Briefings

edited by CONSTANCE HOLDEN

Questions Raised on Math Rankings

A reversal of the old question "If you're so smart why aren't you rich?" has been posed by a National Science Foundation official: If our science education system is so rotten, how come the United States still enjoys overwhelming dominance in scientific productivity?

Iris C. Rotberg, writing in a National Academy of Engineering publication, *The Bridge*, says the answer may be that international comparisons of student achievement in science and math have been providing "highly misleading indicators" of the actual quality of education systems and student expertise.

Rotberg, a program director with the Directorate for Education and Human Resources, argues that a major problem stems from sampling biases: The percentage of teenagers enrolled in high school is much higher in the United States than in many other countries—and the less selective the test-taking population, the lower the scores will be. By the same token, distortions are imposed by huge variations in the proportions of students who take advanced math courses. For example, according to the International Association for the Evaluation of Educational Achievement, Hungary ranks near the top in 8th-grade math achievement. But by the 12th grade, the country falls to the bottom of the list because it enrolls more students than any other country—50%—in advanced math. Hong Kong, in contrast, comes in first, but only 3% of its 12th-graders take math.

Rotberg says these problems also affect the Educational Testing Service's (ETS) International Assessment of Education Progress, initiated in 1988. In the first project, only six countries participated, sample sizes were small, and there was no way of knowing if the results reflected differences in students' socioeconomic status rather than differences in the quality of schooling. Rotberg says sampling problems have gotten even more complicated with the recent expansion of the project to 20 countries. In some countries—particularly poor ones, where many students have already left school by the 8th grade—only the elite will be sampled, while countries attempting to democratize education will appear to fall short. Logistical decisions—like including only Mandarin-speaking Chinese in the China sample—also result in an elite bias. The solution? "Let's focus our attention on the difficult public policy issues...rather than on comparisons and rankings," says Rotberg.

Both the Department of Education and the ETS disagree with Rotberg and other critics. According to *The Washington Post*, Diane S. Ravitch, assistant secretary for educational research and improvement, argues that in the first ETS assessment, 99% of the teenagers in all the countries surveyed were in high school. Archie Lapointe of ETS is quoted as saying the surveys "don't overstate anything.... The fact is students in other countries do better than our students in mathematics."

Rating University R&D (cont.)

Seven weeks ago we published a table comparing the National Science Foundation's ranking of university R&D with a new "research activity index" (RAI) developed at the University of Arizona's Center for the Study of Higher Education (27 September, p. 1485). The RAI is based on a broad range of factors in addition to R&D expenditures. Unfortunately, we switched the headings on the table.

Herewith the corrected table. The third column is a new "total expenditures productivity index" (TEPI), a further refinement recently developed by the Arizona researchers that adjusts the rankings according to university size. This was done by dividing each university's total R&D expenditures by the numbers of full-time equivalent scientists and engineers it employs.

UNIVERSITY R&D ACTIVITY
Three alternative rankings for top 10 institutions

	NSF (1987)	U. of Arizona RAI (1987)	TEPI (1985)*
1.	**MIT**	U. Wisconsin-Madison	**U. Colorado**
2.	**U. Wisconsin-Madison**	Cornell U.	**Stanford U.**
3.	**Cornell U.**	Stanford U.	**U. Texas Cancer Ctr**
4.	**Stanford U.**	U. California-Berkeley	**Caltech**
5.	**U. Michigan**	Harvard U.	**Washington State U.**
6.	**U. Minnesota**	MIT	**Rockefeller U.**
7.	**Texas A&M U.**	U. Illinois-Urbana	**MIT**
8.	**U. California-LA**	U. Minnesota	**Carnegie-Mellon U.**
9.	**U. Illinois-Urbana**	U. Michigan	**Johns Hopkins U.**
10.	**U. Washington**	U. California-LA	**U. California-Berkeley**

*The latest year for which relevant NSF data are available. Nineteen eighty-seven was the latest year for which figures were available for the RAI analysis; that is now being updated.

Catching Some (Cosmic) Rays

If a mission to Mars ever gets off the ground, astronauts will sail into a barrage of high-energy particles from cosmic rays and the solar wind when they leave the protection of Earth's magnetic field. The barrage will go on for some 3 years, until they get back to Earth. "That's a huge time for radiation to interact with humans," says Lawrence Berkeley Laboratory (LBL) biologist Aloke Chatterjee.

To study the effects of that long-term exposure, NASA is establishing a Specialized Center of Research and Training in Radiation Health at LBL, funded for 5 years at $1 million a year, with Chatterjee as director and John Lett of Colorado State University as codirector. After the center opens on 1 January, the researchers will create a simulacrum of the radiation environment of deep space using LBL's Bevalac accelerator, which can accelerate heavy nuclei such as iron to high energies.

Heavy nuclei make up only about 1% of cosmic rays and are even scarcer in the solar wind. But, says Chatterjee, their multiple positive charges make them highly disruptive when they interact with the electrons in biological molecules such as DNA.

To find out just how much damage these heavy ions could do to interplanetary travelers—and how effectively their bodies would repair that damage—Chatterjee's team plans to expose human and animal cells to the Bevalac's ion beam. Ultimately, they hope to be able to say how much risk of cancer or cataracts—two effects of radiation exposure—the deep-space radiation poses.

The NASA center will also study countermeasures such as shielding. The key issue, according to Chatterjee: What kind of shielding would a Mars vessel have to carry "so that the risk factor is similar to that at Earth's surface"? Eliminating radiation exposure completely is out of the question, he says. Heavy radiation armor can stop iron nuclei—but at the cost of shattering some of the particles into multiple light nuclei, which would spray into the cabin. There's no place to hide in outer space, it seems.

Students Thwart USDA Pest Plan

Hopping-mad graduate students at the University of Wyoming have helped force officials at the U.S. Department of Agriculture (USDA) to reconsider a plan to control western grasshoppers.

Every 7 years or so, several Western states get a population explosion of rangeland grasshoppers that feed on the same grasses as livestock, thus endangering their food source. Insec-