PASSAGE TO METHUSELAH: SOME DEMOGRAPHIC CONSEQUENCES OF CONTINUED PROGRESS AGAINST MORTALITY

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INTRODUCTION

Suppose progress continues to be made in reducing mortality rates at all ages. What impact would this progress have on the size and age composition of the U.S. population?

The supposition that mortality rates will continue to fall is admittedly questionable. The view popularized by James F. Fries is that "the median natural human life span is set at a maximum of 85 years with a standard error of less than one year" (Fries and Crapo, 1981). Paul Demeny, in making long-term population forecasts for the World Bank, assumes that even by the year 2100 there will be no country with a life expectancy above 82.5 years.

Demeny notes that in some countries life expectancy seems to be slowly decreasing. The possibility of a general decline in life expectancy cannot be ruled out. On the other hand, as Demeny points out, "the upper limit to life expectancy" of 82.5 years "may yield to technological changes in medicine and to changes in life styles, perhaps even within the next few decades" (Demeny, 1984).

As documented by Crimmins (1981), remarkably rapid progress in reducing mortality rates was made in the United States from 1968 to 1977. This progress has continued and even accelerated from 1977 to 1983. At most ages, including older ages, mortality rates over the last decade have been declining at a rate of one or two percent per year.

Hope that this progress might continue is butressed by recent advances in the biological, medical, and gerontological sciences. The life sciences appear to be poised at roughly the point the physical sciences were a century ago and breakthroughs comparable to electricity, automobiles, television, and computers may be forthcoming in the areas of genetic engineering, prevention and treatment of such diseases as atherosclerosis, cancer, and diabetes, and perhaps understanding and control of the process of aging itself (see, e.g. Walford (1983), Bulkley (1983), and Rosenfeld (1976)).

As argued by Manton (1982), the only judicious position to take, in light of the conflicting evidence and theories about the rate and direction of future mortality change, is to admit uncertainty. There is a chance that mortality rates will continue to decline at recent rates, there is a chance this progress will level off, there is a chance that mortality rates will increase, there is a chance of some major breakthroughs that will radically reduce mortality rates. Given this uncertainty, it seems reasonable to try to gain some understanding of the demographic consequences of alternative mortality scenarios.

In this note, we explore three possibilities: no change in mortality rates, continued progress at two percent per year at all ages, and a radical breakthrough that cuts mortality rates in half in the year 2000. Our focus is on the impact of such scenarios on the size and age composition of the U.S. population. Because our aim is insight and not prediction, we assume that fertility rates stay unchanged and that net migration amounts to zero: these simplifications avoid obscuring the effects of mortality change with fertility or migration change.*

NO CHANGE IN MORTALITY RATES

If age-specific mortality rates stay at 1980 levels (and if age-specific fertility rates also stay unchanged and there is no net migration at any age), then the age composition of the United States will change over the coming century as shown in Figure 1. It may seem surprising that no change produces so much change: the shift in the age composition results from the differences in historical levels of mortality and fertility compared with the 1980 levels.

The age distribution in 2080 peaks at age 45. The distribution falls off toward age zero because 1980 fertility rates are somewhat below replacement levels; the distribution falls off after age 45 because of deaths.

Compared with 1980, the proportion of the population under age 20 declines from 31 to 23 percent, the proportion in the prime years from 20 to 64 decreases slightly from 58 to 57 percent, and the proportion above age 65 almost doubles from 11 to 20 percent. Centenarians, who numbered 24 thousand in 1980, multiply to nearly 110 thousand in 2080: the scarcity of centenarians today is a legacy of high mortality rates and smaller population sizes a century ago.

*To study continued progress against mortality we needed mortality rates at advanced ages, well beyond the usual stopping point of 85: we based the rates we used up through 119 on Faber's (1982) actuarial study; after this age we made the conservative assumption that mortality rates increased by nearly nine percent per year. A more detailed description of our methods and a more complete analysis of the results can be found in Gowan and Vaupel (1985).

