scientists. Convened in December 1996, the 10-member SAF task force was chosen from academia, government, and—unlike the Forest Service committee—industry. According to Don Floyd, the natural-resource policy specialist at SUNY Syracuse who heads the task force, individual parcels of land can be managed either as long-lasting tree farms for industry or as long-lasting wilderness preserves, but not both at once. "You can't both clear-cut an area and keep it as wilderness," he says. "It's common sense." Society, he explains, should decide which areas to devote to logging, and manage them as timber farms, and which to devote to nature preserves, and manage them to restore desired environmental qualities.

Although many SAF task force members favor giving greater overall weight to ecological factors, they argue that it's not up to scientists to make that choice. Congress, the task force's draft report concludes, should "act decisively," revamp or scrap NFMA, and "establish clear priorities ... through new legislation."

Members of the Forest Service committee say they are not the ones setting the priorities. The idea of parceling the land into separate timber and wilderness areas has "consistently and roundly been rejected by the American people," says committee member Margaret Shannon, an environmental-policy analyst at Syracuse University's Maxwell School of Citizenship and Public Affairs. And the Forest Service's Wood rejects the notion that Congress needs to settle the debate over values. "Most folks have so much disposable income," he says, "that they are looking at forests in terms of the positive outcomes of good stewardship, like biodiversity, like tourism, like existence values, like knowing that there's a wilderness out there and I can go there if I want to even if I'm sitting in this cubicle in Washington, D.C." Worrying about the role of value judgments in science is "interesting but academic," because society has already made the relevant decisions on values—and chosen sustainability.

As long as Congress remains interested in forest management, this conclusion may be premature. Craig's bill, which reaffirms the importance of logging, will likely resurface in the next few weeks, says Senate staffer Rey. As for the committee report, he says, "we're interested in seeing the work, because the system needs to be modernized." But Rey says that his interest may be tempered if the report ventures from "scientific and technical advice" into policymaking. "If scientists want to offer me a policy recommendation, they may have experience that's useful," he says. "But I hope they don't expect me to genuflect to them just because they're a scientist."

On 16 March, both committees testified to their contrasting views in the House. Providing Congress does not quickly pass Craig's bill, the Forest Service will incorporate the committees' suggestions into a new set of draft regulations. It hopes to issue final regulations early in 2000. Whether it can meet that ambitious schedule depends, in part, on whether the two reports help to settle, rather than further ignite, the controversy over the forests.

–CHARLES C. MANN AND MARK L. PLUMMER

Mann and Plummer are the authors of *Noah's Choice*.

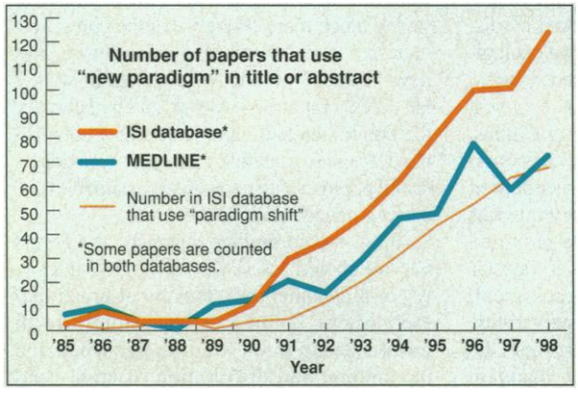
SCIENTIFIC PUBLICATIONS

The March of Paradigms

The number of grants and papers invoking the term "new paradigm" has been growing by leaps and bounds, yet most seem to have little impact

Forget about those dour predictions of the end of science or those lamentations about the passing of a golden age of discovery. New findings are apparently overthrowing entire bodies of evidence at an unprecedented rate, replacing them with novel frameworks for understanding everything from particles to organisms to the universe itself. The evidence is right there in the scientific literature: Last year alone, 124 papers in leading journals invoked the term "new paradigm" in their titles or abstracts. And use of the expression has been growing steadily throughout the 1990s.

