



A Presentation by

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Introduction

Good evening. I'm pleased to be with you tonight, to once again have a chance to speak at the annual Sigma Xi lecture series. This year I would like to address the subject of "Scientific Integrity and the University." Actually, during the past couple of years I have had a crash course in the subject. For you see, in my role as chair of the National Science Board, I am in the strange position of having the Inspector General of the NSF and all of the apparatus for the investigation and adjudication of scientific misconduct report directly to me.

However, this evening I am definitely *not* going to talk to you as chair of the NSB, for to do so would probably drag me deeply into the controversy surrounding federal policy in this complex area. Rather I would like to talk to you as president of the University but even more as scientist to scientist.

Public Perceptions

The press and many members of Congress are of the opinion that scientific integrity is an oxymoron; that scientific misconduct is rampant; that things are out of control. And to be sure, several cases certainly have dominated the headlines, most notably the charges surrounding Nobel Laureate David Baltimore, which eventually led him to withdraw as president of Rockefeller University, and the investigations of the AIDS research of Robert Gallo, which continue to go back and forth (most recently "forth" with last month's ORI report). Indeed, we have even had some visible activity here at Michigan.

Unfortunately, we are living in a time of general public cynicism toward higher education and over the last few years, scientific misconduct has contributed to this cynicism. It is worth noting that according to the National Academy of Sciences, over the past few years, more than 200

allegations of misconduct in science were reported to U.S. government offices. Of that number, about thirty cases have resulted in confirmed findings of misconduct in science. This number could be viewed as relatively small compared to the 26,000 research grants supported each year by the National Institutes of Health and the number of scientists active in the field today. Yet even this small number of cases has caused serious damage to public trust and confidence in the research enterprise.

And what about the situation right here at home? According to the Office of the Vice President for Research, the University of Michigan has an average of two cases of misconduct in progress at any one time. That does not mean two new cases every year. It means that of all of the research performed by 3,300 faculty members at the University of Michigan, there is a consistent average of two cases of scientific misconduct being investigated or adjudicated.

Unfortunately, when such cases first began to receive attention by government bodies and to draw the attention of the media, the initial reaction, both by the scientific community and academic institutions, was defensive. We tended to retreat behind our fortress walls, insisting that such cases were rare, and that they could be well-handled within the normal process of scientific inquiry. Yet, the attention of public officials, recent studies by scientific organizations, and the interest of the media all make it clear that the problem of misconduct in science is real, and it is not going away.

Indeed, as science plays an increasingly critical role in political, economic, and social decisions, and as the federal government's support of basic research grows to billions of dollars, it is inevitable that society will demand a higher level of accountability. The federal government is now deeply involved in regulating the practices of laboratory researchers and trying to define the limits of unacceptable behavior.

The Seriousness of the Situation

Scientific misconduct is a serious threat to the intellectual integrity on which the advancement of knowledge depends. It can taint the reputation of the University and its honest scholars and researchers, disrupting their lives and destroying their futures as scholars. It can compromise the position of collaborators, research assistants, and research directors. It can lead other investigators down fruitless paths of inquiry at enormous costs of knowledge, morale, careers, time, and money.¹ Crimes against science are like crimes against mankind; even one incident is too many. Yet the rare cases of misconduct have a disproportionately large impact on us. Besides damaging the reputations of the individuals and the institutions involved, they contribute—along with indirect cost scandals, for example—to a negative public perception of both researchers and the academic community. As you can imagine, the costs involved with such cases are enormous. Investigations consume staff time; there are legal and administrative fees; cases end up in court. Those of you who have, as faculty members, spent time assisting with investigations know that the process can sometimes take years. It can be a very stressful and costly experience.

Scientific misconduct is indeed a matter to be taken very seriously by all. Indeed, while much of the scientific community has been initially resistant to the intrusion of government oversight, we now are coming to understand and accept that we have to make our code clear and enforce it—or others will do it for us.

What is It?

Part of the problem is one of definition. Scientific integrity is sometimes considered so fundamental a part of the scientific process that both defining it and including it in education and training is taken for granted. As Frank Press, president of National Academy of Sciences says,

“It is a largely tacit code of professional conduct,” that guards “the integrity of the scientific enterprise.”² Of course, there are many forms of misconduct:

- Fraud, falsification, fabrication (the Three Fs)
- Ownership, plagiarism, falsely claiming credit
- The mistreatment of students, assistants, colleagues
- Violation of safety and human subjects regulations
- Contractual violations
- Conflict of interest

The Office of Research Integrity of the Public Health Service definition reads: “Misconduct or misconduct in science means fabrication, falsification, plagiarism, or other practices that seriously deviate from those that are commonly accepted within the scientific community for proposing, conducting, or reporting research. It does not include honest error or honest differences in interpretations or judgments of data.”

