WHAT'S IT LIKE STARTING
AN ACADEMIC CAREER TODAY?
JUNIOR FACULTY MEMBERS ARE
EXPECTED TO RAISE MONEY—
AND LOTS OF IT—TO FUND
RESEARCH PROJECTS AND BE
SUPERSTARS IN THE CLASSROOM.

21ST
CENTURY
PROF.
TED ARMSTRONG
ENGINEERING PROFESSOR
A DAY IN THE LIFE!

EARLY MORNING: TEACHING.

MIDMORNING: RESEARCH.

NOON: TECHNICAL PAPER WRITING.

AFTERNOON: LECTURES.

LATE NITE: GRANT PROPOSAL WRITING.

WE WILL HOURS: WRITING UP RESEARCH RESULTS.

HEH, TED, WAKE UP!
YOU'LL NEVER EARN TENURE SLEEPIN' ON THE JOB!

YAHN

HUSH?
WHEN RICHARD M. FELDER launched his career as a professor of chemical and biomolecular engineering at North Carolina State University (NCSU) in 1969, he didn’t feel under any immediate great pressure to snag huge research grants. In those days, newly hired engineering professors could take two or three years to figure out where they wanted their careers to head before they were expected to raise research bucks, recalls Felder, now a professor emeritus at NCSU. Partha Roy, an assistant professor of bioengineering at the University of Pittsburgh, has heard older colleagues talk about those less-pressurized days of yore. He can only shrug wistfully and say, “We don’t have that luxury now.”

That’s an understatement. The working environment for the new generation of engineering professors has been hit by its own version of global warming. Within a very few decades, it’s become a hothouse ecosystem where money (and the ability to raise it) is king. Research and the grants to pay for it have always been paramount to the survival of most top engineering schools, but in recent years the stakes have risen dramatically and junior faculty members are now expected to bring in wads of cash from day one, or risk not getting tenure. Moreover, many schools now say they expect young academics to also be superstars in the classroom, not just the lab—a tougher task at a time when undergraduate students are more digitally inclined yet more verbally challenged and certainly in need of more nurturing than the students Felder and his peers faced. “You are expected to produce, and produce more quickly, and the road (to tenure) has gotten steeper and steeper,” Felder says. “It’s a killer environment. I’d imagine the stress levels are through the roof.”

Actually the cutthroat competition begins even before they’re hired. Nariman Farvardin, dean of the School of Engineering at the University of Maryland, explains that while U.S. schools churn out about 6,000 to 7,000 engineering Ph.D.s a year, only the top 100 or so of those recipients get faculty jobs each year. That’s because 20 years ago, research universities were expanding their engineering schools. Today, most are mainly maintaining faculty numbers. “Universities are in fierce competition with each other for the cream of the crop,” Farvardin says. That means an awful lot of very talented engineering doctorates get shut out. Moreover, those who are hired are paid huge startup packages that can average around $500,000.

This money is used to pay for graduate assistants and to establish labs that are often filled with expensive equipment. “This is a new cost for universities, and they need to cover it,” Farvardin says. “That’s why there’s more pressure on new faculty to bring grant money in.” Adds Felder: “More and more research dollars are needed to make the engines run,” to help the universities keep the lights on. “It’s become their lifeblood.”

Pressure Cooker

CERTAINLY JUNIOR FACULTY members are well aware of the pressures on them. “It is one of the most challenging careers you can choose,” admits Pamela Abshire, an assistant professor of electrical and computing engineering at Maryland. Orlin D. Velev is an associate professor of chemical and biomolecular engineering at NCSU who received tenure earlier this year. “Today’s reality, at a good university, is sink or swim,” says Velev, 41.Adds David Keffer, an associate professor of chemical engineering at the University of Tennessee-Knoxville: “The main criterion for tenure is how much research money you bring in.” Keffer, 36, who earned tenure two years ago, says money totals are used to judge the value of an academic’s research. “The amount of dollars raised is used as a metric for the quality of your research.” Young researchers are also well aware that, suddenly, other people—the graduate students and post-docs they’ve hired—are also counting on them for their livelihoods. “We are trained to do research,” says Abshire, 36. “But we are then asked to also do many other tasks.” They include marketing, counseling, teaching and management. “But most of us seem capable of it,” she adds. “To some extent, the system selects people who can multitask.”

Adding to the pressure-cooker atmosphere: There’s less funding available these days from government and corporate sources. The Bush administration’s American Competitiveness Initiative calls for more research and development money for engineering and the physical sciences, but much of the total budget is earmarked for weapons and space-vehicle development. So money for basic and applied research remains tight. Not surprisingly, many young academics—whose workweeks can range from 50 to 80 hours—can easily spend nearly half their time writing grant proposals, often for minimal returns. University of Pittsburgh’s Roy was recently awarded a five-year, $1.27 million National Institutes of Health (NIH) grant to research the possible role of the protein profilin in breast cancer cells, but it took three years and two rewrites of his proposal before he got the money. And then he and his team got less than the $1.7 million requested because of NIH budget cuts. Roy agrees proposal writing is time-intensive. On average, he spends two months writing major proposals and three weeks on minor ones.

