

## Essay: Fraud in Scientific Research

Science attempts to make sense out of the elements of nature. To do so, scientists have to work endlessly with experiments, gathering dull facts and statistics. It is often a grueling, thankless job, but the glory of a discovery is the lure to those who give their lives to science. Sometimes an impatient scientist will make an illusion of discovery to gain fame and recognition. But, unfortunately, in this case the discovery is a fake and the scientist is guilty of committing fraud.

When fraud occurs, scientific institutions typically minimize the implications of the incident by saying the scientist in question was demented, stressed, or otherwise mentally impaired. They are quick to assure those outside of academia that the incident is rare and there is no cause for concern. They claim that there are mechanisms that ensure that any significant error or fraud will be detected and expunged. They cite the self-correcting and self-policing mechanisms present in scientific research for the reasons why we should not be alarmed. But, just what are these self-correcting and self-policing mechanisms?

A science writer June Goodfield claims that, unlike all other professions, science has no full-time critics. This is so because scientists fulfill this role for themselves. Goodfield is referring to the three-principle, self-correcting mechanisms of replication, peer review, and the referee system. Beyond that, Goodfield says, the cognitive structure upon which science is built is a significant deterrent as well (Broad 61).

The cognitive structure is the hierarchical system of scientific knowledge. First, facts are obtained through observations. From these facts, hypotheses are formed. Then the hypotheses must be tested by experiments to give corroboration or disproof. At each level, there are many rules and regulations to be observed. There is a rigorous back-and-forth procedure between hypothesis and experiment which is a major part of the scientific process. Scientists claim that because this structure requires strict adherence to procedure, the incident of fraud is minimized. Regardless of their claim, there are a number reasons why this structure isn't the deterrent that the scientific community would like to believe that it is.

Most university science research is funded by the federal government through grants. Scientists applying for a grant must submit an application to a committee of specialists who advise the government agencies which scientists should be supported and which should be denied funds. The committee consists of fellow experts in the field and they judge the merits of the detailed grant applications. Funds are then channeled according to the decisions of the peer review committee. This process is called the "peer review system."

In addition, scientists must go through a series of tests when they apply for funds. They must publish the results of their research in a scientific journal. The journal editor sends each article out to scientific reviewers, known as referees. The referees advise the editor whether a work is new, whether it properly acknowledges the other researches on whose results it depends, whether the right methods have been used in conducting the experiments, and of the validity of the arguments in discussing the results. This process is called the "referee system" and is the most rigorous test an article may undergo. It is a prime point at which fraud or self-deception should be caught.

The scientific claim, thus, has gone through two checks for reliability before it is published: Once through peer reviewers and once by journal referees. There is a third defense against fraud: Replication. Those who study the logical structure of science point out that science differs from other branches of knowledge in that the assertions of one scientist can be objectively tested by another. When scientists publish their findings they must describe exactly how they did the experiments so others can repeat them and thereby, confirm or refute the results. Thus, replication is the crucial test through which science judges theories and experiments. Fraudulent experiments would be exposed when others try to replicate them. The more important the false claim, the quicker the attempted replication by others will bring it down.

Many believe that scientists are inherently honest because they are seeking the truth. The German sociologist Max Weber said it's the scientists "devotion to the truth (that) keeps science honest" (Broad 60). A committee of scientists at the National Institute of Health (NIH) drafted a five-page pamphlet describing what a scientist should be:

The ideal scientist is a good mentor, a teacher who imparts to his or her students the ethos of a life in science and recognizes that the trainee is not simply an additional laboratory worker. The ideal scientist knows the importance of hanging on to primary data and recording them in a way that makes them accessible to colleagues. ...The ideal scientist publishes just the right amount—neither too much nor too little and, when possible, makes reagents and the like available to colleagues who want to follow up on published data . . . . The ideal scientist is listed as an author of a paper only when is he or she actually did some of the work . . . . The ideal scientist never abuses peer review by taking a colleague's idea for his own. Nor does he tell anyone else about the substance of a paper or proposal under review—especially not in casual conversation. (Culliton)

The ideal scientist and the self-correcting mechanisms of science sound convincing. If these impressive standards indeed do exist, then why are such notable scientists such as Ptolemy, Galileo, Newton, Dalton, Mendel, Millikan, and

Burt on the list of perpetrators of scientific fraud? Perhaps the scientific community overestimates its ability to police itself.

