New Theory on the Origin of Twins

Identical twins result from tiny genetic mutations within a developing embryo that lead one portion of the embryo to reject the other as foreign, causing the two to split, a researcher proposed last week at a conference of geneticists. Other scientists, while intrigued by this concept, caution that the supporting evidence remains inconclusive and that further studies are needed to confirm the theory's accuracy.

Judith G. Hall, a pediatrician and geneticist at the University of British Columbia in Vancouver, says she has found genetic dissimilarities between two twins that arose from the same fertilized egg. One twin has developed as a dwarf, while the other has attained normal height and body proportions, Hall reported at the Short Course in Medical and Experimental Mammalian Genetics at Jackson Laboratory in Bar Harbor, Maine. She hypothesizes that this difference resulted from a mutation in one part of the embryo that caused it to split, creating two different "identical" twins.

Fraternal twins and identical twins result from two separate processes. In the case of fraternal twins, a woman releases two eggs in one month. The two eggs are then fertilized by two different sperm. The two resulting fetuses are no more similar than other siblings, although they are almost always born together. Identical twins, on the other hand, are known to result from a single egg fertilized by a single sperm.

For years, geneticists have believed that such twins are genetically, as well as physically, identical. But they have had few theories to account for why a single fertilization event sometimes results in two fetuses.

"There really is no substantiated theory as to what causes [identical] twinning," says Kenneth Lyons Jones, a pediatrician at the University of California, San Diego.

Hall now proposes that all so-called identical twins are really subtly different genetically and that this difference is what causes the embryo to split in the first place. However, she asserts, physicians would detect the tiny genetic difference only in the rare instance when the mutation responsible for twinning happened to disrupt a crucial gene, leading to a disease in one twin but not in the other.

The dwarf twin from the set Hall studied has diastrophic dysplasia, a genetic disorder thought to result from mutations on chromosome 5. Hall hypothesizes that this dwarf twin arose very early in embryonic development, when a single cell of the embryo developed the mutation spontaneously and the other cell or cells ousted that cell as foreign.

"Some of the cells looked at another and said, 'You don't belong here, get out of here,'" suggests Hall.

Once on its own, the expelled cell developed into a complete fetus — identical to its twin except for the mutation, Hall believes.

Victor McKusick, a medical geneticist at Johns Hopkins University in Baltimore — and an identical twin himself — counters that Hall's theory poses a potentially unanswerable dilemma similar to the question of which came first, the chicken or the egg. "Whether the difference [between the embryo's cells] came first or the split came first isn't clear," he contends.

McKusick suggests that the dwarf twin might have resulted from a so-called somatic mutation in one cell *after* the two twins had separated. If this mutation occurred early enough — say, at the eight-cell stage — most of the affected twin's cells would later contain the mutation, possibly leading to a medical disorder, he says. McKusick notes that other geneticists have recorded instances in which one of two otherwise identical twins has Turner's syndrome — a developmental disorder that results from having only one X chromosome instead of the normal XX for girls and XY for boys. However, he concedes that Hall "would read other significance into this" as support for her theory.

Linda Corey, a genetic epidemiologist at Virginia Commonwealth University in Richmond, agrees with McKusick. "The [study's] sample size is a little small to draw the type of conclusions [Hall is] drawing," she adds. Corey, who also directs the Virginia state twin registry, says researchers are only beginning to do detailed comparisons of twins' genetic material to look for the mechanism of twinning.

Jones, on the other hand, advocates a wait-and-see attitude. "I don't think [Hall's theory is] totally off the wall," he says. — *C. Ezzell*

Genetically engineered fungus fights blight

Once a dominant tree in eastern North America, the mighty American chestnut was felled by a fungus introduced from Asia at the turn of the century. Now, molecular biologists have developed a strategy for disarming this fungus so that a new generation of chestnuts may one day tower in the forest.

The strategy improves upon the use of a less deadly strain of chestnut blight to neutralize killer strains. Rather than destroy bark and make the tree wilt and die, this "hypovirulent" strain causes only superficial, temporary sores on the bark, says Donald L. Nuss of the Roche Institute of Molecular Biology in Nutley, N.J.

A viral infection reduces this fungal strain's ability to destroy the tree, Nuss and Roche colleague Gil H. Choi report in the Aug. 7 SCIENCE. By making DNA that encodes the virus' RNA, Nuss and Choi plan to harness this virus — or an improved version of it — for controlling chestnut blight.

"It's a new and novel approach for a pathogen that's devastating," comments James L. White, a biotechnologist with the U.S. Department of Agriculture in Hyattsville, Md. "For fungal biocontrol, [this strategy] may be very important."

For more than a decade, plant pathologists have recognized that the less deadly chestnut blight contains double-stranded RNA — a virus of sorts — in its cells. Nuss and Choi proved that this virus renders the fungus hypovirulent.

They began by piecing together a gene for the virus' RNA. When they transferred that gene to virulent fungus, the fungus underwent a transformation: Like the hypovirulent strain, it made less orange pigment and less of certain enzymes. The transformed fungus also caused small cankers to develop on a chestnut stem rather than large, rapidly expanding ones, says Nuss.

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American chestnut tree.