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WHERE ARE THEY NOW?

C&EN catches up with seven professors we profiled at the start of their careers in 2000

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There's something special about new professors. Their world is fresh and exciting and full of nascent discoveries. Everything seems possible to them.

Their world is also full of stress. They must quickly set up laboratories, obtain research grants, compete with their fellow professors for graduate students, publish their results, teach and mentor students, serve on all kinds of committees, and somehow squeeze in a personal life.

Four years ago, *Chemical & Engineering News* profiled seven professors who had just begun their careers (June 19, 2000, page 41). They included professors from institutions large and small, public and private, undergraduate-oriented and research-intensive. They included three women and four men, some of whom entered academia along a traditional path and some who came into it after a detour.

We now catch up with these seven representatives of the professorial life as they reflect on the past four years and describe where they are now.

It's safe to say that these academics still relish their profession. Indeed, all but one are still at the same institution as four years ago.

Palmer
PHOTO BY DIAN ARIFIN

Andre F. Palmer is the exception. He began his academic career in 1999 as an assistant professor of chemistry at Howard University. Palmer had earned a B.S. in chemical engineering at Howard and says he wanted to "give back" to his alma mater. He found, however, that he longed to return to a chemical engineering department, where he could "pursue biomedical engineering research while drawing on fundamental chemical engineering principles." In 2001, Palmer moved to the University of Notre Dame, in Indiana, as an assistant professor of chemical engineering. He explains:

"Leaving Howard was a difficult and complex decision for me. But, ultimately, I believed that I could more fully pursue my research goals at Notre Dame."

Starting anew provided some advantages. "I have more experience in terms of teaching, writing competitive grants, and negotiating a better start-up package," Palmer says.

ONE OF THE BIGGEST differences Palmer noticed in moving to Notre Dame was the easing of his teaching load. Where he taught four courses per year at Howard, he now teaches two and a half.

Paul T. Jackson, who has been an assistant professor of chemistry at St. Olaf College, Northfield, Minn., since 1999, has the heaviest load of the seven professors. He teaches the equivalent of three courses per term. Most of the other professors teach one course per term, or occasionally two.

Professors are often left to their own devices in the classroom, though some receive a bit of guidance from their peers. Jonathan J. Wilker, an assistant professor of chemistry at Purdue University, West Lafayette, Ind., since 1999, gets feedback about his teaching techniques from a committee of three tenured professors who sit in on a lecture or two each term. He also picks up pointers from student evaluations.

Bridget R. Rogers, an assistant professor of chemical engineering at Vanderbilt University, Nashville, since 1998, says her department's accreditation procedures do double duty as an internal check on teaching quality. For each course, the department has set up teams of three professors, usually consisting of the instructor of that course and the instructors who precede and follow it in the curriculum. The committees "help evaluate whether we are teaching what we should be teaching and whether the students are learning what they should be learning in order to pass through our curriculum," Rogers says.

Peidong Yang, an assistant professor of chemistry at the University of California, Berkeley, since 1999, says that "teaching is one of the biggest responsibilities of the faculty job." But he admits that he didn't really feel prepared for the task in his first year as a professor. He called on his campus' Office of Educational Development for help. Office personnel "sit in on your class and look at your presentation," he says. "Then they sit down with you and discuss different ways to improve your teaching. It is extremely helpful."

Heather C. Allen, who became an assistant professor of chemistry at Ohio State University, Columbus, in 2000, says: "Teaching is

very rewarding. But, especially the first time you teach a class, it's a tremendous time sink," particularly if the subject isn't especially familiar. "You have to know the subject enough to give the students the facts, but also hopefully give them some insight and excitement about the subject matter."

Like Yang, Allen says she was "definitely not prepared for teaching. Doing it is what prepares you for it--the actual experience of being in front of people and having them look at you as the expert. You can have some great moments in the classroom, and you can have other moments where you just don't know something or you've said something wrong. And it's really important how you handle that, to keep respect."

