

## ON THE DEMOGRAPHY OF AGING\*

Jacob S. Siegel

U.S. Bureau of the Census, Washington, D.C. 20233

I had a great deal of trouble deciding what to talk about on this occasion, assuming I had to go along with the tradition and give a talk at all. I thought of talking about the role of politics in the compilation of demographic statistics, or about errors in census data, their measurement, and their implications for public programs, or the measurement of immigration, legal or otherwise, or problems in estimation and projection of population. Or I might have given a polemic about the deplorable plight of old people. But I didn't go those ways. I held a contest and offered a prize of \$500 to the individual writing the best Presidential Address. I won the prize myself since I was the sole applicant and the judge. Accordingly, I am pleased to bring you the following extended remarks, concerned with the contributions of demography to gerontology or the demography of aging and identified by the code name GERONTOL or DEMOGAG. I speak to you as your President, not as a resident employee of the U.S. Bureau of the Census.

The demography of aging brings demographers to focus holistically on a population group, the elderly, and a demographic process, aging. The same question of scope concerns us here as in the case of demography in general, i.e., where does the central discipline of demography leave off and such other multidisciplinary disciplines as sociology, economics, statistics, psychology, and geography take over alone or with one another?

I want to identify the major interests of an "aging" demographer, i.e., a gerontological demographer, and to consider

some of the outstanding issues and problems to which demographers have contributed and can contribute in the study of aging. Time permits only a very illustrative treatment. It is important to recognize that gerontologists have not confined their interest to old age but have been concerned with the process of aging and have been examining the life course or life cycle familiar to sociologists. The concern with the process is important because the status of the elderly cannot be understood without an understanding of antecedent experiences in their life history.

### DEFINITION OF OLD AGE AND AGING

Questions persist as to the definitions of aging and old age. There are social, psychological, and biological aspects of the aging process and these give rise to alternative definitions and measures of aging. There is still no universally acceptable definition of normal biological aging (Borkan and Norris, 1980; Brown and Forbes, 1976). Hence, any reference to the "aging process" still has an uncertain meaning. Researchers are asking whether biological components wear out and at the same or different rates for different individuals (Abernathy, 1979). The genetic and environmental factors in differential aging are also being explored (Schneider, 1978; Finch and Hayflick, 1977).

Cultural definitions of old age vary according to the longevity of a population, the proportion of persons in the older ages, and the degree to which persons at different ages are engaged in useful activities. In these terms a redefinition of old age is now occurring in the United States.

The demographer commonly uses simple chronological designations to define the bounds of old age corresponding

\*Presidential address presented at the Annual Meeting of the Population Association of America, Denver, Colorado, April 11, 1980.

to those ages cited in the principal legislation affecting older persons. These may be 60, 62, 65, or 72. Then there are other bounds for young-old age, middle-old age, old-old age, and frail old age (Neu-garten, 1974).

Old age has typically been fixed in terms of years from birth, usually an arbitrary fixed number of years. An alternative concept is linked to the level of longevity. Progress in longevity has also been measured traditionally in terms of years from birth. A very different concept of old age being advanced is based on the average number of years until death (Ryder, 1975; Jackson, 1980). Like average life expectancy, it applies to population groups rather than individuals. According to this concept, old age covers the period of life beginning with the age after which the particular groups has a specified average number of years to live, say 10 or 15 years. Accordingly, groups with lower life expectancies have lower ages for the beginning of old age. For example, the age at which males have 10 years until death on the average is lower (72 in 1977) than the corresponding age for females (78 in 1977). Blacks have lower ages when they "have 10 years to go" than do whites. We men are older than we think.

This concept can have important economic, social, legal, and ethical implications. The concept has been used in some recent court decisions (Cain, 1979; Cain, 1974). Should the economic and other privileges of old age be accorded to men and blacks at an earlier age than women and whites, respectively? A chronically ill person could claim the benefits of old-age legislation at a younger age than a healthy person. To implement the idea of old age based on age at death would pose serious problems as to the adequacy of current data and methodology. It would require a wide variety of life tables, including tables for classes of persons in various socioeconomic categories (e.g., income, marital status) or with certain types of health conditions. Life tables of this kind do not exist and would have to be

developed; in fact, the basic data on mortality and morbidity needed to construct them are lacking.

#### AGE STRUCTURE

The demography of aging is firmly grounded in the theory of the growth and structure of population developed by Lotka (1939), Coale (1972), Lopez (1961), Keyfitz (1977a), and Pollard (1973). Their studies and others (Lorimer, 1951; United Nations, 1954; Bourgeois-Pichat, 1979) have shown that populations age as a concomitant of the demographic transition and that, in the aging of populations, fertility tends to be the primary determining factor, overshadowing mortality and net immigration, barring unusual circumstances (Coale, 1956; Coale, 1957; Lorimer, 1951; and United Nations, 1954).

U.S. demographers have been concerned with the measurement of the relative contribution of these factors to change in the number and proportion of the elderly in past intercensal periods in the United States. A preliminary analysis of the relative contribution of fertility and mortality to the growth in the number of the elderly in the United States, by decades over the last century, shows that the actual or potential effect of changes in the number of births far exceeds the effect of changes in survivorship. Although a much larger percentage of babies born 65 to 79 years ago reach old age today than did so under mortality schedules applicable to birth cohorts which reached these ages 50 years ago, the number of births in the corresponding cohorts has shifted sharply upward also. Most lay persons and many social scientists still believe that increasing longevity, i.e., "medical progress," is the primary factor that accounts directly for the rise in the numbers of the elderly. The emphasis on the size of birth cohorts does not, however, rule out an important role for declining mortality.

A similar error of interpretation is commonly made with regard to the basis of the past trend in the proportion of elderly persons and differences between popu-

lation subgroups. The greater importance of the role of fertility than mortality is applicable both to explaining the rise in the proportion of elderly in the United States (Hermalin, 1966) and the differences in age composition between the main segments of the U.S. population. Since many government officials, journalists, and social scientists, including gerontologists, still impute the rise in the proportion of elderly largely to increasing longevity, the demographer has a responsibility to convey this message more widely.

Providing national and subnational estimates and projections of the population (including its distribution according to sex and age) is a fundamental part of the work of demographers. These figures permit an analysis of trends in aging and of the size and composition of the older population and serve as the basis of the gerontologists' studies of needs for services to and facilities for the elderly. Population projections also serve as the basis for estimating the supply of specialized personnel available to serve the elderly.

The prospects for the United States in the next half century are for generally rising numbers and proportions of elderly persons, sharp fluctuations in the increase in the numbers (reaching a low in 1990–2000, when the depression-born cohorts arrive, and a peak in 2010–2020, when the baby-boom cohorts arrive), and the more rapid growth of the extreme aged. Demographic analysis clearly establishes the fallacy of assuming that the numbers and proportions of elderly will continue to grow at past rates or even an attenuated version of these rates. Moreover, it has been the demographer who has often taken the lead in identifying the socioeconomic implications of fluctuations in the past and future numbers of births and in the future numbers of elderly.

Both "actual" and model calculations for the United States show that, potentially, if not in fact, for the next several decades the past record of births is expected to dominate the changes in the future numbers of elderly, and that the pro-

jected birth rates, in combination with the past numbers of births, are expected to dominate the changes in the future proportions of elderly (Siegel, 1978; U.S. Bureau of the Census, 1978a; and McFarland, 1978). Mortality declines will play a secondary role. Unlike past experience, mortality declines are expected to raise the proportion of elderly since, under the conditions of very low mortality prevailing in the United States, the declines are likely to be concentrated at the older ages.

