NEWS

A Day in the Life of a Topflight Lab

The work day lasts well into the night, but the rewards are considerable for postdocs in Robert Langer's chemical engineering laboratory at MIT

CAMBRIDGE, MASSACHUSETTS— If Robert Langer's chemical engineering laboratory at the Massachusetts Institute of Technology (MIT) were an independent company, it would dwarf many of the biotech start-ups in the Cambridge area. But there's a big difference: None of the workers get stock options, high salaries, or other lucrative financial inducements. Instead, they get paid in a different coin of the realm—the chance to publish in the world's top journals, and an edge in the race to become an academic top dog themselves.

Langer's 20 postdocs, 15 graduate students, three or four visiting professors, and two dozen undergraduates are spread out over most of the third floor of MIT's Whitaker Health Sciences Building, and they spill over into offices in the neighboring building. The labs themselves bustle with people measuring out reagents in fume hoods, calibrating instruments that measure the strength of a polymer film or, off in a sterile corner, injecting rat brains with new materials designed to improve drug delivery.

On a day-to-day basis, the lab does run a bit like a company, with Langer as the president and CEO of a $3 million to $5 million a year enterprise and the postdoctoral fellows and senior graduate students as research directors who oversee other members of the lab. Although he didn't plan it that way, Langer says the analogy isn't too far off. "I come up with the general ideas and raise the money," he says, which comes from the National Institutes of Health, the National Science Foundation, and an array of biomedical and pharmaceutical companies. The specific projects and the day-to-day benchwork are the province of postdocs and students. The lab works on an endless variety of projects, from drug delivery to artificial organs. Among the lab's recent papers are pharmaceutical-dispensing microchips (*Science*, 29 January, p. 619) and artificial arteries (*Science*, 16 April, p. 489).

CREDIT: SAM OGDEN

On the job. Many hands lighten the load as grad students, postdocs, and technicians work at the bench in Langer's lab.

Postdocs, Langer says, are a crucial part of those projects; he estimates they do perhaps half of the lab's work while accounting for only slightly more than a third of the personnel. Indeed, a review of the last 6 years shows that 51% of the 246 papers from the lab carried the name of a postdoc as first author. Besides benchwork, he says, postdocs train and supervise junior lab members, help write grants and papers, and give talks at meetings.

Each postdoc sets his or her own hours, but several say it isn't unusual to work 12-hour days and 4 or 5 hours over a weekend. On a typical day the early risers are in the lab by 6:30 or 7 a.m., and the lab starts to fill up around 8:30 a.m. There is no discernible lunchtime lull, and the desktop shakers and centrifuges don't fall silent until nearly 8 p.m. A sign on the main office door asks people to lock up if they're the last one out, which often isn't until the wee hours of the morning. "A lab without coffee doesn't run as efficiently," quips postdoc David Putnam, who says some of his best ideas have come from 2 a.m. gab sessions with other postdocs or students in the lab. The long hours are self-imposed, says postdoc Eric Crumpler, or dictated by a particular project. "There isn't peer pressure to spend time in the lab," he says.

There is also the relentless pressure of the job market. "Publish or perish trickles down to us as well," says Putnam. And tenure-track jobs are harder to come by, notes Maria Rupnick, a former postdoc, now a research associate overseeing several projects in Langer's lab. "It used to be if you went to Harvard or MIT, then your ticket was written. But these days you can work at a world-renowned lab and still not get the job of your choice. Doing a postdoc in Bob's lab gives you a leg up, but the pressure is still there."

Although the exact contribution of postdocs is difficult to measure, in some laboratories it is undoubtedly much higher than Langer's estimate. An unofficial survey at Harvard and its medical school, home for about 2500 postdocs, offers some striking evidence. In pathologist Peter Howley's laboratory, which studies human papillomavirus, all but one of the 30 papers published between 1993 and mid-1999 lists a postdoc as first author. In developmental geneticist Douglas Melton's lab, a postdoc was first author on 75% of the papers published between 1990 and 1999. In molecular biologist Tom Maniatis's lab, 70% of the papers in the last 6 years carry a postdoc at the lead slot. And what's true for elite institutions applies to the journals that publish their work. A survey of the research articles in two recent issues of *Science*, for example, found that 43% of the first authors were postdocs.

Authorship on important papers isn't the only way of reaping credit for good work. It's not unusual for Langer's postdocs and senior graduate students to give talks at major meetings and to be interviewed by the media. Research associate Prasad Shastri, who has just been promoted from postdoctoral fellow, recalls speaking with reporters from *New*

Scientist, NOVA, and the Discovery Channel when his work on electrically stimulated nerve regeneration attracted attention last year. "[Langer] doesn't think the project is successful just because of him," Shastri says.