Stephanie L. Brock, an assistant professor of chemistry at Wayne State University, Detroit, since 1999, has taught many different subjects. But a first-semester general chemistry class of 330 students was probably her most demanding assignment.

Most of Wayne State's students commute, many of them work full time, and some have been out of school for a while. In addition, they are culturally diverse. Brock had to cope with these challenges and also learn to manage a large number of teaching assistants. Not only that, but, as she came to realize, "first-year college students are not very mature."

Brock has learned ways to work with the system. She negotiates classroom rules of behavior with her students so they'll buy into the rules. She steers clear of using examples such as references to old TV shows that could exclude students from non-U.S. cultures. And to keep her students from noisily gathering their papers together as she winds down a lecture, she avoids verbal cues that indicate she's nearly finished.

LAB LIFE Brock (left) shares her lab space with 10 Ph.D. candidates, a master's student, and two undergraduates, while Wilker works with eight grad students, a postdoc, as many as six undergraduates--and hundreds of mussels.

PHOTO BY MJ MURAWKA, WAYNE STATE UNIVERSITY MARKETING & COMMUNICATIONS

PHOTO BY DAVID UMBERGER, PURDUE

OF COURSE, "teaching" encompasses activities beyond the classroom. A considerable amount of instruction takes place in the professors' research labs, where students and postdocs learn techniques and absorb the culture of science.

These groups can get quite large. Yang, for instance, is working with 14 graduate students, four postdocs, and three undergraduates. The group is studying semiconducting nanowires, including their synthesis and physical properties and how to assemble them into larger structures. Most are made of wide-band-gap materials such as zinc oxide and gallium nitride that emit ultraviolet and blue light for high-density data storage and microanalysis applications.

In addition, Yang is investigating silicon-germanium nanowires, which could be used in thermoelectric devices. Other research interests include chemical and biological sensors based on high-surface-area nanostructures.

Yang and his group have published about 60 papers during his time at Berkeley, including one that reported the first ultraviolet nanowire nanolasers [*Science,* **292,** 1897 (2001)].

As is the case with his colleagues' institutions, Yang's university pays him a nine-month salary during each academic school year. Yang's team is also supported by the Department of Energy, the National Science Foundation, the Department of Defense, and the National Institutes of Health, with grants from each agency ranging from $100,000 to $200,000 per year. Several foundations also back him, including the Arnold & Mabel Beckman Foundation, which has provided a $240,000 Young Investigator Award.

At Notre Dame, Palmer's primary backing comes from a $374,000 Faculty Early Career Development Award from NSF. He is also a co-principal investigator on another NSF grant worth $400,000.

Palmer is developing long-circulating drug delivery vehicles that respond to shear forces in the bloodstream and artificial blood substitutes. Palmer creates some of these blood substitutes by either encapsulating purified bovine hemoglobin in liposomes or cross-linking and polymerizing hemoglobin into large aggregates.

Palmer is aided by eight graduate students and an average of five

undergraduates. The team has published seven papers since Palmer arrived at Notre Dame, including one in *Langmuir* that describes how to engineer the shape of liposomes [**20,** 4629 (2004)]. The work may lead to the design of more hydrodynamic liposomes for drug delivery applications.

Brock studies solid-state materials that are normally linked in three dimensions, such as the diamond structure, and examines what happens to their physical properties when they are restricted to fewer dimensions, such as in a thin film, a chain, or a nanoparticle. Brock has also used semiconducting metal chalcogenide nanoparticles such as cadmium sulfide to create aerogels of intermediate dimensionality that retain the optical properties of the component nanoparticles. These materials could be used in photovoltaic and sensing applications.

Based on her work at Wayne State, Brock has published eight papers, including two in the *Journal of the American Chemical Society* about methods for producing nanoscale transition-metal phosphides with potential applications in magnetic devices or catalysis [**125,** 4038 and 13960 (2003)].