Given the trend of recent and prospective fertility, there is the possibility that the U.S. population will cease to grow sometime in the next several decades and the proportion of elderly will reach unprecedentedly high levels, perhaps in excess of 17 percent (U.S. Bureau of the Census, 1978a). What are the consequences that may flow from this fact? It may be surmised, for example, that the higher prospective ratio of aged persons to persons of working age and the smaller ratio of children to their elderly parents will necessitate a greater role of government in the provision of services to the population in general and the older population in particular, but what will actually happen is uncertain in view of pressures for balanced budgets. It is important now to explore rather fully the demographic, social, economic, and psychological implications of slowing population growth, zero growth, and population decline for society as a whole and for the elderly in particular. Several important studies of the implications of slowing population growth and a stationary population have appeared, among them studies by Day (1978), Espenshade and Serow (1978), and Spengler (1978), but little work has been done on the implications of population decline (Council of Europe, 1978).

### *Balance of the Sexes*

One of the more salient facts and problems of the older years in the United States and other highly industrialized countries is the large excess of women, an

excess which mounts rapidly with increasing age in later life. The excess has been growing and promises to persist into the foreseeable future. If we can accept the proposition that most older people do not want to live alone and that they live more happily with a marriage partner, we should seek to implement ways of reducing the imbalance of the sexes in later life or, at least, of adjusting institutionally to it.

To correct the balance demographically would involve manipulating sex differentials in fertility, mortality, or migration. I have not been able to think of any feasible policy that would have the desired effect without creating at least as many new social problems as it would solve. Many "demographic" and "institutional" solutions can be imagined but they would not generally be viewed as realistic (Siegel, 1980b). I would like, however, to send you a clear message that I am seriously concerned about the physical and emotional isolation of older women and am groping for ways to mitigate the problem through the avenue of balancing numbers. Even though I anticipate increased economic independence of women, this change will not greatly affect the situation.

#### MORTALITY TRENDS AND PROSPECTS

Necessarily, matters of mortality and longevity figure heavily in the demography of aging. Death rates determine the proportion of births surviving to older ages. Deaths figure prominently as a factor in the gross change in the number of elderly and account for the high "turn-over" of the elderly population. Key issues are the analysis of factors in past declines in death rates, the possibilities and prospects of extending life expectancy and even life span, the problems of measuring socioeconomic differentials in mortality, and the possibilities of reducing group differences, particularly for the sexes.

#### *Analysis of Recent Trends*

We have witnessed in the last several decades some dramatic variations in the

trends of the age-adjusted death rate and life expectation, variations which are perhaps not as spectacular as those shown by the fertility rate during the same period, but still notable. Specifically, we saw a rapid decline in mortality during the post-war years 1945-54, relative stability between 1954 and 1968, then a resumption between 1968 and 1979 of the decline at a more rapid rate than in the 1945-54 period. Little attention has been given to the analysis of these broad swings in the trend of mortality. How do we account for them and, particularly, for the stability in mortality in the 1954-68 period? Would a time series analysis of the data, such as the ARIMA-type analysis that has been applied to fertility data by Lee (1974), Saboia (1977), and McDonald (1979), be useful? Research has been initiated in the application of structural equation models to the analysis of changes in mortality in the post-war period (Land and McMillan, 1980).

Secular and cyclical analyses of mortality and identification of the social and economic correlates of mortality changes deserve a share of current attention. For purposes of planning the use of health resources and the financing of research on health matters, it is important to determine the extent to which the declines are due to new medical developments and the extent to which they are due to other factors, such as changes in the system of health care delivery, life style, and public health practices. For example, the death rate from heart disease declined sharply in the 1968-77 period even though there were no new basic biomedical discoveries; this suggests the greater role of changes in life style or in health care delivery as illustrated by the mass screening for high blood pressure.

#### *Prospects for Longevity*

Demographers have tracked the rise in life expectation from the earliest historic times to the present. Taking off from the important distinction between life expectation and life span, they have charted the increasing rectangularization or, to

use a really fancy word, orthogonalization, of the curve of survivors in relation to the human life span of about 95–105. For much of the prehistoric and historic period the techniques of historical demography have had to be used to measure the rise in life expectancy (Howell, 1976). Increasingly sophisticated methods of constructing life tables have been devised so that we can now measure life expectation with increasingly spurious precision. You see, nothing much has been done to correct for the errors in the basic data—a bigger task remaining to be done.

Projections of life expectancy have been made to fill the needs for population projections, public health planning, and insurance planning. Projections of mortality based on a deterministic age-specific death rate model or, more specifically, an age-sex major-cause-of-death rate model have long been employed in official studies, made under the sponsorship of the National Resources Planning Board, the U.S. Census Bureau (1977), and the U.S. Social Security Administration (1978). Underlying the explicit assumptions for these categories are implicit assumptions regarding biomedical developments, socioeconomic developments, environmental changes, and their interrelations. These projections have tended to be too conservative and, like fertility projections, have been unable to predict both the trend and cyclical swings in mortality very closely (Siegel, 1978; Myers, 1978a; 1978b).

We should now be ready for new approaches to the projection problem. In addition to providing alternative series of projections defining a range of uncertainty or a confidence interval, we could try deterministic cohort models, macrodynamic or stochastic structural-equation models (Land and McMillan, 1980), time series analysis by the ARIMA technique (Lee, 1974; Saboia, 1977; and McDonald, 1979) or some combination or merger of these. We could try to take explicit account of probable biomedical developments, changes in life style, etc. Will interferon, prostaglandin, and DMSO turn

out to be the hoped-for wonder drugs? Suppose everyone modified his/her life style to accord with present recommendations regarding smoking, nutrition and exercise? Can we integrate the new information on joint or multiple causes of death and the new theoretical developments on competing risks (Manton, Tolley, and Poss, 1976; Manton and Poss, 1979; Manton, Stallard, and Poss, 1980)? Projections which eliminate current socioeconomic differences, following Kitagawa (1977), or which reach the lowest current level of endogenous mortality, following Bourgeois-Pichat (1978) and United Nations (1979), should prove useful as projective tools.

The rectangularization of the curve of survivors is likely to continue in the future, but opinions differ as to whether it will continue at a slower or faster pace than in past decades. Even the more sanguine demographic futurists find it difficult to believe that the progress of the last decade in the United States can be maintained (Keyfitz, 1978). Endogenous mortality in the best countries has moved forward haltingly in the last quarter century (Bourgeois-Pichat, 1978).

A question can be raised as to whether the prospects are to be considered simply in terms of rectangularization in view of the current explorations by molecular biologists of the possibilities of extending life span (Gordon, 1979; Bourgeois-Pichat, 1980; Rosenfeld, 1976; and Havighurst and Sacher, 1977). Some biologists, such as Comfort (1979), confidently anticipate a substantial extension of life span by the end of the first half of the next century. Others, such as Strehler (1979), see this extension merely as a hopeful possibility and still others, such as Hayflick (1979; 1977), reject an expansive view, seeing such possibilities as visionary and Panglossian.

