Race to find human stem cells ends in tie

Two research groups are reporting the isolation of seemingly immortal human cells that can give rise to any cell type in the body.

Researchers hope ultimately to use these cells, known as embryonic stem (ES) cells, to study human development, test drugs, and provide unlimited supplies of cells to replace tissues damaged by diseases or injuries. ES cells induced to form heart cells, for example, might help strengthen failing hearts. Or neurodegenerative illnesses, such as Parkinson's disease, might be treated with transplants of brain cells grown from ES cells.

Human ES cells are "potentially going to revolutionize medicine in the next century," says Austin G. Smith of the University of Edinburgh, Scotland, who has been searching for these mother cells.

Most human cells are specialists, forced during embryo development to choose a lifetime career as, say, muscle or liver cells. But until they make such a commitment, embryonic cells retain their ability to develop into any cell type. Recognizing the potential uses of these unrestricted cells, several research teams have braved the furor of working with human embryos and fetuses and have raced to isolate human ES cells.

At a meeting last summer, John D. Gearhart of Johns Hopkins Medical Institutions in Baltimore described his group's apparent success at finding these versatile cells by sifting through tissues, from aborted fetuses, normally destined to give rise to either sperm or egg cells (SN: 7/19/97, p. 36). Gearhart and his colleagues now detail their results in the Nov. 10 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

Researchers led by James A. Thomson of the University of Wisconsin-Madison have also unearthed human ES cells, but by following a strategy they employed to find monkey ES cells (SN: 8/26/95, p. 139). They plucked cells from the insides of human blastocysts, balls of about 100 cells at an early stage of embryonic growth. The blastocysts were originally created during in vitro fertilization efforts but went unused, says Thomson.

The blastocyst cells have proved able to replicate indefinitely; Thomson's group has kept some alive for 9 months. Moreover, in test-tube experiments, the cells show an ability to differentiate into specialized cells. When injected into mice, the putative ES cells form growths of human cells containing bone, muscle, nerve, and many other cell types, the researchers report in the Nov. 6 SCIENCE.

In addition to their medical potential, human ES cells should allow biologists to study areas of human development not well mirrored in animals such as mice. Thomson plans to examine how the cells differentiate into placental cells. "The placenta in mice and people are completely different," he notes.

Thomson suggests that human ES cells may also speed drug discovery. A firm wishing to test thousands of potential heart drugs might use ES cells to generate massive amounts of human heart cells. "You could screen 50,000 potential drugs and pick out the 3 that look promising," he says.

To provide desired cells for transplants or drug screening, investigators must still learn to convert ES cells into specialized cells. "You have to figure out how to teach cells which pathways to go down," explains David I. Gottlieb of Washington University in St. Louis. He and other researchers, for example, have already induced mouse ES cells to develop into neurons and other types of brain cells. That experience should carry over, predicts Gottlieb. "I'm very confident we will quickly go from human ES cells to human neurons," he says.

Some scientists hope to take a shortcut in that journey by using neural stem cells. While seemingly immortal, like ES cells, neural stem cells have already made a limited career choice. They can develop into the various cell types of the brain, but not into those of other tissues.

In the November NATURE BIOTECHNOLOGY, Evan Y. Snyder of Children's Hospital in Boston and his colleagues report for the first time the isolation of human neural stem cells. Derived from the brain tissue of an aborted fetus, these stem cells have been kept alive and healthy in the laboratory for more than 2 years. The researchers have also injected the neural stem cells into the brains of newborn mice and confirmed that the cells develop into neurons and glia, the two major classes of brain cells. Snyder's group can even add new genes to the stem cells, a skill that could prove useful in treating certain human brain disorders.

In a related NATURE BIOTECHNOLOGY paper in the same issue, Ronald D.G. McKay of the National Institute of Neurological Disorders and Stroke in Bethesda, Md., and his colleagues describe how they injected human fetal brain tissue into brains of embryonic rats. The human cells formed every kind of brain cell and integrated into all major regions of the rodents' brains. Creating such chimeric brains, notes McKay, should help scientists better understand how embryonic human brain cells develop, migrate, and form connections, issues almost impossible to investigate experimentally in people. —*J. Travis*

Radiation gives these plants the blues

With its chlorophyll extracted, this plant becomes a potential botanical Geiger counter by displaying some of its radiation-induced mutations as blue spots. These spots record the gene-altering threat of radioactive pollution, including fallout.

*A Ukrainian-Swiss research team inserted inactive bacterial genes into thale cress (*Arabidopsis thaliana*). When mutated, these genes make an enzyme that accepts a standard, blue chemical stain.*

Working both in a laboratory and at outdoor locations around Ukraine, the scientists exposed the plants for several weeks to soil tainted with fallout from the 1986 Chernobyl reactor accident.

The greater the radiation dose, the more plant tissue accepted the blue stain, the researchers report in the November NATURE BIOTECHNOLOGY. The increase in staining correlated with the genetic damage the researchers measured in chromosomes of onions exposed to similar levels of radiation.

The mutation rate fell, however, once radiation levels got too high (about 900 curies per square kilometer). At these exposures, the plants' cells began dying, explains Barbara Hohn of the Friedrich Miescher Institute in Basel, Switzerland, a study author. In practice, Hohn suspects, "Pots [of plants] would be put into contaminated areas for a week or two" and then treated to reveal any spots.

This is "a handy and useful tool," says geneticist Yuri E. Dubrova of the University of Leicester in England, who studies Chernobyl's effects. Until now, he notes, "it's required literally hours with a microscope and damaging one's eyes to [tally] chromosome aberrations" due to radiation. —J. Raloff