The real lab rats

Clive Cookson MAY 22 2009

By Allegra Goodman
Atlantic Books £12.99, 344 pages
FT Bookshop price: £10.39

Ending the Mendel-Fisher Controversy
By Allan Franklin and others
University of Pittsburgh $27.95, 330 pages

Plastic Fantastic: How the Biggest Fraud in Physics Shook the Scientific World
By Eugenie Samuel Reich
Palgrave Macmillan £15.99, 200 pages
FT Bookshop price: £12.79

Intuition

In 2005, South Korean stem cell biologist Hwang Woo-suk hit the headlines for being the first person to clone human embryos. In 2006 his name was splashed across the papers again – this time because it turned out his results were fake.

Research fraud is one of the guilty secrets of the scientific world. Academics and administrators generally ignore research misconduct, unless a case of dishonesty is so blatant that action is unavoidable. They like to maintain that fraud is a rare blemish on the open and trustworthy face of science.

However, the few senior academics who investigate research misconduct say policymakers seriously underestimate its prevalence.

Michael Farthing, vice-chancellor of Sussex University, estimates that research-oriented universities in the UK average about one serious case a year each – an annual total of perhaps 40 significant frauds in Britain alone. Nicholas Steneck of the University of Michigan, a leading US chronicler of scientific misconduct, believes between 0.1 and 1 per cent of all researchers – thousands of people worldwide – engage in "seriously wrong practices". Only a tiny fraction of cases reach the media; most are never detected or reported, and institutions usually deal quietly with the few that come to their attention.

Three very different books now seek to bring research misconduct to the fore. One analyses a contemporary fraudster, one studies a historical case and one takes a fictional approach. All illustrate the human personalities and emotions that lie behind hard science – and come to the surface when fraud threatens.

Hwang Woo-suk is still the most famous scientific fraudster of the past decade. But the most damaging, in terms of the number of discoveries he faked and the distinguished colleagues he misled, was Jan Hendrick Schön. He was a *wunderkind* of physics until his astonishing deception was uncovered in 2002. He promised to revolutionise electronics: he specialised in coaxing organic materials – plastics – to show previously unknown properties, including superconductivity and emission of laser light.

Scientists in a dozen top physics laboratories wasted years of effort and millions of dollars trying to replicate and explain the discoveries Schön made over four years at the world-famous Bell Labs in New Jersey, and published in top journals Science and Nature.

That Schön's fraud is not better known outside the physical sciences reflects the media's tendency to focus more on biomedical research than physics. Now Eugenie Samuel Reich, a journalist specialising in fraud investigations, has pieced together Schön's story in *Plastic Fantastic*, a wonderful piece of forensic writing. Behind the specifics of this case lie some important general points about scientific fraud, notably the trusting nature of the whole research process – from the initial grant application to final submission of results for publication.

Schön was 31 when Bell Labs fired him in September 2002, after an external report detailed his fraud. He fled to Europe and Reich tracked him down and spoke to him by telephone, but Schön refused to discuss his actions or motivation. So her book relies on investigation of his publications and interviews with 125 colleagues and scientists who interacted with Schön.

In retrospect it is astonishing that everyone trusted the amiable young German for so long – they blamed themselves when they couldn't replicate his experiments; they accepted polite excuses for him not to show them his materials and equipment. It helped that he maintained a research role at the University of Konstanz in Germany in addition to his Bell Labs position; he could always claim that something was on the other side of the Atlantic.

There is nothing new about charges of scientific misconduct. Historians have accused Isaac Newton, founder of modern physics, of fudging calculations, in his work on light and optics. The spectrum of fraud and misconduct can range from full-scale faking of experiments, as in Hwang's and Schön's cases, down to the mildest massaging of what a researcher regards as faulty readings on an instrument. Anyone who did science practicals at school will remember the urge to indulge in a little fudging to produce a smoother graph.

One of the most famous projects in the history of science was Gregor Mendel's 19th-century experiments with pea breeding, which led to the modern principles of genetic inheritance. His work has long been overshadowed, however, by accusations that his results were statistically "too good to be true" – that he must have doctored data to fit his emerging theory of what we now label dominant and recessive genes.

Mendel carried out his pea crossing experiments in the Augustinian monastery at Brno, today in the Czech Republic. He observed how features of plants and their seeds changed over eight years. Although Mendel published his results in 1865, the scientific world did not recognise their significance for another 35 years or so. Then, after 35 more years had passed, British biologist and statistician R. A. Fisher suggested that data must have been falsified – though probably by an assistant rather than the great monk himself. The probability that real data would fit Mendel's expected ratios between dominant and recessive traits was only 7 in 100,000, Fisher calculated.