We can accept the notion of a fixed life span for each animal species, including humans, in historic and late prehistoric times, but was there a previous period, in the evolution from the anthropoid apes (*Pongidae*) to the ancestors of modern

man (early *Hominidae*) to modern man (*homo sapiens*), when hominoid life span advanced to its present level? Paleodemographers and evolutionary biologists have given us some interesting but conflicting insights here (Acsádi and Nemeskéri, 1970; Beaubier, 1979). If such evolution occurred, we should have a more receptive view of the possibility of further biological evolution, especially since such evolution may be culturally influenced to an important degree. Society may develop the know-how to intervene in effecting genetic change, possibly with increased longevity as one of the goals.

A major policy question is how to allocate public resources between efforts to "conquer" specific diseases and efforts to slow the aging process. Even more important is the question, do we want to succeed in extending life span, if there is no assurance of a better quality of older life?

The implications of an extension of life span are so tremendous that demographers and other social scientists should begin to explore them in their multifarious aspects without further delay. The whole structure of society would undergo a metamorphosis of a major sort. Among other things, we would see many five-generation families and the concept of retirement would undergo a radical change (Gordon, 1979). Assuming that the level of fertility will remain low, the proportion of elderly persons in the population will be tremendous, but then what is elderly?

#### *Measurement of Mortality Differentials*

Another concern in the general area of longevity and survival is the matter of sex, race, size-of-place, and socioeconomic differentials in mortality—their measurement, the findings, and the interpretation of results. The basic facts of sex and race differences in the United States are well known. For the former the puzzling and intriguing issues are the extent to which the monumental excess of female longevity is biologically determined and the prospects for a significant reduction of the male-female difference. The evidence on

the first issue is mixed and authorities differ in their views (Madigan, 1957; Retherford, 1975; Waldron, 1976; Waldron and Johnston, 1976; and Pressat, 1973). I have concluded from this evidence that women do have a basic biological superiority, preventing complete closure of the gap. An opposing point of view is held by some gurus of the feminist movement who reject all differences between the sexes except a little anatomy, even when they are to the advantage of women.

I do anticipate a significant reduction of the male-female difference in the United States in the next half century because of the importance of environmental factors in accounting for the present gap and the change expected in the role of these factors. I do not think that this will come about simply because some women are now working at more hazardous occupations or more responsible jobs. It will come about largely because the new generations of boys and girls are being reared with a unisex outlook, in particular the "work or perish" ethic that boys have always been reared by. This socialization of girls for holding responsible jobs, smoking like chimneys, and using four-letter words will finally do them in—up to a point. However, you cannot easily beat the biological odds, especially the natural protection of the hormonal changes and blood-clotting factor provided during the female reproductive period, and this period has been steadily lengthening. So some difference in longevity will remain.

The interesting research issues about race differences in longevity include, first, the extent to which the white-black differences are accounted for by socioeconomic factors as compared with genetic factors and, second, the theoretical basis of the well-known "crossover" phenomenon whereby death rates of blacks cross below those of whites at about age 75. In these days when racial politics is intruding into scientific research, investigation of the first question, the basis of race differences, can be dangerous to the health of your research grant. In the analysis of the

crossover of the death rates of whites and blacks at the older ages, the role of errors in the data is being minimized in the light of the observed widespread occurrence of the crossover phenomenon between paired population groups with data of good quality; hence, other, more substantive explanations are being sought (Nam, Weatherby, and Ockay, 1978; Nam and Ockay, 1978; Manton and Poss, 1979; and Manton, Poss, and Wing, 1979). The prevailing explanation for the lower mortality of elderly blacks sounds like the Darwinian theory of natural selection, i.e., survival of the fit. A refined version of this hypothesis offered by Manton (1980) is that in populations which are "heterogeneous with respect to their endowment for longevity, a crossover or convergence of the age-specific mortality rates can occur if one population has markedly higher earlier mortality." This may be the ultimate answer but the matter merits more study.

The last national study on the topic of socioeconomic differentials related to 1960 (Kitagawa and Hauser, 1973) and, although some local studies have been made since then (Lerner and Stutz, 1976), there is need for an up-to-date national study. Several methodological proposals have been put forth. They include a replication of the 1960 census—death certificate match study, a retrospective study of a sample of deaths, ecological correlation analysis with county areal units, and a longitudinal follow-up of a sample from the census. The research is important because of its bearing on public health planning, particularly in the area of occupational and environmental health, prospects for reducing mortality, the preparation of projections of the socioeconomic characteristics of the older population, and the construction of life tables for these groups to assess their relative longevity for legal and other purposes. Each of the procedures mentioned has serious problems of design, interpretation, and cost, but I hope a new national study can be initiated soon.

### *Implications of Variations in Mortality for Variations in Longevity*

Demographers have long recognized the important difference in the variation between death rates and the variation between the corresponding life expectancy values. The broader implications of the difference in the way measures of mortality and measures of longevity vary have only recently been explored. These implications involve the design of standardization formulas in comparative mortality analysis, the relation between general declines in mortality and increases in longevity, and the effect of reduction in specific causes of death on future life expectancy. More specific questions posed are: What is the effect on life expectancy if age-specific death rates are reduced by a fixed percentage? By percentages varying with age? How does this relation vary with the general level of life expectancy? How do the alternative measures of mortality and longevity differ in their indications of the comparative mortality of two groups, e.g., males and females? What is the effect on life expectancy when death rates from cancer or heart disease are reduced by a stated percentage or eliminated? Keyfitz and Golini have made an important contribution by formulating these relations mathematically (Keyfitz and Golini, 1975; Keyfitz, 1977b), and Siegel and Fonner (1976) have analyzed the relation between changes in age-adjusted death rates and changes in life expectancy empirically on the basis of data for the United States since 1900.

### *Health of the Elderly*

I have never been sure whether health is an appropriate segment of demographic study, but most demographers interested in the elderly population think so and surely there are important interrelations between the health of older persons and demographic changes. Demographers have given attention to the health status of the older population, the health care delivery system, the allocation of re-

sources for health care, the relation between morbidity and mortality, and, particularly, the anticipated demographic changes which would affect the demand for health care and the provision of health services (Kovar, 1978; Morrison, 1979; Brehm, 1978; and Rice, 1978).

Indexes of health status indicate greater health problems and needs among the elderly than other age segments of the population. Most elderly people could be in much better health if they received the best care available and followed a more healthful life style, apart from new medical developments. Prominent among the obstacles to the receipt of better care are the health practitioners' lack of up-to-date knowledge and skills (resulting at times in iatrogenic illnesses), the maldistribution of health care resources, the philosophy of health care which stresses treatment rather than prevention, financial barriers, and attitudes which keep persons, particularly men, from seeking health care when needed (Antonovsky, 1979). Some measure of these obstacles could be secured by a KAP study on health care—yielding information on the public's knowledge of the existence of treatment methods, personnel, and facilities, their attitude toward securing health care, and their actual practice in this regard. These obstacles exist in greater degree for the inner-city and rural population than for the remaining urban population. There are signs of changes in the recent emphasis on "wellness," self-care, and prevention and in the increased tendency to adopt life styles which are healthful (weight reduction, exercise, avoidance of smoking).

