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## Source of Hair Regeneration Found at an Unexpected Site

By NATALIE ANGIER

In a discovery that turns the prevailing wisdom about hair growth on its head, researchers have found that the source of new hair cells lies not at the very base of the hair, as scientists had long assumed, but further up the hair follicle, just below the scalp.

The finding has significant implications for the study of hair loss, hair regeneration and baldness. Researchers say that by understanding the origin and behavior of the parent cells that give rise to new hair, they can better treat hair problems and hair loss.

Researchers from the University of Pennsylvania School of Medicine and the New York University Medical Center reported their work in the latest issue of the journal *Cell*.

"This is an exciting, beautiful piece of work," said Dr. Karen A. Holbrook, a professor and associate dean of dermatology at the University of Washington School of Medicine. "It gives us a whole new way of thinking about hair follicles." Scientists have long known that hair shared with certain other tissues in the body, like the blood, skin and stomach lining, the need for constant regeneration. That requirement meant that somewhere beneath every hair, whether on the head or elsewhere, there must be a pool of immature cells, called stem cells, ready to proliferate and form a new shaft of hair. A hair is a connected strand of mature cells, of which those sticking out from the skin are already dead.

But identifying stem cells of any tissue type is extremely difficult, and so until recently scientists believed that the immature cells governing hair growth must lie within the hair bulb, the shiny nodule seen at the bottom of a hair when it is yanked out. One reason for their conviction is that the bulb is perched atop another vital component of hair growth, called the dermal papilla, a tiny knob of connective tissue and blood vessels that releases hormones and chemical signals to promote hair renewal.

But in the latest experiments, researchers devised sophisticated techniques to discriminate between the stem cells and other cell types.

Applying the new approach, they found the stem cells at a region fractions of a millimeter above the bulb, a long distance on the scale of a hair follicle. The cells are sequestered in a structure on the side of the follicle known as the hair bulge.

The investigators also determined that hair growth is more complex than previously believed. To form a new hair, the dermal papilla releases a signal that cues the stem cells in the bulge to migrate toward the dermal papilla. Those cells then chemically interact with the dermal papilla, an operation that promotes cell division and maturation. Eventually the new hair is pushed up and out into the world.

In other words, said Dr. Robert M. Lavker, a professor of dermatology at University of Pennsylvania School of Medicine, hair does not just grow up; it grows down and then up.

Dr. Lavker believes that the findings will influence the quest for hair-growth products. "People who now want to make products that would stimulate vigorous production of hair will now have a new area to look at, the bulge," he said. "If you have quiescent hair, you'll want to be able to stimulate those cells that can produce all the lieutenant cells that will be going out to the front lines."

Diagram illustrating where hair is born. (source: University of Pennsylvania)