Dean Farvardin says, too, that junior researchers are often at
a disadvantage because they're competing for money against seasoned veterans. "Good senior people have an edge. They've got a name, a track record, they know the contacts." However, there are grants designed for young academics. For instance, many federal funding agencies offer Young Investigator Grants. Ichiro Takeuchi, an associate professor of materials engineering at Maryland since 1999, got two early on: one for researching rapid exploration of novel ferromagnetic share memory alloys and the other for investigating functional metal oxide materials. "They helped me tremendously," Takeuchi, 41, says. And the National Science Foundation (NSF) offers Faculty Early Career Development Grants. They're highly competitive, though. Only 10 percent of applications are approved in each round, but researchers can apply up to three times. Velev says many top schools expect their junior faculty to get one. "It is a very big deal. You either get one says Sheri D. Sheppard, an associate professor of mechanical engineering at Stanford University. George D. Stetten, a professor of bioengineering at Pitt and a researcher at Carnegie Mellon University's Robotics Institute, says "the risk is that young researchers may not clearly establish their own reputations. Tenure eventually goes to those who bring money directly in from the outside." No matter how much essential work a junior collaborator brings to the project, Stetten says, "unless he or she is the principal investigator (PI), the university may not recognize the contribution when it is time for promotion."

But Keifer says the fear "that a junior will ride on the coattails of a senior no longer applies." Universities are more willing to acknowledge the contributions of younger team members, he says, because they realize the funding environment has changed the way research is done. Moreover, he adds, there are ways for ju-

or you're in deep, deep trouble."

University of Tennessee-Knoxville's Keifer says competing against senior colleagues can be tough, but "successful institutions create environments where there's a high probability that junior faculty can succeed." And today, that usually means being part of a multidisciplinary team effort. "The days of an individual or single project with a single investigator are gone," Keifer adds. Engineering researchers now not only regularly link with older colleagues but with researchers from other departments, disciplines, schools and universities. For younger faculty, the obvious advantage of joining a team led by a senior researcher is the increased likelihood of grabbing a piece of a winning proposal. But there is a danger. It may be harder for them to establish their contribution to the project and how they advanced the science. "Ultimately, you're assessed on what you contribute to the body of knowledge,"
Teaching vs. Research

IN THE NOT SO DISTANT PAST, few engineering schools placed much emphasis on how well their faculty taught classes, so long as they were successful researchers. However, with the advent of the ABET 2000 assessment program, which requires schools to show that students have actually learned and understood what they’ve been taught, many engineering educators say that the old attitudes are gone and that teaching performance now counts toward tenure. It will never equal the importance of research, Felder says, “but you can no longer do a completely rotten job at teaching, even if you are an outstanding researcher.” That’s also Farvardin’s take: “There was a time when, if you were a strong researcher and a mediocre teacher, you could survive. Today, that’s impossible. You have to be great at everything you do.” And Velev says the additional emphasis on teaching also extends to outreach and recruitment.

New faculty members, he says, are also expected to help efforts to attract high school students, particularly minorities and women.

But many young faculty members say the only pressure they feel to teach well is self-induced. As far as they’re concerned, it’s still only money and research that count toward tenure. “In my opinion, it hasn’t changed at all. There’s been no ABET impact,” Keffer says. He likes teaching and makes an effort to do it well. Indeed, Keffer has won kudos for using innovative references to literature, art, music and theater in his chemistry classes. But classroom preparation doesn’t consume much of his time. “The pressures we have to succeed are in research. So I am reluctant to invest any time on something I’m not sure is going to pay off.” Takeuchi also says it’s no contest. “Research is more important. That’s how we get judged.” He says he makes an effort to be a good teacher “because I really hate to do anything half-assed.” Both he and Abshire say they can now spend less time on classroom preparation because they’ve been teaching the same classes for some years, and they’re running smoothly. That’s a smart attitude, says Stanford’s Sheppard. Teaching is important, she says, but academics, who tend to be A-types, can invest too much time in trying to improve their courses if they’re not careful. “It’s hard to know when to put limits on it, when good is good enough.”

One thing that hasn’t changed much over the years is that relatively few engineering professors are taught how to teach. Most of today’s younger faculty, like their elders, rely on trial and error, and base their methods on those used by their teachers. Some schools are starting to offer teaching workshops, however, says Felder, who with his wife, Rebecca Brent, co-directs the National Effective Teaching Institute. Felder advocates “active learning” teaching techniques, which require students to solve problems and debate and brainstorm in class; these techniques include learning-by-do-

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guage they don’t understand.” By and large, they’re also students who have trouble gleaning information from the written word.

