Morin uncovered was with grades—and although, at 0.48, it was much stronger than ETS's own figure, Morin still considers it weak. "For the students who did come here, the GRE physics [test] didn't mean too much," he concludes.

ETS suggests that the correlation with graduate school grades is weak because students who score very low on the test never make it to graduate school—where, presumably, their low grades would have bolstered the correlation. But Georgi argues that the test sharply underpredicts or overpredicts the physics performance of particular groups of students. On the one hand, he said at the APS session, the very highest scores on the test often go to what he calls "idiot savants": students who are good at manipulating symbols but have little understanding of physics.

On the other hand, Georgi noted that some of his most brilliant women students have bombed on the physics GRE—anecdotal support for a gender disparity that shows up as a nearly 100-point differential between male and female test-takers between 1992 and 1995. As a result, many women, including Siders and Zappardino, see the test as a "gatekeeper" contributing to the dismal gender disparity in physics, the largest such gap of any major scientific field. In an independent study in the graduate physics program at UT Austin, Siders found that the number of women admitted fell precipitously—from an average of about 10 to just one or none—when cutoffs based on physics GREs went into effect.

No one claims to understand why women score lower than men. "Women get lower scores on this test even when they are equally good by any other measure," says John Schwarz, a physicist at Caltech. Possible reasons, he says, range from a different test-taking style to a dislike of time pressure. But when Georgi queried one talented woman about her low score, he said at the APS meeting, "She told me that the physics GRE was simply too nerdy to be taken seriously by an intelligent woman." Georgi drew laughter when he paused and said, "I'm not sure what that says about the men."

Handle with care

ETS isn't laughing about these disparities. Individual GRE questions receive close monitoring for sensitivity and bias toward or against any demographic group, and must pass muster with women and minority members of the GRE faculty committee. "I would not tolerate it if I saw any question which had a taint of bias against women or minorities," says Garcia, of the GRE faculty committee. But he allows that the test "does have warts. It does have flaws."

In an effort to minimize them, says Jacqueline Briel, associate program director for the GRE, ETS has tentatively scheduled a so-called FAME conference—for fairness, access, multiculturalism, and equity—for the winter of 1997 to explore possible reasons for the demographic disparities. The testing service is also looking at ways to base bulk-graded exams on something other than multiple-choice questions—say, by using computers to grade a student's approach to a problem, rather than just the final answer. But Minnesota's Halley notes that "it's daunting to teach a machine to measure that," and any solution is still probably far off.

In the meantime, Briel stresses, the tests should be applied cautiously: They are "one source of information to be used in conjunction with other criteria"—grades, recommendations, essays, and any record of other activities, such as published research. Adds James Stith, a physicist at Ohio State University: "What we have to do is convince our colleagues on these committees that this is not a good single indicator. For those who use it as a data point" among many others, says Stith, "I don't see that it does any harm."

Georgi, however, insists, "We should either fix it or seriously consider getting rid of it." As the ongoing, and sometimes agonizing, discussion shows, neither side in the debate is likely to let the issue rest.

–James Glanz

PLANETARY SCIENCE

The Moon Looms Large in Japan's Plans

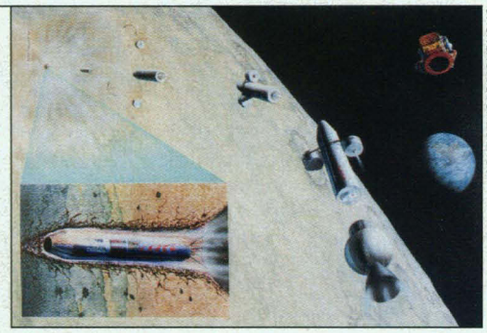
KYOTO—Moon viewing is an autumn tradition in Japan in which friends gather to gaze at the harvest moon while penning poetry and sipping sake. The moon is also getting a lot of attention from Japan's space scientists: Last week, at a major international meeting here, Japanese researchers and officials provided fresh details of an ambitious lunar exploration effort that holds a high priority in the nation's space program.

