faculty member who got a letter informing you that you might be fired, as occurred in New Jersey in July. While things never quite reached the panic stage, the atmosphere was hardly favorable for planning for a new term that was little more than a month away. Under such conditions, it is probably true, as several university sources claimed, that people get concerned not only about their jobs but also about the general stability of the university, and that it is the best of the younger people who get the job offers and actually leave.

A special problem for New Jersey, which is not easily documented in terms of dollars, of faculty fired, or of students refused admission, is that the system is a relatively new one which is still in the process of expansion. Other state higher education budgets have been sharply curbed in recent years, but by the standards of California and many Midwestern states the New Jersey system is still underdeveloped.

The recent compromise in Trenton provides a respite for higher education, but no promise of higher financial horizons. What then are the lessons of the last few months?

First, it is evident that public higher education is not insulated as it has appeared to be in the past—that it must compete for scarce funds with other state services and that faculty and staff are regarded essentially as are other public employees. That a governor plays a crucial role in times of financial stress was proved in New Jersey last fall when the state colleges experienced a system-wide strike of faculty, said to be the first anywhere. Effects of the strike varied among colleges, but the individual institutions were bypassed in the bargaining process, and a settlement, a rather inconclusive one, was negotiated by top union officials and emissaries of the governor.

The New Jersey system, in common with other state systems, is unexpectedly encountering limits to growth. While New Jersey has been faithful in its fashion to higher education since the middle 1960's, it appears that the state system must now adjust to arrested development, at least for a period. The efforts of the past decade, while they have greatly improved the state system, made no dramatic changes in New Jersey's standing relative to other states in the provision of higher education. New Jersey still stands at the top in the percentage of its students attending college in other states and well below the median in per capita expenditures on higher education. Any substantial surge would require major new sources of funding—which in New Jersey automatically returns the discussion to the state income tax. Ironically, even most opponents of the income tax say that its coming is inevitable and then add, "But not now." So the battle of Trenton continues.—JOHN WALSH

A second article will focus on the relation of the state higher education authority to the public institutions of higher education, and particularly to Rutgers, the primary locus of research and graduate education.

NSF: A "Populist" Pattern in Metallurgy, Materials Research?

The National Science Foundation (NSF) seems to be proving the old adage that trouble comes in threes. First Senator William Proxmire (D–Wis.) began mocking the titles of some NSF social and biological research grants. Then Representative John B. Conlan (R–Ariz.) began a campaign against some of NSF's work in social science education. Now some of the foundation's own scientific advisers have raised serious questions regarding the distribution of NSF's funding of basic research in materials science and metallurgy.

The materials science flap reached something of a peak on 29 July when Doris Kuhlmann-Wilsdorf, professor of applied science at the University of Virginia and a member of NSF's advisory panel on metallurgy and materials, testified before a subcommittee of the House Committee on Science and Technology, which has been holding extensive hearings on NSF's operations (*Science*, 8 and 15 August).

Kuhlmann-Wilsdorf presented the results of her own independent study of the funding patterns of one subdivision of NSF, the Metallurgy and Materials Section (known affectionately among researchers in the field as the M and M section), which doles out approximately $10 million a year for basic research. Her conclusion is that the best university departments in the field (including her own University of Virginia) receive a disproportionately small share of the money while middle-ranked departments get the lion's share. In other words, the M and M section of NSF is not supporting basic research on a strictly merit basis; the funding pattern is skewed along what she termed "political" lines. She concluded her testimony with questions about the "basic justice" of this system, the cost effectiveness of NSF's funding research in this manner, and other basic criticisms.

Kuhlmann-Wilsdorf's paper was an expanded, final version of presentations she made in May to the NSF advisory panel and to NSF officials. The advisory panel was sufficiently impressed to request NSF to make its own study. NSF officials, prodded not only by her May presentation but also by the fact that the congressmen who heard her testimony (among them Conlan) appeared sympathetic, are finally getting a study under way.

The M and M section funds $10 million in individual research grants each year, or less than a fourth of NSF's total $43 million support of basic materials research, which is administered by the Division of Materials Research. In addition, government defense and energy agencies support university materials research. The question raised by the Kuhlmann-Wilsdorf study of this one small piece of NSF's pie, however, is whether the pattern is characteristic of the way the foundation operates generally and whether it is a wise pattern in the first place.