Brock works with 10 Ph.D. candidates, a master's student, and two undergraduates. Her lab's primary research funding comes from a $450,000 NSF Faculty Early Career Development Award.

Wilker also has one of these awards, valued at $447,000, as well as a Beckman Foundation Young Investigator Award of $240,000 and other smaller grants.

In addition to the hubbub created by his eight grad students, a postdoc, and as many as six undergraduates, Wilker's lab is filled with the gurgle and hum of saltwater aquariums containing hundreds of marine mussels. These creatures are central to his work on mussel adhesives--research that has made a splash in media outlets ranging from ABC News to Scientific American. Wilker described the work in a paper in *Angewandte Chemie International Edition* [**43,** 448 (2004)], one of nine papers he has published on his work at Purdue. His research suggests that mussels extract iron from water and use it to cross-link protein to form their adhesive.

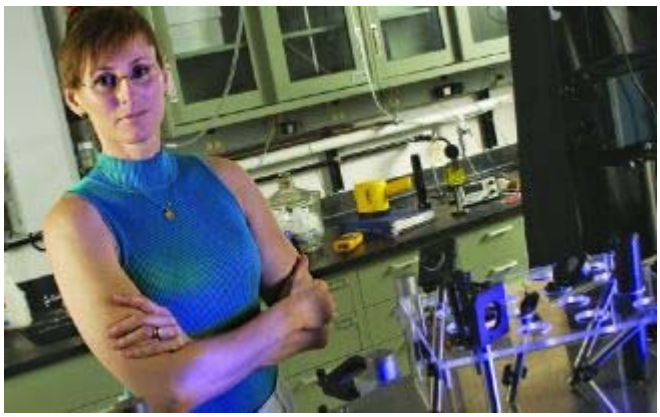
Wilker is also studying the role of dietary metals such as selenium and vanadium in preventing cancer through a mechanism he terms toxin interception. "These inorganics may consume toxins before they have a chance to react with DNA and bring about genomic damage," he explains. He is also preparing metal-linked nucleic acids as potential drug treatments for genetic diseases. These antisense compounds bind to a gene or messenger RNA to prevent expression of the disease-related genes.

WORK IN ROGERS' lab is centered on developing thin films used as high-permittivity gate dielectrics for transistors in integrated circuits. "These new materials will allow the continued scaling of devices to make them faster and more compact," she says. "My program involves everything from design of precursors to the development of the deposition equipment and process to studying the effect of processing conditions on the electrical properties of the films."

Rogers PHOTO COURTESY OF BRIDGET ROGERS

Rogers, who is currently working with four Ph.D. students, has published eight papers since coming to Vanderbilt. One in *Thin Solid Films* [**408**, 87 (2002)] "ties the differences in how aluminum films form on different metals to the metal's work function, or how easily the metal can donate an electron to the adsorbed precursor," she says.

Rogers' research is funded in part through a $500,000 Presidential Early Career Awards for Scientists & Engineers grant from President George Bush. The grant will allow her to expand her research into ultra-high-temperature materials for use in harsh environments, such as the leading edges of hypersonic vehicles. Rogers notes that the PECASE award is "the highest honor bestowed by the U.S. government on outstanding scientists and engineers early in their research careers. This award shows me that there are people who think I have the potential to do great things." Rogers' work is also supported by a $375,000 NSF career award.



THE NEXT GENERATION Allen enjoys seeing her former students go on to "bigger and better

things."
PHOTO BY JO MCCULTY, OHIO STATE UNIVERSITY PHOTO SERVICES

Ohio State's Allen recommends that assistant professors put together several grant proposals in their first year. "You likely won't be funded the first time around, but keep improving your proposal and get to know your program officers at the funding agencies, their goals, and their ideas about the research programs that they head up." Using the officers' input, researchers can refine their initial proposals and resubmit them, often successfully. As Allen says, "The review process is meant to mentor you through to success."

