of animal feed derived from animal carcasses and require cattle slaughtered for food to be no older than 30 months, "already take into account the possibility of subclinical infection," says Smith. He notes that previous studies have turned up no evidence that pigs and chickens are infected with BSE.

Although Smith thinks the findings might raise a warning flag, he too believes the media went overboard. But he's not surprised. "Anything that has BSE attached to it is going to produce a big media response," he says.

–MICHAEL BALTER

DEVELOPMENTAL BIOLOGY

Brain Cells Turning Over a New Leaf

Many of us may pine for our lost youth, but we know we can't turn back the clock. Biologists had long assumed that the same is true in development—that once a cell becomes committed to a particular fate, it can't reverse its tracks and become something else. A spate of recent work seems to have turned this biological dogma on its head, however. New findings described on page 1754 offer the strongest evidence yet that certain cells can be steered onto new career paths after all.

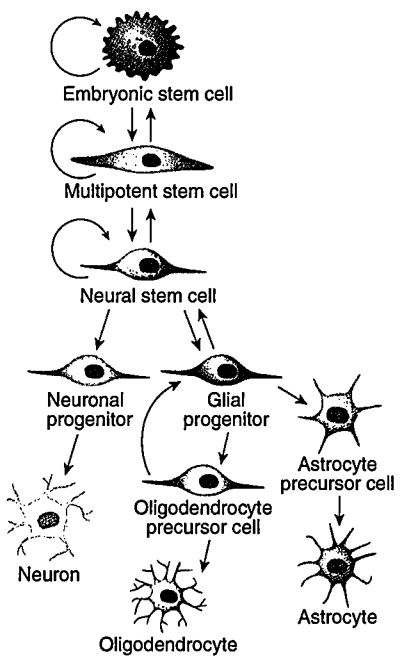
Previous reports that adult cells can be reprogrammed have been dogged by the question of whether scientists had really tapped a cellular fountain of youth or whether immature cells hiding in their culture dishes gave rise to unexpected cell types. In the current work, Toru Kondo and Martin Raff of University College London, managed to coax rat oligodendrocyte precursor cells (OPCs), which scientists thought were irreversibly committed to becoming neuronal handmaidens called oligodendrocytes or astrocytes, into becoming neurons. Because Kondo and Raff ran several experiments to test the purity of their well-characterized OPCs, they say it is unlikely that the effect was due to undetected immature cells.

"Until recently in most people's minds, there was no reverse arrow" for OPC development, says stem cell researcher Ron McKay of the National Institute for Neurological Disorders and Stroke in Bethesda, Maryland. With this work, he says, "it's pretty clear there is a reverse arrow." If the feat can be duplicated with human OPCs, it raises the tantalizing prospect of a new approach to treating Alzheimer's or other diseases marked by the loss of functional neurons: OPCs drawn from fetal tissue or even an adult patient might be reprogrammed to serve as replacement neurons.

Kondo and Raff began by isolating OPCs from the optic nerves of newborn rats and used previously described techniques—culturing the cells in fetal calf serum or exposing them to bone morphogenetic proteins—to turn them into astrocyte-like cells. They then treated the cells with basic fibroblast growth factor, a protein known to stimulate proliferation of neural stem cells. Nearly half started dividing, producing cells resembling nervous system stem cells, which the team induced to develop into neurons and astrocytes as well as oligodendrocytes.

Fetal calf serum and fibroblast growth factor, it appears, had somehow induced the OPCs to revert to a more primitive state. "There had been all sorts of evidence that these were committed precursor cells," says stem cell biologist Ben Barres of Stanford University. But the evidence that the OPCs' developmental clock can indeed be wound back, he argues, is "totally convincing."

Not to everyone, however. To test for renegade stem cells, the researchers cultured the OPCs in a series of factors that turn neural stem cells into neurons. After 2 weeks, they found no sign of neuronal markers in their cells. But neuroscientist Fred Gage of the Salk Institute for Biological Studies in La Jolla, California, says that "it still remains possible that there are undetected multipotent stem cells that exist within the culture." Last fall, his team reported that cells from the optic nerve of adult rats could, when treated with similar proteins, also become neurons. But adult cells are harder to purify than those from fetal nerves, and Gage says he wasn't convinced that his team's preparation did not contain immature stem cells.