The dilemma thus raised is a classic one: whether federal agencies supporting basic research should do so only on a "purely elitist" basis—as another materials advisory panel member, Rustum Roy, of Pennsylvania State University, advocated before the House subcommittee. The alternative—which appears to be currently followed at NSF—is for a federal agency to spread the money around among some good and many mediocre institutions in the name of strengthening American science overall.

Kuhlmann-Wilsdorf concluded that "the best departments are the most underfunded on the national average," on the basis of citation analysis, a tool coming into vogue as an index of the quality of scientific work (*Science*, 2 May). Using a standard list of materials and metallurgical science faculty members in the country, she counted from published citation listings the numbers of times each faculty member had been cited as a first author over a 6-month period. She then divided the number of citations of a given depart-

ment by the number of faculty in the department, thus obtaining an average citation rate for each department. This average citation rate was the basis for ranking the departments in the order of scientific quality.

Because the study also involved a confidential questionnaire (returned by 50 of the 80 department chairmen to whom it was sent), Kuhlmann-Wilsdorf's paper does not list the departments by name. However, she says that the top of ten departments in her ranking are: Harvard (1), University of Maryland (2), Stanford (3), University of Southern California (4), Massachusetts Institute of Technology (5), University of Virginia (6), Northwestern (7), University of California at Berkeley (8), University of Kentucky (9), and the University of California at Los Angeles (10).

She then correlated the rankings of excellence with the amount of money each department had received from the M and M section in fiscal 1973 and 1974. But instead of discovering a steadily rising curve with the lowest-ranked departments getting the least and the highest-ranked departments getting the most, she found a bell-shaped curve. This was the basis of her conclusion that this section of NSF discriminates against the best schools.

"What is at issue," she testified, "is a

Slow Going on the Endangered Species Front

The Convention on International Trade in Endangered Species of Wild Fauna and Flora went into effect on 1 July, 90 days after Uruguay became the tenth nation to ratify it.* However, owing to a stunning case of bureaucratic inertia on the part of the U.S. Department of the Interior, the machinery necessary for this country's implementation of the pact is yet to be set up. Even if Interior gets moving at once, it will be months before the United States is prepared to enforce the agreement—this despite the fact that this country called for the meeting on endangered species, hosted it, drafted the treaty, and was the first to ratify it (*Science*, 23 February and 16 March 1973).

The treaty is the first all-encompassing attempt at international regulation of trade in endangered species. It sets up a complicated system of import and export permits designed to monitor and restrict the international flow of hundreds of species of animals and plants and their products.

Endangered flora and fauna, those at greatest risk, are listed in the first of the treaty's three appendices. Trade in these species—the largest categories are primates, crocodilians, and big cats—is virtually prohibited except for "noncommercial" uses such as biomedical research. Threatened species, listed in Appendix II, are subject to lesser restrictions. Appendix III is reserved for animals and plants that a nation wants to put unilaterally on the list, which means that the convention would apply to those species in trade with that nation.

Every country that ratifies the treaty is supposed to set up separate scientific and management authorities—the former to see that trade in a particular creature will not be detrimental to the survival of the species, the latter to see that everything is done in accordance with the law.

The Department of the Interior, however, has as yet failed to see that the proper authorities are designated. A draft executive order for this purpose has been floating around the department for months, but its arrival at the White House for presidential signature does not seem imminent. (That this draft has not been worked over very carefully would seem to be indicated by the fact that the President comes out as "Gerald F. [instead of R.] Ford.") There seems to be no particular explanation for Interior's failure to keep up with the requirements of the convention except that other priorities have supervened, and when it comes to wildlife, officials are more at home sorting out problems related to domestic game animals than those concerning lemurs, noisy scrub birds, and pearly mussels.

The State Department has urged Interior to get moving, and the Fund for Animals, Inc., a private wildlife-saving organization, is also very upset. Lawyers for the latter have put the department on notice that legal action will be forthcoming if it continues to do nothing. Of related concern are uncorrected discrepancies between the treaty and the Endangered Species Act of 1973, one of whose principal purposes is to make the convention into law. The U.S. list of the world's endangered species (prepared in 1969) is shorter than that contained in the treaty, and updating of the U.S. list is long overdue.

