Valangiman Subramanian Ramamurthy, a nuclear physicist and secretary of the Department of Science and Technology, says that what's needed is a system of laboratory accreditation "so that a fair system of checks and balances is in place." Currently, scientists planning experiments need only inform the ministry of their plans and gain approval from either institutional ethics boards or the government. Ramamurthy says that his department would be more than willing to help set up such an accreditation board. In the meantime, he says, "the country has a 100% need to upgrade its animal facilities."

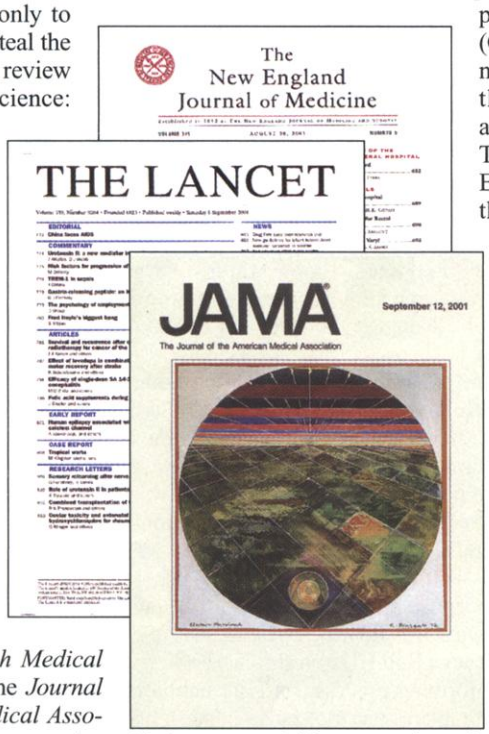
–PALLAVA BAGLA

SCIENTIFIC PUBLISHING

Peer Review and Quality: A Dubious Connection?

BARCELONA, SPAIN—Mention "peer review" and almost every scientist will regale you with stories about referees submitting nasty comments, sitting on a manuscript forever, or rejecting a paper only to repeat the study and steal the glory. Even so, peer review remains a pillar of science: Despite its flaws, letting scientists anonymously judge each other's work is widely considered the "least bad way" to weed out weak manuscripts or research proposals and improve promising ones.

But that common wisdom was questioned last weekend at a meeting* attended by hundreds of editors of medical journals and academics, organized by the *British Medical Journal* (*BMJ*) and the *Journal of the American Medical Association* (*JAMA*). In a meta-analysis that surprised many—and that some doubt—researchers found little evidence that peer review actually improves the quality of research papers. "It's a peculiar paradox," says Frank Davidoff, former editor of the *Annals of Internal Medicine*, about the study. "People cling to a system even though we don't know much about its value."



Under wraps. Critics are urging editors to lift the veil of secrecy surrounding peer review.

To rectify that situation, some speakers argued that more journals should study their own practices with the scientific rigor they demand of their authors—as should agencies that rely on peer review to dole out billions of dollars in research money.

Recently, many medical journals have become increasingly critical of their own procedures, in part because "they can be complicit in killing patients" by publishing bad or biased research, says Richard Horton, editor of *The Lancet*. [Just last week, for instance, a group of leading editors announced that they would no longer publish studies carried out in name by academic researchers but underwritten and run from behind the scenes by the pharmaceutical industry (*Science*, 14 September, p. 1969).] And some scientists and journal editors are putting peer review and other editorial processes to the test.

This emerging research enterprise has shed light on many individual steps of the editorial process, including very small ones; one study presented at the meeting examined whether it was best to prod tardy reviewers by phone, fax, or e-mail. (Conclusion: It makes no difference.) But the sobering meta-analysis, presented by Tom Jefferson and Elizabeth Wager of the Cochrane Centre in Oxford, U.K., showed that it has not answered the most burning question: Does peer review have a measurable effect on the quality of manuscripts?

The team scoured the literature for studies that had analyzed peer review as rigorously as new drugs are put to the test: in a trial in which two or more methods were compared and outcomes scored in some quantitative way. Those strict criteria yielded only 19 studies, but none of them really clinched the case for peer review. For instance, nine studies looked at the effects of blinding the reviewers to the authors or vice versa; they found it made little difference to the quality of the final paper. Two other studies found scant evidence that making peer reviewers use a standardized checklist led to better reviews, while two more revealed that training reviewers was

* Fourth International Congress on Peer Review in Biomedical Publication. Barcelona, Spain, 14–16 September.