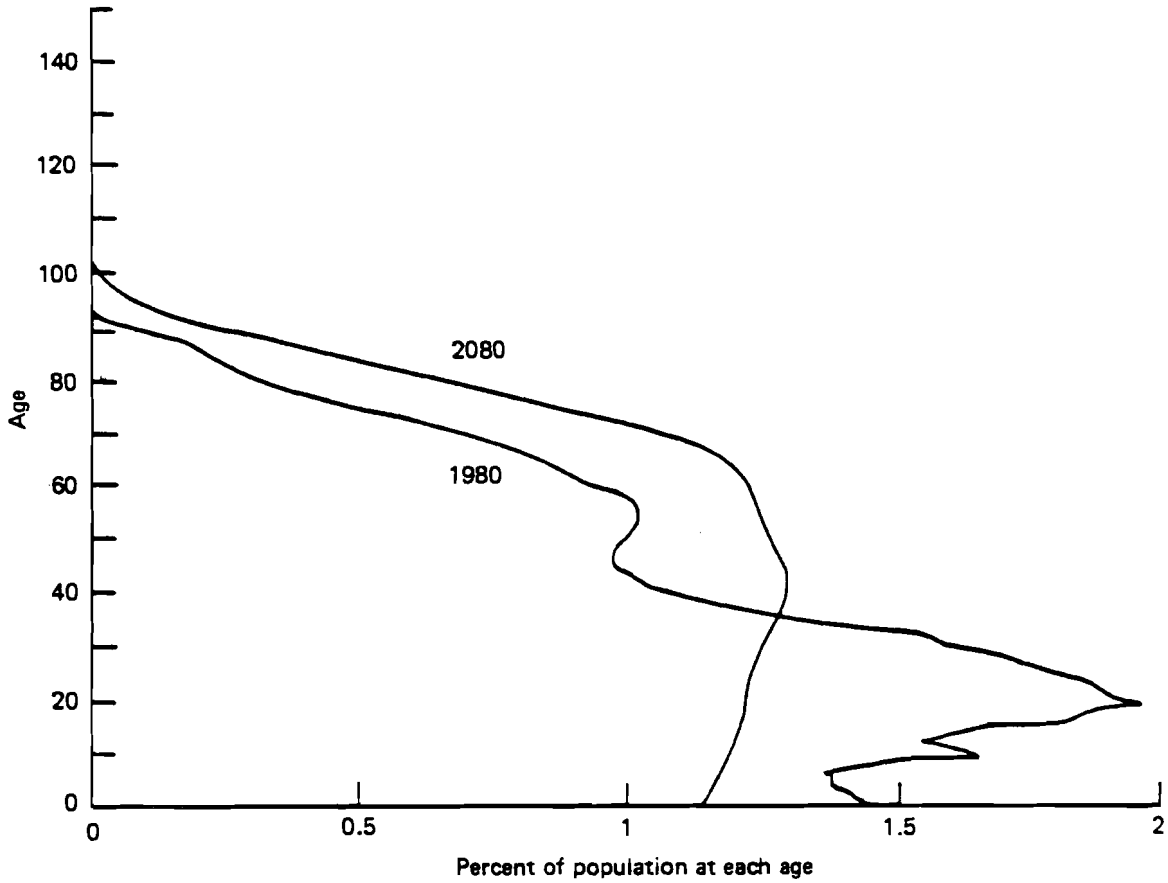

Figure 1. Age composition of U.S. population in 1980 and in 2080 if age-specific mortality and fertility rates remain at 1980 levels.

Even though the 1980 fertility rates are below replacement level, the U.S. population will continue to grow under this scenario, from 225 million in 1980 to 254 million in 2020. As the population ages, however, and the reverberations of the baby boom dampen out, deaths overtake births and from 2020 to 2080 the population declines to 206 million.

STEADY PROGRESS

Suppose mortality rates continue to decline at all ages at a rate of two percent per year. As shown in Figure 2, this steady, gradual progress would radically transform the age composition of the U.S. population in a century. By 2080, the proportions of the population under 20, between 65 and 84, and above 84 would be about the same, close to 18 percent in each case. The population between 20 and 64 would correspondingly decline to 45 percent of the total.