Many important bioethical issues impinge on the demographers' studies of aging. Bioethical issues arise, first, in the decisions regarding the provision of health care to elderly people. Public and private budgets, involving as they do the allocation of limited resources, usually make explicit decisions as to various health programs on prevention, maintenance, and treatment and, hence, implicit decisions

as to who shall live or die. We need to face more directly the issue whether it is more useful to allocate funds to maintain the "life" of some old people at all costs or to apply funds to preventive programs affecting younger adults. The latter course could, in the long run, be more effective in maintaining and improving the general quality of life among the elderly and reducing the inequality of male and female death rates. The question is not "How can we save everyone?" but "How can we apply the most reasonable rule of triage?" Should we finance more life support systems, more mobile cardiac units, or more highway safety improvements? Should we have more cancer research or more heart disease research? We are beginning to have the demographic information in terms of lives saved and years added by the elimination of specific causes of death (Preston, 1974; Keyfitz, 1977b) and the economic information in terms of costs, to guide us in some of these difficult planning and policy decisions. Will they be used?

Other bioethical issues arise with respect to the individual's decision as to the amount and type of health care he or she wishes to receive. As the proportion of older persons in the population increases and the older population itself ages, the relative frequency of persons with incurable and intractable conditions, both physical and mental, including terminal and hopeless conditions, will increase. This prospect adds impetus to the desirability of pursuing intensive research into the complex bioethical issues relating to "life with dignity" and the "right to die" and suggests the need to explore these concepts in the context of basic human rights (Haug, 1978; Pressey, 1977; and Williams, 1973). In this view we expand the concept of the right of every child to be born wanted and well, entrusted as a correlative obligation to every prospective parent, and add the principle of the right of every adult to decide whether he or she shall live or die, limited of course by certain general obligations pertaining to all



basic rights. I urge the National Institute on Aging to begin to consider the "right to die" as a basic human right and to explore how this concept can be integrated into its goals for the improvement of life for the elderly and society in general.

#### GEOGRAPHIC DISTRIBUTION AND MOBILITY

Population geographers conducting gerontological research have directed their attention to analyzing the spatial distribution of older persons, including the role of migration, and evaluating the effect of the natural and physical environment on the demographic behavior of older persons. Wiseman (1978) has presented an introductory synthesis of the field.

Demographers, among them Kennedy and DeJong (1977) and Cowgill (1978a; 1978b), have noted the emergence of gerontic enclaves—concentrations of elderly persons—in the central parts of large cities and have measured the residential clustering of age groups in cities. Others have shown, however, that the bulk of urban elderly do not reside in urban "ghettoes." Reconciliation of these studies depends on the meaning of the concept of concentration. Some analysis of the dynamics of neighborhood changes which lead to gerontic enclaves have been made (Golant, 1979). Principal factors accounting for them include low income (which inhibits desired out-migration) and voluntary decisions to stay in the same area with friends and neighbors of the same ethnic background and age class. Residential clustering of the elderly in cities can be expected to continue (Cowgill, 1978a).

With the aging of the post-World War II pioneer settlers in suburban metropolitan America, we would expect to see the emergence of gerontic enclaves there also. In fact, several researchers, among them Golant (1979) and Gutowski and Feild (1979), have observed and analyzed the concentration of elderly persons in suburbia. Measurement of the "natural" concentrations is confused by the "artificial"

concentrations in congregate housing, retirement villages, and nursing homes, but these artificial concentrations can be removed from any analysis. The history of the inner cities is repeating itself with a variation. As the family grows older, the young members leave the parental family to work or attend school elsewhere, and the oldsters remain behind in their old neighborhoods. Although many drive automobiles, soaring gasoline prices and the cutting back on special services to the aged augur an old form of isolation of the elderly in a new environment.

We lack detailed data on the level of and reasons for mobility at the older ages. The reasons for movement at the younger ages do not apply (U.S. Bureau of the Census, 1979); conditions related to job and career are obviously far less applicable than noneconomic determinants. Moreover, earlier retirement is freeing a larger proportion of the population from living where opportunities for work are located. Changes of residence related to family and housing needs, albeit important at the younger ages, begin to dominate at the older ages, along with reasons related to climate, recreation, and health, especially for the part of the older population that has the necessary wealth to move. The changes in housing needs associated with the stage of the family cycle have been charted in some detail (Foote et al., 1960).

The geographic location of the elderly is typically not a result of active voluntary adjustment on their part, however. As Golant has noted, at the older ages, inertia, in addition to low income and neighborhood ties, retards adjustment to desires and needs, and geographic concentrations of the elderly tend to result from immobility rather than mobility (Golant, 1972). Elderly people are generally just left behind in the old, usually decaying areas—in the small rural towns and in the inner zones of large cities—while younger persons migrate out to improve their lot. Florida and Arizona retirement communities are the exception.

The myth of heavy migration of elderly persons to attractive retirement areas persists and turns attention away from the real need to deal with the problems of the elderly in the rural communities and older urban areas of the United States.

While mobility and migration rates appear to decline steadily with increasing age after youth (U.S. Bureau of the Census, 1978b; Shryock, 1964), we do not know exactly how mobility and migration rates vary at the oldest ages. There is some evidence that they turn up again at extreme old age, possibly because the very old move to nursing homes and other institutions or to the residences of their children or siblings (Heltman, 1975). The migration of the elderly—patterns and characteristics—and their community impact apparently are quite different from general migration and yet have received little attention. Carefully designed models of migration and residential change of the elderly, including models of the decision-making process, could be valuable additions to the body of research on the movement of the elderly. The state of knowledge concerning the migration of the aged in the United States is discussed in a special issue of *Research on Aging* (Longino and Jackson, 1980).

#### THE LIFE COURSE

The measurement and analysis of the life course or life cycle are of special interest to gerontological demographers, particularly because of the relation of the process of aging and the life course to the characteristics of the older population (Riley, Johnson, and Fonner, 1972). The basic pattern of the life course is childhood, adolescence, adulthood, and later life, or, in functional terms, participation in education, work, marriage, parenthood, and retirement. However, the characteristics of each cohort (e.g., its size) and period changes (e.g., specific historical events, including social and environmental changes) modify the basic pattern of the life course and make it quite variable, as Riley (1979) has forcefully indicated.

Variation from the "normative" ordering of events has been analyzed by Hogan (1978) among others.

We can then identify three general factors affecting the life course: age, period, and cohort effects. The problem posed for the demographer has been to identify these sources of variation in specific demographic aspects of the life course, to try to separate their effects, and to analyze the relative contribution of each factor to the demographic change under study. The problem applies, for example, to the analysis of labor force and retirement patterns, marital patterns, migration, and mortality, etc. Some scholars, including Uhlenberg (1979), Ryder (1965), Riley (1979), and Robin et al. (1979), have dealt with the conceptual problem; others, among them Ryder (1964), Honig and Hanoch (1979), Farkas (1977), Duncan (1979), Pullum (1978), Clogg (1979), and Glenn (1976), have worked on the disaggregation problem. Farkas, and later Duncan, for example, have estimated the separate effects of age, cohort, and period factors on labor force behavior by regression methods using data from the Current Population Survey.

Another important contribution to life course analysis is the work by demographers in the construction, extension, and generalization of multiple decrement tables. Such tables have proved useful in the lifetime analysis of a wide range of demographic, social, and economic variables, e.g., labor force participation, migration expectancy, and family formation and dissolution. Commonly, these tables represent the experience of a synthetic cohort subject to death and other factors of change and describe the complete lifetime or partial lifetime experience of the cohort with respect to the variables. New developments involve use of data for real cohorts, as in the tables of working life prepared by Fullerton (1972a and b), the extension of these tables to include increment-decrement components, as in the tables of working life prepared by Smith (1980), the design of a generalized model

of multiple increment-decrement tables by Schoen and Land (1979), and the construction by Trussell (1980) of life tables with socioeconomic covariates applied as proportional hazards in tables of marital dissolution.