Allen found herself in this situation when NSF chose not to fund her first grant proposal. But she didn't rework it because her scientific fancy had subsequently been caught by another project that involved ammonium sulfate particles. The new subject "just took over my thought processes," Allen says.

She began pursuing financial support for this new idea. Allen concedes that starting her fund-raising over again was risky. But "you spend a lot of time reading the research, thinking about the experiments, and writing, and it's a lot easier to write about something that you get real excited about," she says.

In any event, her gamble paid off: In her first attempt with the new topic, NSF provided her with a CAREER Award worth $485,000. Additional support comes from a $240,000 Beckman Young Investigator Award and a Department of Energy grant shared with two other investigators, of which her portion is $126,000.

Allen's work concerns interfacial phenomena, particularly in relation to the environment. She recently published a paper about atmospheric aerosols in the marine boundary layer above oceans. She is also studying reactions that occur when methanol adsorbs onto the surface of sulfuric acid aerosols in the upper troposphere, which can affect the atmosphere's reflection and absorption of light.

Among Allen's 10 publications are several in the *Journal of Physical Chemistry B*, including one featured on the cover [**107,** 10823 (2003)]. The paper described the change in relative orientation of the molecules within airborne droplets of 1-methylnaphthalene as they become water saturated. The work suggests that adsorbed atmospheric water vapor affects the reaction pathway of common pollutants on urban particle surfaces.

Allen, who shares her lab with eight grad students, three postdocs, and three undergraduates, advises new professors to recruit students from a variety of research fields to help fill out the intellectual scope and capabilities of their labs.

That is easier to do at a large institution with numerous grad students. Jackson teaches at St. Olaf, a liberal arts college focused primarily on undergraduates, so he conducts much of his research himself or with the assistance of an undergraduate or two. He generally has two undergraduates working with him during the 10-week summer research session, however.

Compared with research universities, "it's a different style of research in terms of both the pace and the types of questions that you can ask," he says. But the environment offers compensations. "To share in an undergraduate student's excitement about the world and to witness him or her learning something new by posing questions is quite a thrill."

Jackson is absorbed primarily by two questions. First, he wants to know how reverse-phase liquid chromatographic stationary phases provide separation. His other field of interest concerns the quality of the water released by wastewater treatment facilities. The water can be contaminated with remaining traces of compounds such as steroids and over-the-counter medications.

In one of his publications, Jackson describes the chromatographic selectivity of a carbon-coated zirconia liquid chromatographic phase for isomeric analytes [*J. Chromatogr., A,* **958,** 121 (2002)].

NURTURING NATURE Undergraduates Kyle Halvorson (from left) and Justin Seningen help Jackson check water quality in the Cannon River near St. Olaf College. PHOTO BY JAMES CASTLE

Jackson has used funds from the Dreyfus Foundation, Merck in association with the American Association for the Advancement of Science, and the Howard Hughes Medical Institute to support undergraduate researchers in his lab.

Because he's based at an undergraduate institution, Jackson spends almost two-thirds of his time on teaching. Research gets a bit more than half of his remaining hours, and service a bit less.

His service duties have included membership in a departmental review committee and faculty search committees. He chairs the safety committee and coordinates the department's purchases of analytical and separations instruments. He has served as a liaison to the informational and instructional technologies department and as a faculty adviser to the student affiliate chapter of the American Chemical Society. He helped organize a Pittcon symposium and just completed a term as a director of the Minnesota Chromatography Forum.

SERVICE DUTIES at other campuses are similar, though the time allotted can vary widely. Teaching, research, and service are each supposed to take up a third of Allen's time, but she has found that "sometimes it's easier just to be immersed in teaching or just to be immersed in research." Allen taught two courses last quarter so she could concentrate on research this quarter.

The tasks for assistant professors don't all fit neatly into the three categories of research, teaching, and service. Brock estimates that she spends 20% of her time at Wayne State on activities such as "dealing with bureaucracy and departmental politics, helping students with personal problems, and entertaining guests and seminar speakers."

