Responsible Conduct of Research Case Study Series
Jan Hendrik Schön

Bell Labs in New Jersey is a research and development organization. Originally a division of AT&T, it is now a subsidiary of Alcatel-Lucent. Bell Labs has an enviable record of discoveries and work performed by its researchers; seven Nobel Prizes have been awarded for work completed there.

Jan Hendrik Schön joined Bell Labs in 1998 after receiving his Ph.D. at the University of Konstanz in Germany. He worked as part of a team, primarily in the fields of condensed matter physics and nanotechnology. Schön published prolifically with members of his team during his tenure at Bell Labs: In 2000 he published as first author five papers in Science and three in Nature; and, in 2001 he was first author on four papers in Science and four in Nature, and wrote an average of one paper every eight days.

Researchers within Bell Labs, around US and internationally spent enormous amounts of time and money trying to reproduce Schön’s results to no avail. And the primary reason was because the majority of the data were fabricated and falsified. In 2002, researchers from within and outside Bell Labs noticed several figures, published in different papers, looked very similar. Some figures contained the same “noise” for different experiments. As they looked at more papers, they found more problems. They notified Bell Labs management who launched an investigation. Twenty five papers were questioned; Schön was the author common to all and involved 20 coauthors.

In 2002, Bell Labs released a report detailing an investigation committee’s findings for 24 allegations of misconduct. Of the 24 allegations, the committee found Schön had committed misconduct in 16 of the cases. Had his results been real, they would have represented significant breakthroughs in a number of areas of condensed-matter physics and solid-state devices, some with significant practical implications, such as the cost of electronic devices. The committee made the following general findings (pp 9-11):

1. “The devices used in the work in question were (with a few exceptions) fabricated by Hendrik Schön alone, with no participation by any coauthor or colleague, either at Bell Labs or at the University of Konstanz, where much of the work in question was physically carried out….
2. Physical measurements of the significant devices underlying all papers in question were (with one exception) carried out by Hendrik Schön alone, with no participation by any coauthor or other colleague….
3. No measurement or demonstration of a significant physical effect or device characteristic (e.g., transistor action, quantum Hall effect plateau, light emission, superconducting transition or Josephson junction behavior) was witnessed by any coauthor or other colleague (with one exception), despite repeated requests in at least two cases (laser action and superconductivity)….
4. No laboratory records (e.g., signed notebook, dated sheets of paper, or data/sample logs) were systematically maintained by Hendrik Schön in the course of the work in question, either with respect to samples, processing, characterization or measurement….
5. All primary electronic data files were deleted by Hendrik Schön. Current records, provided in response to the Committee’s request for supporting information on six papers, comprise only secondary, processed data kept in numerous computer files and on loose sheets of paper – and these not systematically so….”
6. No working devices with which one might confirm claimed results are presently available. In addition, no nonworking devices are available for structural or other types of characterization. All of the hundreds of devices that are claimed to have been studied were either damaged during measurement, damaged in transit from Konstanz or simply discarded….
7. All figures in the papers in question were (with one exception) processed and prepared by Hendrik Schön alone, with no direct physical participation by any coauthor…..”

The committee made the following findings related to alleged misconduct (pp: 11-12):

A. “Substitution of data in the papers in question did occur in multiple instances. Specific examples include:
   I. Substitution of whole figures, single curves and partial curves in different or the same paper to represent different materials, devices or conditions.
   II. Nontrivial alteration or removal of individual data points or groups of data points within a data file…. 
Further examples of substitution and alteration of data include:

I. Substitution of fitted or assumed mathematical functions (e.g., power laws, sine functions, exponentials, exact zeros) where measured data would be expected. In some cases, these surrogate data were spliced, using unspecified matching procedures, with other surrogates or with real measurements to create the overall curves that were presented.

II. Selection of data for illustration of trends so as to match the expected trend to within a few percent, even though the original data varied by more than a factor of ten.

Instances in which the data in figures have characteristics that are manifestly unreasonable also occurred. There are three types:

I. Individual curves in different figures or even the same figure that are identical in shape (e.g., simply shifted vertically) over their entire extent or over only a portion of the curve.

II. Statistical plots that are inconsistent with the unbiased sampling process implied in the associated paper.

III. Perfect numerical symmetry in measured data values for continuous upward and downward sweeps in a control parameter.

Schön admitted to making mistakes; he also admitted to manipulating and misrepresenting data, and acknowledged that he should not have done so. But he did state his conviction that many of the physical effects he reported were real, and that given the opportunity he would work hard on reproducing them. The committee cleared all coauthors of any misconduct but raised the issue of professional responsibility; that is, did the coauthors exercise appropriate responsibility in ensuring the validity of reported data and physical claims?

Bell Labs fired Schön on the day they released the report. Between October 2002 and March 2003, Science, the Physical Review journals, and Nature withdrew eight, six, and seven papers, respectively, by Schön. In 2004, the University of Konstanz revoked Schön’s doctorate, not because the data in his dissertation were found to be fabricated or falsified but rather due to “dishonorable conduct.”

Source:

Questions for Discussion:
1. Schön’s doctorate was revoked due to “dishonorable conduct.” What did Schön do wrong and why?
2. What enabled Schön to be so successful, publishing in Science and Nature?
3. What authorship issues does this case raise? Why didn’t the coauthors’ identify the problems early on?
4. What are some of the data management issues that this case raises?
5. What issues does the case raise about collaborating with others?
6. How did Schön manage to publish fabricated and falsified data in Nature and Science? Why didn’t peer review identify the problems with the data and the figures?
7. What are some of the mentoring issues raised by this case?
8. Are there any intellectual property issues in this case?
9. Does this case raise any conflict of interest or commitment concerns?
10. What are some of the consequences of Schön’s actions? For Bell Labs? For co-authors? For physics in general?
11. What are some lessons learned from this case?
12. What responsibilities do students (graduate and undergraduate) have in cases where they serve as co-authors on papers where data falsification has occurred?
13. What other professional fields suffer from issues related to data fabrication and/or falsification? Consider specific examples, if possible.