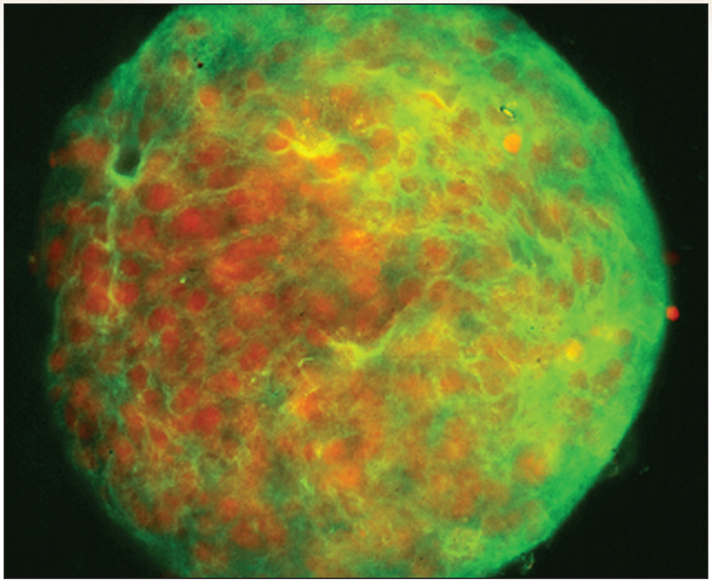
Brain neurons are so specialized that they are referred to as being "terminally differentiated." As such, neurons do not divide. However, people acquire new skills because the human brain has more than enough neurons, with a nearly infinite number of connections possible. The human brain, however, does harbor extremely small numbers of neural stem cells, which can divide to ultimately give rise to neural progenitor cells, whose daughter cells can differentiate into neurons or into the neuroglial cells that support them. So rare are these stem cells, which one researcher calls "brain marrow," that their recognition took many years.

Researchers had shown as long ago as 1912 that in rats, some cells in the hippocampus, the memory center, can divide. Then in the mid-1980s, researchers identified rare dividing cells in the brains of chickadees and canaries learning to sing. The division rate of these cells peaked when young birds needed to learn their songs to survive. In experiments that placed the birds' food farther away than usual, the division rate rose as the birds had to sing longer to communicate the food location.

Identifying neural stem cells in humans proved more challenging than doing so in rats and birds, simply because brain tissue is hard to obtain. In the late 1990s, researchers applied a chemical, bromodeoxyuridine (BrdU), to slices of brain tissue from tree shrews and marmosets, which are more closely related to humans in an evolutionary sense than rats or birds. BrdU is preferentially taken up by dividing cells, and so the fact that marked cells showed up in the brain slices confirmed that cell division indeed occurs in cells in the mammalian brain. But neurons do not divide. Does the human brain harbor neural stem cells?

To find out, researchers at the Salk Institute in La Jolla, California, asked several patients being treated with BrdU for cancers of the tongue or larynx to donate their brains upon their deaths. The brains revealed actively dividing neural stem cells in a region of the hippocampus called the dentate gyrus. These cells divide to generate more stem cells, and also give rise to cells that migrate to other areas of the brain, where they differentiate as either neurons or neuroglial cells. Further experiments



Neurospheres cultured in the laboratory consist of neural stem cells. These cells can divide and differentiate to give rise to neurons and neuroglial cells. In the body, neural stem cells occupy certain areas but are exceedingly rare. Researchers do not yet understand the conditions that might stimulate neural stem cells to divide and replace neural tissue.

identified neural stem cells near spaces in the brain called ventricles, and in the olfactory bulb, where the sense of smell originates.

The fact that the human brain contains reservoirs of cells that are capable of division and differentiation has clinical implications, if researchers can learn how these cells migrate and specialize. Neural stem cells can be grown in the laboratory, obtained from cadavers, or from the individual who requires treatment of a brain-related disorder. It might be possible some day to treat neurodegenerative conditions, such as Parkinson disease or multiple sclerosis, from within, by coaxing a person's own neural stem cells to heal the damage. First, researchers must learn much more about neural stem cells, so that cell division can be controlled sufficiently to treat and not harm. ■