#### LIVING ARRANGEMENTS AND FAMILIAL SUPPORT

##### *Marital Status and Living Arrangements*

One of the principal areas of the interface between demography and gerontology is the study of the marital composition and living arrangements of the elderly (Glick, 1979; Soldo, 1978) and the associated process, the family cycle (Ryder, 1977; Spanier and Glick, 1980). A characteristic feature of the older population is the large proportion of women living alone—typically widows—as compared with men. The great majority of elderly persons have living children but only a small proportion live with them.

As is well known, the sharp difference in the marital status of older men and women results from the higher mortality of men and the cultural norm of men marrying somewhat younger women. These factors account for a long and increasing period of widowed life for women, now about 16 years for women who become widowed at age 65. We know a lot about how the longevity gap has been widening, at least for all men and women if not for married persons separately. We know less about the changes in the gap in the age of married couples at mid-life or in the age of partners in second marriages, in which a large and increasing proportion of couples find themselves. Can and should society provide incentives to reduce or even reverse this gap in the interest of extending the years of joint married life? How many men would be willing to marry a woman several years older than themselves, for example?

The proportion of older women living alone has increased sharply in the last few decades (Michael, Fuchs, and Scott, 1980). What are the social causes and

consequences of this change? It is not a result of a rise in the death rates for older married men although it does correspond to a decline in past fertility rates. Have children been ungratefully abandoning their aging mothers? Not really. We have evidence that elderly people prefer separate homes; yet they want to, and do, maintain close ties with their children and grandchildren (Soldo, 1979; Shanas, 1979). Older people prefer the assistance of their children to the assistance of neighbors and the organized community when they need help.

We can speculate whether the economic and social changes of recent years will lead to significant changes in the living arrangements of older people. So far as expansion of private housing is concerned, the relative superiority of age-segregated housing (e.g., retirement villages) and age-variegated housing remains an unresolved issue, but this is a question where consumer preference should probably prevail (Golant, 1980). In spite of the pressure on budgets, it is to be hoped that greater public support will be given to programs which permit older people to live alone independently in their own homes, such as meals on wheels, home health aides, and visiting homemakers. Many older people may want to move in with their adult children as a result of the spiralling cost of living, including particularly the high cost of fuel for home heating and private transportation. Some incentives, such as tax rebates, and other social "supports," such as more gerontic day-care centers and "granny sitting" arrangements, will be needed. The developments in semi-independent living, such as congregate housing and foster homes for older persons, will mean more widespread living with nonrelatives, but they may help retard the trend toward institutional care.

Much attention is being given to the utilization and financing of long-term care facilities because of the problem of high costs and doubts about the appropriateness of institutionalization for many el-

derly persons (Soldo, 1978). The size of the institutional population has been growing rapidly because of the rapid increase in the numbers of older persons, the aging of the older population, and the diminution of the relative numbers of persons in the family support system. Some of these factors should shift within the next few decades and the institutional population may grow more slowly.

There is now considerable information regarding the size and characteristics of the institutional population (U.S. Bureau of the Census, 1978c), but information is lacking on some key parameters such as the proportion of the population at age 50 that can expect to spend some of its time in an institution and the average number of years people who have entered an institution after age 50 will spend in an institution. These measures will supplement the less informative figure on the percent of the elderly population in institutions at any particular time (Kastenbaum, 1973). We should engage our trusty multiple decrement tables to work these out.

### *Support Systems and Familial Dependency*

Gerontologists are concerned with the personal support systems and "social convoys" of older persons since these support systems have important implications for the social, psychological, and economic well-being of older persons. Information on such support systems are best secured through demographic surveys calling for data on intra- and extra-household relationships (Gokalp, 1978). Such surveys can tell us directly the proportion of older persons who have living siblings, children, grandchildren, and even parents, and their "linkages." Although a number of small-scale surveys have been conducted to determine how older persons relate to their relatives, friends, and neighbors, up-to-date national data are not available (Shanas, 1979).

The need for national measures of the social and economic dependency of older persons has partly been filled by de-

mographers by the use of various measures of "age dependency" and relative intergenerational size (Clark and Spengler, 1978). These measures simply relate the numbers in various age categories to one another. Some of these serve as measures of dependency of the elderly on their families, particularly their children, while others serve as measures of dependency on society as a whole. The former tend largely to be surrogates for measures of social and psychological support of the elderly, whereas the latter tend largely to be surrogates for measures of economic support. The ratio of persons 65-79 to persons 45-49 is a type of familial dependency ratio relating the elderly to their middle-aged children. The ratio of persons 80 and over to persons 60-64 is a type of familial dependency ratio relating the extreme aged to their young-old children. The prospective shifts in the age structure of the population suggest that the extent of the problem of familial support of the aged will fluctuate in the future, reflecting mainly past trends in fertility rates, and that, in general, it will tend to become greater than at present and at times serious (e.g., about 2020).

Age ratios are not very good indications of the level of familial dependency and serve to provide only rough indications of its trend. We can now derive only crude estimates at best of the direct measures, such as the proportion of elderly persons with one or more living children, especially daughters, or the proportions with one or more living siblings, one or more living grandchildren, or one or more living children who are themselves elderly. Direct national information on these important aspects of social support is needed. The decennial census is not a suitable instrument for securing information about relatives of household members not resident in the household and a national survey on kinship networks is needed. Such a study would not only identify the kinship networks but also measure the social contacts of elderly persons, including the effect of distance

and migration and the role of a variety of forms of communication.

SOCIETAL DEPENDENCY, WORK,  
RETIREMENT, AND USE OF TIME

*Societal Dependency*

Measures of societal dependency in the form of age ratios tend largely to be used as surrogates for measures of economic support even though they should be seen merely as representing the contribution of the age composition of the population to the economic support problem. The ratio of persons 65 and over to persons 18 to 64 is the commonest type of societal dependency ratio. Where the data are available, the ratio of elderly nonworkers to workers should be employed in lieu of mere age ratios to represent the economic dependency of the elderly. In either case, the level and trend of the economic burden of the dependent elderly needs to be considered in the context of the level and trend of the economic burden of the total dependent population, including children (Schulz, 1980; Clark and Spengler, 1980). While the rising dependency of the aged has been more than "offset" by the falling dependency of the children, the economic support problem of the elderly is the greater one when one considers public support only.

*Work Experience and Retirement Prospects*

The potential impact of the changing work experiences of women on their prospective situation in old age has been subjected to little analysis as compared to studies for men (Rix, 1979). Furthermore, the data available for assessing these impacts are inadequate. For example, past projections of labor force participation of women have persistently tended to underestimate the actual levels (Flaim and Fullerton, 1978). This may be a result of the fact that underlying theory has been lacking or defective. Rix predicts, for example, that there will be substantial increases in female workers ratios, even if the future rate of economic growth is low,

as a result of inflation, divorce, growing insecurity, coping with "enforced leisure" and loneliness, need to support an aged parent, lack of private pension coverage, and a possible statutory rise in age at which persons may receive benefits. By the time the baby boom cohorts begin to enter the retirement ages after 2010, we can expect greatly increased employment opportunities for women, if not a general labor shortage.

