

Book Reviews

On Fact and Fraud: Cautionary tales from the front lines of science by David Goodstein. Princeton Press, 2010. 184pp. \$22.95, £15.95. ISBN 978-0-691-13966-1



David Goodstein has almost a lifetime's worth of experience in investigating allegations of scientific misconduct. In this erudite and entertaining book we are guided through a number of well-known cases of potential fraud. I say "potential" because what constitutes fraud is a controversial topic in itself, as Goodstein points out through several excellently presented examples.

First, though, Goodstein analyses the causes of fraud. What drives scientists and sometimes clinicians to falsify data in the first place? He states that three factors are almost always present in cases of fraud: the perpetrator was under pressure to succeed; they thought they already knew the answer; and they were working in a field where exact reproducibility was not expected. This last point probably explains why fraud is found more in biomedicine than in the physical sciences.

Goodstein begins by examining the infamous case of Robert A Millikan's measurement of the charge on an electron, which of the examples elaborated in this book takes its place as my favourite. Millikan fitted the first of the criteria likely to make one falsify data, that of being under considerable career pressure. He was a physicist at a time when others, such as Planck and Einstein, were making great advances, and I suppose that Millikan felt that somehow he had to "keep up with the big boys". Millikan realised that he could obtain an accurate measurement of the unit of electric charge (e) by applying an electric field to droplets of oil and observing how rapidly the droplets fell under gravitational force. It was not until 1984 that Millikan's misdemeanour was exposed, when the research honour society Sigma Xi suggested that Millikan had "cooked" his data. Their accusations were based on Millikan's 1913 publication, which contained data showing that larger charges on oil droplets were always an integral value times that obtained for the value of " e ". When Millikan's laboratory notebooks were scrutinised it became apparent that he had been rather selective in his reporting – he reported measurements of only 58 drops of a total of 175 measured over a six-month period in 1911/12.

One could attribute this "oversight" of data that did not exactly fit his hypothesis to a spell of selective amnesia bought on by his powerful belief that the data he did include were the accurate ones and that any other data points were flawed by experimental difficulty, but for the fact that he stated in this paper: "It is to be remarked, too, that this is not a selected group of drops but represents all of the drops experimented upon during 60 consecutive days". Goodstein

reproduces several pages of Millikan's notebooks and talks us through first the cheating, and then the covering up by lying, in one of the most important scientific papers of the twentieth century – work that ultimately led to his being awarded the Nobel Prize in physics in 1923. I can only speculate what would have happened had Millikan thought to destroy his notebooks.

Other chapters in the book deal with similar cases of scientists so badly wanting to succeed that they transgress the boundary between truth and falsification. Duplication of panels in a Southern blot published by Vipin Kumar (working in Leroy Hood's laboratory at Caltec) in 1989 is something that, in these more enlightened (or untrusting) days, would now be detected at peer review – most reviewers deliberately seeking to detect such duplication. James Urban, working in Hood's laboratory at the same time as Kumar, went so far as to submit a paper that was based on invented data to a journal. In defence, Kumar argued that he was "green and naive" and thus didn't know any better (a claim rejected by the investigating committee), and Urban claimed to know how the experiment would turn out if he had actually done it (so are we to applaud him for trying to save science a good deal of time and money?). Both claimed to be under pressure to be seen as successful.

These are just three of the examples that Goodstein elaborates on in this entertaining journey through scientific misconduct. The physicists among you will probably find Goodstein's analysis of the events surrounding what he calls "The Cold Fusion Chronicles" (claims of solving the world's energy problems with an inexpensive low-tech means of fusion) fascinating from both the scientific and political points of view. The lengths scientists will go to get the recognition they feel they deserve are truly extraordinary!

Although this book has its depressing side – it is after all a catalogue of misconduct – it should be remembered that cases of deliberate falsification are very rare and that most scientists are as honest and upstanding as we hope and expect them to be. In his closing paragraph Goodstein states: "I hope that the reader will close this book with a deeper appreciation of how science (and scientists) actually work. If so, you will have an understanding grounded in the reality, not theory, of what science is. You will be able to apply the principles described in this book in looking at future cases, and of course, avoid committing fraud yourself."

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