Since the early 1980s, the number of fraud cases seems to be escalating. In response to concern by Congress and the public, in 1987 the National Science Foundation put forth a three-part definition of misconduct. However, this paper is concerned only with the first part. The other two parts are concerned with federal rules and regulations regarding safety issues, etc. The report defines misconduct as "fabrication, falsification, plagiarism, or other serious deviations from accepted practices in proposing, carrying out or reporting results from research" (Hansen 9).

There is disagreement whether the incidents of fraud is actually increasing or if its nothing more than media hype. Philip Handler, then president of the National Academy of Sciences, as he addressed the House Committee on Science and Technology in 1981 claimed that the problem of fraud had been "grossly exaggerated" by the press (Broad 11). Many in the scientific community still make that claim. However, according to a survey taken by the American Association for the Advancement of Science (AAAS), 27% of scientists "believe they have encountered or witnessed fabricated, falsified, or plagiarized research over the past 10 years" (Hamilton). And during the same period, 1100 articles have appeared on misconduct (Abelson). Surprisingly, there is no reliable data available. Although a number of reports have been published on fraud, they don't deal adequately with the extent and types of misconduct (Abelson). Some experts believe that it should be about the same as fraud in society at large.

Regardless of how small the percentage of scientists who might be fakers of data, it requires only one case to surface every few months for the public credibility of science to be severely damaged. A look at some cases of fraud will show how extremely important it is to keep fraud out of the halls of science. There are famous incidences of fraud that have gone undetected for decades and become part of common knowledge. Science is a field that builds on itself and is, therefore, important that it builds on solid facts and data.

Probably one of the oldest fakes known was committed by Claudius Ptolemy, considered to be the greatest astronomer of antiquity. He lived during the second century A.D. in Alexandria, Egypt. He was one of the most influential scientists in history. His system for predicting the positions of the planets lasted for 1500 years. His ideas shaped man's view of the structure of the universe. It was not until the nineteenth century when astronomers began to re-examine Ptolemy's original data. This re-examination showed gross errors, even by ancient standards. It appears that Ptolemy never made the observations he claimed; rather he lifted them entirely from the work of an earlier astronomer, Hipparchus. He also is accused of having derived the data to support his theory from the theory itself—not from nature.

Another shocking fact of fraud was perpetrated by Isaac Newton, the founder of physics and perhaps the greatest scientist in history. Newton wasn't above falsifying his data when the real results didn't win acceptance for his theories. He altered various data in his theory of gravitation so it would agree precisely with the theory. More than 250 years passed before the manipulation was completely revealed. Unfortunately, this wasn't the only example of Newton's "sleight of hand" (Broad 27).

More recently is the incredible story of Elias A. K. Alsabti of Basra, Iraq. The fraudulent schemes that Alsabti used to promote himself spanned from Iraq to Jordan to the US. Over the course of his illusionary academic career, he forged a medical degree, had duped the Jordanian government into giving him tens of thousands of dollars for research, had fabricated his relation to the royal family, had lied his way into US universities, had bestowed a Ph.D. upon himself, and, while allegedly doing research in a handful of prestigious US labs, had pirated many, perhaps all, of his sixty published papers. His tactics deceived the editors of dozens of scientific journals around the world. In addition, his lies and conjuring took in the governments of two Middle Eastern countries, the review committees of eleven scientific societies, and the administrators from six US institutions of higher education (Broad).

These are only three examples of countless others. Unfortunately, they are not the worst examples. A more innocuous example of deception, although not out-and-out fraud, is described by an article in Science, "Do NASA Images Create Fantastic Voyages?" The article explains how scientists publish distorted images of planetary bodies, by accident or by design, which misleads the public. Some of these images portray Venus with a towering volcano when it's actually a "Venusian molehill" (Kerr). The almost invisible volcano was exaggerated in height by a factor of 22.5. "That's like stretching a two-story home until it has the proportions of the Washington Monument," says Kerr. The color images of Mars sent back in 1976 showed a landscape of orange rocks and dust when the Martian surface is actually a dark yellowish brown. Likewise, images shown of the moon Io, the asteroid Gaspra, and other celestial bodies, were published with striking color distortions. Clark Chapman of the Planetary Science Institute in Tucson concedes that although there are difficulties in rendering color as humans would see them, he thinks NASA could at least "alert the public to the inevitable distortions" (Kerr). Besides the obvious publicity value for NASA, Chapman says, "it sets people up to be disappointed with the true nature of the universe" (Kerr).

