Six faculty named top young investigators

About the awards . . .

The National Science Foundation Young Investigator Program, which began last year, replaces the Presidential Young Investigator (PYI) Awards, which had been offered since 1984.

The Young Investigator Program provides $25,000 in research funding each year for five years, and the NSF contributes up to $37,500 for outside matching funding to encourage university-industry cooperation. That brings the total support for each participant to a potential $100,000 per year.

Cornell has had 36 PYIs, or about 5 percent of all engineering PYIs nationwide. This year, the NSF selected 202 scientists and engineers out of 1,600 applicants nationwide, chosen on the basis of accomplishments and their potential to become academic leaders in teaching and research. These stories describe Cornell's 1992-93 Young Investigators and their work.

Peter Morenus/University Photography

Paul Pedersen

Paul Pedersen, *Computer Science*

By Larry Bernard

Why would a Wall Street computer expert give up the high life of year-end bonuses for a chance to earn an assistant professor's salary? It's not for the money.

"Believe me, I wouldn't be here if I were in it for the money," says Paul Pedersen, assistant professor in the Computer Science Department. "The reason I got out of Wall Street and got my Ph. D. was that I thought it would be nice to teach, specifically, to teach undergraduates. I have not been disappointed. The undergraduates at Cornell are hard-working."

Pedersen, 37, came to Cornell in 1991 after earning a doctorate in computational mathematics at New York University's Courant Institute. Prior to that, he spent 10 years in the workplace, including four years at Kidder-Peabody and three at Merrill-Lynch on Wall Street, the heart of the nation's financial industry, developing programmed trading systems.

But he traded that in for academia after, as he puts it, "the bubble burst. By 1989, they were shedding whole departments and staff, 10 percent every few months. I figured it was time to get out."

Pedersen now does research in computational mathematics, and this year is a National Young Investigator. Computational mathematics overlaps constructive mathematics, applied mathematics, theoretical computer science and engineering. He describes it as "experimental mathematics. I try to use new technology to solve old mathematical problems."

Hybrid techniques

"For example, I would like to use hybrid techniques which combine numerical approximations with algebraic manipulations to obtain exact information about systems of equations. The equations I am interested in are of the type which naturally arise in engineering problems."

Pedersen earned an undergraduate degree from Harvard College in 1976. He was a graduate student at the University of California-Berkeley until 1979, when he was lured away by the glamour of Wall Street. He subsequently earned an M.S. and Ph.D. from NYU Courant in 1990 and 1991, respectively.

Last semester Pedersen taught Parallel Algorithms to graduate students, and this semester he teaches Data Structures to undergraduates.

The opportunity to do research and teach was attractive, so much so that he rejected a highly lucrative offer from AT&T Bell Labs, he said. "I definitely wanted to teach," Pedersen said. "Since arriving at Cornell, I have been much impressed with the attention given to the undergraduate curriculum. We discuss the undergraduate curriculum all the time. Cornell also maintains an excellent research environment, particularly in my areas of interest. The 'field' system permits a good hybridization of ideas from computer science, applied math, operations research and math."

Born in Paris, reared in Asia, South America, Africa, Europe and, finally, Westchester, N.Y. – his father was a United Nations worker – Pedersen and his fiancee make their home in downtown Ithaca. Still, they visit New York City "at least once a month," he said.

Joel D. Brock, *Applied & Engineering Physics*

By Melissa Jacobs

Joel D. Brock has evolved from solid trumpet playing in musical bands to studying bands of molecules that form solids.

An assistant professor of applied and engineering physics, Brock played in bands through high school in Evanston, Ill., and undergraduate years at Stanford University. Despite his interest in music and English, Brock took the "path of least resistance" and studied physics, he said.

"I've always been interested in science and math. I was a person who took things apart," he added.

An NSF Young Investigator, Brock, 34, came to Cornell in 1989 after completing postdoctoral research at the Massachusetts Institute of Technology, where he received his doctorate in physics in 1987. He considers his professorship "an accident" because he did not interview at many universities for a faculty position. "I can't claim any long-range planning was involved in this," he said.

Do a better job

After earning his undergraduate physics degree from Stanford in 1981, Brock worked for a year at Tektronix Inc. in Beaverton, Ore., as a staff physicist designing ink jets for printers. He returned to school because, he said, "I thought I could do a better job than the people I was working for."

A member of the Materials Science Center here, Brock studies condensed matter, or solid material, to understand how solids are formed. If researchers could master the problem of how materials form, manufacturers could grow new types of material or improve current growing processes, for materials such as liquid crystals and semiconductors.

A crystal solid, such as ice, forms by randomly arranged water molecules lining up to create a structured crystal, he said. Scientists are just beginning to understand how a jumble of atoms turns into an organized solid.

To help answer this, Brock uses the Cornell High Energy Synchrotron Source to bounce X-rays off the solid material to elucidate its architecture. He chose to study condensed matter because "it's the closest area of physics to what people experience every day," he said.

Brock teaches a course on electromagnetism to undergraduate applied and engineering physics majors. He enjoys teaching because the students are motivated and help him gain a better understanding of the finer points of physics through their questions.

He characterized his students as "a very talented group of young people. They are sharp, ask questions and challenge you. They make you perform up to snuff."

