technology firms. Among them are the French General Electric company; Thompson-CSF, the country's biggest electronics firm; Rhone-Poulenc (chemicals and textiles) and Saint Gobain (electronics and glass); and, in a particularly French seminationalization, the Matra group (military equipment and publishing) and Dassault-Breguet (arms and military aircraft). The new wave of nationalizations is ascribed to a socialist distaste for large corporations, particularly multinationals, but also to a conviction that French private enterprise has invested too little in R & D.

The newly nationalized Thompson-CSF, which now constitutes about half the French electronics industry, is expected to be the focus of government "mobilization" in behalf of electronics. In the computer field, a new agreement with American Honeywell opens the way to nationalization of the French CII-Honeywell Bull, a computer firm with a long and complicated history of French-American collaboration. Under the proposed deal, Honeywell of Minneapolis would reduce its share in the firm to 19.9 percent from 47 percent. CII-HB would gain operating independence, but would continue to cooperate with the U.S. firm in research and commercial matters.

The socialists are determined to develop their own style of directing government aid and influence to industry. They now seem to favor the Japanese over the American model. In a visit to Japan in mid-April the French president made it clear that his government sees Japan as a model of economic success for France to emulate and the two countries as potential close partners. Chevènement also expressed confidence that France and Japan were on the way to "exemplary cooperation" but added the qualification that "we need to study Japan and adapt their methods to our society and culture and to the model of development France has chosen." Despite their proverbial politeness, however, it was not clear that the Japanese are quite ready to accept the French as their technological equals.

Considering France's achievements in basic science, nuclear industry, aerospace, and telecommunications technology, French high technology aspirations can hardly be dismissed. Perhaps the most serious problem facing the French is the persisting gap between the universities where academic research is concentrated, and the elite *grandes écoles* that produce engineers and managers. This discontinuity will be discussed in another article. The immediate question, however, is whether the Mitterrand government will be able to provide the time and resources to give its ambitious agenda for science and technology a chance.—JOHN WALSH

Slave Labor on Campus: The Unpaid Postdoc

Most academics are hard pressed these days, not least of all the second-class citizens known as postdocs

Dear (deleted):

I am pleased to be able to follow up our phone conversations of the past week and formally offer you a postdoctoral fellowship in the Department of (deleted) at the Children's Hospital Medical Center. This fellowship will additionally carry an appointment as a postdoctoral fellow with the Harvard Medical School. . . .

My associates and I are quite positive you would find this postdoctoral year a valuable experience. In addition to our own computerized laboratory, we have access to a number of clinical populations within the hospital. The position will require your participation in ongoing clinical and research activities of our program. . . .

Should you wish to accept our offer I will require a letter stating your intention to accept under the terms offered. . . .

I look forward to receiving your letter and hopefully to having you as a colleague in the upcoming academic year. I hope you will be able to accept as I feel next year will be one of exceptional opportunity for us here. . . .

This missive was recently received by a postdoc at a major Midwestern university who was looking for a new appointment. What makes the letter unusual is that the fellowship, contrary to usual practice, would have been a post without pay.

Just how many individuals take up such an offer is impossible to estimate. Unpaid postdocs have not been the subject of systematic study by learned academies, and, if recent interviews are an indication, they prefer to remain anonymous. Reports of most cases are second-hand. Yet this invisible class of individuals perhaps has significance beyond its numbers, if only as indication of the shifting demographics of academic science and of the health of U.S. institutions of higher education. They are, perhaps, a straw in the wind.

"There seem to be quite a few of them in the biomedical area," says Lee Grodzins, a nuclear physicist from Massachusetts Institute of Technology (MIT) who chaired a recent National Academy of Sciences (NAS) panel on postdocs. Though its report *Postdoctoral Appointments and Disappointments*, issued last year, did not mention unpaid postdocs, Grodzins is familiar with the phenomenon. "These individuals are given space in a lab and told to find their own grant money. Some never do. I've also known several people who have been in a position where their grants ran out or their fellowships ran out and they kept on working for nothing. They just kept hoping that something would come along."

It is not uncommon in biomedicine to be offered a multiyear paid postdoctoral post and encouraged to find private funding, especially for the first year. Self-financing is another story. Says Porter E. Coggeshall, an NAS staffer who worked on the report: "We came across a few instances when we did our survey, especially of spouses, and it wasn't always the wife who was willing to take an unpaid position."

The foot soldiers of research, postdocs in general are excluded from the traditional faculty tenure track, and their plight of late has been exacerbated by a number of factors. The class itself is a creation of the postwar influx of federal funds for academic research. During the past decade, the number of postdocs has grown more than twice as fast as faculty positions, for the most part because tenured faculty are getting older but are not yet old enough to be retiring in droves. In the biosciences, for instance, the postdoctoral population between 1972 and

0036-8075/82/0514-0714$01.00/0

1979 soared from 3650 to 7325. Many of these individuals, moreover, have had more than one postdoctoral appointment. Supply and demand has taken its toll. In 1979, according to the NAS report, the average postdoc, based on a survey of all scientific fields, received an annual stipend of $12,000—less than 60 percent of that paid to colleagues holding faculty positions. The figure is lower in biomedicine. Of late, the gloomy picture has been complicated by the fact that federal support for these individuals has been shrinking. For fiscal years 1981, 1982, and 1983, at the National Institutes of Health (NIH) predocs and postdocs in extramural training programs number, respectively, 10,700, 9,700, and 8,900.

