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-

ticides are traditionally used to kill the critters, says Jeffrey Lockwood, an entomologist at the University of Wyoming. But the USDA, hoping to steer away from chemicals, wanted to test a biological weapon: It planned to unleash grasshopper-munching Australian wasps onto rangelands.

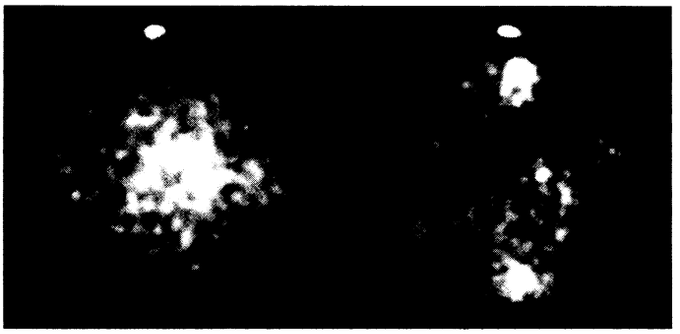
On hearing of the plan last spring, graduate students in Lockwood's course, "Insect Population Biology," took action: They drafted a document challenging the USDA to assess the ramifications of introducing an exotic species into an established ecosystem. "Surprisingly to me, [USDA officials] weren't aware of the ecological consequences," Lockwood says. For example, he says, the wasps might also scarf up beneficial weed-eating hoppers.

Late last summer USDA put its wasp plan on hold. An official says the students' report was only "one of many incentives" that led to the decision. But a USDA memo suggests their initiative carried more sting than that. It stated that the Wyoming work was "so compelling that the USDA must seriously reconsider its initiative of importing exotic parasites...." Lockwood says there's a lesson here: that while broad-spectrum insecticides should be curbed, biological controls don't "automatically wear a white hat."

An Ice Cap on the Hottest Planet?

Astronomer Martin Slade of the Jet Propulsion Laboratory (JPL) recalls that when he and his colleagues were trying to figure out the nature of a newly discovered bright spot at the north pole of Mercury—the solar system's hottest planet—"our first reaction was: It can't be ice, so what is it?" But on further reflection, Slade, Duane Muhleman, and Bryan Butler of the California Institute of Technology, and Raymond Jurgens of JPL decided an ice cap on Mercury isn't such a crazy idea after all.

CALTECH/JPL



Radar images of Mercury. *White spot at the top signals possible subsurface ice cap.*

The notion seemed plausible when the researchers considered the fact that Mercury's polar bright spot appeared in radar maps rather than in conventional telescope images, so any ice could be below the surface (where radar can penetrate) and thus be somewhat protected from the rigors of space. It would also be preserved by the relative cold of Mercury's polar regions. Because the planet lacks seasons, the equatorial areas of the planet are baked by the sun to 430°C while the poles are a chilly -148°C.

But "ice is still somewhat of an uncomfortable explanation," says Slade. It's better than conventional ones that invoke a rough, rocky surface, but "it's hard to know why the ices didn't evaporate" over billions of years. While that question is being investigated in the artificial chill of the laboratory, the radar astronomers will be looking toward Mercury again. They think they caught a glimpse last summer of a second spot, this time at the South Pole.

Relaying Science to the People

A new bridge between science and society is being established in the form of an international quarterly, *Public Understanding of Science*, to be launched in January by the Science Museum in London in association with IOP Publishing.

The prime mover behind the journal is John Durant, the museum's assistant director and visiting professor of the history and public understanding of science at Imperial College in London. Durant, who edits the journal, claims that it will be unique in its focus on public understanding of science—"an emerging interdisciplinary research field." It will be aimed at a broad audience including journalists, educators, and policy-makers, as well as scientists. The first issue includes articles on antiscience (by Harvard physicist Gerald Holton, who is also a member of the journal's international editorial advisory board); popular science in the United States after World War II; and representations of scientific controversy in museum exhibits.

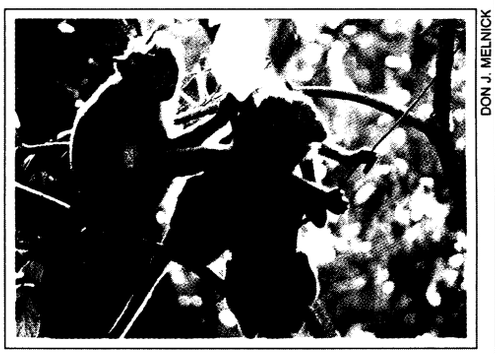
The U.S. subscription address is the American Institute of Physics Subscriber Services, 500 Sunnyside Blvd., Woodbury, New York 11797-2999. Subscriptions are $190 a year for institutions; $68 for individuals.

Primatologists Band Together

New York City probably boasts the highest concentration of physical anthropologists in the United States. Though a good many of them work just a subway ride apart and are pursuing similar studies of the evolution of primates—including the nonhuman ones found outside the city—they have had few formal ties. Now, however, the National Science Foundation (NSF) has taken an unusual step to bring together 22 anthropologists at three universities, a museum, and a zoo in the Big Apple: It has awarded them $1.6 million to form a consortium to pool their research and for student education and training efforts.

The New York Consortium in Evolutionary Primatology will link anthropologists at the City University of New York Graduate School, Columbia University, New York University, the American Museum of Natural History, and the New York Zoological Society. Each of those institutions has particular areas of expertise, but each also has gaps in its graduate and research programs. Together, however, the programs are remarkably comprehensive. "It's a happy marriage—the collective fills the gaps," says Don Melnick, chairman of Columbia's anthropology department.

DON J. MELNICK



Toque macaques in Sri Lanka.

Students will be the first to benefit. Starting in fall 1992, NSF will fund at least two new Ph.D. students at each university in each of the first 3 years of the 5-year grant. That means at least 18 graduate students and five postdocs. The graduate students will be required to take courses and do research with scientists at each of the institutions, learning from experts in every facet of primatology, including paleontology, behavior, ecology, genetics, and conservation. Until now, says Melnick, "it seems we weren't taking advantage of being in a big city."