Reversing course. Extracellular signals can prompt oligodendrocyte precursor cells to "dedifferentiate" and become neural stem cells.

The evidence that OPCs can rejuvenate in the lab is good news for eventual disease treatments. But it is not yet clear what it means for researchers who study how normal brains develop and repair themselves, notes Sean Morrison of the University of Michigan, Ann Arbor. "We have to be very careful to distinguish what happens to a cell in vivo and the potential it can have after being reprogrammed in vitro," he says. Still, he adds, attempts to pin down the molecular signals that drive reprogramming should help scientists better understand the signals that govern normal development.

Together with previous reports of shape-shifting cells, Barres says, the new work "raises the question, 'What else can be reprogrammed?' " If more elixirs can be discovered for various cell types, then more degenerative diseases might fall victim to newfound fountains of youth.

–GRETCHEN VOGEL

PALEONTOLOGY

Biggest Extinction Hit Land and Sea

There was no hiding from the greatest mass extinction of all time. Two hundred and fifty million years ago, at the end of the Permian period and the opening of the Triassic, 85% of the species in the sea and 70% of the vertebrate genera living on land vanished. Whatever pummeled life in the sea did its dirty work in a geologic moment of less than half a million years (*Science*, 15 May 1998, p. 1007). Now from South Africa comes evidence that the Permian-Triassic extinction of land plants was equally brutal and swift.

The new signs of ecological catastrophe come from rocks that started as sediments laid down in South Africa's Karoo Basin 250 million years ago. In a paper on page 1740 of this issue of *Science*, paleontologist-geologist Peter Ward and geomorphologist David Montgomery of the University of Washington, Seattle, and sedimentologist Roger Smith of the South African Museum in Cape Town report that the rocks tell of an abrupt switch in style of sedimentation, as if the land had been permanently stripped of the rooted plants that held it in place. "It looks a lot like we just lost the forests," says paleontologist Gregory Retallack of the University of Oregon, Eugene. Something with the power of an asteroid impact seems to have shattered life on Earth. But in the absence of any trace of an impact, researchers are groping for an equally far-reaching explanation.

The Karoo ecological disaster left its mark in the mud and sand laid down as water drained from the landscape. At seven spots scattered across 400 kilometers of the basin, Ward and colleagues found the same pattern of changing sedimentation. Their benchmark

ILLUSTRATION: C. CAIN

was the Permian-Triassic (P-T) boundary, a layer of rock marked by evidence of extinctions and a globally recognized shift in carbon isotopes. In tens of meters of rock laid down before the boundary, the researchers found sandstones filling broad channels, as if deposited by meandering rivers. Above the extinction bed, the river deposits are entirely different. They are typical of quick-flowing, "braided" river systems carrying large amounts of water and sediment in narrow, interconnecting channels.

The scene of the crime. Extinctions in 250-million-year-old rock (foreground) were followed by heavy erosion (lighter rock above and beyond).

CREDIT: P. WARD/UNIV. OF WASHINGTON, SEATTLE

The group's preferred explanation is the loss of the larger rooted plants, including the recorded extinction of the treelike seed fern *Glossopteris*, that held the soil in place, especially along stream and river banks. Montgomery can often see the same sedimentary transition when forests are clear-cut today. At the P-T boundary, it seems to have been global. "The pattern they see is matched beautifully in Australia and Antarctica," says Retallack, based on his own work. Everywhere the transition occurred, says Ward, "it was fast. This was a really rapid, short-term event."

The rapidity shows up best in marine sediments. In the 21 July issue of *Science* (p. 432), paleontologist Jin Yugan and his colleagues at the Nanjing Institute of Geology and Palaeontology in China and paleontologist Douglas Erwin of the National Museum of Natural History in Washington, D.C., showed that the devastating extinctions in the sea took place even faster than anyone had thought. Radiometric dating of the P-T outcrop at Meishan, China, had narrowed the generally accepted duration of the extinctions from millions of years to less than 500,000 years (*Science*, 7 November 1997, p. 1017). Now, by conducting a detailed census across the boundary of 333 species of everything from fish to microscopic foraminifera, they find that all the extinctions could have occurred in a single bad day 251.4 million years ago, says Erwin, just as many species clearly went extinct in a geologic instant 65 million years ago at the moment of an impact.