Brock, who lives with his wife in Groton, has not played the trumpet in 10 years. Although he played sporadically once he started graduate school, he found it frustrating because, "I can't do musically what I used to be able to do."

Charles Harrington/University Photography

Joel D. Brock (left) and graduate student Emma Sweetland examine the tip of a refrigerator cylinder that is used to chill tiny metal samples to a few degrees above absolute zero. Once chilled, the materials are exposed to X-rays to help researchers learn more about their microscopic structure.

Bernd Sturmfels, *Mathematics*

By Larry Bernard

Bernd Sturmfels could not have asked for a better year. First, the 30-year-old mathematician snagged a big award, the NSF National Young Investigator, giving him research funds for five years. Then he received another major award, the David and Lucille Packard Fellowship, for another $100,000 each year for five years.

"This was all very exciting," said Sturmfels, a German native who came to Cornell in 1989. An associate professor of mathematics, Sturmfels earned Ph.D.s in mathematics from the Technical University in Darmstadt, Germany, and the University of Washington in Seattle, where he also met his wife.

Sturmfels studies computational algebra, algebraic geometry and combinatorics, which he describes as "the study of finite objects, such as polyhedra in three-dimensional space."

More specifically this semester, Sturmfels is interested in solving non-linear algebraic equations, which require new algorithms. "These have been too hard to solve in the past," he said. "Now the hardware and algorithm development can efficiently solve systems of equations."

As an example, the programs that drive robots need algorithms to solve equations that determine the exact position of a robot hand. "You can have the hand open and close, but you cannot control the position of the hand, only the joints. You have to ask, for which values of these angles is the hand at the desired position? This leads to algebraic equations. And you want to do it fast. Very fast. You can't take 10 hours of computing, you want the hand to be in position immediately."

Sturmfels is interested in such interdisciplinary work, and finds Cornell conducive to that.

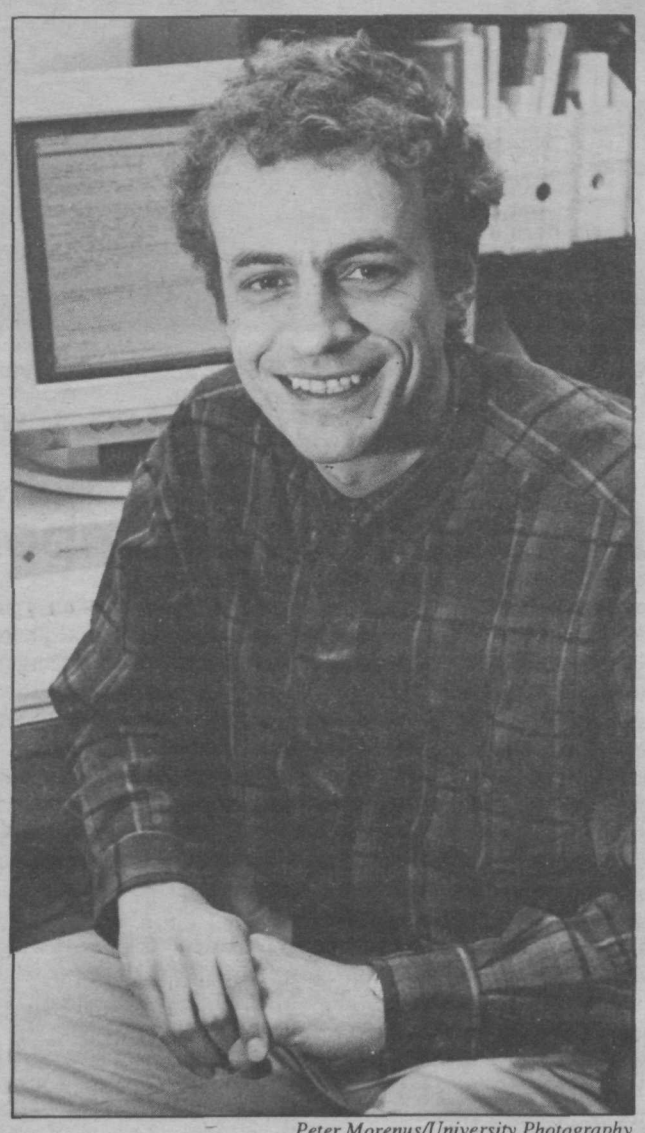
Mathematics happens everywhere

"At Cornell, a lot of mathematics happens outside the Mathematics Department," he said. "There is coding theory in electrical engineering, string theory in physics, robotics in computer science and optimization in operations research. I'm really a mathematician at heart, trying to branch out and work with other departments. It leads to very interesting mathematical questions. I enjoy the interplay of concrete and abstract mathematics you get from this approach."

Sturmfels is affiliated with the Mathematical Sciences Institute, which provides support for seminars, workshops and visiting scientists in the field. He is a member of the graduate fields of operations research and industrial engineering, computer science and applied mathematics. Last semester, he was on leave at the Mathematical Sciences Research Institute in Berkeley, Calif.

While supervising five doctoral students, this semester he is teaching a graduate course in Real Algebraic Geometry, and in the fall he will teach an introductory computational algebra course for undergraduates.

A former Sloan Research Fellow, he has written or co-written four books, most recently *Algorithms in Invariant Theory* (in press).



Peter Morenus/University Photography

Bernd Sturmfels