course, comes from the death rate. Though one Pakistani child in four still dies by the age of 5 and life expectancy is barely 50 years, the death rate is nonetheless a third of what it was only 20 years ago. Pakistan's current population is estimated at 71 million. An even greater problem is that, because of the soaring survival curves, more than one-half of this population is under 15, so that even if the ideal of the two-child family is achieved in the near future, Pakistan's population will still double by the first quarter of the next century.

Scrutinizing those figures more closely, the experts have figured that if the percentage of couples using contraception remains at the 1973 level—estimated at 4 percent—the population will rise to 84 million by 1980. If, under the current program, the contraceptive percentage rises to 10, the 1980 population will be 83 million, a difference that seems almost negligible. The government's goal is a contraception level of 20 percent, which will lower the birth rate from 45 to 35 per thousand, but, even if this is attained, it will still leave the population at 81 million in 1980. No real difference will be felt until the 35 percent level of contraception is reached, which is still well below Western practice. At that point, the 1980 population can be kept to 77 million. Yet, realistically, no one believes that, whatever the availability of contraceptive devices, the process of changing habits can be accelerated to such a pace.

It is these habits, of course, which experts have tried to understand in order to devise a body of theory on which to base birth control programs. Currently, the conventional wisdom among the experts holds that parents in underdeveloped societies have many babies because they want them—to work in the fields, to provide for old age, to assure a measure of immortality, to bring them status in the community. This conventional wisdom holds that birth rates are unlikely to come down until societies assure parents that the babies born are likely to survive, that a better life is possible with fewer children, that old age without a huge family need not be a lifelong worry. The theoretical purists have gone so far as to suggest that birth control programs are futile without prior economic and social development.

Pakistan's current experiment rejects this view as extreme, and looks to a more modest theory. It recognizes that no one is quite sure why couples choose to have or not to have children. It holds that, whatever the level of social and economic development, some of these couples at least would like to limit their families, and they ought not, out of official indifference or rigid devotion to dogma, be deprived of the chance by lack of knowledge or material.

Paradoxically, if Pakistan's experiment is successful, it may be because the conventional wisdom is actually right. There is evidence of sociological change in Pakistan which corresponds nicely with current theory. Most notably, the experts say, the introduction of the Green Revolution's methods of agriculture—chiefly fertilizer and new seed—have broken age-old patterns of cultivation. Farmers who were once considered wedded to tradition are now calling for more technology. Perhaps for the first time, they have been introduced to the notion that they might have some control over their destiny. There are signs of resistance to the subdivision of their plots among sons; there are also signs of a reexamination of the old attitude of marrying off daughters at the earliest possible age. Peasants may not yet have electrified homes but they do have transistor radios—which have exposed them to the outside world, as well as to the birth control propaganda the government transmits over the air waves. Such changes may, indeed, be the preconditions for successful population programs.

If it is these changes that have led in Pakistan to new attitudes on family planning, then the current experiment might have quite different results if tried in, say, India or Egypt, where patterns are emerging quite differently. No one is sure, and it will take years before the figures confirm whether the current experiment is having a real impact. Yet, after a long period of despair, the experts think they may be onto something in Pakistan, and are hopeful.

—MILTON VIORST

The author is a Washington-based freelance writer who returned recently from a visit to Pakistan.

Materials Research: Scientists Show Scant Taste for Breaking Ranks

A controversy over the fairness of materials research grant awards made by the National Science Foundation (NSF) has been heating up ever since it was first ignited by a woman researcher at the University of Virginia in congressional testimony last summer. But all the letter writing, new studies, and meetings on the subject have produced so far only one discernible lesson—namely, that he or she who marches to a different drummer, by questioning the way federal research grants are awarded, runs a great risk of being beaten over the head.

In August, Doris Kuhlman-Wilsdorf, University Professor of Applied Science at the University of Virginia, presented the results of a study of NSF funding patterns to a subcommittee of the House Committee on Science and Technology. The burden of the study was that the Metallurgy and Materials Section of NSF's Division of Materials Research (DMR) was taking a "populist" approach to grant awards by lavishly funding departments of only medium quality while giving disproportionately little money to the top-ranked, elite schools (*Science*, 22 August).

Her testimony, and reports of it in the press, have stirred strong reactions among materials researchers around the country. Most of the mail received both by the House committee and by *Science* has bestowed kudos on NSF while making some less-than-charitable asides about her.

Both in for-the-record statements and in private conversations, several materials scientists have accused Kuhlmann-Wilsdorf of attempting "political blackmail" of the NSF and called her a "disgruntled seeker of research funds," a "difficult person" who is "outside the club." They have termed the NSF in its decisions on materials grants as "fair" and "unbiased."

But many of those who have written to *Science* and to the House committee would seem to have a stake in the status quo. A tally of mail received at both places shows that much of it came from universities which have benefited handsomely from NSF's materials research division. Among them were the University of Pennsylvania (which Kuhlmann-Wilsdorf ranked 18th in quality but which in 1973–74 received $1,939,800 from DMR); Carnegie-Mellon

Ratings of the ten best materials science schools in the nation, as found in two private surveys (left and center columns) and by an academy committee (right column).