Officials estimate it will be at least a year before the treaty has identifiable impact on world wildlife trade. Wayne King of the New York Zoological Society, who participated in the negotiations, says that factions within member nations are already pressuring the International Union for the Conservation of Natural Resources and Nature, the designated secretariat for the convention, to hold a meeting. They want to amend the treaty in order to get some commercially valuable species taken off the list (no one seems to want to put more on the list). The United States is trying to delay this until more nations have joined.

Most conspicuous for their failure to sign the treaty are the members of the European Common Market, which includes Italy and France, the world's leading traffickers in hides and pelts. Since there are no customs restrictions between Common Market countries, the idea was for them to ratify en bloc. Political pressures have prevented this, so it looks as though their entry will be piecemeal, with England, West Germany, and Belgium the closest to ratification. The other big nonjoiner is Japan, a nation far more oriented to trade than conservation. Japan is expected to resist the treaty for some time, but Earl Baysinger of the Department of the Interior's Fish and Wildlife Service is optimistic that she will join. Baysinger (who is very eager to get things moving) is confident that the treaty will prove to be "a pretty damn strong document . . . most of the loopholes have pretty big plugs in them." He points out that with a few more joiners the treaty will have a self-perpetuating effect, since any nation that trades with a member of the convention is bound by its rules. The nation that stays out thus finds its trade restricted anyway, and it suffers from not having a say in future negotiations over the treaty. Furthermore, since implementation of the agreement requires systematic record-keeping and monitoring of threatened populations, the world will be able to keep better tabs on what flora and fauna are heading toward endangered status.

The treaty, at best, can only be expected to slow the accelerating rate of species extinction, by reducing incentives to snatch up or destroy rare biota. It is still helpless to prevent the shrinking of forests and habitats as they are destroyed to make way for human economic activity.—C.H.

*It has now been ratified by 13 governments: the United States, Switzerland, Tunisia, Sweden, Nigeria, the United Arab Emirates, Cyprus, Ecuador, Chile, Uruguay, Canada, Mauritius, and Costa Rica.

question of basic justice, as far as the individual scientists, the different universities, and the states are concerned. As far as the national interest is concerned, the problem is one of cost effectiveness. If the 'political' funding pattern . . . revealed in the present study should spread through a larger segment of American science funding, cost effectiveness will be poor and the American public will not get optimal return for their research dollar. . . ."

NSF's own study of the matter should clear up some questions which the study does not quite answer completely. One is that some of the departments are also designated as national Materials Research Laboratories by another section of NSF, from which they receive large block grants for basic materials research. Whether this influences the requests for and award of individual research grants by the M and M section is unclear at this time.

Some critics of the study (some of whom are advisory panel members from middle-ranked institutions) question her use of first-author citations as the index of departmental quality. One professor noted that out of 115 papers he had coauthored, on only a dozen or so did his name appear first; hence such a ranking would measure only one-tenth of his output. Others argue that papers on which a faculty member is the first author are the important original ones likely to be cited often. Kuhlmann-Wilsdorf, in her study, maintains that first-author citations, on a general statistical basis, will be an accurate indicator of quality. Hopefully NSF's study will clear this up. It will be undertaken by a former chairman of the M and M section, Charles Wert of the University of Illinois (which was ranked 14th). Another criticism of her ranking system is that it does not take into account the fact that some departments have virtually no undergraduates, hence that a much larger proportion of the faculty is engaged in research and would be likely to have many more citations.

But whatever bones critics may pick with Kuhlmann-Wilsdorf's methods, her conclusions seem to be shared by materials science faculty members at the top-ranked schools. Spot checks by *Science* with faculty at four of the five top-ranked institutions revealed a surprising similarity of opinion that they find it easier to get research grants from the Department of Defense or the Energy Research and Development Administration (ERDA) than from NSF's M and M section. The remarks of a senior Stanford professor echoed those of the others.

"NSF has a very populist view of science," he said. "If somebody is good, they think the chances are he will be receiving funds from other agencies, and NSF will not fund him. There is this attitude that every faculty member . . . has a saturation level of $50,000 or $60,000 per year. . . .