They’re a generation whose reality is heavily cyber-influenced. Author Marc Prensky calls them “digital natives.” Keffer recognizes the type. “Our undergraduates will not go to the library to look something up, they’ll go to Google,” he says. “For better or worse, that’s their first option.”

Forget the Lingo

"YOUNG" IS A RELATIVE TERM, and when discussing new-generation engineering professors, we’re mostly talking about academics who are in their 30s or even 40s. In part, that’s because most Ph.D.’s are expected to do one or two post-docs before they’re hired as faculty. That means when these junior academics step into a classroom crammed with freshmen, they’re often crossing an age gap of 15 to 20 years. It also means that despite their relative youth, they have little more in common with these students than do senior professors. Abshire is certainly aware of the generational divide. She tries to avoid pop culture references in class for fear they’re already outdated.

Still, while junior faculty may not qualify as digital natives, they’ve still spent large chunks of their lives using computers. So there’s some common ground there. But being computer and internet savvy isn’t the same as having a working knowledge of classroom software and gadgetry. Sheppard says many students don’t have a clue as to how to use such fairly common tools as Matlab or Excel or PowerPoint. And many young teachers aren’t fully aware of the plethora of digital teaching tools now available. Or if they know about them, many haven’t used them because they don’t know how. Universities haven’t done a great job of bringing in experts to train faculty how to use these tools, says Jack Lohmann, vice provost and professor of industrial and systems engineering at the Georgia Institute of Technology. Many of the younger profs interviewed for this story haven’t ventured too far into digital teaching. All of them, however, do post lectures, handouts, assignments and other information for students online. That’s good, Lohmann says, because “students are so accustomed now to finding this stuff on the Web.” PowerPoint is popular, too. Abshire regularly uses PowerPoint because her school’s curriculum is so ambitious she finds she can’t get through it all without it. But she also knows she can’t overdo the pace. “The danger can be you’ll blow away the students and no one will understand anything because you’ve moved so quickly.”

Senior engineering faculty members come from an era when the vast majority of their students were white males. It was also a time when engineering schools expected a certain percentage of their students to fail; that “weeding out” mentality meant they had the luxury of mainly teaching students who already “got it.” Potentially good students who could have become good engineers, but needed a bit more help, were left behind. But ongoing efforts to diversify the profession to help meet the demands for more engineers have cast aside notions of acceptable failure rates.

Today’s young profs now need to work harder to help and nurture struggling students. “This is a different challenge,” Velev admits. By and large, he says, most of these students have good work ethic and want to learn, but many don’t know how to prepare or study properly, or how to manage their time wisely, and are often unsure of how to interact with teachers. Sheppard thinks that having to deal with a diverse group of students, many of whom require extra hand-holding, is probably harder for younger faculty who are necessarily preoccupied with research and proposal-writing. Velev thinks so, too. “These issues get easier with experience,” he says. “Some of our best (teaching) faculty are senior faculty.”

The academy has long been a world where a researcher’s family life can easily take a back seat to the demands of his or her career. But Felder thinks the job pressures on today’s younger crop of researchers must cut even deeper into home life. “I can’t imagine how bad it is,” he says. Roy, who has a wife and 3-year-old son, says, “I wish I could spend more time with my family. The long hours are just part of the game; it’s a tradeoff.” Takeuchi told himself he’d work fewer hours after he got tenure, but that hasn’t happened. “You got to do what you got to do, and you hope your family understands. It’s hard to strike a balance.” Abshire says she’s cut back from between 70 and 80 hours a week to between 50 and 60 since the birth of her daughter nearly two years ago. She often works after she gets her baby to sleep. “I know I don’t get a lot of sleep.”

Still, it’s the rare junior faculty member who wants to do anything else. “I have a great job. I love being a chemical engineering professor, both the research and the teaching,” Keffer says. Takeuchi doubts whether any other profession would afford him so much intellectual fun: “Research is what keeps me motivated.” Abshire can’t “imagine a better job description: I get to work with bright, young people and move the state of knowledge further ahead.” That’s why they all freely sign up, despite knowing the demands that await them. And this life of constant pressure is the only one they’ve known. When senior colleagues yak about the days of easy grant money and cakewalks to tenure, to them, it’s like hearing descriptions of alien worlds. Velev, for one, is glad the “old-boy network” days are history. “The system has been largely democratized with regards to science and professional recognition these days . . . the perception of a few senior ‘genius’ faculty who get the lion’s share of attention and recognition has withered a lot, and many younger faculty are now given the opportunity to rise quickly.” For many junior academics, that’s a payoff that makes their higher stress levels worthwhile.

*Thomas K. Grose is a freelance writer for a number of national publications.*

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