ScienceScope

Science Budgets Uncertain With government spending plans in disarray due to major new outlays for recovery and military efforts, biomedical researchers fear that the move to double the National Institutes of Health's budget to $27 billion by 2003 is in jeopardy. Although a major increase for next year appears safe, future raises could be scaled back. But some areas—such as research on defenses against biological attack—could prosper.

Researchers funded by the military, meanwhile, may face feast or famine. Programs judged marginal may be cancelled to free up funds for military operations, observers say. Pentagon R&D projects considered critical—such as developing new security technologies—may be put on a fast track.

Congressional leaders this week were expected to decide whether to buy themselves some time by passing legislation that would freeze budgets at existing levels for up to 6 months into the new fiscal year, which begins 1 October, or try to finalize new spending numbers by the end of next month.

End of Discussion The battle over White House plans to develop a ballistic missile defense (BMD) system is finished, at least for this year. Opponents in the Senate and House this week said they have dropped efforts to cut funds from the president's $8-billion-plus BMD budget request and place restrictions on planned tests, which they fear will breach international arms control agreements (*Science*, 7 September, p. 1750).

Timely study Months before the attack, the National Academy of Engineering (NAE) in Washington, D.C, had already decided the time was right to mount a study of "homeland defense" against terrorism. Now, academy chief William Wulf says the effort will "move ahead smartly," with a report due "as soon as possible." He's already recruited a lead staffer—former Congressional Research Service terrorism expert Raphael Perl, and expects to announce panel members soon. "We hope to convey to the public in a nonalarming way what the threats are and what we might do to protect ourselves," he says. Wulf promises that the homeland defense study will be just the first of several efforts mounted by the U.S. National Academies to "mobilize our immense intellectual resources on this issue."

Contributors: Eliot Marshall, David Malakoff, Elizabeth Pennisi

practically useless. Only two papers compared the quality of papers submitted as a manuscript with the version that later appeared in print, and their results were difficult to generalize. "If I manufactured a drug called peer review and went to the Food and Drug Administration with it, they would collapse laughing," Jefferson concluded.

The study—which, like all contributions at the meeting, had been peer-reviewed—was "pretty depressing," concedes *BMJ* editor Richard Smith. Still, Smith and other editors remain convinced that the review process helps, even if studies can't objectively show it. Part of the problem may be that standardized quantitative scales are not the right way to gauge a paper's quality, says "*JAMA* deputy editor Drummond Rennie, because they don't capture certain flaws, such as a researcher misinterpreting his data. "I could name scores of scientists who have had their reputations saved by peer review," Rennie says.

Although peer review is clearly here to stay, a few editors urged their colleagues to at least shatter the secrecy surrounding the process—specifically, by releasing the names of the reviewers. Critics say that anonymous review enables researchers to trash a rival's paper for no good reason—and sometimes get away with it. "It's power without accountability," says Rennie. "And it's an anachronism." But many journals argue that guaranteeing anonymity is the only way to assure reviewers that they can speak their minds without fear of retaliation.

In a pioneering move 3 years ago, the *BMJ* began making reviewers' names known to authors; since then, "the sky hasn't come down," says Smith. Only 20 or 30 of the *BMJ*'s 5000 or so reviewers have quit, and although the reviews tend to contain less verbal abuse, they have not become less critical, Smith says. BioMed Central, an online publishing house, even goes a step further, by posting the reviews of all papers accepted by its 40 medical journals on the Web, along with the author's response.

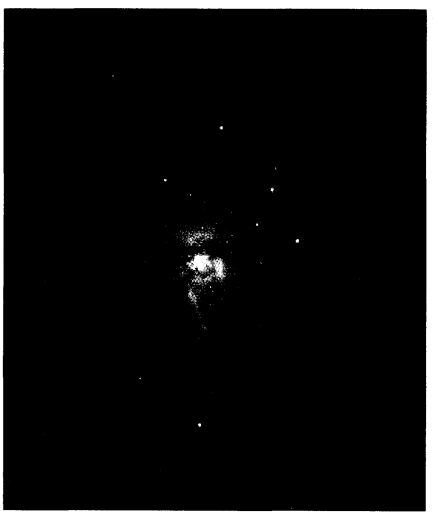
Other journals watch such experiments with interest—but few plan to follow suit. Rennie, for instance, has not been able to convince fellow editors at *JAMA* to reveal reviewers' identities. Horton would like more evidence that the "culture of robust and honest criticism" doesn't suffer before lifting the veils of *The Lancet's* peer review system.