Recently, there have been efforts to distinguish between scientific misconduct and professional misconduct. The National Academy of Sciences and others have sought to narrow this definition to the three great scientific sins: falsification, fabrication, and plagiarism. They would then classify other forms of misconduct such as non-collegiality, sloppy notebooks, nastiness, not sharing resources, not helping younger colleagues, as nonprofessional behavior—but *not* as scientific misconduct.

Indeed, the Office of Research Integrity itself has recently proposed a new term, “research misconduct,” that would substitute for the phrase “deliberate falsification . . . or other deliberate misrepresentation in proposing, conducting, reporting, or reviewing research.” In this scheme, deliberate falsification of research would fall in the sanction category.

On the other hand, failing to credit the technical services of a graduate student would be improper. My remarks will focus primarily on fraud, although other forms of abuse are regarded as scientific misconduct by agencies such as the National Science Foundation. (On this campus these forms of abuse are dealt with by other policies, such as Sexual Harassment, Human Subjects, Conflict of Interest, and so on.)

Here it is important to distinguish between scientific fraud and honest mistakes or sloppy research. Fraud is a deliberate misstatement, made with an intention to deceive others. It involves a deliberate effort to deceive and includes:

- Plagiarism
- Fabrication of data
- Misrepresentation of historical sources
- Tampering with evidence
- Selective suppression of unwanted or unacceptable results
- Theft of ideas

It is important that the distinction between fraud and negligence be observed. Once a question of fraud exists, it must be investigated under established procedures. If it becomes clear that fraud is not involved, then the investigation should cease, regardless of the degree of carelessness found in the work under scrutiny.

How Rare or Prevalent is Scientific Misconduct?

Scientific misconduct has a lengthy history. Some of the big names in science, we have since discovered, were involved in some questionable practices, if not outright fabrication or plagiarism. You may already know about Ptolemy, otherwise known as the greatest astronomer of antiquity. He supposedly plagiarized the work of a Greek astronomer. Galileo, Newton, Bernoulli, Dalton, Mendel, Darwin, and the list goes on.

Today, actual numbers are unknown. We do not know how many cases go unreported. But with the media staying right on top of this issue, a single case becomes widely known to the public. The media reports that cases of fraud have increased, but sometimes fails to mention that the amount of research has been growing exponentially at the same time. It is fair to say that the *reporting* of such cases has increased over the last decade, especially as fraudulent behavior or misconduct becomes more clearly defined and as protection for the accuser and the accused is improved.

Greater Pressures Today

Where is it all coming from? Some have even tried to argue that science attracts a type of person who hopes for great recognition and often does not care what it takes to achieve this. Billy Graham once said, "Everybody has a little bit of Watergate in him."

But there are many contributing factors. Quoting from an editorial in the May 29, 1992, issue of *Science*:

"Humans respond to the pressures, intellectual climate, and rewards systems to which they are exposed. The pressures at universities have tended to emphasize mere numbers of publications and the amounts of grant money brought in. Skilled lectures to undergraduates have counted for little. The poor performance of a few universities in dealing with serious cases of fabricated data and delays in addressing allegations of misconduct have tarnished the images of all universities."

Competition for grants and recognition has intensified. Many young scientists feel that the pressure to publish may be a contributing factor to colleagues' misconduct. Respondents to an

American Association for the Advancement of Science survey on scientific misconduct cited their own personal views of its causes:

- The 'rat race' to publish findings first
- Unearned or 'honorary' authorship
- University reliance on 'quantitative measures of academic/scientific performance' (more is better)
- Competition for grants and recognition³

Congressional/Agency Reactions and Overreactions

Certainly, politicians have been one factor in the higher visibility given to scientific misconduct. It makes good copy for the media; portraying the investigator as stamping out scandal and crime. Indeed, some have built their reputations on such cases and are known to be receptive to whistleblowers, whether legitimate or contrived.

So too some in elected positions have become true masters of manipulating the media and public opinion, trampling over confidentiality and occasionally truth to capture a headline or to gain political support. In part out of fear of Congress and the press and in part out of concern for the scientific enterprise itself, federal agencies have responded by building large administrative structures to investigate scientific misconduct cases.

For example, the Office of Scientific Integrity of the Public Health Service, has a couple of dozen staff handling almost one hundred cases per year (including highly visible cases such as the Gallo investigation). The National Science Foundation established its Office of Inspector General, with a budget of \$3 million per year, reporting directly to the National Science Board.

How Do We Handle Scientific Misconduct?

So, how *do* we handle cases of possible scientific misconduct? In theory, research should be predicated on mutual trust and honesty, since scientific research attempts to seek truth. As Harry Truman noted, "A person who is fundamentally honest doesn't need a code of ethics. The Ten Commandments and the Sermon on the Mount are all the ethical codes anybody needs."

