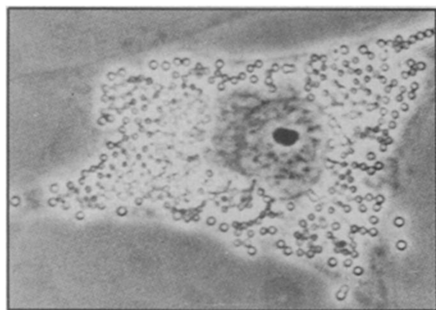
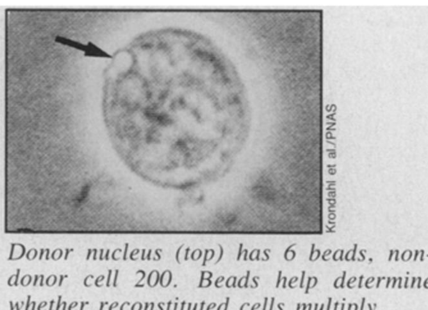
after death. Bada announced in 1972 that he had determined the rate of this conversion: It takes 300,000 years after death for D- and L-isomers to equalize, he said. That would make it possible to measure a fossil's age far beyond the 40,000 to 50,000 year limit of C-14.

Skeptics noted that the method was not only unproven, but it had a major drawback—racemization depends on the climate. The hotter the temperature, the faster the rate (the tooth measurements, for example, can be done only in cemeteries in cool regions). But Bada and his colleagues say they have calibrated and measured the technique's fossil-dating accuracy against known C-14 datings at various temperatures some 25 times since 1973, and the difference has averaged just 7 percent. Results of the latest tests—against known geological and anthropological information at sites in South Africa, Israel and Eastern Europe—indicate the racemization method is "accurate," Helfman reports. "Who's to say that radiocarbon dating is always accurate?" she asks. "Now, radiocarbon dating is the word of God, but the burden of proof is on those who choose to deny our dates." Bada and his colleagues have found 48,000-year-old remains at six California sites, Helfman says. □

Artificial synthesis of cells





Donor nucleus (top) has 6 beads, nondonor cell 200. Beads help determine whether reconstituted cells multiply.

Back in 1970, James Danielli of the State University of New York reported what appeared to be the first instance of artificial synthesis of a cell, that is, reconstitution of a cell using various living cell parts. He transferred nuclei from some amoebas into the cytoplasms of others, and the reconstructed one-celled animals lived most of the time (SN: 12/12/70, p. 443). Then in 1974, artificial synthesis of cells was given another boost when George Veomett and his colleagues at the University of Colorado transferred the nuclei of mouse cells into the cytoplasms of other mouse cells, and the reconstructed cells lived (SN: 6/22/74, p. 397).

Now another significant advance in artificial synthesis of cells is reported in the February PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES by Ulla Krondahl and his colleagues at the Karolinska Institute in Stockholm. They have reconstituted mammalian cells that not only live, but multiply, by simple cell division. Such viable, multiplying cells can also be made from two different species.

Actually, cell division among reconstituted mammalian cells may have occurred before. But it has been difficult to demonstrate this division because intact parent cells tend to contaminate both nucleus and cytoplasm preparations. So, to show that reconstituted cells truly divide, the Swedish investigators tagged both the nuclei used in reconstitution and the intact parent cells from which they had come.

First they cultured mouse cells, then centrifuged them in the presence of a fungus by-product known as cytochalasin B to facilitate separation of the cytoplasms from the nuclei. After they obtained mouse cytoplasms, they cultured rat cells as well. But this time they did the culturing in the presence of plastic beads. This way they could determine how many plastic beads were incorporated into an intact rat cell. They found that it was around 200 beads. Now they had a marker for an intact rat cell. After that, they centrifuged the cultured rat cells in the presence of cytochalasin B to obtain separate rat cell nuclei. Then they analyzed the nuclei alone for the number of beads present. Each nucleus contained less than 20 beads, usually 5 or 6. So they now had a marker for the rat cell nucleus as well.

They were then ready to perform experiments to show that when rat cell nuclei fuse with mouse cell cytoplasms, the reconstituted cells divide and form colonies. They placed Sendai virus, which is capable of fusing a donor nucleus with a recipient cytoplasm, in the presence of rat nuclei and mouse cytoplasms. As expected, the nuclei and cytoplasms fused. And as they hoped, the reconstructed cells were also able to divide and form colonies. Evidence for division and colony formation lay in the fact that each colony contained less than 20 beads. In other words, each colony must have arisen from one rat cell nucleus. In contrast, when they put mouse cytoplasms and rat nuclei together, but without Sendai virus, no reconstituted cells formed, as they expected. However, some cell colonies did appear. And proof that these colonies came from intact cells contaminating the nuclei and cytoplasms, rather than from reconstituted cells, lay in the fact that each colony contained some 200 beads each. In other words, each colony must have originated from an intact cell rather than from a reconstituted cell.

Now that colony formation among reconstructed mammalian cells has been demonstrated, cell biologists have a means of rapidly culturing many of these cells for study purposes. Showing that nuclei and cytoplasms from two different species can fuse is also of interest. But the larger purport of these studies, as well as of those done before along these lines, is that they are giving biologists powerful tools to learn more about nuclei and cytoplasms and their roles in gene expression and other cellular actions. Artificial synthesis of cells should also help researchers learn more about diseases and aging at the cellular level. For example, Leonard Hayflick of Stanford University has already used cell reconstitution to see whether cellular aging is triggered by the nucleus or the cytoplasm. Both nucleus and cytoplasm appear to be responsible, he has found. Cell reconstruction may even eventually benefit medical diagnosis and treatment, Veomett (now at the University of Nebraska) speculates. For instance, cells might be taken from a patient with a certain inherited metabolic disease, nuclei removed from these cells and replaced with healthy nuclei. If the healthy nuclei could reprogram the cells (a feat yet to be demonstrated), then the treated cells might be reinjected into the patient and hence correct his disease. □

NASA's Fletcher to resign May 1

The administrator of the National Aeronautics and Space Administration, James C. Fletcher, is resigning from the agency effective May 1. He was named head of NASA on April 27, 1971, near the end of the Apollo lunar-landing program, and presided throughout the Skylab project, the joint U.S.-Soviet Apollo-Soyuz mission and the beginnings of the space shuttle.

Fletcher has reportedly said that he does not expect President Carter to name a new administrator for a couple of months, but several names have been floating about in the "rumor mill" as possible candidates. Included among them are: Albert J. Kelley, dean of the School of Management at Boston College and former director of the now-closed NASA Electronics Research Center among other agency positions; Rocco Petrone, former associate administrator of NASA and now in private business; and Edgar Cortright, former director of the NASA Langley Research Center in Virginia. □

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