Unfortunately, says Smith, big funding agencies like the National Institutes of Health, the Medical Research Council, and the European Union have so far shown little interest in supporting studies of peer review. "They want to study diseases, not the scientific process," says Smith. "To them, it looks like navel-gazing." **–MARTIN ENSERINK**

ASTROPHYSICS

New Model Shows Sun Was a Hot Young Star

According to Genesis, when the newborn Earth arrived on the scene, "darkness was upon the face of the deep." Not so, say two German astronomers. In fact, their elaborate computer simulations indicate that our infant planet's main light source—the young sun—was much hotter and brighter than astronomers have thought. "The sun started out quite different from what people have assumed until now," says Günther Wuchterl of the Max Planck Institute for Extraterrestrial Physics in Garching. If they hold up, the new results could change the way scientists think about other young stars and Earth's early climate.



Brighter. Young stars, such as these in Cygnus, may be more luminous than astronomers thought.

CREDIT: SUBARU TELESCOPE, NATIONAL ASTRONOMICAL OBSERVATORY OF JAPAN

At an age of 1 million years (1/4600th of its current age), Wuchterl says, the sun was still a protostar—a ball of gas in which the nuclear fusion of hydrogen into helium was just about to start. It's no surprise that this protostar shone more brightly than today's sun, because its contracting gases temporarily released more energy than fusion does now. But whereas current evolutionary models peg its luminosity at just twice the present value, the new simulations estimate that the young sun was four times as bright as it is now and that its surface was 500 degrees hotter.

Using a special-purpose supercomputer called GRAPE (*Science*, 13 July, p. 201), Wuchterl and his colleague Ralf Klessen simulated the entire star-forming process, starting with a fragmenting interstellar molecular cloud and continuing through the formation of protostellar "embryos" and the accretion of gas onto the young protostar. Most earlier simulations treated each step "separately and, hence, inconsistently," says theoretician Adam Burrows of the University of Arizona in Tucson. "For 40 years, the astrophysics community has been seeking a comprehensive and predictive theory of star formation. This new work is a big step toward that goal."

The results, which have been accepted for publication in *Astrophysical Journal Letters*, may have consequences for the study of star-forming regions. Astronomers deduce the mass and age of a young star from its luminosity and surface temperature, on the assumption that young protostars get fainter with age. But if protostars start out brighter than current models predict, their ages may well be underestimated, Wuchterl says.

Ray Jayawardhana of the University of California, Berkeley, agrees. "We still need a lot more work, both theoretically and observationally, to fully understand the picture," he says. But ultimately, the new work by Wuchterl and Klessen "might help us pin down the exact ages of very young stars better."

More tentatively, the new results might also change ideas about Earth's early climate. Our planet probably formed when the sun was a few million years old—about the time the bright protostar became a full-fledged star. Astrophysical models indicate that within a few hundred million years, the sun had faded to some 70% of its current luminosity before growing gradually brighter over the past 4 billion years or so. Yet geological evidence shows that average temperatures on Earth during the stellar chill-out never dipped below freezing. If the young sun was so faint, how did Earth stay warm?

The answer, Wuchterl and Klessen's simulation suggests, may be that the faint young sun wasn't so faint after all. But scientists caution that the new simulation covers only the first few million years of a star's life—far too short a time to give a conclusive ruling on the "faint young sun" paradox. "The important question ... is whether these effects [of higher temperature and luminosity] persist until after more than 100 million years of the sun's history," says Christopher Chyba of the SETI Institute in Mountain View, California.

Some experts say there's no need to adjust the solar thermostat at all. "Climatologists already have an answer—a very good one, I would argue—to the faint young sun paradox," says Jim Kasting of Pennsylvania State University, University Park. Greenhouse gases such as carbon dioxide and methane, he says, would have kept Earth warm during a solar cold spell. "The Earth system can very easily counter a 30% decrease in solar luminosity," Kasting says. "So, from my standpoint, no drastic revision of solar evolution theory is needed."