations may attempt misconduct on a larger scale the next time. "Nobody arrives at fraud as the first thing they ever do....They got there by doing little things and getting away with it. Calling them in might stop people from going off the deep end," said Paul Friedman of the University of California at San Diego.[17] In addition, the system of tenure in universities can lead to a "cloak of academic freedom," where a professor's research may not undergo the necessary internal scrutiny before publication, because professors "invariably resist intrusion from their fellow departmental colleagues."[25] The environment of the research setting seems to push researchers to produce results at any cost.

## Who Is to Blame?

The issue of responsibility for fraudulent papers has been much disputed recently. Those often mentioned as culpable include co-authors, supervisors, and peer reviewers. With multiple authors from multiple countries working in cross-disciplinary fields, it is hard to hold each person accountable for every piece of data or analysis reported in a paper. In the Schön case, when co-authors were questioned as to the particulars of data measurements, they professed to know little. Yet it can be argued that, since each receives part of the credit for a successful paper, each should bear responsibility for the contents. As Donald Kennedy of *Science* remarked, "If

the benefits of authorship are enjoyed jointly and severally by all the authors, shouldn't the liability be shared in the same way?"[20]

Supervisors and management are also often blamed for failing to catch errors before an article goes to press. While some accountability for the results produced is expected of a supervisor, it is unreasonable to expect 100 percent overseeing of a project. Where should the line be drawn? Finally, no one has ever claimed that the peer review process is perfect. Unless an article is in their particular field of research, reviewers are unlikely to question the validity of a paper. Furthermore, while peer review is an anonymous process, a reviewer would be identified and subject to legal action if he or she were to accuse an author of misconduct.[25] As Donald Kennedy of *Science* wrote, "A clever laboratory cook can invent data that are immune to vigilant reviewers and to any diagnostic test, save repetition, the only proven scientific remedy."[20] However, increasingly complex research means that duplicating another's experiment to ascertain its validity can be phenomenally costly and time-consuming, if not downright impossible.

## What To Do Next?

The ORI has several plans in the making, but all have been met with stiff resistance. Its funded proposal to investigate those found guilty of scientific misconduct to learn about their mentalities and what caused them to behave in such a way was halted by the Office of Management and Budget (OMB) after the completion of the first stage.[26] The ORI also proposed a Gallup survey to send to 3,000 researchers to further define standards of ethical research conduct. The survey required the scientists to answer questions dealing with improper citation of articles and poor research supervision, but this approach has been attacked as too broad. Critics also feel that the ORI may be exceeding its limits to areas not included in the OSTP definition of scientific misconduct.[26,27,28] The president of the Federation of American Societies for Experiment Biology (FASEB), Stephen Teitelbaum, calls the survey "a terrible instrument" and its questions "outrageous."[26]

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In Britain, the General Medical Council plans to specify both the standards for research practice and the punishments for those who violate them.[10] Individual researchers have also developed their own ways to deal with issues of fraud, such as checking the work of their associates more carefully.[21] Some supervisors even feel unable to reveal the identity of reagents to researchers working in their laboratories for fear of data falsification.[15] The Institute of Medicine has also suggested continuation and expansion of research ethics training, though Arthur Rubenstein of the University of Pennsylvania, the panel's chair, anticipates "quite a lot of flak" on the controversial idea. Rubenstein even goes so far as to recommend ethical conduct as a part of promotion considerations and research ethics programs as a requirement for university accreditation.[27] Even with ethics courses, as Hubert Markl of the Max Planck Institute remarked, "One shouldn't expect too much from formal

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[ethics] courses; there are tons of lawyers who finish their formal legal training and still go work for the mob." Instead of merely endorsing ethical practices, "You have to teach it by example; the young scientists have to see it day in, day out," stated Lord Kilpatrick of Kincraig, a past president of the British General Medical Council.[15]

As to the best way to prevent and punish scientific misconduct, there seems to be no clear answer. Awareness of the problem alone is a huge step forward, but it is certainly not enough. Perhaps the best suggestion comes from Paul Grant, of *Nature*—for colleagues to educate each other about their work, to the level that any co-author can defend another's work. Not only does this reduce likelihood of fraud, it also allows scientists to interact with one another to expand "technical vitality."[30] Without any additional supervision for each and every researcher, the problem of scientific misconduct will not go away. In the words of Cai Decheng, former vice president of the Chinese *Science and Technology Guide*, "There must be no compromise over dishonesty and no cover-up. Taking pity will harm the cause of science."[16]