An important issue is the relative occupational status of males and females as it may affect the economic status of women in later life. Women may remain occupationally disadvantaged for more than a brief period if this disadvantage is measured in terms of the male-female difference in earnings. The signs are quite favorable for a rapid diminution of the inequity gap, at least with respect to educational opportunity and possibly with respect to the willingness of employers to hire female workers. The signs are less favorable for an early end to the inequality gap in the work status of the sexes. A major obstacle may be the limited availability of jobs in the professional and managerial job areas. Most of the new jobs that will be created are likely to be located in job areas where women have traditionally worked—ones which are neither remunerative nor prestigious. Up to now, women have been socialized to go into such jobs rather than professional and managerial jobs. A new task in counselling women is to impart to them a sense of responsibility for their own destiny, so that they will choose to prepare for occupations that provide greater rewards.

We can anticipate an evolution in the traditional life course pattern of education, work, and retirement which could result in substantial changes in this pattern (Morrison, 1978). The pattern is being reexamined in many quarters, especially by the National Commission for Employment Policy. Other patterns being considered involve alternating periods of study and work, punctuated by periods of leisure and keeping house, or simultane-

ous combinations of them. Periodic retraining will be essential to keep up with new technological developments and the "knowledge explosion"; by the year 2000 the average worker will have to be retrained at least twice in his/her lifetime to be able to continue in the "same" job.

It appears to me that a major revolution is in prospect with respect to the retirement situation of older women. This prospect is now adumbrated by rising labor force ratios, more continuous work history, more full-time work, changing attitudes about the employability of women, more remunerative occupational roles, and changes in domestic and labor law. Women may, in fact, actually tend toward an older retirement age than men in their efforts to put in enough years to qualify for adequate pensions (Sheppard and Rix, 1979).

The retirement situation and outlook for men are also undergoing change. More and more men are choosing early retirement as Social Security coverage has been extended, private pension plans have become more widespread, and the workers' pension status has become legally protected through ERISA. At the same time the nature of retirement has been changing as many employees "retire" to new full-time, part-time, or intermittent jobs, quit a principal job to continue in a second job previously held, or take on volunteer work on a regular basis. This outlook should be qualified by the prospect of countervailing influences, such as a possible rise in the "mandated" age of retirement if problems of financial solvency plague the Social Security system.

#### *Measurement of Retirement Changes*

There are a number of questions relating to retirement that merit the demographer's exploration. First, the concept lacks a standard operational definition. After specifying a lower age limit in later life, say age 50, and excluding withdrawals from the labor force due to deaths, the definition should still incorpo-

rate a particular concept of retirement because so many "retirees" continue to work part-time or even full-time. Retirement from the principal job of one's work career or receipt of a pension or annuity could be one basis. The data would only be useful if the "retirees" are classified according to their work status after retirement. The concept of retirement of women presents special problems which promise to diminish as worker ratios for women rise and become less irregular.

We need also to improve the basis of measuring the change in retirement age, now roughly inferred from changes in worker ratios. Tables of working life could be a useful tool for this purpose. They could be improved by incorporating separate mortality rates for persons in the labor force and those not in the labor force (prior to joining the labor force and after retirement); however, the basis for this refinement needs to be developed.

Generation tables of working life, such as those of Fullerton (1972a and 1972b), can give a more realistic assessment but, as for any cohort analysis, such tables require data over many years and the results cannot be assigned to a particular year. Kestenbaum has used the Continuous Work History Sample of the Social Security Administration to measure trends in retirement age (Kestenbaum, 1980). Longitudinal data on retirement, such as obtained in the Social Security Administration's retirement history study, are ideally informative about the process and experience of retirement (Ireland, 1972; Sherman, 1974). While it is costly to repeat such studies, we continue to need the kind of information which only such longitudinal studies can effectively provide.

#### *Retirement Policy*

The prospective changes in labor force participation and retirement practices and other prospective demographic changes, including particularly the increase in aged dependency ratios and in life expectation, have profound implications for retirement

policy. Because many demographic elements are involved, this is a particular area in which demographers can make a contribution. Demographers can identify and quantify the demographic factors which affect the solvency of the Social Security Trust Fund, can aid in evaluating their relative effects, and can help clarify the policy options relating to the management of the fund. This effort could include the trend analysis and projection of total and aged dependency ratios, economic dependency ratios, life expectancy, years of expected working life, and years of expected non-working life. It would be useful to have projections of employment (full-time and part-time work) and post-"retirement" labor force participation, in addition to the basic projections of the age-sex distribution of the population and the labor force.

The Social Security Trust Fund will be under increasing pressure as a result of economic (e.g., inflation), demographic, and social factors (e.g., rising expectations); however, the real crunch will come after 2010 when the baby-boom cohorts enter the older age bracket. To bolster the solvency of the Social Security Trust Fund, public policy could conceivably be designed to manipulate various demographic factors such as the death rate, the birth rate, labor force participation, the retirement age, and the pattern of work after "retirement." We need to design models of the effect on Social Security funding of extending life expectancy and work life for varying periods of time, in combination with shifts in the other factors, in order to evaluate these possible policies.

Contributions to retirement-age policy are also being made by those demographic analysts, among them Keyfitz (1973), Cantrell and Clark (1979), and Stewman (1980), who have examined the effect of demographic factors such as population growth rates, death rates, and worker ratios, and mandatory retirement and hiring-exit policy, on prospects for promotion. Cantrell and Clark have ana-

lyzed the extent to which rapid population growth contributes to opportunities for promotion and the extent to which raising the retirement age retards them or lowering it accelerates them. Their model can hopefully be extended so that it can be used to project the effect of prospective mortality, worker ratios, and mandatory retirement ages on the trend of promotion opportunities.

### *Use of Time*

There is need for national data on the use of time by the elderly. The demographer can play an important role by applying his/her skills in the design of an appropriate sample survey which would secure a variety of relevant demographic data in addition to data on the use of time. The orientation on the concept of major activity usually applied in censuses and surveys needs to be restructured for the elderly. The traditional classification on major activity includes working or looking for work, enrolled in school (graded system only), keeping house, unable to work, or retired. For elderly persons the categories of work need to include or distinguish volunteer and paid work; pre- or post-retirement work; enrollment in school outside the graded system; shopping and business visits; personal visits to friends, neighbors, and relatives; home entertainment; other leisure activities, etc.

### A FINAL NOTE

If you have followed the main drift of this discourse, you will recognize that, in addition to the confessed gerontologists among you, there is a little bit of the gerontologist in all of you. Nearly every one of you has dealt with time or age as a variable in demographic analysis, has been a student of the dynamics of population structure, or dabbled in subject fields having a particular concern with aging and old age, such as mortality and health, family structure and living arrangements, labor force participation, and income and poverty. As you see, you are all actual or

potential contributors to the demography of aging.

#### ACKNOWLEDGMENTS

The author wishes to thank three gerontologists, Nona J. Boren, Sally L. Hoover, and Anne S. Kahl, who provided helpful comments or stimulated his thinking on matters treated in the paper. He also wishes to thank Maria Davidson for professional assistance in its actual preparation. The author was spared the agony and missed the ecstasy of anticipating and acting upon comments by anonymous reviewers and so must forego this opportunity to thank them. It is a pleasure, however, to acknowledge the fine secretarial assistance of Mary J. Kisner. Finally, I wish to thank Conrad Taeuber for his gracious introduction at the Presidential Address Session of the PAA meeting in Denver, Colorado.

