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Panel Says Bell Labs Scientist Faked Discoveries

By KENNETH CHANG

A series of extraordinary advances in physics claimed by scientists at Bell Labs relied on fraudulent data, a committee investigating the matter reported yesterday.

The findings, in effect, dismiss as fiction results from 17 papers that had been promoted as major breakthroughs in physics, including claims last fall that Bell Labs had created molecular-scale transistors.

The committee concluded that data in the disputed research, published between 1998 and 2001, had been improperly manipulated, even fabricated, confirming suspicions raised by outside scientists in May. The committee placed the blame for the deceit on one Bell Labs scientist, Dr. J. Hendrik Schön.

"He committed scientific misconduct," said Dr. Malcolm R. Beasley, a professor of applied physics at Stanford University who headed the committee. "Nobody else did."

Bell Labs immediately fired Dr. Schön, 32, a scientist who a year ago had been thought to be on a fast path to a Nobel Prize.

Dr. Schön did not return a phone call asking for comment. In written comments in the report, he admitted he had made mistakes and apologized, but he insisted that his findings were all based on experimental observations. "I am convinced that they are real," he wrote, "although I could not prove this to the investigation committee."

Despite the panel's finding that no other scientists were guilty of misconduct, the scandal tarnishes surrounding participants, including the co-authors who noticed nothing amiss, the scientific journals that critics say moved too quickly to publish the sensational findings, and Bell Labs' parent company, Lucent Technologies, which has been buffeted by a collapse of the market for its telecommunications equipment and tens of thousands of layoffs.

The case also raises questions about the core of the scientific process, in which scientists critique each other's work for errors but rely on trust that the data is honest. If the panel is correct, Dr. Schön pursued his fabrications in one of the hottest areas of research, working with a revolving cast of co-researchers, and managed to continue the charade for several years.

Dr. Schön's molecular-scale transistors were seen as particularly exciting because they worked the same way as current silicon transistors. That suggested this technology could be used for computer chips when the shrinking of silicon circuits hits fundamental physical limits in about a decade.

Scientists in the nascent field of molecular electronics — building circuits out of individual molecules — worry that the negative publicity could diminish the reputation and financing of the field.

Bell Labs officials portrayed the scandal as the transgressions of one scientist, not a wider problem at the laboratory. "This is an individual case performed by an individual," said William T. O'Shea, president of Bell Labs. "In this case, we had an individual who didn't live up to the scientific requirement for integrity."

The committee examined 24 accusations of scientific misconduct and found Dr. Schön guilty in 16. The committee did not directly judge whether the findings in the papers were invalid, but it is clear that scientists in the field no longer believe them.

The committee exonerated all 20 of Dr. Schön's collaborators of complicity or knowledge in the fraud. But it also suggested that perhaps Dr. Bertram Batlogg, the former director of solid state physics research at Bell Labs who hired Dr. Schön in 1998 as a post-doctoral researcher, should have taken a more critical look at data Dr. Schön was producing. Dr. Batlogg, now a professor at the Swiss Federal Institute of Technology in Zurich, was the senior author of several of the papers.

The responsibility of scientists for the work of their co-authors is, the report said, "an extremely difficult issue, which the scientific community has not considered carefully."

Dr. Batlogg could not be reached for comment.

The report does not address if higher-level managers should have picked up signs of the problems earlier. But some outside scientists, including former Bell researchers, said they thought such a scandal would not have occurred at a Bell Labs of an earlier era, because scientists scrutinized each other's work more closely.

"I honestly don't believe it would have," said Dr. Robert C. Haddon, a professor of chemistry at the University of California at Riverside, who worked at Bell Labs until 1997. He cited an experiment of his at Bell Labs in which soccer-ball molecules of carbon known as buckyballs unexpectedly lit up when a current passed through them.

"As soon as we tried to release this for publication, we had a director and two department heads coming down and demanding to see this experiment work," Dr. Haddon said.

