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cannot yet be isolated. It posits that, contrary to standard electromagnetic behavior, the forces attracting quarks to one another *increase* the farther apart quarks are pulled, creating a rubber-band-like effect.

Two major tasks now loom before particle physicists. They must determine whether quarks are truly basic building blocks or composed of still smaller entities. And they need to find out how color and flavor interact, in order to formulate one comprehensive theory of matter. No designs drawn to date are satisfactory, but all include one spectacular, unsettling assumption: Protons are unstable and constantly decaying. Glashow sets the proton's lifetime at 10^{32} years. If this is true, then 10^{33} years from now, there will be no solid matter left in the universe, only a gas of leptons and electromagnetic photons.

Eternal Life Is Not in the Cards

"The Cell Biology of Human Aging" by Leonard Hayflick, in *Scientific American* (Jan. 1980), 415 Madison Ave., New York, N.Y. 10017.

The only obstacles separating man from eternal life may well be disease and that mysterious pattern of decay known as "the aging process." But seekers after perpetual youth will probably be disappointed. Recent findings in cell biology suggest that aging is one of the body's normal functions, instead of a breakdown of those functions, writes Hayflick, a biologist at the Children's Hospital Center of Northern California.

In cell biology, age is measured by the ability of cells and their "descendants" to function and divide—not by the "life-span" of a single cell. A California medical team grew cultures of human fetal lung cells in glass bottles. The cells divided and doubled their numbers until they covered the bottles' bottoms. At this point, crowding prevented further divisions, so the cultures were split in half and transferred to two different bottles. Again, the cells divided and doubled their populations until overcrowding set in. The researchers repeated these steps to assure further population doublings. But though the size of the "daughter cultures" continued to be controlled, cell division consistently stopped after 50 total population doublings, which occurred between the seventh and ninth month. Then, the cells decayed and died.

Cells in a living body act differently from those grown in a lab. Therefore, the experiment does not bear directly on the natural length of human life. It does suggest that aging is a property built into cells.

Calculating life-span from these results is also complicated by the fact that different kinds of cells age at different rates. Specialized cells such as nerve and sensory cells produce fewer generations than do skin cells. The systems they comprise undergo the greatest age-related changes. As cells near death, they lose their ability to function. If not replaced, this loss reduces the body's overall performance; and the fundamental cause of death in the later years is the body's increased vulnerability to accidents and disease.