million times slower than the RAMs.

Soon a new development—the optical memory disk—may overshadow all other memory technologies. Pinpoint laser beams encode optical disks by burning tiny pits into them. Recently released by Toshiba, the first commercial optical disks can store the equivalent of 33 books of 300 pages each; but they offer a "sluggardly" retrieval time of half a second. Optical disks have one other serious drawback: They cannot be amended or rerecorded.

The most promising micromemory technology, as Douglas sees it, involves making silicon chips "superconducting"—cutting their resistance to the passage of electricity by bathing them in cold liquid helium. Computers using superconducting chips would require minimal power and generate little waste heat. As a result, circuits could be packed more tightly on the chips, and the shorter distances travelled by electrical currents would mean faster retrieval times.

Until now, only corporations, universities, and governments with the biggest computers have enjoyed large electronic memory capacities. Putting big memories in small packages would allow the most complex problems to be solved on inexpensive home systems. It might even mean the advent of sophisticated robots.

The Impact of Longevity

"Life Expectancy and Population Growth in the Third World," by Davidson R. Gwatkin and Sarah K. Brandel, in *Scientific American* (May 1982), P.O. Box 5969, New York, N.Y. 10017.

In 1945, the average life span in the Third World was 40 years. Today, thanks to better health care and sanitation, it is 55 years. Will further advances in Third World longevity only lead to intolerable population growth? Gwatkin and Brandel, Senior Fellow and Associate Fellow, respectively, at the Overseas Development Council, say no.

The Third World is now going through a demographic change that the West experienced beginning around 1830—a switch from a population equilibrium of high death and birth rates to one of low death and birth rates. The shift begins with an increase in life spans, and in the time it takes for the birth rate to drop, population jumps. The biggest jump occurs at the very beginning of this adjustment, because the average life span grows chiefly as a result of declines in infant mortality. More children thus grow up to have families. That stage, say the authors, has already taken place in the Third World.

As life spans continue to rise, the people saved are increasingly older, and effects on population are smaller. Boosting Third World life expectancy from 55 to 60 years would mean a population jump only half as large as that accompanying the increase from 35 to 40.

United Nations demographers predict that Third World population, at current rates, will increase from 2.89 billion in 1975 to 4.80 billion in 2000, finally leveling off in 2100 at 8.46 billion. They expect the average

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life span to reach 75 years around the year 2030. (Life expectancy in the West today is 73 years.) Efforts to increase life expectancy 50 percent faster—so that the average life span reaches 75 years by 2015—would put the total population at 4.90 billion in 2000, an increase of only 2.1 percent, and a modest price to pay for a much healthier population.

At this point in the demographic transition, the biggest population changes are likely to come from drops in the fertility rate. The UN projections assume an annual decline of .07; a 50 percent greater decline would mean an 18.8 percent *decrease* in the projected population by 2100. In fact, the most effective techniques for extending life expectancy cut infant mortality *and* reduce fertility. Education of women, for example, results both in fewer infant deaths and in raised aspirations that delay marriage and curtail childbearing.

First Bird

"Running, Leaping, Lifting Off" by Kevin Padian, in *The Sciences* (May-June 1982), New York Academy of Sciences, 2 East 63rd St., New York, N.Y. 10021.

How did birds learn to fly? Most paleontologists today believe that birds began as tree-dwelling reptiles that leaped from branch to branch. At first, their broadening primitive "wings" helped to break their fall; then, with further evolution, feathered appendages enabled them to glide and, finally, to fly.

But, says Padian, a Berkeley paleontologist, this theory errs in assuming that it is an easy step from gliding to flying. In order to sustain the "flight stroke"—which works on an entirely different aerodynamic principle—birds have a specialized bone structure, a high metabolism, and powerful muscles. Present-day gliders, such as flying squirrels, depend on little more than a membrane stretched between their limbs. Notes Padian, "there is no evidence that any group of gliding animals . . . are, or have ever been, 'on their way' to active flight."

Recently, three scientists at Northern Arizona University—ornithologist Russell P. Balda, chemist Gerald Caple, and physicist William R. Willis—have developed another scenario, based on estimates of the evolutionary steps that might have been necessary to make the complex flight stroke possible.

The flight stroke consists of two motions of the wings—down and forward and then up and backward—which together describe a lazy figure eight. "Proto-birds," the three scientists argue, were small, land-based dinosaurs that flushed out insects, ran them down, and caught them in their mouths. When a human runs he balances his stride by swinging his arms alternately. But in two-legged dinosaurs, the tail did the balancing and the forelimbs hung useless—ready to evolve a new function.

The proto-birds were able to achieve greater stability and lift as their finger bones enlarged to support a winglike surface. By swinging these "wings" forward—much the way a long jumper throws forward his