Scientists and historians have for decades fought over the validity of Fisher's conclusion. *Ending the Fisher-Mendel Controversy* gives us a flavour of that debate: five experts, led by Allan Franklin of the University of Colorado, plead Mendel's case. They exonerate him, and his assistants, of deliberate fraud – though he may have neglected observations that would have made his findings less clear-cut. Some of Mendel's defenders seem to feel his discovery was so significant for the development of genetics that he can be forgiven a little data cleaning.

Franklin and his collaborators hope that their (very academic) book will be the last word on what has become rather a sterile controversy. Experts have carried out seemingly every conceivable statistical and botanical analysis on Mendel's methods and results. Not only is Mendel long dead, his notebooks, which might have answered the question, were burned after his death.

By contrast, Allegra Goodman had full access to Cliff Bannaker when writing about his alleged fraud at the Philpott Institute in Cambridge, Massachusetts – because Bannaker is a product of her imagination.

Intuition, Goodman's third novel, is a brilliant fictional account of what might drive a scientist to manipulate data – and why a colleague might expose his misconduct. It captures the sheer uncertainty and ambiguity over research misconduct – and the arbitrary way in which it comes to light.

Intuition belongs to an underpopulated genre, sometimes known as "science in fiction" or "lab lit". Fraud proves itself an excellent theme for bringing out the human side of science.

Bannaker is not a blatant fraudster on the Schön or Hwang scale; he is more of a fudger or data selector like Mendel. What drives Bannaker, besides a desire for scientific honour and glory, is a strong intuitive conviction that his strain of respiratory syncytial virus (RSV) can transform cancer cells into normal cells. He persists with his experiments, despite instructions from the lab directors to stop the work. Eventually he starts recording spectacular tumour regression in the animals.

Intuition and jealousy drive his main accuser, Robin Decker. This is a novel, let's remember, so she is far from a disinterested party – she's a fellow postdoctoral researcher whose work is going nowhere, and also his neglected girlfriend. She observes various irregularities which convince her that Bannaker manipulated his data; she steals one of his notebooks as evidence. As the media hype about Bannaker and his possible cancer cure grows, Decker takes her case to the Office of Research Integrity at the National Institutes of Health, the US biomedical funding agency.

The twists and turns of the official NIH inquiry and subsequent appeal are breathtaking. And Goodman brings off a masterpiece of ambiguity, without dissatisfying the reader. What her novel presents so well, however, is a hard fact that many like to forget about science: that every "proof" and every "truth" is brought to us by humans, who are far from infallible.

While motives vary, one feature of many scientific fraudsters is that "they know they are right", says Michael Farthing: "They truly believe they have the answer to a problem." That was certainly true of the fictional Bannaker and of Hwang, who showed supreme confidence that he knew how to clone embryos – human and animal.

Schön, though, seems to have been different. He was not a great independent thinker, motivated by belief in his own brilliant ideas. As Reich shows, he took the best ideas floated by other researchers in his field – and then apparently put them into practice. If someone speculated about how to make an organic superconductor or a plastic laser, Schön would do it.

"No wonder then that scientists were so thrilled by his papers," she writes. "Schön had turned their best ideas into fabricated data that were bound to seem appealing. This helped to explain both why his claims got a good reception and why those claims had something in common with results later achieved in reality by other scientists."

These books suggest that successful fraudsters in science tend to be nice, friendly people – like financial swindlers trying to extract money from their victims. They avoid making enemies who might look for evidence of wrongdoing and expose them. Schön kept going so long because he was amiable and eager to please; Bannaker would have avoided his ordeal if he had been nicer to his girlfriend.

Scientists like to talk about the "self-correcting" nature of research – the fact that faulty experiments will be put right by future work. But Reich argues that self-correction almost failed in Schön's case. He was ultimately exposed not by the dozens of people who tried to replicate and follow up his work but by two physicists who noticed that Schön had used identical data in papers about two different experiments, published respectively in Nature and Science.

By focusing on individual cases, the three books miss out on the broader view of scientific fraud and misconduct. Indeed, even more worrying than the serious cases, says Farthing, is "the undercurrent of low-grade alteration of results, which occurs much more commonly and which is perturbing the scientific literature". New technology increases the scope for alteration, for example by subtle digital manipulation of images.

Universities and research institutions have reluctantly been increasing efforts to tackle the problem over the past 20 years, but more needs to be done. Mechanisms for detecting, reporting, investigating and resolving research misconduct are still inadequate. It should be possible for scientists to look more actively for signs of dishonesty in their colleagues, for example when they scrutinise papers in the "peer review" process before publication – without destroying the trust between researchers on which the efficient conduct of science depends.

Clive Cookson is the FT's science editor

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