Professors can find themselves torn by all the competing demands on their time. "I feel that teaching and service are essential to keep the department going. And from the perspective of producing high-quality students, mentoring is very important," Brock says.

"It's easier to gauge somebody's output based on grant money and publications, but I'm not sure that that really details the person's impact, both on the future generation of scientists and the state of the science," she says. Brock will soon find out exactly what her department and her community value when she submits her tenure review package this fall.

Rogers also comes up for tenure this fall, so she will prepare her tenure review package this summer. It will include her teaching statement, record, and evaluations; her research statement and papers; and her service record. The package will be sent to outside reviewers--some recommended by her and some suggested by her department. Once the reviewer comments are returned, her department will vote.

If her department recommends Rogers for tenure, the decision passes to the School of Engineering, then to a university-level committee, and lastly to Vanderbilt's provost. "By the end of June 2005, I should have an answer," she says. "If it's 'no,' I have a year left on my contract to find another job. If it's 'yes,' then I'm promoted to associate professor and given tenure."

Purdue's Wilker describes the all-or-nothing nature of the tenure decision as "very binary. It's either, 'You're doing great. Now continue,' or it's, 'There's the door.'"

As with many institutions, he says, "you can get tenure if your teaching isn't great, but you cannot get tenure if your research is weak." And although he knows that "your goal shouldn't just be to get tenure, tenure really is something you need in order to continue a successful academic career."

Allen recommends that assistant professors establish professional relationships with senior faculty who can back their tenure application--something she says she hasn't done as well as she would have liked. She also wishes she had made better use of the mentoring committee that her department assigns assistant professors to guide them through the tenure process. "I should have initiated more conversations with my mentoring committee, particularly about teaching," she says. But approaching the committee for help can be a bit intimidating, since the members are also responsible for analyzing the assistant professor's performance. "There's some reservation in asking for help, because you don't want to appear incompetent," she explains.

Nevertheless, she appears to be navigating the shoals successfully, "mainly because of successful grant writing and a highly visible research program," Allen says.

The tenure review process at St. Olaf is broken into stages. At the two-year mark, assistant professors are evaluated for their development as teachers. At four years, progress in professional activities is emphasized. And at six years, their entire performance is evaluated. This fall, Jackson will prepare a package that includes, in addition to the usual materials, a self-critique. He'll address what he's done well, what he hasn't done as well as he had hoped, opportunities for growth, and how he sees his career developing in the future. He'll learn the results of his application next February or March.

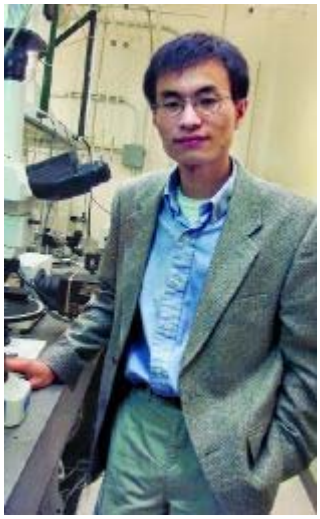
Notre Dame's chemical engineering department is unusual in that teaching makes up half of the tenure decision. Palmer's teaching will be judged on the basis of course evaluations written by his students.

Berkeley's Yang, who went up for tenure a year early, will be promoted to associate professor on July 1.

THE PROFESSORS PROFILED in this article clearly love their profession. But the career they chose comes at a cost. "This is a job that requires really

full dedication. You need to commit lots of extra hours, so the important thing is to do what you're interested in," says Yang.

"You have all these teaching and research responsibilities and the committee service," he adds. "And in the first couple of years, you are setting up the lab and the lab is expanding. I started with two students, and now I'm up to 20. Then you need to worry about lots of things: research directions for each student, writing manuscripts and proposals, and preparing lectures for teaching. And there is lots of traveling to conferences and to give seminars."