One year ago, the NAS panel made four recommendations to help this group, which, the panel says, has played "an increasingly important part in enhancing research productivity in the academic sector."

- Establishment of 250 federal postdoctoral fellowships, with modest funding for innovative research and with 2-year stipends competitive with starting salaries in academia.
- Establishment of 50 additional fellowships for talented minority scientists and engineers.
- Establishment of standing committees within universities to monitor the situation of postdoctoral and other nonfaculty doctoral research staff.
- Expansion of the National Science Foundation's (NSF) survey activities to compile, on a regular basis, national data on the employment situation of postdoctorals.

The recommendations have been almost universally ignored, according to Grodzins. "To my knowledge, there have been no follow-ups, no new support; in fact, the situation has gotten worse." Due to federal budget cuts, for instance, the NSF beginning in fiscal 1982 has been forced to abandon its fellowship program, which during 1980 and 1981 supported 50 postdocs a year.

"The institutions of science protect themselves fairly well," says Grodzins. "The system works to protect the established researcher. . . . It's the people on the bottom who get hurt. And science is eventually the poorer for it because they get fed up and get out. We're seeing it in spades."

A case in point is the campus of NIH, where the people on the bottom, the postdocs, have had a turbulent time during the past year and a half. "Lots of people were promised positions on the understanding that in fiscal 1982 the money would show up," says a postdoc at the National Cancer Institute. "But by the time they packed their bags and came out [to NIH] they found that there was no money for them. I'm sure the lab chiefs didn't do it maliciously and thought it was just going to be a passing phase, but it went on for quite some time.

"It was really acute a few months ago, but the situation is still hard to predict. It's worse than the stock market. There was this one guy who came in April on the understanding there was going to be some kind of auxiliary funds, but it turns out he's not going to be paid until July." The postdoc notes that the cancer institute, the big boy on the block at NIH with a budget of nearly $1 billion a year, has fared relatively well in its postdoctoral support. "The horror stories come from the other institutes," he says.

Many people attribute the problems of paying new intramural postdocs at NIH to President Reagan's federal hiring freeze, although one NIH official said the problem also stems from the fact that "the people on the bottom tend to get squeezed."

Postdocs are not universally the object of neglect. Several universities around the country during the past years have formed standing committees to monitor postdoc salaries and working conditions, to give access to pension plans and fringe benefits, and to see if special career ladders can be created. Examples can be found at MIT, Stanford, the University of Wisconsin at Madison, and the University of Washington at Seattle. MIT has four separate ranks for professional nontenured research staff.

Grodzins, a veteran of many NAS studies on the nonfaculty problem and a physicist with, perhaps, a physicist's prejudice, says neglect of postdoctorals today may be worst in biology and medicine, especially in large research mills that emphasize quick and copious publication. "There seems to be much greater concern in the physical sciences with multiple postdoctorals and the exploitation of young people. I don't see nearly as much universal concern among the medical profession. Of course, the people with M.D.'s have no problem, but the Ph.D.'s really do get exploited."

Perhaps this apparent disparity has something to do with the differing demographics of publication from field to field. In biomedicine, to a seemingly greater degree than any other discipline, a lab chief often feels he needs hundreds of publications in order to be competitive. Large teams of young researchers expedite the process, and with it, the winning of grant renewals, promotions, and peer approval.

The current crunch for postdocs, according to some observers, may be creating a situation similar to one earlier in the century, before the federal government made deep commitments to the support of science and when laboratory work represented more of a calling than a career. "In those days," says Frederick E. Balderston, of the University of California at Berkeley, and a member of the NAS panel, "it was unfortunately true that a lot of people who were seriously interested in original work really had to be self-financed one way or another, by their families or an inheritance, or by making tremendous personal sacrifice. Back in the 19th century, it was very much the tradition that enlightened amateur scientists, who also had a great deal of inherited wealth, bankrolled the bright people. In many cases, private benefaction paid for the equipment and personal sacrifice paid for the time."

"The system works to protect the established researcher. . . . It's the people on the bottom who get hurt."

Still, there is little incentive today for a postdoctoral fellow to work without pay, especially when peers with faculty appointments are making a decent wage. Why do they do it? Apparently for the same reason that many people go into postdoctoral programs in general: because they cannot find other employment. As Grodzins observes, however, some of the individuals eventually decide to drop out of the research game. A case in point comes from the situation sketched out at the beginning of this article. That postdoc received several other invitations to work without pay in addition to the offer from Children's Hospital and the Harvard Medical School in Boston. Although his career goals originally revolved around research, the individual recently put those aspirations aside and took a full-time teaching position at a small Midwestern college.—WILLIAM J. BROAD