Langer says he has always encouraged lab members to take the initiative. "I'm not someone who likes giving orders," he says. "I give people a very open environment. … I'm just there to act as a guide." That freedom, he says, helps his postdocs learn how to think critically: "I want to get [postdocs] to the point where they're asking questions rather than looking for answers." Langer says he learned that skill from his own postdoc adviser, cancer researcher Judah Folkman of Children's Hospital in Boston. "In Judah's eyes, almost anything is possible. He has ideas about everything." For his part, Folkman says he and Langer both place a high priority on "increasing the scientific self-confidence of the young scientists" who work in their labs.

Rupnick says Langer has definitely shaped her ability to formulate scientific questions. When she arrived in the lab, she says, she went to him and asked what he'd like her to work on. "What excites you?" was Langer's reply. After tossing around a few ideas, Langer told her to "go think some more." For two and a half months, she says, Langer would tell her only to do what would make her happy. "The level of frustration was just enormous—and it was perfect," she says. After finally settling on an idea, and winning Langer's approval, she was ready to pour her heart and soul into it. "He pushes you out of your comfort zone. That's how you develop a scientific ego."

Such freedom has its downside, however. "People sometimes end up reinventing the wheel" for part of a project, Rupnick says. "And if you tend to ask big questions, 2 or 3 years can go by without a publication." Several postdocs in Langer's lab say they collaborate on several secondary projects as an insurance policy against the failure of their primary, high-risk project.

Even so, Rupnick says she much prefers Langer's style of mentoring. "I have been in [other] labs where the mentor saw you as an extension of her ideas and as a means of accomplishing significant aims 1, 2, and 3 in grant A," she says. "In those labs, where the ideas don't flow that easily and are not tested that rigorously, the end product is a junior faculty member who doesn't ask the big questions. Or if they think of the big questions, they don't have the scientific ego to go after them."

One of Langer's talents is spotting those who are up to the challenge, Shastri says. Langer has plenty of candidates to choose from—he estimates that he gets 1000 inquiries a year for five or six slots. "We are picky," he admits, and he looks for more than top academic qualifications. "People who thrive here are people who want to be independent," he says. He relies heavily on recommendations from an applicant's Ph.D. supervisor, looking for people whose advisers say they are the best they've ever seen.

David Putnam says he sought to distinguish himself from the throng of applicants by persuading the department secretary at his graduate school, the University of Utah, to let him chauffeur Langer to and from the airport when he came to speak at the campus. That gave him a captive audience to discuss his ideas. Although the car ride alone didn't persuade him, Langer says that a combination of good grades, a strong Ph.D. project, and an excellent recommendation put Putnam ahead of other candidates.

For those who make the cut, the chance to work in Langer's lab can provide a tremendous boost into the job market. "He's spawned some very brilliant careers," says former postdoc Marsha Moses, now an assistant professor at Children's Hospital at Harvard Medical School. Indeed, Langer's former postdocs populate top-tier universities across the country, and several head their own biotech start-up companies. Many still collaborate with Langer.

What postdocs don't get from Langer is day-to-day advice on the details. "There are some mentors who will help you very much with what to put in your gel, or how many animals to use. Bob is not good at that," says Rupnick. Indeed, as one of 60 lab members, a postdoc can go for several weeks without talking with Langer in the lab, although they say he's almost always available if they need him. "He's amazing about returning calls," Rupnick says—even if it's 11:30 at night and he's calling from a plane on the way to Japan. Lab members also have an open invitation to schedule a meeting in his appointment book.

Langer also extends his mentoring beyond the lab—in particular, to a pickup basketball or softball game, or to his annual party at a beach house on Cape Cod. Both current and former lab members speak warmly about the all-day gathering that features sand, sun, and science. "It's a kind of think-tank vacation," Rupnick says. "He definitely uses the occasion to say, 'How are you, how's work going, have you thought of this?' " But the result in no way resembles the forced camaraderie of a dreary company picnic, she says. "Science to him IS a good time. So it's not surprising that they mix."

–GRETCHEN VOGEL

GETTING AHEAD, SLOWLY

As postdocs

Class (number)	% postdocs at graduation	% postdocs in '96–97
1992–93 (124)	59%	18%
1991–92 (124)	60%	14%
1990–91 (113)	58%	8%
1989–90 (112)	68%	2%
1988–89 (89)	64%	2%

Other jobs

Class	Academic (nonpostdoc) at exit	Academic (nonpostdoc) 3+ years	Nonacademic at exit	Nonacademic 3+ years
1992–93	1%	44%	19%	34%
1991–92	8%	40%	19%	43%
1990–91	12%	51%	22%	38%
1989–90	11%	65%	14%	32%
1988–89	15%	56%	15%	39%

Delayed rewards. Recent study shows that even Harvard Ph.D.s from the graduate school of arts and sciences take a long time to move from postdocs to tenured faculty jobs.

R&D meets R&R. Each summer Langer (second row, center, in gray shorts) invites his entire lab out to his Cape Cod house for a day at the beach.

CREDITS: (TOP) HARVARD UNIVERSITY, GSAS, 1997; (BOTTOM) ROBERT LANGER