Many of these claims, however, may not be quite the kinds of developments science philosopher Thomas Kuhn had in mind when he made the term new paradigm famous with his paradigm-shifting 1962 book, *The Structure of Scientific Revolutions*. Kuhn described the process—which he called a paradigm shift—by which a prevailing set of theories and supporting evidence gives way to a new set: the replacement of natural order by natural selection, for example, or Newtonian mechanics by quantum theory. The recent spate of new paradigms has a different ring: integrating genomic function and nuclear architecture, osteopathy to manage back pain, EBNA1 and E2 as origin-binding proteins, and links between spiritual care and the environment or between epidemiology and the liberal arts. New paradigms are now so commonplace that one author felt obliged to note that "problem-based learning" was not a new paradigm.



To get a quantitative sense of the remarkable proliferation of new paradigms, *Science* asked the Institute for Scientific Information (ISI) in Philadelphia, Pennsylvania, to analyze the frequency with which the phrase crops up in papers published across a broad range of scientific disciplines. Use of the term in abstracts and titles in the ISI database of leading journals increased steadily from 30 papers in 1991 to 124 in 1998. A search of MEDLINE—a database of biomedical publications maintained by the National Institutes of Health (NIH)—for the same period reveals a similar trend: "New paradigm" usage increased at a rate of 26% a year, from 21 papers to 73. And probes of the NIH and National Science Foundation databases of new grants turned up evidence of the same sharp increases (see graphs)—which should keep new paradigms flowing into the literature for years to come.

If these papers point to new scientific vistas, they should be highly visible in the scientific literature. To find out, ISI's David Pendlebury analyzed how many times other publications cited each of the 292 papers published between 1981 and 1999 that used new paradigm in their titles. Surprisingly, only 32 received 10 or more cites—including citations in separate publications by the same authors. "These data show that 90% of new paradigm papers affected the research world very little indeed," Pendlebury says. Indeed, they were cited less often, on average, than papers that avoided the term. Only 22 of the most cited papers, notes Pendlebury, exceeded the average

SOURCE: INSTITUTE FOR SCIENTIFIC INFORMATION/NATIONAL LIBRARY OF MEDICINE

number of citations for papers published in the same journal during the same year. "So, the new paradigm fell flat, it would seem, for 31% of these 32 most cited papers," Pendlebury concludes.

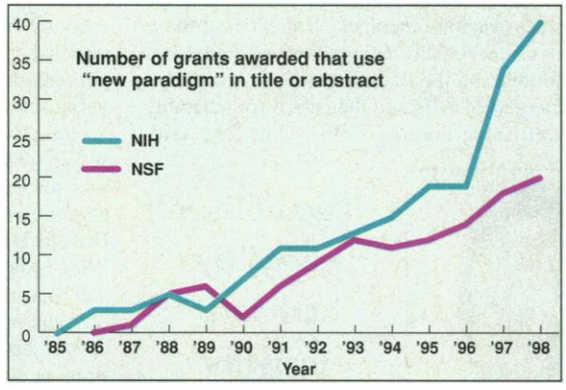
Perhaps the problem lies in citation analysis itself: The new paradigms may be so radical that the rest of the scientific world, stuck in the old ways of looking at things, hasn't yet shifted to them, depressing citation counts. So *Science* turned to a time-honored, although less rigorous, evaluation: We randomly selected a few current papers and contacted independent experts to ascertain whether the papers indeed had revolutionized their views.

Asked to comment on a *Journal of Biological Chemistry* paper entitled "Regulated co-translational ubiquitination of apolipoprotein B100: A new paradigm for proteasomal degradation of a secretory protein," Daniel Steinberg, an apolipoprotein B100 authority who works at the University of California, San Diego, says it "is stretching the words very thin" to call this a new paradigm. The paper, says Steinberg, offers "an alternative hypothesis." Steinberg—who notes that he has much respect for the paper's last author, a former postdoc in his lab—may be an especially tough critic, however. He happened to have been at Harvard with Thomas Kuhn and had many discussions with him. "I thought we should reserve 'new paradigm' for Darwin, Freud, and Newton," says Steinberg. "Maybe we use it five times in a century."