Kuhlmann-Wilsdorf	Stein	COSMAT
1. Harvard	M.I.T.	M.I.T.
2. Univ. of Maryland	Univ. of Calif., Berkeley	Pennsylvania State
3. Stanford	Rensselaer	Case Western Reserve
4. Univ. of So. Calif.	Lehigh	Univ. of Illinois
5. M.I.T.	Stanford	Rensselaer
6. Univ. of Virginia	Northwestern	Northwestern
7. Northwestern	Pennsylvania State	Ohio State
8. Univ. of Calif., Berkeley	Ohio State	Univ. of Calif., Berkeley
9. Univ. of Kentucky	Carnegie-Mellon	Lehigh
10. Univ. of Calif., Los Angeles	Univ. of Illinois	Stanford

(ranked 29th but received $690,100); and the University of Connecticut (ranked 37th but received $317,200).

As for Kuhlmann-Wilsdorf, her department of materials at the University of Virginia, although ranked 6th in her study, has received an estimated $40,000 from the DMR since 1971. An application to NSF to establish a block-funded Materials Research Laboratory there is still pending at NSF in Washington. She says that at first the scientific community may have misunderstood her study and what she was trying to say, but that, of late, her contacts with colleagues have been friendly.

But personalities aside, the Kuhlmann-Wilsdorf study has raised the more substantive question of how to determine whether the NSF's materials division—or, indeed, any government research agency—is awarding its grants fairly. Some NSF staffers and a committee made up of the chairmen of materials science departments—known as the DEPTH committee—have been reviewing Kuhlmann-Wilsdorf's study and her finding that top-ranked departments are slighted.

Her study used the citation index—a list showing how many times a scientist's work is cited in the technical literature—as an indicator of scientific merit. In her ranking system, she divided the number of citations of a given department by the number of faculty in the department, thus obtaining an average citation rate for each department. Some 60 materials departments around the country were so ranked.

Both NSF officials and materials scientists who have commented on the study have countered that this is not an appropriate method. Among other things, they say, first-author citations ignore the custom in the field of putting graduate students' names first on papers. First-author citations also list the scientists by last name and first initials only—allowing errors in the case of homographs, because one scientist can appear to be frequently cited when in fact the citations belong to several people with similar names. First-author citations also give preference to old-timers who have authored many papers but who may no longer be productive researchers.

These problems were deemed sufficiently serious for the DEPTH committee, at a November meeting, to pass formal resolutions supporting NSF but urging DMR not to use the citation index "as an indication of the research quality of metallurgy and materials individuals and/or departments." In addition, the NSF has asked a former materials grant administrator, Charles Wert, to make his own study of the citation index problem.

Among the most controversial of Kuhlmann-Wilsdorf's conclusions is her listing of the top ten materials science departments in the country. Many who wrote to *Science* ventured their own, off-hand guesses of which departments were best (and where the University of Virginia should be placed). But Dale Stein, Chairman of the Department of Metallurgical Engineering at Michigan Technological University, drew up his own formal ranking, based on the methods employed in a previous ranking of physics departments (*Science*, 5 November 1971). In addition, a report just released by the National Academy of Sciences' Committee on the Survey of Materials Science and Engineering (COSMAT) contains another ranking of the ten departments judged the most attractive for graduate-level study. (COSMAT tactfully listed them in alphabetical order, but their actual, approximate order has been obtained by *Science*).

Hence, there has been all kinds of activity in the materials community as a result of the issues raised last summer, but it's unclear whether all the sound and fury will lead to anything constructive. Wert, who is now at the University of Illinois carrying out his study for NSF, says his findings will be ready in the next few months. NSF itself has been compiling data on the success of various schools—including those which Kuhlmann-Wilsdorf says are being slighted—in applying for NSF materials research funds. A more general review of NSF's peer review system is also under way—but there are few signs that it will lead to major reforms. The DEPTH committee, meanwhile, has appointed a subcommittee to keep track of these developments and review the Kuhlmann-Wilsdorf study.

In her criticism of NSF's grant awards Kuhlmann-Wilsdorf had raised, by implication, the question of what NSF was getting for its investment in materials research. So far, one answer seems to be that it has at least gotten a great many friends.—DEBORAH SHAPLEY

"Nessie": What's in an Anagram?

The existence of the Loch Ness monster remains conjectural, but speculation about Nessie, as it is familiarly called, has been enlivened lately by the publication of some underwater photographs and sonar traces which are said to have caught the creature's likeness or at least part of it. The evidence was published in the 11 December *Nature* in an article by British naturalist Sir Peter Scott and Robert Rines, a Boston patent lawyer who has been the main organizer of a technologically sophisticated, intermittent effort over the past 6 years to acquire proof of Nessie's existence. In the *Nature* article, which the editors printed without declaring themselves on the pros or cons of the controversy, Scott and Rines proposed a scientific name for the animal on the grounds that if it exists it should be given the protection afforded endangered species under a new British law.

The name put forward is *Nessiteras rhombopteryx*. The rough translation from the Greek would be Ness monster with the diamond-shaped flipper (the most clearly suggested anatomical feature in the photos).

Experts disagree vigorously about the validity of the evidence and, as usual when Nessie surfaces as an issue, the skeptics have been busy. A retired Scottish librarian, himself a loch watcher, suggested that the photographs might show a model monster made for a movie in the late 1960's and which foundered and sank in the loch. And British newspapers and television have noted that an anagram of *Nessiteras rhombopteryx* is "monster hoax by Sir Peter S."—J.W.