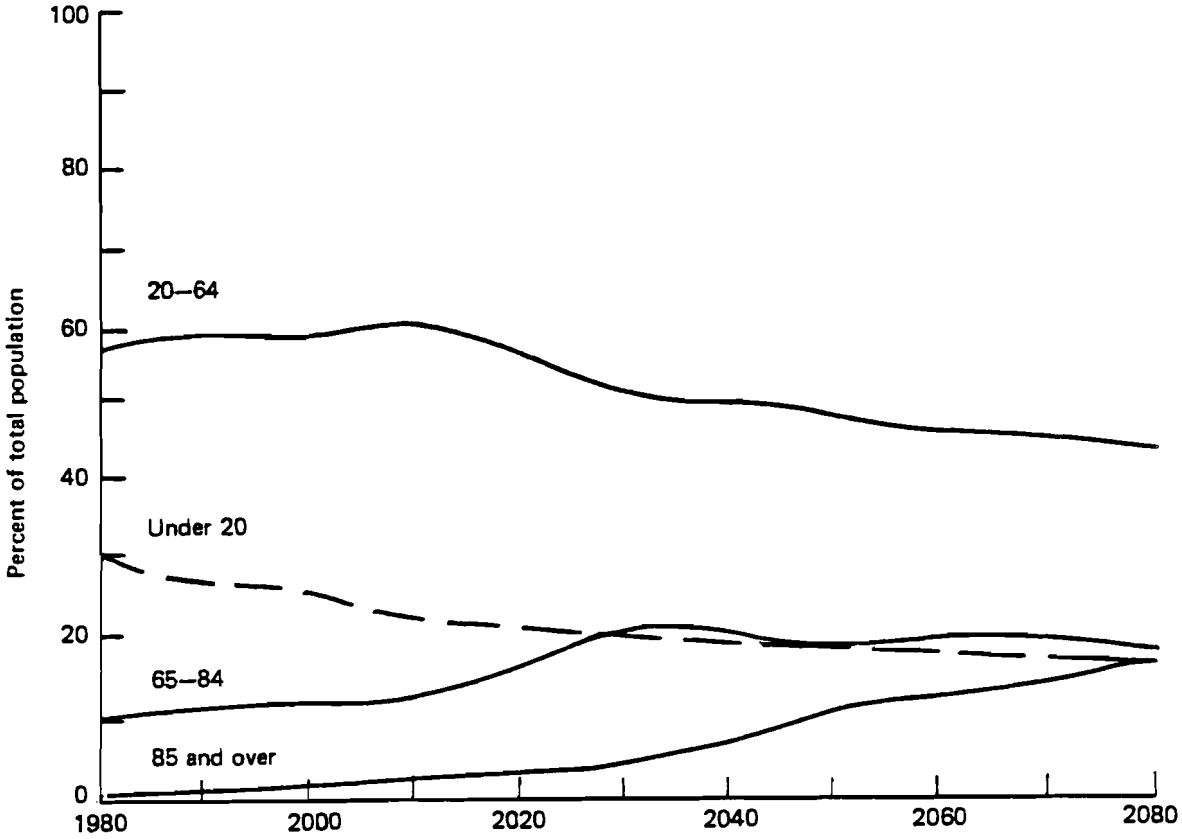

Figure 2. The evolving age structure of U.S. population if age-specific mortality and fertility rates remain at 1980 levels.

As shown in Figure 3, these proportions imply that the age structure of the population would be roughly level from birth to age 100, with a small peak at age 70. The population would fall off above age 100, but it would not be unusual to survive to 125 and a few hardy individuals would be 140 or more. The total number of centenarians would approach 19 million and nearly 400,000 of them would be at least 125. Those 400,000 will have been born before 1955; one of us (Gowan) will only be 117 in 2080.

In 1980 about one person in a thousand was above age 90; in 2080 under this scenario, about one person in seven would be above age 90 and more than one person in a thousand would be above age 125.

