Nose nerve cells show transplant potential

In the Woody Allen film "Sleeper," a nose rules the world and its followers seek to clone people from these tyrannical nostrils to create a new world order. While noses will probably never give rise to whole organisms, they are helping scientists seeking ways to repair and replace damaged brains.

Neurobiologists have created miniature "noses" inside a brain and in a laboratory dish — important steps toward harnessing the body's ability to regenerate olfactory neurons, says Sarah K. Pixley of the University of Cincinnati.

Nerve damage in the central nervous system is often permanent because the brain cannot make new cells to replace those lost or because regenerating nerve cells cannot reconnect to other nerves. But the nose's neurons are different. Even in adults, the deep lining of the nose continually grows new nerves. These develop both fine structures, whose ends stick into the nasal cavity to catch odor molecules, and long processes called axons, which connect cells to the olfactory part of the brain that lies just inside the skull.

"The question is, How is [replacement] regulated in the olfactory system?" says Albert I. Farbman of Northwestern University in Evanston, Ill. He, Pixley, and other researchers reported their progress in answering this question last week in Sarasota, Fla., at the annual meeting of the Association for Chemoreception Sciences.

In their work, Pixley and her colleagues tease apart mature nerves, immature stem cells, and other types of cells removed from the inside of the nostrils of newborn rats. They place the dissociated cells into a laboratory dish. Afterwards, they add antibodies and other markers to identify different cell types.

In early experiments, the cells survived but produced no new neurons. Pixley then added brain support cells called astrocytes to the culture. As in other types of cell culture (SN: 4/17/93, p.252), these support cells exert a powerful effect, Pixley told SCIENCE NEWS.

Dissociated cells seem to migrate toward each other, eventually forming large spherical clumps. The layering within clumps indicates that the cells create "a complex replica of the actual nose," Pixley says. The pattern of marker chemicals tells her that mature nerve cells disappear and new ones appear, indicating that nerve cell production occurs.

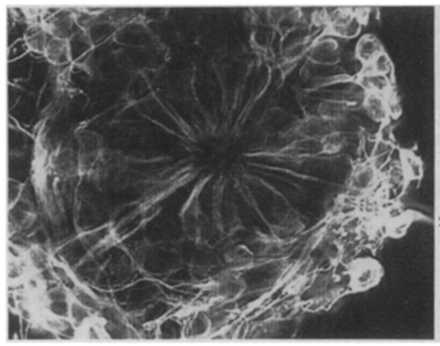
In different experiments, Cincinnati graduate student Raymond J. Grill Jr. used this technique to grow new neurons from the nasal tissue of adult rats. He added dyes sensitive to electrical currents and observed changes indicating that these cultured "noses" even respond to odors.

Rather than trying to recreate noses in a laboratory dish, Edward E. Morrison, a neurobiologist at Auburn (Ala.) University, transplants pieces of the nasal lining of newborn rats into the brains of their littermates. His studies with an electron microscope now reveal that olfactory tissue thrives in the brain and produces new nerve cells.

"Irrespective of where I put them, they go in and they commingle," says Morrison. The axons grow into other parts of the brain and form intimate connections called synapses. Formation of these connections implies that the new neurons may be able to communicate with other neurons, he adds.

Farbman and his colleagues are examining the role of proteins called growth factors in stimulating the replacement of olfactory nerves. Other scientists have demonstrated that epidermal growth factor (EGF) can prompt cells from mature brains to divide and form new nervous tissue (SN: 4/4/92, p.212).

EGF also increases the number of dividing nerve cells in cultures of fetal rat nasal tissue, Farbman reports. In addition, his research group has discovered that a protein called transforming growth factor-alpha revs up replacement even more than EGF and is 100 times more potent.



Pixley/Univ. Cincinnati

With confocal microscopy, a cross-sectional view of cultured "nose" sphere shows neurons (bright circles) along the outside. Bright nerve endings project into the center, which to the nerves may represent the nasal cavity.

Neither Farbman nor Morrison thinks that nose neurons themselves will work as replacements for the brain's neurons. However, axons from olfactory nerves can get past barriers that other nerve cells can't. So Morrison hopes one day to use transplanted olfactory nerves to create a path for injured nerves remaking connections to the brain. — *E. Pennisi*

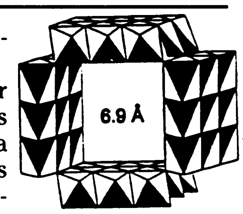
Deep-sea molecular sieves surface in lab

Several decades ago, scientists discovered deep on the ocean floor nodules containing materials that performed remarkably well in the laboratory as catalysts that speed oxidation reactions. Unfortunately these porous manganese oxides — called todorokites — never became commercially useful because they were scarce and occurred as mixtures too difficult to separate. Predicting that the pure materials could serve as "molecular sieves" that adsorb substances into their crystalline channels, researchers long hoped to make synthetic todorokites.

Now chemists can create the promising materials in the lab, a team from the University of Connecticut in Storrs and the Texaco Research Center in Beacon, N.Y., announces in the April 23 SCIENCE. Unlike the products of previous attempts, the synthetic todorokite retains its basic properties at temperatures up to 500°C. And it fulfills scientists' original hopes.

"These substances make good oxidation catalysts, sorbents, and electrical conductors," says Connecticut's Steven L. Suib. "They're very interesting materials."

Todorokite captured the attention of chemists because of its large pores and ability to selectively soak up and then release positively charged cations, much as zeolites do (SN: 8/3/91, p.77). Todorokite offers intriguing possibilities for catalysis and electrical conduction because its manganese accepts varied numbers of electrons.



Suib/SCIENCE

Molecular sieve crystal contains parallel 6.9-angstrom-wide tunnels formed by three manganese oxide octahedral units per side.

To build their crystals, Suib's group developed a new synthesis method using doubly charged manganese cations and potassium permanganate mixed together at a very alkaline pH of 13.8. A layer of clay-like material precipitated, to which they added magnesium cations that settled into specific grooves. For a week, the crystals grew around these cations, forming tunnels. Then the material was heated to about 170°C for five days to set the structure. The new todorokite — a black powder — performs as well as commercial oxidation catalysts commonly used in processing hydrocarbons, the team reports.

Kathleen Carrado at Argonne (Ill.) National Laboratory calls this work "extremely relevant to industrially important technologies." She and her colleagues propose to study synthetic todorokites for use as cathodes in rechargeable lithium batteries. Suib's group is now modifying its synthesis technique to make derivatives for a wide variety of applications. — *K.F. Schmidt*