These kinds of distortions may not be absolute examples of fraud, but they are nonetheless, dishonest. They fall somewhere in a grey area, but once the public learns of these deceptions, however subtle, the perception is clear that they have been misled. It's another rip in the fabric of the veil of honesty and truth that surrounds science and the endeavors of scientists.

Frauds such as data fabrication, falsification, and plagiarism are the manifestations of a scientific process that is created and governed by rhetoric, propaganda, appeal to authority, and all the usual arts of human persuasion to win

acceptance for a scientific theory. The reality of the scientific process is that it is a flawed ideal. It is flawed with self-deception and gullibility, abuse of peer review, a lack of replication, elitism, unearned authorships, and a proliferation of worthless published papers. Scientific institutions are becoming what is known as "lab mills."

From the beginning, scientists have striven for two goals: To understand the world and to achieve recognition for their personal efforts in doing so. It is this duality of purpose that lies at the foundation of scientific enterprise. When an experiment does not come out exactly as expected, or when a theory fails to win general acceptance, this dual purpose can cause conflict. Science claims that it differs from other belief systems and rests on reason alone. But history shows otherwise. Scientists are also influenced by their own personal belief systems and theories. The scientific method is widely assumed to be a powerful and self-correcting device for detecting and uncovering fraud. This is sadly not the case, so where does it fail?

The reward system and career structure of contemporary science are among the factors that create the inducement to fraud (Broad). Replication, peer review, and the referee system simply don't work as detectors or deterrents. The notion of replication to test validity of another's experiments is a myth. If fellow scientists attempt to replicate an experiment for the purpose of testing its validity, it is by its very nature, seen as a direct challenge. The implication that an experiment might be fraudulent would arouse instant antagonism and defensiveness. Replication is undertaken only in special circumstances and is, in fact, rarely done.

The peer review system is controlled by elitism, or the "old boy network." According to John B. Conlan, Representative from Arizona, "The peer review system operated by the National Science Foundation is an 'old boys system' where program managers rely on trusted friends in the academic community to review their proposals. These friends recommend their friends as reviewers" (Broad 100). Conlan says that this "buddy system" frequently stifles new ideas and scientific breakthroughs, while controlling multi-millions of dollars in Federal grant money. The scientific elite wield a substantial amount of power and influence through the distribution of funds and promotions, so this issue is a crucial one.

Thus, it is the system of rewards in science that corrupts the peer review system as well as the referee system. It allows immunity from scrutiny because it ensures that the achievements of scientific celebrities and their proxies will be more widely noticed than the equivalent accomplishments of lesser-known researchers. The more recognition a scientist has, the less likely his papers will receive scrutiny when reviewed by a referee. Therefore, this mechanism to weed out bad or fraudulent research is not universally applied. The roots of scientific fraud and misconduct are due to:

1. Cost of research.
2. Government subsidies through grants.
3. Competition for grants and recognition.
4. Unearned or "honorary" authorship.
5. Failure of research institutions to accept responsibility for fraud.

Probably the most significant of those is the cost of research. In recent years, the cost of research has sky-rocketed. As technology improves, costs go up, as in the health care industry. As costs increase, the amount of available money shrinks and the competition for grants becomes fierce. "Pressures at universities have tended to emphasize mere numbers of publications and the amount of grant money brought in. Skilled lectures to undergraduates have accounted for little" (Abelson). As a result, a scientist's career depends on published articles in scientific literature. To be successful, he must get as many published articles as possible to secure government grants, then build up a lab, hire graduate students to do the research work to increase the production of published papers, and so on. This activity leads to what is now called the "lab mill."