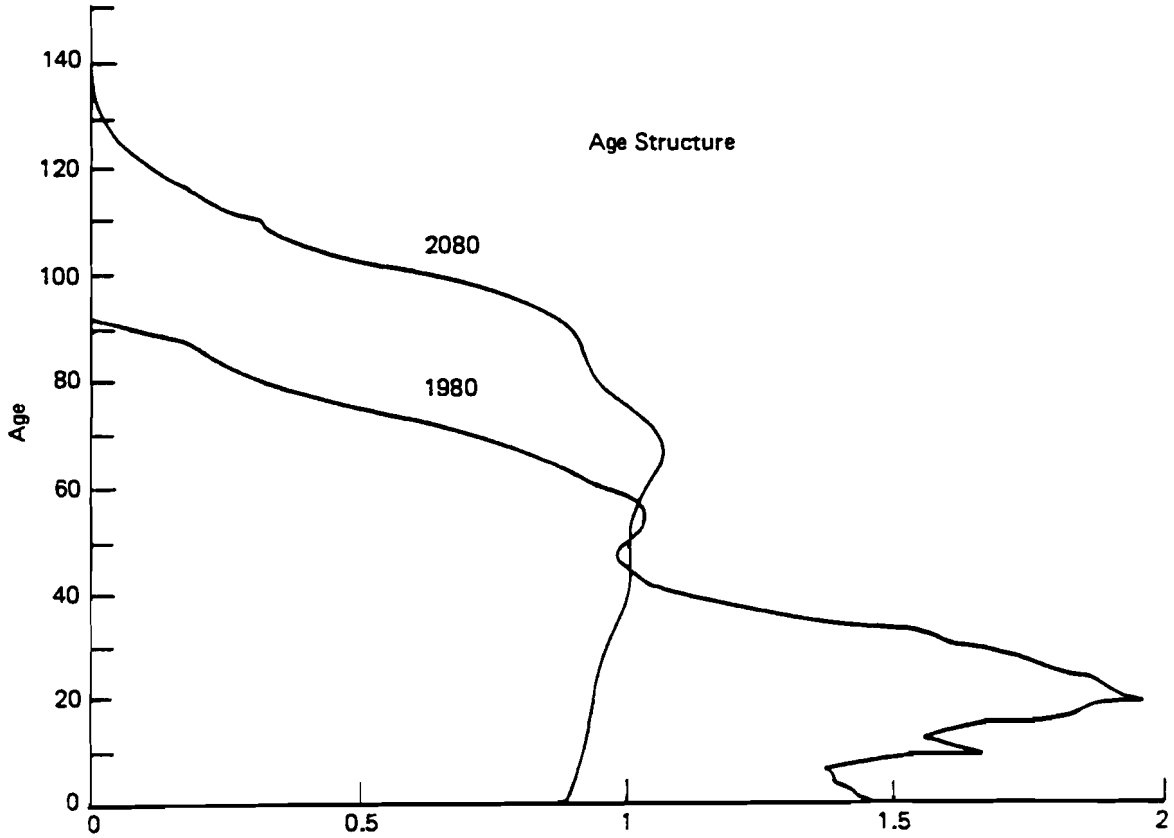

Figure 3. Age composition of U.S. population in 1980 and in 2080 if age-specific mortality rates decline at 2% per year.

Figure 4 shows the trends in births, deaths, and total population size. Births gradually decline and deaths increase until they meet and then slowly decline together: the progress in reducing mortality offsets the low level of fertility so that population size remains constant, at 286 million.

