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Data handling causes image problem for top lab

Two papers — one published more than a decade ago and the other a preprint from last year — have raised doubts among experts about the work of a world-renowned microscopy laboratory.

In a Corrigendum in this week's issue of *Nature* (see page 235), three authors from an atomic-imaging group at Oak Ridge National Laboratory in Tennessee admit to treating critical data inconsistently in a paper from 1993 (ref. 1). Two of the three authors are also co-authors on an August 2005 paper, on the arxiv.org preprint server², in which some data were reproduced from one of the group's earlier papers³ without citation and another figure included duplicated data points on two sides of a plot. The authors posted a revised version, with added citations and a replacement figure, on 15 May 2006 (ref. 4).

An investigation over the summer by an independent panel, formed at the behest of the Oak Ridge lab, found "no evidence of research misconduct or fraud in either paper", according to James Roberto, the lab's deputy director for science and technology.

But within the community, doubts linger. "It's obvious that some games are being played," comments John Silcox of Cornell University in Ithaca, New York, who was a reviewer of the 1993 *Nature* article. "I don't trust their work."

Few researchers were willing to go on the record, but several told *Nature* privately that they also were concerned about the papers.

The group is led by Stephen Pennycook, a physicist who has been at Oak Ridge since 1982. His group helped pioneer the scanning transmission electron microscope (STEM), which uses a narrow beam of electrons to simultaneously take spectra of and image materials. The microscopes cost millions of dollars and the field is intensely competitive. Pennycook's group is at the forefront, says John Spence, a physicist at Arizona State University in Tempe: "They have the



Questions have arisen over data from a team at Oak Ridge National Laboratory.

best machine, the most money, and very good people."

In the *Nature* paper, the collaboration reported taking spectra and images of a boundary between a thin wafer of cobalt silicide and one of silicon. At the time, imaging such an interface was difficult. The team proved it was possible by showing clear spectra of both the cobalt silicide and silicon.

But in the Corrigendum, the authors admit that the cobalt silicide spectra were reproduced from an earlier conference paper by the same group⁵. The admission contradicts the authors' response to a 1993 referee report (obtained independently and verified by *Nature's* news team) in which they deny that the spectra came from the proceedings. Pennycook says that the original statements were made because the group was confused about the referee's criticisms.

The duplication of some but not all spectra meant that different methods were used to process the background noise on either side of the boundary. Some researchers are unfazed by the error: "Clearly it's a minor mistake, but fundamentally it has no influence on the results," says Christian Colliex, head of the STEM group at the University of Paris South, who collaborates with Pennycook but had no role in the 1993 paper. But others believe the

mistake should invalidate the result. "I don't understand why they haven't retracted this paper," says Silcox. *Nature's* view is given on page 123.

The more recent arxiv.org paper is also a study of the boundary between two materials: one ferromagnetic and one superconducting. In the first version of the paper², several graphs and one image appear identical to those in an earlier paper by the group³. In addition, a plot in the paper contains identical but mirrored data on its right- and left-hand sides. "It looks fishy," says David Muller, a physicist at Cornell, who obtained his PhD under Silcox.

The paper was first posted at arxiv.org on 23 August 2005. Others in the field became aware of the irregularities in the spring of 2006, when a version was submitted to *Nature Physics*, according to sources outside *Nature* familiar with its history. Within days of being notified of the issues, the authors posted a revised version⁴, which added references for all but one image. It also contained a version of the data plot that had been cropped in a way that eliminates the duplicated data points.

In a phone interview, Pennycook and lead author Maria Valera admitted that the data were duplicated on either side of the plot: "I think it was an effort to make it look more attractive to *Nature*

editors, frankly," Pennycook says. "It was the wrong thing to do," adds Valera. She says she was the first to use the mirrored data plot, at an American Physical Society conference, but she does not recall who originally put the plot together. Valera also admits that she did not appropriately cite the earlier paper³ from which several figures were reproduced.

"Obviously mistakes have happened," says Pennycook. "Mistakes always happen in science." He says that he believes the criticisms spring primarily from his rivals at Cornell, and adds that he stands by his work: "A lot of people think we are the number one group in the world," he says. "We have no reason to say anything that's not absolutely right."

The investigating panel of three scientists found "errors in judgement", but no evidence of falsification or fabrication, says panel member Paul Peercy, dean of engineering at the University of Wisconsin at Madison. He says that they concluded that the graph with mirrored data was improperly presented, but that it did not change the paper's core result. "In today's world of PowerPoint," he says, "there is a tendency to present data in whatever the author may think is the best form."

But some in the field continue to have doubts. "There is a pattern of sloppiness here," says Spence. "This is very troubling." ■
 Geoff Brumfiel

1. Browning, N. D., Chisholm, M. F. & Pennycook, S. J. *Nature* 366, 143–146 (1993).
2. Varela, M. et al. arxiv.org/pdf/cond-mat/0508564v1 (2005).
3. Varela, M. et al. *Solid State Electron.* 47, 2245–2248 (2003).
4. Varela, M. et al. arxiv.org/pdf/cond-mat/0508564 (2006).
5. Browning, N. D. et al. in *51st Ann. Proc. Microsc. Soc. Am.* 576–577 (San Francisco Press, California, 1993).

Editor's note: In keeping with *Nature's* practice of confidentiality, *Nature's* news team was provided with no access to any material pertaining to either of the papers other than the text of the Corrigendum itself.

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