#### REFERENCES

- Abernathy, J. D. 1979. The Exponential Increase in Mortality Rate With Age Attributed to Wearing Out of Biological Components. *Journal of Theoretical Biology* 80:333-354.
- Acsádi, György and Janos Nemeskéri. 1970. History of Human Life Span and Mortality. Esp. Chap. IV, pp. 138-181. Budapest: Akadémiai Kiadó.
- Antonovsky, Aaron. 1979. Implications of Socioeconomic Differentials in Mortality for the Health System. Proceedings of the Meeting on Socioeconomic Determinants and Consequences of Mortality, Mexico City, June 19-25, 1979, pp. 483-502.
- Beaubier, Jeff. 1979. Lifespan Negentropy. Pp. 316-17 in Hajeme Oriono et al. (eds.), *Recent Advances in Gerontology*. Amsterdam: Excerpta Medica.
- Borkan, G. A. and A. H. Norris. 1980. Assessment of Biological Age Using a Profile of Physical Parameters. *Journal of Gerontology* 35:177-184.
- Bourgeois-Pichat, Jean. 1978. Future Outlook for Mortality Decline in the World. Pp. 12-41 in *Population Bulletin of the United Nations*, New York. Also published: United Nations. 1979. Projections of Population: Methodology and Assumptions. *Population Studies* 67:227-242.
- . 1979. La Transition Démographique: Vieillesse de la Population. *Conférence sur la Science au Service de la Vie*, Vienna, 1979 pp. 211-239. Liège: IUSSP.
- . 1980. Discussant statement. Proceedings of the Meeting on Socioeconomic Determinants and Consequences of Mortality. Mexico City, June 19-25, 1979, pp. 562-565. Geneva: World Health Organization.
- Brehm, Henry P. 1978. The Future of U.S. Health Care Delivery for the Elderly. Pp. 225-258 in B. Herzog (ed.), *Aging and Income: Programs and Prospects for the Elderly*. Gerontological Society Special Publication No. 4. New York: Human Sciences Press.
- Brown, K. S. and W. F. Forbes. 1976. Concerning the Estimation of Biological Age. *Journal of Gerontology* 22:428-437.
- Cain, Leonard D. 1974. The Growing Importance of Legal Age in Determining the Status of the Elderly. *The Gerontologist* 14:167-174.
- . 1979. Uses of "Counting Backward from Projected Death" by the Courts. Unpublished paper presented at the Annual Meeting of the Gerontological Society, Washington, D.C., November 25-29, 1979.
- Cantrell, R. Stephen and Robert L. Clark. 1979. Implications for Retirement Age Policy and Population Change on Individual Promotional Prospects. Unpublished paper presented at the Annual Meeting of the Gerontological Society, Washington, D.C., November 28-30, 1979.
- Clark, R. and J. J. Spengler. 1978. Changing Demography and Dependency Costs: The Implication of Future Dependency Ratios and Their Composition. Pp. 55-89 in B. Herzog (ed.), *Aging and Income: Programs and Prospects for the Elderly*. Gerontological Society Special Publication No. 4. New York: Human Sciences Press.
- . 1980. Chapter 3, Population Aging and Demography in: *The Economics of Individual and Population Aging*. Cambridge: Cambridge University Press.
- Clogg, C. C. 1979. The Dependence of Labor Force Statistics on Age, Time-Period, and Cohort. In: *Measuring Underemployment*. New York: Academic Press.
- Coale, Ansley J. 1956. The Effects of Changes in Mortality and Fertility on Age Composition. *Milbank Memorial Fund Quarterly* 34:79-114.
- . 1957. How the Age Distribution of a Human Population is Determined. *Cold Spring Harbor Symposia on Quantitative Biology* 22:83-89.
- . 1972. *The Growth and Structure of Human Populations*. Princeton: Princeton University Press.
- Comfort, Alexander. 1979. Space Gerontology. *Zeitschrift für Altersforschung* 34:147-152.
- Council of Europe. 1978. Population Decline in Europe: Implications of a Declining or Stationary Population. Proceedings of a seminar held in Strasbourg, September 1976. New York: St. Martin's.
- Cowgill, Donald. 1978a. The Future Location of the Elderly Population Within Metropolitan Areas. Pp. 200-206 in: *Consequences of Changing U.S. Population: Demographics of Aging*. Joint Hearings before the Select Committee on Population



- and the Select Committee on Aging, U.S. House of Representatives, Vol. 1, No. 9, May 24, 1978.
- . 1978b. Residential Segregation by Age in American Metropolitan Areas. *Journal of Gerontology* 33:446–453.
- Day, L. 1978. What Will a ZPG Society Be Like? *Population Bulletin* 33: No. 3. Washington, D.C.: Population Reference Bureau.
- Duncan, B. 1979. Change in Worker/Nonworker Ratios for Women. *Demography* 16:535–547.
- Espenshade, Thomas J. and William J. Serow (eds.). 1978. Economic Consequences of Slowing Population Growth. See especially Jeffrey Evans and Signe Wetrogan, The Demographic Dimension of Slowing Population Growth in the United States. New York: Academic Press.
- Farkas, George. 1977. Cohort, Age, and Period Effects Upon the Employment of White Females: Evidence for 1957–1968. *Demography* 14:33–42.
- Finch, Caleb B. and Leonard Hayflick. 1977. *The Biology of Aging*. New York: Van Nostrand Reinhold.
- Flaim, Paul and Howard Fullerton, Jr. 1978. Labor Force Projections to 1990: Three Possible Paths. *Monthly Labor Review* 101:25–35.
- Foote, N. N., J. Abu-Lughod, M. M. Foley, and L. Winnick (eds.). 1960. *Housing Choices and Housing Constraints*. New York: McGraw-Hill.
- Fullerton, Howard N. 1972a. A New Type of Working Life Table for Men. *Monthly Labor Review* 95:20–27.
- . 1972b. Sensitivity of Generation Tables of Working Life for Men to Different Projections of Labor Force Participation Rates and Mortality Rates. Proceedings of the Social Statistics Section, 1972. Washington, D.C.: American Statistical Association.
- Glenn, N. D. 1976. Cohort Analysts' Futile Quest: Statistical Attempts to Separate Age, Period, and Cohort Effects. *American Sociological Review* 41:900–904.
- Glick, P. C. 1979. The Future Marital Status and Living Arrangements of the Elderly. *The Gerontologist* 19:301–309.
- Gokalp, Catherine. 1978. *Le Reseau Familial*. *Population* 33:1077–1094.
- Golant, Stephen M. 1972. *The Residential Location and Spatial Behavior of the Elderly*. University of Chicago, Dept. of Geography Research Paper No. 143.
- . (ed.). 1979. *Location and Environment of Elderly Population*. Washington, D.C.: V. H. Winston.
- . 1980. Locational-Environmental Perspectives on Old-Age Segregated Residential Areas in the United States. D. T. Herbert and R. J. Johnston (eds.), *Geography and the Urban Environment: Progress in Research and Applications*. Vol. III. New York: Wiley.
- Gordon, Theodore T. 1979. Prospects for Aging in America. Pp. 179–196 in Matilda W. Riley (ed.), *Aging from Birth to Death. Interdisciplinary Perspectives*. Boulder, Colorado: Westview.
- Gutowski, Michael and Tracey Feild. 1979. *The Graying of Suburbia*. Washington, D.C.: Urban Institute.
- Haug, M. 1978. Aging and the Right to Terminate Medical Treatment. *Journal of Gerontology* 33:589–591.
- Havighurst, Robert J. and George A. Sacher. 1977. Prospects of Lengthening Life and Vigor. Pp. 13–18 in Bernice L. Neugarten and Robert J. Havighurst (eds.), *Extending the Human Life Span: Social Policy and Social Ethics*. Committee on Human Development, University of Chicago. Washington, D.C.: National Science Foundation.
- Hayflick, Leonard. 1977. Perspectives on Human Longevity. Pp. 1–12 in Bernice L. Neugarten and Robert J. Havighurst (eds.), *Extending the Human Life Span: Social Policy and Social Ethics*. Committee on Human Development, University of Chicago. Washington, D.C.: National Science Foundation.
- . 1979. The Cell Biology of Aging. *Journal of Investigative Dermatology* 73:8–14.
- Heltman, Lynne R. 1975. Mobility of the Aged in the United States. Unpublished paper presented at the Annual Meeting of the Population Association of America, Seattle, Washington, April 17–18, 1975.
- Hermalin, A. I. 1966. The Effect of Changes in Mortality Rates on Population Growth and Age Distribution in the United States. *Milbank Memorial Fund Quarterly* 44 Part 1:451–469.
- Hogan, D. P. 1978. The Variable Order of Events in the Life Course. *American Sociological Review* 43:573–586.
- Honig, Marjorie and Giora Hanoch. 1979. Age, Cohort, and Period Effects in a General Model of Labor Market Behavior of Older Persons. Unpublished paper presented at the Annual Meeting of the Gerontological Society, Washington, D.C., November 1979.
- Howell, Nancy. 1976. Toward a Uniformitarian Theory of Human Paleodemography. Pp. 25–40 in R.H. Ward and K.M. Weiss (eds.), *The Demographic Evolution of Human Populations*. London: Academic Press.
- Ireland, L. M. 1972. Retirement History Study: Introduction. *Social Security Bulletin* 35:3–15. United States Social Security Administration.
- Jackson, Jacquelyn J. 1980. *Minorities and Aging*. Belmont, California: Wadsworth.
- Kastenbaum, R. 1973. The 4-percent Fallacy: A Methodological and Empirical Critique of Extended Care Facility Population Statistics. *The International Journal of Aging and Human Development* 4:15–21.
- Kennedy, J. M. and G. F. DeJong. 1977. Aged in Cities: Residential Segregation in 10 U.S.A. Central Cities. *Journal of Gerontology* 32:97–102.
- Kestenbaum, Bert. 1980. Measuring Trends in Retirement Age: A New Application of the Continu-