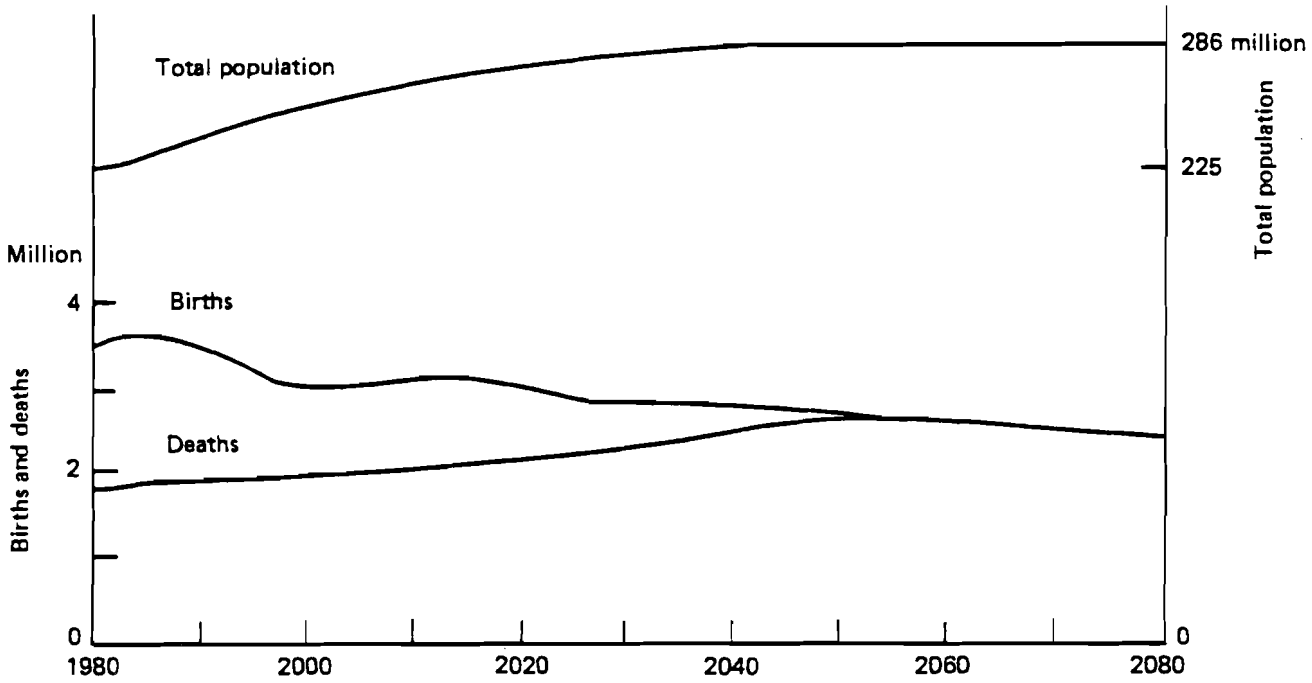

Figure 4. U.S. births, deaths, and total population from 1980 to 2080 if age-specific mortality rates decline at 2% per year.

A BREAKTHROUGH

Suppose at the turn of the millenium a breakthrough was made that cut mortality rates in half at all ages, but that before and after this breakthrough mortality rates remain unchanged. Figure 5 shows the effect on deaths, births, and total population. By 2030 deaths overtake births and the total population declines by 2080 to 238 million. As shown in Figure 6, the age structure of the population in 2080 is intermediate between the structure with no progress and the structure assuming two percent annual progress. Indeed, this age structure is similar to the structure that would emerge from steady one percent progress against mortality.

