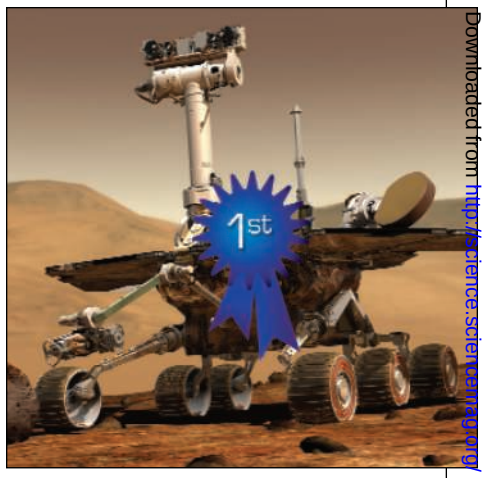
Breakthrough of the Year

Well, there wasn't much doubt about this year's winner. Unlike some past Breakthroughs, this one unfolded very much in the public eye, and the arguments that sometimes ensue when *Science*'s News and Editorial staffs converge for the selection were pretty tame this time around. The two Mars rover missions—well advertised by NASA beforehand—succeeded where two other recent attempts had failed, and succeeded spectacularly. The descent of the rovers held an enthralled audience of scientists and television viewers in suspense as they lit, took several pillowed bounces, and eventually came to rest.

The Breakthrough comprises the new evidence that Mars was once warm, wet, and salty: a candidate environment for early life. The emerging analysis, particularly from Opportunity, which landed amid Martian rock outcrops, confirmed that aquatic processes were responsible for depositing, forming, and altering rocks on a large scale on early Mars. The discovery is dramatic enough, showing what can be accomplished by a remote geologist with a good program. Of even wider significance is the demonstrated value of robotic technology—the real hero of the story—for a whole set of exploration and sampling tasks. Indeed, there is now serious talk of rescuing the Hubble Space Telescope with a robot. Other planetary sampling projects made the news in 2004 as well: Cassini, which will drop a probe to evaluate Titan's atmosphere in January; Mars Express, the European mission to sample the Martian atmosphere; Stardust, which sampled a comet; and Genesis which, despite crashing in Utah, seems to have returned with samples of the solar wind.



First place wasn't a headache, but picking the runner-up gave us a real challenge. The tiny hominin with the small brain, found on the island of Flores by an Indonesian-Australian scientific team, gripped the imagination of many. The finding that this was an island-dwarfed relict population of *Homo erectus* radically altered what we thought about human evolution. But it also raised questions: How could these primitive little people have coexisted for tens of millennia with big aggressive modern humans? (see the Perspective by Diamond, p. 2047). Controversy quickly arose, and the lone skull and related postcranial material are now under reexamination. We'll see how the story unfolds.

There were lots of other contenders. "Junk" DNA is being actively explored and yields a variety of riches: transposable elements, regulatory sequences, even codes for small RNAs. Other geneticists (some in companies, some in a well-funded public project) are mapping haplotypes: signature sequences in the human genome that may provide clues to ethnic history or disease liability. Astrophysicists were delighted by the discovery of a pair of pulsars orbiting in tandem: a system that may shed new light on these enigmatic spinning neutron stars.

Some of this we actually predicted in last year's Breakthrough issue in "Areas to Watch." We did reasonably well this time around. Mars activity led the list, and we called for a DNA data deluge (see above). We like our call on soil microbiology, and biodefense research did well, as predicted. But the controversy over open-access publishing resisted a clear resolution; and science and security, far from progressing significantly, remains a mess.

Each year, some disappointments ("Breakdowns") accompany the successes, reminding us that the scientific venture is fragile and dependent on public regard. Underscoring that point: This year's Breakdowns recognize a widespread crack in the social contract between the science community and the polity. That kind of disaffection was evident in Europe, as Italian scientists demonstrated to protest planned losses of tenure and French scientists went on strike to win some government concessions.

A Breakdown of a different kind was evident in the United States, where exchanges of tough rhetoric between the president's science adviser and a number of leading scientists made front-page news. Scientists objected, some of them on this page, to the use of political tests in the appointment of government science officials and the members of scientific advisory committees. There were sharp disagreements between many scientists and administration positions on stem cells and global climate change. And in more local and direct interactions with the American public, scientists faced a steady increase in challenges to the teaching of evolution in the public schools. It appears, alas, that this kind of tension is growing and that it may become a chronic feature of the landscape.

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