Josef Penninger of the University of Toronto has a similar view of a paper published last August in the *European Journal of Endocrinology*, "Osteoprotegerin and its cognate ligand: A new paradigm of osteoclastogenesis." Penninger, who admits to similar paradigmatic offenses himself, says this paradigm once was new. But that was in 1972, when a paper in *Science* described the basic finding that a factor made by white blood cells could trigger osteoclastogenesis, the mechanism of bone reabsorption.

Even the new paradigm paper that ISI found had the most citations may involve a questionable use of the term. Published in *EMBO Journal* in May 1989, "Human atrial natriuretic peptide receptor defines a new paradigm for 2nd messenger signal transduction" had a big impact on its field, garnering 237 citations. But the paper, says Lincoln Potter of the Salk Institute for Biological Studies in La Jolla, California, essentially validates a controversial hypothesis put forward decades before by Earl Sutherland, who won the Nobel Prize in 1971 for his discovery of second messengers.

What, then, might account for the proliferation of new paradigms in the scientific literature? Nobel laureate Steven Weinberg, a physicist at the University of Texas, Austin, has one possible explanation. Weinberg—who attacked Kuhn's proposition that new paradigms displace old ones in a critique that ran last year in the *New York Review of Books*—suggests that the rise is linked to the increasing specialization of science. "It's harder and harder for scientists to make a splash that goes beyond their fellow specialists," Weinberg says. The term is an attention-getter, says Penninger. "I use it, too, sometimes, but really for political reasons—to make reviewers happy and for funding," he says.



SOURCES: NSF, NIH

One especially puzzling result of *Science*'s investigation is the nursing paradigm paradox: 67 of the 459 uses of "new paradigm" in the MEDLINE database from 1968 to 1999 involved nursing research. Patricia Grady, director of NIH's National Institute of Nursing Research, offers a simple explanation: "Nursing research is relatively new on the horizon of scientific research." The newer the field, the more new paradigms there are to discover. Grady says she personally eschews the phrase, however. "People often ask, 'What does that mean?' " says Grady. "I try to avoid speaking in ways that are mysterious."

Grady is not the only person who finds the term difficult. Kuhn himself had trouble precisely pinning down the meaning of paradigm. "Turn now to paradigms and ask what they can possibly be," wrote Kuhn in a 1969 postscript to the second edition of the book. "My original text leaves no more obscure or important question. One sympathetic reader ... prepared a partial analytic index [of the book] and concluded that the term is used in at least twenty-two different ways." To help solve this problem, Kuhn introduced yet another phrase with which to discuss a paradigm: "disciplinary matrix." A MEDLINE search on that term yielded only one hit: "Philosophic analysis of a theory of clinical nursing." —JON COHEN

PEER REVIEW

NIH Invites Activists Into The Inner Sanctum

Under pressure from advocacy groups to open up the grant-review process, the NIH is adding lay members to some study sections—to mixed reviews

For more than half a century, the holiest of holies at the National Institutes of Health (NIH) has been the peer-review "study sections"—the small panels of 15 to 20 researchers that weigh the scientific merit of more than 24,000 grant applications each year. Scientists whose ideas are turned down often criticize the study sections bitterly, but at least they know they have been judged by fellow scientists. "The important thing about peer review," says molecular biologist Keith Yamamoto of the University of California, San Francisco, "is that it's peers."

Now that's changing, fast. Under political pressure to listen more closely to specific-disease advocates and ordinary people, top NIH officials are pressing individual institutes to place patient representatives on some study sections—particularly those dealing with potential therapies. "No directives have been issued, but we're encouraging it," NIH director Harold Varmus said in a recent interview. "Our assessment is that under appropriate circumstances, having informed patients on study sections can be extremely useful." But some scientists worry that NIH is "diluting" expert advice.

The use of nonpeer reviewers isn't totally untried. Following a recommendation of the Institute of Medicine, the U.S. Army since 1995 has been including two "consumers"—that is, patients—on each review panel in its $210 million research program on breast, prostate, and ovarian cancer and neurofibromatosis. Scientists who have served on these panels say the process works surprisingly well.

Pressured by advocacy groups to become more open, the National Institute of Allergy and Infectious Diseases (NIAID) and the National Cancer Institute (NCI) have been seating patients on selected study sections for some time. Consumer panelists offer exper-