CASSINI-HUYGENS

Mission to Saturn Rises From Ashes

Last year, space scientists got some very bad news: A flaw in a communications device imperiled the high-profile Cassini-Huygens mission. If the problem wasn't fixed, nearly all the data from the Huygens probe, which the Cassini spacecraft is supposed to release while orbiting Saturn's moon Titan in 2005, would be lost. The reason: Cassini would be unable to interpret the probe's transmissions. As the months passed, researchers dampened their expectations about Huygens's scientific payoff.

On track. Huygens glitch is fixed.

Now they are smiling again. Engineers last month worked out an elegant solution that should save the mission's science. "We were in hell, now we're in paradise," says Marcello Fulchignoni, a Huygens scientist and astronomer at the Paris Observatory.

After its anticipated arrival at Saturn in July 2004, the $3 billion Cassini-Huygens mission, a joint operation of NASA and the European Space Agency (ESA), is slated to image the planet and its moons and study its magnetosphere and ring system. Most thrilling to some researchers, however, is Huygens's parachute through Titan's atmosphere, rich in prebiotic molecules such as nitrogen and hydrocarbons. "Although [Titan is] colder than the early Earth and lacking water, we hope to gain some insight into the processes that precede the formation of life," says Huygens scientist Guy Israel of the French research agency CNRS in Verrieres-le-Buisson.

The communication glitch dealt those expectations a huge blow. Last year it became increasingly clear that most of the data Huygens would gather and send back to Earth would be indecipherable. An inquiry board established by NASA and ESA found that engineers had miscalculated the Doppler shift in the probe's transmission, leading to the installation of an incorrect component in the Huygens receiver on Cassini. "We have a technical term for what went wrong here," says Huygens scientist John Zarnecki of the Open University in Milton Keynes, U.K. "It's called a cock-up."

Last fall, the agencies established a working group to look for a solution. After working out the performance characteristics of the receiver, given the anomalies they were observing, NASA engineers in February beamed to Cassini the range of frequencies and signal strengths expected from Huygens. The test confirmed the nature of the glitch. Armed with this information, experts at NASA's Jet Propulsion Laboratory in Pasadena, California, recalculated Cassini's trajectory to achieve an orbital path that allows the receiver to pick up the critical portion of the probe's signal. The new trajectory reduces the Doppler shift, bringing the probe's transmission frequencies within detection range. The fix will not delay the start to Cassini's planned 4-year mission. "It's a fantastic solution," says Zarnecki.

An inquiry by the space agencies didn't assign blame for the flawed receiver, stating that the error was caused by the system rather than an individual or organization. It's not the first such breakdown: In 1999, the use of English units, rather than the called-for metric units, sent NASA's Mars Climate Orbiter on a fatally low entry into the martian atmosphere (*Science*, 19 November 1999, p. 1457). To avoid more such embarrassments, ESA has ordered two upcoming missions—Integral, a gamma ray observatory, and Rosetta, which will explore comet Wirtanen—to undergo the kind of in-depth testing that might have spotted the Huygens problem on the ground.

–HELEN GAVAGHAN

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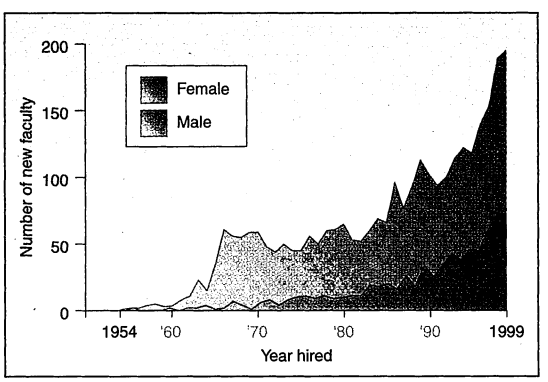
UNDERGRADUATE RESEARCH

Liberal Arts Schools Pass Science Checkup

BATAVIA, ILLINOIS—U.S. liberal arts colleges and small universities that focus on undergraduate education have been hiring science faculty at record rates the past few years. Educators say this trend is one of many signs of research vitality at these schools, which train a disproportionate share of the nation's scientific workforce compared with the big research universities.

The data come from a new study of the research environment at 136 predominantly undergraduate schools that covers everything from the average number of publications per faculty member to the number of students doing summer research projects.* The $300,000 survey was designed and paid for by five foundations—W. M. Keck, M. J. Murdock, Camille and Henry Dreyfus, Robert A. Welch, and the Research Corp.—that support undergraduate research in the natural sciences. The survey, presented at a 2-day meeting here late last month for nearly 200 college presidents and other research administrators, is perhaps the richest compendium of data ever compiled on this sector of American education.



Welcome aboard. U.S. undergraduate colleges have added scores of new science faculty in recent years.

The foundations were concerned that applications for research grants from faculty members at these colleges hadn't increased in the past decade despite a 21% increase in new faculty. The reasons remain murky, however. "We've learned a heck of a lot [from the survey], but it's an open question where we go from here," says Robert Lichter, executive director of the New York City–based Dreyfus Foundation.

The survey reaches no conclusions and does not identify specific institutions. But school administrators said the data are invaluable for self-analysis as well as for comparisons with other schools for which they compete for students and faculty. (Institutions contributed vast amounts of hard-to-get data with the promise of confidentiality; schools can identify themselves through a key.)

Among the mass of data:

- Full professors generate 0.6 research publications a year and receive research grants that average $26,700; the figures are 0.48 and $17,500 for associate professors and 0.45 and $27,100 for assistant professors.
- The average number of faculty members per institution in the natural sciences has risen from 27.5 to 33.5 over the decade.
- More students are majoring in the natural sciences—led by the biosciences—with their numbers rising by nearly 50% from 1990 to 1997 before tapering off slightly.
- Faculty members spend more time on research and less time on teaching than a decade ago. But even those at the most research-intensive of these institutions—public schools that award some advanced degrees—still spend 3 hours teaching for every hour in the lab.
- The gender gap is narrowing among new hires, standing at 55:45 in favor of men for those hired in the past 5 years compared with 82:18 for the period 1975–80.

–JEFFREY MERVIS

* *Academic Excellence: The SourceBook*, 2001, $50 (www.rescorp.org)