Japan is pressing ahead with its lunar program at a time when most other nations are focusing their space efforts elsewhere—a fact that drew some envy from the 150 researchers in fields ranging from astrophysics to civil engineering who gathered here for the Second International Lunar Workshop, held simultaneously with the first International Lunar Exploration Working Group. "I wish we had done this years ago," says Michael Duke of the Lunar and Planetary Institute in Houston. Hitoshi Mizutani, a planetary scientist at the Institute for Space and Astronautical Science (ISAS) and chair of the workshop session, acknowledged that "Japan has taken on a leading role in lunar activities." In particular, Japan is backing two of the three international missions now scheduled to land on or orbit the moon in the next several years.

The first of these missions, the LUNAR-A mission, lifts off next summer. An ISAS project, the satellite will orbit the moon and release three penetrators that will slam into the moon's surface. The penetrators, traveling at 250 to 300 meters per second, are designed to burrow 2 meters into the ground in the first attempt to drop such penetrators from an orbiting spacecraft. Two of the 90-cm-long penetrators, each housing a seismometer and a heat probe, will be placed on the near side of the moon and one will be placed on the far side. They will transmit seismic and heat-flow data to the orbiter when it passes overhead, about once every 15 days for a year. The orbiter will then relay the data to Earth, helping scientists to better understand some geological forces that are easier to monitor on the moon than on its larger sister. "It will capture a part of the Earth-moon history that is lacking on the Earth," says Carlé Pieters, a planetary scientist at Brown University in Providence, Rhode Island.

A few months later, NASA will launch its Lunar Prospector mission, a 223-kg package of remote-sensing instruments placed into lunar orbit. The 1-year mission hopes to plot the distribution of elements such as uranium, iron, and silicon; search for ice at the lunar poles; and study the moon's magnetic and near-side gravitational characteristics. The data will add greatly to knowledge of the composition of the moon and identify potentially valuable resources.

The most ambitious of the three missions is Japan's Selenological and Engineering Explorer (SELENE), planned for launch in 2003. A joint mission with Japan's National Space Development Agency (NASDA) that is



SOURCE: ISAS/MONBUSHO

New digs. Japan's LUNAR-A satellite will launch penetrators to burrow into the moon's surface.

awaiting final approval, SELENE would use NASDA's H-II rocket to send into lunar orbit a 1.5-ton package containing a low-altitude orbiter, a lander, and a high-altitude, data-relay satellite. In addition to refining and extending many of the elemental and magnetic observations of the Lunar Prospector, SELENE will produce high-resolution topographic maps and detailed observations of the magnetic characteristics of the moon's far side, as well as study Earth's plasma environment and magnetosphere. The data should flesh out sketchy maps of the moon's surface, helping scientists to understand its varied features and engineers to pick out the best sites for future landings, and may also offer insight into the origin and fate of a possible ancient magnetic field.

The moon has moved to the top of Japan's space plans because of its broad appeal. Mizutani says it offers researchers both a chance to do interesting science and a relatively inexpensive test bed for techniques to be used on more distant objects. Those practical considerations are music to the ears of Masanori Homma, manager of the policy and strategy department at NASDA, the more commercially oriented of the country's two space agencies. "When you think of space applications, the moon is a very appropriate target," he says. With such interest on the part of both space agencies, it was a small step for Japan's Space Activities Commission, which advises the government on space policy, to make the moon one of the focal points of a 1994 report laying out a long-term vision for space.

Scientists at the meeting from other countries say their programs are not keeping pace with Japan's level of activity. U.S. attitudes have been shaped by a "been there, done that syndrome," notes Stephen Saunders, senior research scientist at the Jet Propulsion Laboratory in California. Europe has never had much of a lunar focus in its space activities, says astrophysicist Jean-Pierre Swings of the University of Liège, Belgium, although there is talk of resurrecting a proposal to launch a remote-sensing satellite that was rejected earlier this year in the most recent competition for the European Space Agency's Horizon 2000 program. And the once-proud Russian space program has shrunk considerably in the wake of the country's fiscal problems.