Yet, unquestioned trust can also leave the door open for abuse. It is also clear that the self-correcting mechanisms of science are not always adequate to ensure the integrity of the scientific process. One lesson well-learned is that ad hoc procedures do not work well; they do not allow institutions to respond well to charges of academic fraud. Specific procedures must be developed in advance to handle these cases and reduce the risks to everyone involved.

At the University of Michigan, we have seen the evolution of a variety of policies and procedures over the years. The key policies in place at the University are:

Academic Integrity Policy for
Faculty (1986)

Academic Integrity Policy for
Graduate Studies (1985)

Guidelines for Responsible Conduct
of Research, Medical School (1989)

These policies set out our expectations for scholarly behavior, along with a process to investigate and adjudicate cases of possible misconduct. Because of the potential jeopardy to the reputation and rights of the accused, great care is taken to handle both informal and formal investigations in a way that preserves confidentiality. The policies and procedures are designed with safeguards for both the accused and the accuser and recognize the interest of the community in academic integrity.

How Do Federal Agencies Handle Such Cases?

Despite the need for effective mechanisms for establishing whether misconduct in science has occurred, considerable controversy has arisen over which are the right mechanisms. Two government agencies, the Public Health Service (NIH) and the National Science Foundation, have both had substantial experience in dealing with misconduct in science cases. Both agencies generally assign primary responsibility for conducting the investigation to the host institution, a practice called “deferral.” However, both have very different approaches.

PHS uses the “scientific dialogue” model, which emulates the peer review process by assembling a panel of scientists who both investigate allegations and reach a consensus as to whether misconduct has occurred.

NSF’s procedures are instead derived from well-established administration, criminal, and civil methods of investigation and adjudication. NSF believes that such methods are more appropriate where the issue posed is one of culpability for misconduct in research, rather than an evaluation of whether scientific ideas or results are suitable for publication.

Peer review of articles necessarily relies on the truthfulness of the authors. When the central issue to be resolved is whether an individual is deserving of such trust, the peer review process lacks the appropriate investigative, adjudicatory, and due process mechanisms. The NSF’s Office of Inspector General conducts a non-adversarial investigation for the purpose of gathering information. By calling on staff scientists, trained investigators, and lawyers during an investigation, the OIG brings to bear a balance of scientific and legal expertise that can provide the efficient and confidential acquisition of information essential both to the protection of the whistleblower and to a resolution that is fair to the

accused. If the OIG recommends to NSF a finding of misconduct in science, the subject is entitled to an adjudication by the Deputy Director which provides full due process rights. NSF believes that this clear separation of the investigative and adjudicatory stages is essential to providing efficiency, confidentiality, and fairness in a misconduct in science case.

Although scientific experts play key roles in the process, lawyers also play an essential role in NSF investigations by ensuring that constitutional, statutory, and regulatory provisions are met. Trained investigators with special skills in the art and psycho dynamics of interviewing are used. Fifth Amendment due process rights are *not* required during the investigation phase. The subject of the investigation does not have the right to know the identity of the complaintants or witnesses during the investigation nor do they have the right to cross examine the witnesses. However, full due process protections are given to the accused at the adjudicatory stage, after it is determined that a misconduct in science has occurred.⁴

What Are the University's Responsibilities?

Some of our responsibilities are more obvious than others. We have a responsibility to have policies and procedures in place to address cases, and we must firmly adhere to those policies and procedures. We must reveal known or suspected cases of misconduct. Not doing so constitutes misconduct as well. We must protect the rights and reputations of both the accuser and the accused. Finally, we must take responsibility for human life and the human condition when we consider our choices of research direction and make decisions on publication.

Is it the case of the lesser of two evils? The universities may be newer at the investigating/ adjudicating game, and they may be slow because

faculty and staff who live in the research world have other primary responsibilities.

Other Approaches

There is a different approach: prevention. Some suggestions for preventative changes and improvements are:

- Ethics training
- Mentoring (helping junior faculty, who are probably feeling more pressure than senior faculty, to find their niche)
- Increased collaboration
- Looking at quality rather than quantity of research
- Limiting the number of publications considered for promotions or funding
- Placing more weight on excellence in teaching
- Restructuring faculty roles to decrease stress
- Establishing burn-out prevention and faculty development programs

Cargo Cult Science

Bear with me for a moment, while I set aside my hat as an administrator and chat with you scientist-to-scientist. Whenever I consider the subject of scientific integrity, I always remember a commencement address Richard Feynman delivered many years ago at Caltech on the rather unusual subject of "Cargo Cult Science."