Most of Dr. Schön's disputed experiments, it turned out, were not even performed at Bell Labs in Murray Hill, N.J., but at the University of Konstanz in Germany, where Dr. Schön received his doctorate in 1997. With one exception, none of his collaborators ever witnessed any of the experiments described in the papers, the report said. Typically, organic crystals were grown by Dr. Schön's collaborators, and he then assembled them into electronic devices.

The committee also could not find any evidence to support the veracity of the reports. Dr. Schön told the committee he had deleted almost all of the original data files because his computer lacked hard disk space to store the files. He said he had no laboratory notebooks. Dr. Schön also could not reproduce any of the findings for the committee.

Dr. Schön, a native of Germany, first worked as an intern at Bell Labs in the spring of 1997. As a post-doctoral researcher, Dr. Schön started publishing a dazzling series of papers. Based on ideas of Dr. Batlogg, Dr. Schön assembled transistors on top of crystals of organic materials. The transistors applied an electric field to add or remove electrons, allowing scientists to study the materials' electronic properties in an unusually systematic way.

Dr. Haddon saw a talk of Dr. Schön's at the Materials Research Society on Dec. 2, 1999. Impressed with the findings, Dr. Haddon suggested to Dr. Schön that he redo an experiment that he had unsuccessfully tried a few years before, trying to turn buckyballs into a superconductor by applying an electric field.

Six weeks later, Dr. Schön sent an e-mail message reporting success. "The e-mails look genuine to me," said Dr. Haddon, a co-author of the resulting paper. "It's just what I would have written. He was probably more conservative than I would have been." In the more than two years since then, no other scientist has been able to reproduce the findings, nor subsequent experiments where Dr. Schön claimed to raise the buckyball superconducting temperature to minus-249 degrees Fahrenheit, which is surprisingly warm for a superconductor.

When scientists who were frustrated in trying to reproduce the work approached Dr. Schön, he said the technique was difficult to master. Later, he said only a few of the devices actually worked.

Further doubts arose because it seemed impossible to do that much work. In 2001, Dr. Schön averaged one scientific paper every eight days. For most scientists, a few papers a year is productive.

The molecular transistor papers led to his downfall.

In a paper in Nature last October, Dr. Schön and two colleagues said they had constructed a transistor where the main switching component was a layer one molecule thick. Two months later they had an article in Science reporting they had now made a transistor where the switch was a single molecule.

But other scientists noticed that the two papers included an identical graph. Dr. Schön said he had accidentally included the wrong graph in the Science paper and submitted a correction, which was published later.

Then, in May, Dr. Paul L. McEuen, a professor of physics at Cornell University, noticed more identical graphs, which supposedly represented data from different experiments. Dr. McEuen notified Bell Labs officials, who quickly assembled Dr. Beasley's committee to investigate.

The committee found more identical graphs. Other graphs appeared to be spliced together from different sets of data, often with identical curves appearing multiple times in the same graph.

The data in some other graphs were too perfect. Dr. Schön admitted that in some cases, he used curves of mathematical functions to represent experimental data, the report said.

The journals that published the research must now figure out what to do with the discredited articles. At Science, for example, a paper can be withdrawn only at the request of all of the authors.

"Obviously, the authors are going to have to come together and do something with this," said Dr. Donald Kennedy, editor in chief of Science. "If for some reason that does not happen, then we will have to make some announcement of the journal's position."

Dr. Kennedy said the peer review system that underlies scientific publication is not designed to catch fraud. "I don't think it's ever been expected to detect fraud wherever fraud occurs," he said.

It is also not clear what will happen to the honors that Dr. Schön garnered in recent years, like the Outstanding Young Investigator award and $3,000 from the Materials Research Society.

At Bell Labs, existing policies about documenting research and keeping computer data are being reinforced, said Dr. Cherry Murray, vice president for physical sciences research at Bell Labs. But she said the incident would not greatly change the laboratory.

"We still will continue doing world-class research," she said. "Lucent is committed to basic research."

In a way, said Dr. Beasley, the head of the investigative panel, the scandal proves that the scientific process succeeded in battling fraud. "It got understood and exposed," he said. But he said the case of Dr. Schön also showed the need for scientists to consider how much responsibility they needed to take for their collaborators' work. "Organizations that represent the profession need to examine these issues," he said.