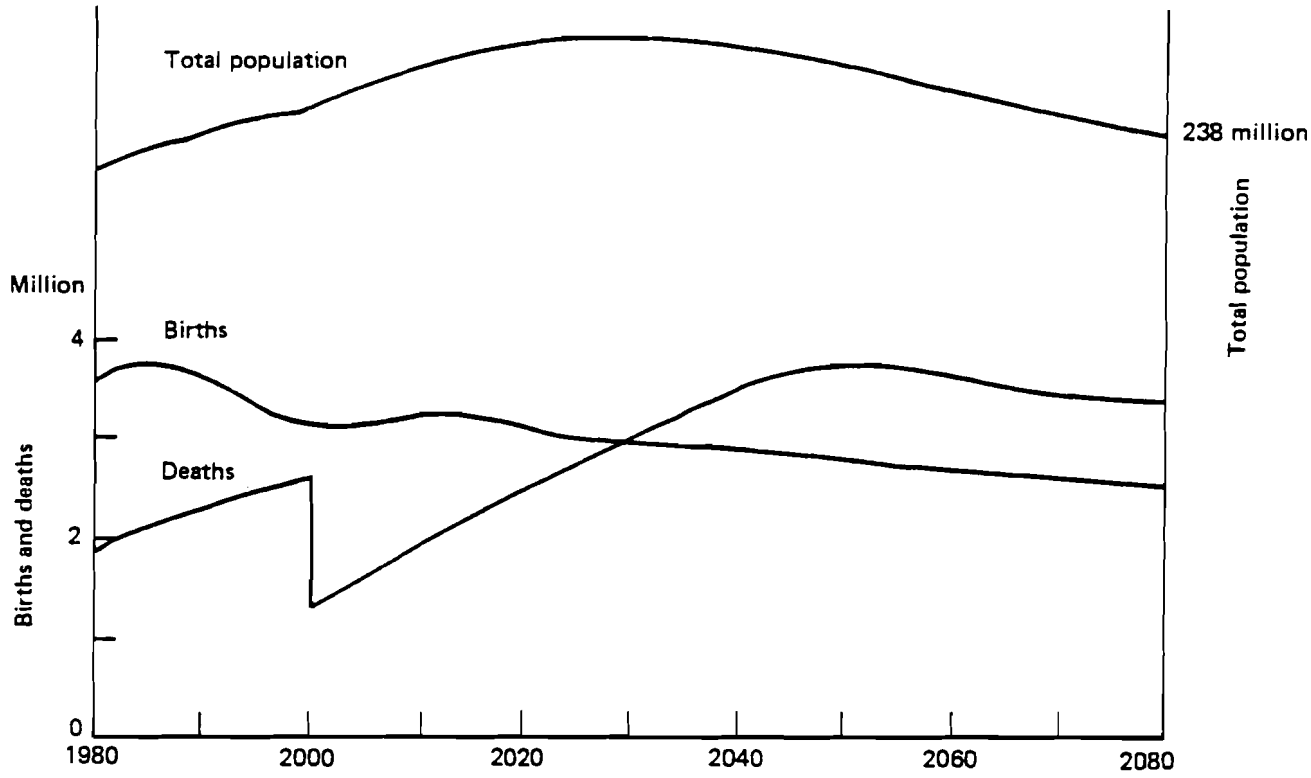

Figure 5. U.S. births, deaths, and total population from 1980 to 2080 if age-specific mortality rates are cut in half in 2000.

Just as the tortoise in Aesop's fable creeps along at a deliberate pace and overtakes the resting hare, steady two percent progress amounts to more in a century than a one-time fifty percent reduction. In fact, with steady two percent progress mortality rates at each age would be cut to about an eighth of their original level in a century.