"A number of people feel this is not proper. NSF should make its decisions based on scientific merit, not on the basis that all faculty members are created equal."

But discrimination against one group implies favoritism toward another; on this other side of the coin arises the issue of whether, and why, NSF is favoring certain middle-ranked schools. Edward C. Creutz, who as NSF's assistant director for research is responsible for the "basic justice" of NSF grant awards, interprets the Kuhlmann-Wilsdorf study as an accusation of an "old-boy network" operating in the M and M section. "She was really saying that certain program directors are playing favorites," he told *Science*. Kuhlmann-Wilsdorf's study, in fact, makes no specific allegations concerning the NSF staff.

Creutz denies that an old-boy network exists in NSF's materials science support, but he acknowledges that most staffers in the division are drawn from the middle-ranked schools, many of which have benefited regularly from NSF's largesse. In fact, current or recently departed staffers in the M and M section and the larger materials division have come from, or gone to, the University of Illinois, Case Western Reserve, Drexel University, or Carnegie-Mellon University (whose former president, H. Guyford Stever, is now the director of NSF). One recent head of the division was Harold Paxton, who came from and returned to Carnegie-Mellon. While Paxton was at NSF, the division designated Carnegie-Mellon as a new materials research laboratory. The three other new ones are also mid-ranked schools: Case Western Reserve, the University of Massachusetts at Amherst, and Pennsylvania State University). Creutz denies that Paxton influenced that decision. "He even invited me to sit in on staff meetings," he said.

As for the prevalence of scientists from mid-ranked institutions in NSF's materials division, Creutz explained that NSF's salaries for those jobs were too low to attract professors from Berkeley or Massachusetts Institute of Technology.

On the question of NSF's eschewing a "purely elitist" approach to science funding, the official answers have been ambiguous. On the one hand, Paul Shewmon, who succeeded Paxton as director of the materials division (Shewmon is from Ohio State University, which ranked 12th), told *Science* that it was his policy to fund "individuals, not departments. . . . If someone orders me to make awards on the basis of departmental ranking, I'll do it. But no one has told me to." Shewmon noted that, in an early part of her study, Kuhlmann-Wilsdorf found a close correlation between individual, first-author citations and NSF funding. "She herself said that this was a curve NSF should be proud of."

On the other hand, Creutz, in a separate interview, said something quite different. "Yes . . . we're considering not only the individual but other factors, how much money is there already, and the geographical location." If two proposals come in of "substantially equal merit," NSF might favor the one from a mid-ranked institution over one from Berkeley on the grounds that Berkeley generally gets lots of materials research money from ERDA. Another consideration, he said, was "whether the university has a reputation for providing a good atmosphere for research," a factor which relates to the quality of a department.

NSF's position on whether it is or is not discriminating against the best universities is fuzzy enough, given the two approaches mentioned by different officials. But then the director, Stever, brought up still another factor during his opening statement to the House hearings. In it, Stever argued that more and more of the better scientists were turned away by NSF because of inflation. The implication was that, if NSF had more money, these problems of distributing it would go away.

> The Foundation's decisions increasingly must be made on factors in addition to the relative scientific merit of competing proposals. . . . Ever increasing numbers of very good proposals—for projects to be conducted by competent and imaginative scientists—are being declined. . . .
>
> In part, the squeeze results from the ravages of inflation against a relatively constant supply of current dollars. In part, the squeeze results from older scientists being turned aside in favor of younger scientists with more attractive, or possibly more productive, ideas. In other cases, the increasing cost of doing some kinds of frontline research simply means that a smaller number of ideas can be simultaneously pursued.

The entire controversy over materials science funding may simply bear out the quip that the NSF's constituency is made up of "grantees and disgruntees" and that a scientist seeking research support will draw up any number of reasons why it is needed. On the other hand, Kuhlmann-Wilsdorf's findings seemed to have struck a sympathetic chord with some members of Congress and with her colleagues at some of the nation's other top metallurgy and materials science departments. The issue then may develop into a specific test case of some of the bigger, grave issues facing NSF, and a test in another sense of how well NSF can stand and fight or otherwise concede gracefully that sometimes its critics may have a point.

—DEBORAH SHAPLEY