On certain South Sea islands following World War II, a strange religion developed among primitive peoples known as "the Cargo Cult." During the war these natives saw Allied airplanes land, carrying lots of good things. But after the war, the planes left for good. The natives wanted to make the planes return, so they built things like runways and a wooden hut for a man to sit in with two wooden pieces on his head like headphones and bars of bamboo sticking out like antennas.

And they waited for the planes to return, except, of course, they never did.⁵ The natives believed they were doing everything right. It looked just as before. The form was perfect. But it doesn't work. Something is missing. The same is true with certain forms of pseudo science: ESP, UFOs, and I guess you could add cold fusion to the list.

The form is right. It looks like science, but it isn't. It doesn't work. What is missing in these Cargo Cult Sciences? It's a kind of scientific integrity, a principle of scientific thought that corresponds to a kind of utter honesty; a kind of leaning over backwards.

For example, if you're doing an experiment, you are obligated to report everything you think might make it invalid—not only what you think is right about it, but other causes that could possibly explain your results. Details that could throw doubt on your results must be given, if you know them. You must do the best you can—if you know anything at all wrong or possibly wrong—to explain it.

In summary, the idea is to try to give *all* of the information to help others judge the value of your contributions, not just the information that leads to judgment in one particular direction or another. Of course, in the end, truth will win out. Others will repeat your efforts and find out if you were wrong or right. It is this integrity, this care not to fool yourself that is missing to a large extent in cargo cult science. Unfortunately, this sense of utter scientific integrity is something we rarely include in our training of future scholars.

The first principle is that you must not fool yourself—and you are generally the easiest person to fool. You have to be very careful about that. After you've not fooled yourself, it's easy not to fool other scientists. You just have to be honest in a conventional way. Note it is also essential that you not fool the layman when you're speaking as an expert.

A Related Concern

Let me mention a related concern. The scientific approach to truth, that of absolute integrity, the responsibility to reveal all—both those facts that support your case and those that undermine it—stands in sharp contrast to the legal approach, which relies on a one-sided presentation of facts and then a carefully structured adversarial process to determine truth. Both the legal and the scientific approach are powerful models of discovery and proof. Yet they are each quite different in theory, values, and process. So different, in fact, that they may well conflict and undermine one another if used together in a given investigation. And, yet, many of our procedures for investigating and adjudicating scientific misconduct attempt to blend these two quite different approaches. It may be best to allow the scholarly examination of facts to proceed without the intrusion of another system for establishing truth.⁶

The investigative procedure should probably retain a non-legalistic character. Once lawyers are involved, the proceedings shift in tone from science to Cargo Cult Science, from scholarly inquiry to legalistic battles. Evidence will be considered not in light of scientific criteria, but in the terms of the courtroom. There is potential for intimidation of scholars who must be able to make judgments on scientific grounds. The possibility of eventually appearing in court will always remain (through suits for defamation of character, violation of employment contracts, etc.). This possibility preserves important rights of those whose research has been found by the investigative process to be fraudulent, and it provides additional incentive for the relevant committees to proceed with care.

Conclusion

Where do we go from here? We are concerned, as are other research institutions, about the current climate surrounding scientific integrity. Clearly, no matter how well Michigan handles its own cases of misconduct and the prevention of misconduct, we need to do more.

Any policy, any procedure, must continually evolve to face new challenges. For example, information technology has opened up an entirely new realm of concerns, from the privacy of electronic mail to the complex task of determining ownership of software. We must aim for a system that is a complex mix of professional, institutional, and public ethics. We must also aim for a community that is deeply respectful of individuals.

I look forward to hearing your thoughts about what we can do here at Michigan. This is an important issue, and we need to have everyone thinking about it.

Feynman's Final Wish

Let me return for a moment to Feynman's commencement address on Cargo Cult Science. In typical Feynman fashion, he concluded with just one simple wish for the Caltech graduates before him:

" . . . the good luck to be somewhere where you are free to maintain the kind of integrity—the academic honesty—where you do not feel forced by a need to maintain your position in the organization or financial support, or so on to lose your integrity."⁷

May you have that freedom. And may Michigan be such a place!

¹ *Report of the Provost's Committee on Academic Fraud*, Issued 24 January 1986, *The University of Chicago Record*, 10 December 1992, p. 2.

² Robin Herman, "Science's Code of Conduct," *The Washington Post*, 12 January 1993.

³ David P. Hamilton, "In the Trenches, Doubts About Scientific Integrity," *Science*, 13 March 1992, p. 1636.

⁴ Karen G. Herman, et al. "Investigating Misconduct in Science: The National Science Foundation Model," 22 September 1992 (draft).

⁵ Richard Feynman, *Surely You're Joking, Mr. Feynman*, New York: W.W. Norton, 1985, p. 340.

⁶ *Report of the Provost's Committee on Academic Fraud*, p. 3.

⁷ Feynman, p. 346.