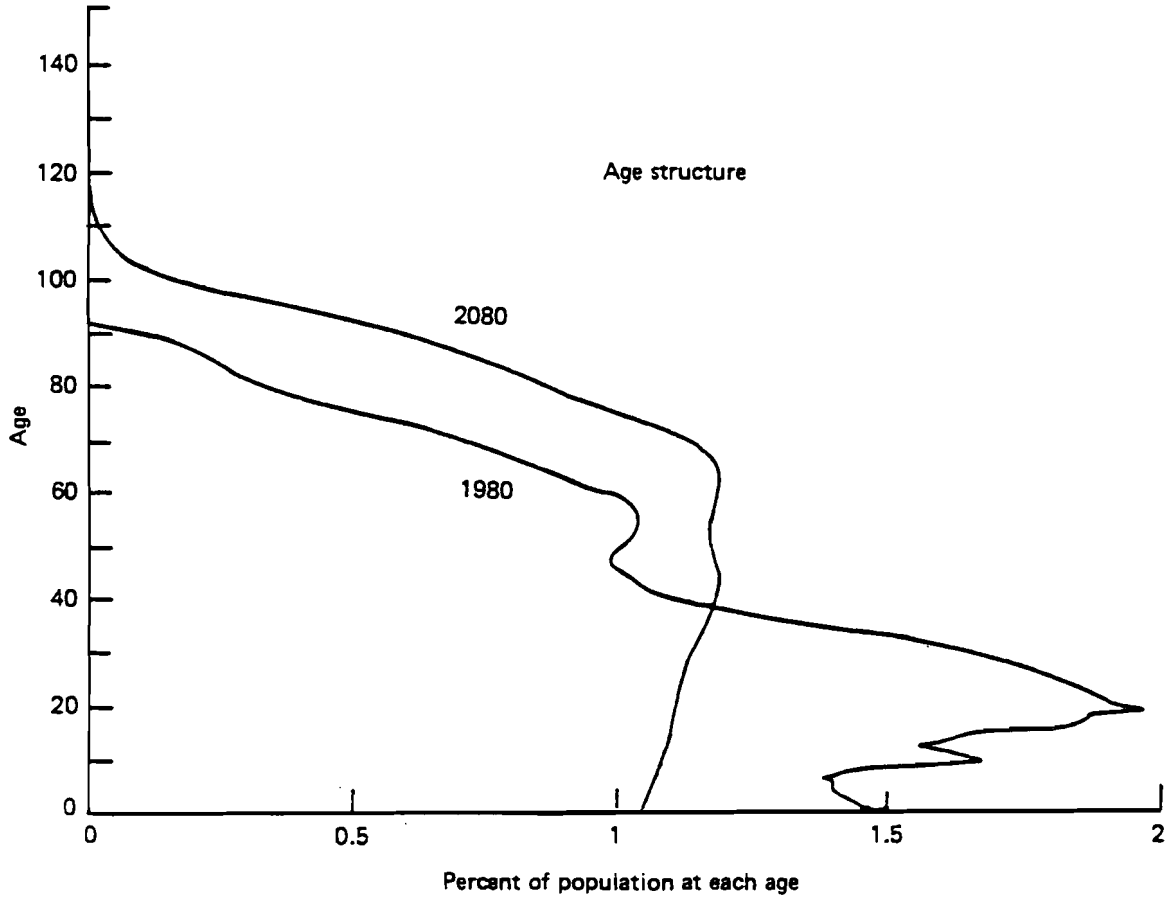

Figure 6. Age composition of U.S. population in 1980 and in 2080 if age-specific mortality rates are cut in half in 2000.

ADJUSTING TO THE NEW DEMOGRAPHY

Whether there is no further progress against mortality, steady progress at one or two percent per year, or some breakthrough that substantially cuts mortality rates, the age structure of the U.S. population (and of the populations of most other developed countries and many developing countries) will shift toward older ages. Even in the case of a radical breakthrough, however, the shift will be gradual: if death were eliminated tomorrow it would still take a century before there would be many two hundred year olds. So society will have time to adjust to the new demography.

Nevertheless, it may be worthwhile to begin speculating about some of the adjustments that might have to be made, not only to start developing the wisdom that will be needed to successfully cope but also because some current decisions depend on long-run trends (Boulding, 1965). Three issues deserve highlighting.

First, will increased life expectancy be accompanied by increased healthy, productive life expectancy? Jonathan Swift, in the section of his *Gulliver's Travels* on the Luggnaggians, describes some of the pleasures and opportunities that would open up if people could live long, vigorous lives and then contrasts this vision with the misery of the immortal but decrepit struldbruggs and their drain on society. Who would wish to live to age 120 in, as Shakespeare wrote, "mere oblivion, sans teeth, sans eyes, sans taste, sans everything". The evidence, as reviewed by Manton (1982), is weak and mixed on morbidity and disability trends in old age; more research is needed.

Second, if the span of healthy life does increase, people may wish to work longer. Furthermore, the increase in the proportion of the elderly may require delaying retirement to save Social Security from bankruptcy. If more of the elderly hang onto their jobs, however, promotional opportunities will diminish for the young and whatever gain there may be in wisdom and experience in an organization may be offset by a lack of fresh thinking and new blood. In addition, the increase in the proportion of the elderly might result in a further shift of political power and even greater governmental focus on the needs of the elderly and inattention to the needs of the young (Preston, 1984). A major challenge to society will be to develop career patterns and social norms that enable the elderly to productively contribute while simultaneously giving the young a chance.

Finally, what kind of education should be offered to a person who has to work and keep amused for a century or more? One of us (Vaupel) just had a baby daughter, Anna. In a related article (Owen and Vaupel, 1985), her life expectancy was forecast to be perhaps 90 to 100 years. That makes the year 2080 seem a bit closer: Anna has a good chance of being alive then. How should she be educated? Our hunch is that she needs an education that enables her to keep learning, because society and technology will change dramatically over her lifetime. In addition, she would probably benefit from a solid liberal arts education—in music, the arts, literature, history, the great books of philosophy and science—because this background, which helps a person maintain an active interest in life, is more readily acquired in youth than in old age.

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