But Japan soldiers on, and scientists say its lunar activities could get a boost from the attention now being lavished on Mars. Duke says that the recent excitement about possible evidence of ancient life on Mars has revived talk of manned missions to the planet. Those plans would almost certainly include preparatory manned missions to the moon. If so, Japan stands ready to provide important clues about the nearest stepping stone to space exploration.

–Dennis Normile

DEMOGRAPHY

A Census in Which All Americans Count

The U.S. Census Bureau has a tough enough time dealing with ordinary Americans. Some people hid behind curtains, recalls Valerie Ramsay of San Jose, California, who was a door-to-door interviewer, or enumerator, for the 1970 census. Others unleashed their dogs. She even had one "older gentleman" holler at her, "Get the hell off my porch. The U.S. government knows too much about me as it is!"

Now another group of Americans, the U.S. Congress, is assailing the often-beleaguered bureau over its recent plan to adopt a new strategy for the 2000 census. Eight months ago, the bureau proposed supplementing its traditional door-to-door interviewing approach with a statistical sampling and analysis of the hard-to-locate or impossible-to-interview, like Ramsay's "older gentleman." Bureau officials say the new, two-pronged approach would bring down the skyrocketing costs of trying to count everyone, and correct what is widely viewed as a fundamental flaw of traditional physical tallies—that they undercount poor people and minorities, who tend to move more often and return fewer mail-in questionnaires than do wealthier Americans.

Diminishing returns. Ballooning spending hasn't reduced the number of blacks missed by the census.

Not so fast, said members of the U.S. House of Representatives. In a report released in September, members of the Republican-controlled House Committee on Government Reform and Oversight countered that census totals produced using sampling and statistical adjustment techniques would have their own flaws, including a high built-in error factor at small geographical scales. The critics say that in its zeal to save money and eliminate the undercount, the bureau is sacrificing the high-resolution data needed for accurately redrawing House districts. Both the report and a bill considered by the Senate before Congress adjourned for this month's elections called on the Census Bureau to carry out a traditional physical count, sans sampling, in 2000.

But many statisticians and demographers who have leapt to the bureau's defense maintain that the committee is more concerned about Democrats than demographics. They say that the U.S. population is now too large and mobile for simple physical counts, and that the Census Bureau's Republican opponents are simply trying to avert undercount corrections that could result in a reapportionment of House seats to states with many urban, mainly Democratic areas. "They want the bureau to go out and do a second-rate enumeration, because they know what the outcome will be relative to their constituencies," says Stephen Fienberg, a statistician at Carnegie Mellon University in Pittsburgh. "This denigration of sampling is unconscionable; I don't think the professional community should stand for it."

By all accounts, the census needs fixing. According to a National Research Council report released last year, the cost of data-gathering has jumped from $11 per housing unit in 1970 to $25 in 1990. Overall, the 1990 census cost taxpayers more than three times as much as the 1970 count. But as costs have increased, so have undercount rates for African Americans (see chart). In 1990, the number of African Americans overlooked by enumerators was the highest ever: some 1.8 million out of a total of about 30.5 million, according to a 1993 demographic analysis by the bureau. "Throwing money at the undercount is not going to solve the problem. The only way we can improve is by [adopting] statistical techniques," says the bureau's associate director for decennial census, geographer Robert Marx.

The bureau's design for the 2000 census calls for sampling in two phases. First, after individuals in at least 90% of households in each census tract have been directly counted, officials will put intensive effort into interviewing a resident in one out of every 10 nonresponding households, and will use this follow-up data to paint a statistical picture of the remaining nonresponders. Then, as a quality-control measure, the bureau will do what