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EDITORIAL

Breakthroughs 1997

Even occasional observers of the scientific scene know that this year has witnessed some incredible achievements by the worldwide research community. In fact, the incredibility itself is the noteworthy feature—things once thought to be impossible have in fact been done. Like the 4-minute mile, which was once believed to be the limit of human running capacity, preconceived limits in several scientific fields were made obsolete this year. Such advances suggest that other barriers that are acceptable by today's logic could eventually yield to persistent research. This year's work has established that somatic cell nuclear transfer can clone a wholly viable sheep from the DNA of an udder cell of an adult sheep and that home observers could follow the exploration of Mars in real time as the Pathfinder mission's Sojourner robot responded to remote commands across 119 million miles. These achievements and others are recognized in this issue as *Science*'s Breakthroughs of the Year.

Many will hold the view that there were no real breakthroughs; that today's scientific headlines are the culmination of much past effort. For example, nuclear transfer had been done before, with frogs, cells, embryos, and fetuses. But many would have claimed that cloning from adult nuclear transfer would never be possible; indeed, the failure rate was extremely high (1 success out of 277 attempts). But the research team who created an identical lamb with the DNA of one parent did so by establishing new principles for the functional state requirements of the donor cell and recipient host ovum. They have now gone on to extend this success by inserting a human gene into fetal fibroblast donor nuclei to clone lambs that contain the gene for human factor IX (pages 2038 and 2039).

This is the ninth year-end recognition by *Science* of the top 10 significant developments in scientific research, assessed by their consequences for society and the advancement of science (see the Special Section coordinated by Deputy News Editor Elizabeth Culotta, beginning on page 2038). Originally termed the Molecule of the Year [*Science* **246**, 1541 (1989)], the section now covers a broader scale. Last year's definition of a breakthrough [*Science* **274**, 1987 (1996)]—a rare discovery that profoundly changes the practice or interpretation of science or its implications for society—certainly describes this year's honorees, from the violence of distant gamma ray bursts to the quiet ticking of cellular clocks. Many of our runners-up also disprove old impossibilities, such as retrieving and sequencing DNA from a Neandertal and coaxing severed spinal nerves to regrow. *Science* firmly believes in the importance of recognizing such major achievements. But we do so knowing that any powerful new technology such as adult DNA cloning could also present serious risks.

Faced with the reality of successful mammalian cloning, some observers have been inspired to imagine how the technology could be put to use: a new form of agriculture in which the products reaped are not milk or meat but rare human hormones, enzymes, or possibly organs for not-so-xeno transplantation. Some, with proper scientific prudence, will hold their enthusiasm until the technology has achieved consistent replicability. Others concern themselves with the complex moral, ethical, and legal issues that could emerge were it possible to extend the technology to the cloning of humans, though with current information that extension remains an impossibility. In the face of extensive public concern, President Clinton referred this research question to the National Bioethics Advisory Commission, which concluded in June 1997 (see the report at http://www.nih.gov/nbac/nbac.htm) that at this time it is "morally unacceptable for anyone in the public or private sector, whether in a research or clinical setting, to attempt to create a child using somatic cell nuclear transfer cloning," although the commission explicitly supported continued freedom of scientific inquiry to search for more breakthroughs. At least one scientific society supports a 5-year ban on human cloning.

As we did last year, we conclude by gazing into our crystal ball to see what will be hot in 1998 and giving ourselves a scorecard on last year's predictions for 1997. This year's advances demonstrate once again that one should never say never in science and that the exercise of imagining what could come to pass may be worth practicing. As Mark Twain noted, you can't depend on your eyes when your imagination is out of focus.

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