For the moment, an impact is just one of several contenders to explain the P-T extinctions. The most discussed of the possible earthbound causes centers on lavas known as the Siberian Traps, whose million-year-long eruption coincided with the P-T extinctions as near as radiometric dating can place them (*Science*, 6 October 1995, p. 27). Four other extinctions, both major and minor, have now been linked in time with huge basaltic lava eruptions like that of the Siberian Traps (*Science*, 18 August, p. 1130). So far, however, no one has found a decisive link between cause and effect.

To shorten the list of potential mass murderers, researchers are combing the P-T geologic record for clues. In south China, Jin and his colleagues reported, the spike in carbon isotopic composition precisely coincides with the extinctions. It may mark a collapse of biological productivity in the sea in parallel with the ecological disaster on land. Other researchers have reported a huge spike in the amount of fungal remains around the world. The spike, which begins just before the extinction in south China, may be a sign of massive decay on land. So far, however, the big picture refuses to snap into focus. The Siberian eruptions could be behind all this, says Erwin, but "it's still difficult to pin down the extinctions to a single mechanism."

–RICHARD A. KERR

FRENCH SCIENCE

New CNRS Chief Hopes to Deliver on Science

PARIS—For years, French research ministers have prodded the nation's scientists to make their research pay off for society. But that message has been slow to sink in. Last week, the government gave the assignment to a biologist who has done exactly that, but who believes that the carrot works better than the stick.

Geneviève Berger takes charge of the CNRS with orders to nudge France's basic research agency out of a malaise stemming from a steady decline in research funding, the graying of the agency's scientific cadre, and debates over how best to reform the $2.2 billion behemoth (*Science*, 30 July 1999, p. 647). "The CNRS has been slipping for several years," says chemist Pierre Potier, a former government science adviser. "Madame Berger is very courageous to agree to lead it."

As director of the CNRS Laboratory of Parametric Imagery in Paris, in the early 1990s Berger co-invented the first instrument to use ultrasound to visualize human bones. The device is now used worldwide for diagnosing osteoporosis. "I would find it

ScienceScope

Help Wanted The United Kingdom may open its borders to droves of foreign high-tech workers. Worried that the nation's economic engine may begin to sputter as record-low unemployment rates make it harder for businesses to find qualified workers, the government next week plans to unveil a proposal to relax its strict immigration laws.

Current law limits foreign workers to temporary stays in the country. The new plan would allow up to 100,000 skilled workers a year to permanently move in and fill jobs in fields such as information technology and teaching, the *Sunday Telegraph* reported on 3 September. Conservative lawmakers, however, are already taking shots at the proposal, arguing that the current rules are sufficient to sustain the boom.

Biomedical Balance The National Institutes of Health (NIH) shouldn't encourage universities to churn out any more biomedical scientists—but it should strive for greater balance in how they are trained, a new National Academy of Sciences report recommends. Currently, the agency's National Research Service Award (NRSA) training program gives grants to universities to help roughly 7000 graduate students a year pursue multidisciplinary studies. Twice that number get NIH funds through grants to individual researchers, who then hire students to work on specific projects.

In the future, however, the proportion of students drawing money from each funding pot should be about equal, concludes *Addressing the Nation's Changing Needs for Biomedical and Behavioral Scientists*, the 11th report in a series that began in 1975. By gradually shifting funds from more focused assistantships to broader NRSAs, NIH can better train researchers able to bridge the gaps separating disciplines, says the report committee, led by medical professor Howard Hiatt of Harvard Medical School in Boston.

NIH officials generally agree with the goal and are considering guidelines that would "encourage" universities and investigators to fund more generalized training, says agency training officer Walter Schaffer. But in an unusual addendum to the report, psychologist John Kihlstrom of the University of California, Berkeley, warns that the behavioral sciences may get short shrift without further reforms. The panel, he says, did not fully consider "the actual and potential contributions that the behavioral and social sciences can make to health and health care."

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