OF PRIME IMPORTANCE Yang says teaching is "one of the biggest responsibilities" of professors. COURTESY OF BERKELEY LAB PHOTO SERVICES

Wilker agrees. "This is not a job for most people," he says. "You've really got to have a conviction to do this job, because it's a lot of hours and it's wearing." In fact, he has only just taken his second vacation since coming to Purdue.

"It's tons of work, tons of time, tons of stress, and if you really work hard to create a successful career, many other things in your life will suffer from neglect," Wilker says. "So you have to really, really want it. And for those of us crazy like that, it's totally worthwhile."

New professors can be more or less aware of what they're getting themselves into, depending on where they trained. Jackson says his Ph.D. advisor, University of Minnesota chemist Peter W. Carr, was "well known for preparing students to go into academic careers." Carr held seminars to inform grad students about teaching and research at the college level and what colleges are looking for in applicants. Jackson also benefited from a University of Minnesota program that offered teaching opportunities to doctoral students.

After spending years in the academic environment, Wilker thought he had a pretty good idea of the life to come. But he found out he was wrong. "You know what it's going to be like, but you don't really know," he says.

The labs in which Wilker did his Ph.D. and postdoctoral work were headed by Stephen J. Lippard of Massachusetts Institute of Technology and Harry B. Gray of California Institute of Technology, respectively. These established faculty members had

large groups to manage and were years past the frenetic sprint toward tenure. That meant that Wilker didn't see them struggling to get their first grants or to get their first papers accepted.

Such experience, even if vicarious, can be invaluable in preparing a budding academic for what's ahead. So Wilker makes a point of sharing these experiences with his team. For example, he has all of his students write up the first draft of journal articles about their work.

Wilker is adjusting to the workload, but he's having more trouble getting used to the vagaries of fund-raising and of publishing. "As a new professor, I thought I would have a really hard time getting anyone to give me lots of money to start up our new projects," he says. On the other hand, he figured that "once we actually had the exciting results, publication would be easy."

As it turned out, Wilker has done just fine obtaining grants, but obtaining approval for his manuscripts has proven a little more difficult than expected. Not all the reviewers have been able to "share our excitement for the results presented," he says dryly. He adds that reviews "often simply contain opinions on the overall merits of a given project rather than true scientific critiques."

Different professors cope with the pressures of the academic lifestyle in different ways. Wilker has responded by taking up a hobby that makes his day job seem positively tranquil: He is learning how to race cars. "The white-knuckle aspect of it is great for putting this crazy job into perspective," he says. "After going into turns at 100 mph all day, coming back to the lab to write an NSF grant is pretty relaxing!"

Rogers may have a different attitude than many assistant professors because of the 15 years she spent in research and manufacturing in industry before coming to Vanderbilt. Perhaps because of her industrial experience and because she is almost a decade older than most assistant professors, Rogers has been willing to take on some tricky projects that required diplomatic negotiations. "I've been involved in a lot of these things, probably something that assistant professors shouldn't get involved in," Rogers says with a rueful chuckle. "But I guess I have a hard time staying out of a fight." Last spring, for instance, she convinced her dean to invest $100,000 in the renovation of four run-down classrooms.

Despite all the challenges, these scientists obviously wouldn't trade their jobs for any other. "The research is amazing," Rogers enthuses. "I'm studying things that I want to study, which wasn't necessarily the case in industry. So as long as I get someone to pay me to do it, I can do whatever I want."

Wilker enjoys the excitement and freedom of running a research program. "I get to work on whatever I find to be the most fascinating science. If it's exciting, we study it. If it's boring, we skip it."

Allen loves the mentoring process, particularly in the lab setting. Several undergraduates who worked in her lab are now in grad school. "That is one neat thing about being a professor--all the relationships and all the young people that you meet. There are many that go on to bigger and better things, and it's really exciting to follow their path"--just as exciting as it is to follow these seven professors as they grow in their careers.

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