Inherent in this system of the lab mill is the proliferation of worthless papers published in science journals, the exploitation by masters of their apprentices, and the abuse of unearned authorship of published papers. The lab mill has the insidious effect of enticing the young scientist to cut corners, to improve on results, or even to fake data entirely. The temptation is strongest where researchers have no stake in intellectual rewards: The process of publication. When the young researcher realizes all they were hired to do was the lab chief's grunt work, and it is he who will benefit by authorship of the resulting paper, the incentive for scientific truth is lost. Extensive study on this subject has been done by sociologist Julius A. Roth (Broad 150).

Today, it is not uncommon for a prominent scientist to appear on many hundreds of papers, unlike the recent past. Just twenty years ago, Nobel Prize winner James D. Watson (co-author of a paper describing the structure of DNA) had published only eighteen papers at the point he was made associate professor at Harvard. A similar candidate today would list 50 to 100 papers (Broad 150). This is not the result of a surge in creativity and tireless devotion, rather is due to the exploitation of the lab chief system. It is often the result of graduates and post doctorates working long hours producing reports and papers to which the lab chief signs and receives credit.

Also, it is common practice that, instead of publishing one comprehensive paper, a researcher will break it down and publish four or five short ones. This practice is known as the "least publishable unit" (LPU). Another example of the publishing game is seen in the rise of co-authorship. A number of researchers can share credit for a single piece of research. The number of authors per paper rose from an average of 1.76 in 1960, to 5 in 1980, and it's not uncommon to see as many as 12 or more (Broad 55).

Over half of these papers are never cited, meaning they essentially go unchecked, unreplicated, and probably unread. Worse yet, these writings are often used by the fraud experts. Alsabti stole insignificant research and thereby avoided detection. However, the papers he compiled still gave him instant entree into the higher reaches of US academia. According to Broad, a safe generalization is that many of today's scientists and much of what they publish are mediocre at best (53).

Scientific authorities deny that fraud is anything of great concern. Former Harvard microbiologist Bernard Davis "continues to argue that science's 'self-correcting' mechanisms of peer review and experimental replicability are sufficient to handle the few cases of misconduct that have cropped up in public" (Hamilton 604). Science is supposed to be a meritocracy in which people and ideas are taken on their merits. But this isn't the case. Like people in other areas of life, scientists pay a great deal of attention to rank and reward. Science is a race and is fraught with furious competition in which individuals and institutions strive to be first. Scientists and scientific institutions need to become aware of the real factors at play in the scientific process. Science is both logical and illogical, rational and irrational, open minded and dogmatic.

What happens in science affects the general public in a way perhaps more profoundly than any other profession. Thus, fraud also impacts the general public in a like manner. There is no absolute defense against fraud that would not bring the process to a screeching halt. But there are things that can be done to more effectively reduce the incidence of fraud than does the mythical "self-correcting" system. But first and foremost, the scientific community needs to acknowledge the human factor that permeates the scientific process. To deny this factor is to remain blindly loyal to an ideal that lacks reality.

The following recommendations are made to help mitigate the degrading effects that the skyrocketing cost of research plays. The recommendations also consider the abusive effects of the power elite in controlling the funds for research.

- Institutions should become more skeptical of elitism.
- Young "superstars" in elite institutions who seem to do too much too fast should be more closely considered.
- Ensure that internal tests, such as peer review and referee systems, are evenly applied.
- Formal guidelines should be set for assigning credit, particularly for the authorship line in scientific papers. For example, all people named as authors should have made a definably major contribution to the work reported. Any minor contributions should be explicitly acknowledged in the text.
- All authors should be prepared to take responsibility for the contents in the same measure they stand to take credit.
- The number of scientific journals needs to be sharply reduced because most are simply "vanity" presses and the taxpayer is supporting them.
- Page charges for publication should also be curtailed to curb the enticement of editors to publish.
- Grant renewals should not be handed out on the basis of long lists of publications and promotions.
- Grant administrators should evaluate research records on citation analysis.
- Reduce the number of researchers.
- Encourage private patrons to support scientific research and limit government involvement.

Unfortunately, science is not an idealized body of dedicated servants of truth. Rather, they are ordinary human beings governed by the same human passions of ambition, pride, and greed, as well as being people professionally committed to find the truth of nature on society's behalf. But when truth is betrayed for personal gain, the signs should not be ignored. Only by acknowledging that fraud is endemic to the process, can the real nature of science and scientists be understood.

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