- ous Work History Sample. Unpublished paper presented at the Annual Meeting of the Population Association of America, Denver, Colorado, April 10-12, 1980.
- Keyfitz, Nathan. 1973. Individual Mobility in a Stationary Population. *Population Studies* 27:335-52.
- . 1977a. *Applied Mathematical Demography*. New York: Wiley.
- . 1977b. What Difference Would It Make if Cancer Were Eradicated? An Examination of the Taeuber Paradox. *Demography* 14:411-418.
- . 1978. Improving Life Expectancy: An Uphill Road Ahead. *American Journal of Public Health* 10:954-956.
- Keyfitz, Nathan and Antonio Golini. 1975. Mortality Comparisons: The Male-Female Ratio. *Genus* 31:1-33.
- Kitagawa, Evelyn. 1977. On Mortality. *Demography* 14:381-389.
- Kitagawa, Evelyn M. and Philip M. Hauser. 1973. *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge, Massachusetts: Harvard University Press.
- Kovar, Mary Grace. 1978. Statement. Pp. 123-148 in *Consequences of Changing U.S. Population: Demographics of Aging*. Joint Hearings before the Select Committee on Population and the Select Committee on Aging, U.S. House of Representatives, Vol. 1, No. 9, May 24, 1978.
- Land, K. C. and M. M. McMillan. 1980. A Macrodynamical Analysis of Changes in Mortality Indexes in the United States, 1946-75: Some Preliminary Results. *Social Indicators Research* 7:1-46.
- Lee, R. 1974. Forecasting Births in Post-Transition Populations. *Journal of the American Statistical Association* 69:607-617.
- Lerner, Monroe and Richard N. Stutz. 1976. Socioeconomic Differentials in Mortality in Maryland, 1959-61 and 1969-71. Pp. 513-519 in *Proceedings of the Social Statistics Section, 1976*. Washington, D.C.: American Statistical Association.
- Longino, Charles F., Jr. and David J. Jackson (eds.). 1980. *Migration and the Aged*. Special issue of *Research on Aging*, A Quarterly of Social Gerontology. Vol. 2, No. 2, June 1980.
- Lopez, Alvaro. 1961. *Problems in Stable Population Theory*. Office of Population Research. Princeton: Princeton University.
- Lorimer, Frank. 1951. *Dynamics of Age Structure in a Population with Initially High Fertility and Mortality*. United Nations, Department of Social Affairs, Population Division, Bulletin No. 1.
- Lotka, Alfred J. 1939. *Théorie Analytique des Associations Biologiques, Deuxième Partie: Analyse Démographique avec Application Particulière à l'Espèce Humaine*. Paris: Hermann.
- McDonald, J. 1979. A Time Series Approach to Forecasting Australian Total Live-Births. *Demography* 16:575-601.
- McFarland, David D. 1978. The Aged in the 21st Century: A Demographer's View. In Lissy F. Jarvik (ed.), *Aging into the 21st Century: Middle-Agers Today*. New York: Gardner.
- Madigan, F. C. 1957. Are Sex Mortality Differentials Biologically Caused? *Milbank Memorial Fund Quarterly* 35:203-223.
- Manton, K. G. 1980. Sex and Race Specific Mortality Differentials in Multiple Cause of Death Data. *The Gerontologist* 20:480-493.
- Manton, K. G. and S. S. Poss. 1979. Effects of Dependency among Causes of Death for Cause Elimination of Life Table Strategies. *Demography* 16:313-327.
- Manton, K. G., S. S. Poss and S. Wing, 1979. The Black-White Mortality Crossover: Investigation from the Perspective of the Components of Aging. *The Gerontologist* 19:291-300.
- Manton, K. G., E. Stallard and S. S. Poss. 1980. Estimates of U.S. Multiple Cause Life Tables. *Demography* 17:85-102.
- Manton, K. G., H. D. Tolley and S. S. Poss. 1976. Life Table Techniques for Multiple Cause Mortality. *Demography* 13:541-564.
- Mason, W. M., K. O. Mason and H. H. Winsborough. 1976. Reply to Glenn. *American Sociological Review* 41:904-905.
- Michael, R. T., V. R. Fuchs and S. R. Scott. 1980. Changes in the Propensity to Live Alone: 1950-76. *Demography* 17:39-53.
- Morrison, Malcolm H. 1978. Flexible Distribution of Work, Leisure and Education: Potentials for the Aging. Pp. 95-127 in B. Herzog (ed.), *Aging and Income: Programs and Prospects for the Elderly*. Gerontological Society Special Publication No. 4. New York: Human Sciences Press.
- Morrison, Peter A. 1979. *The Future Demographic Context of the Health Care Delivery System*. A Rand Note. Santa Monica, California: Rand Corporation.
- Myers, George C. 1978a. Future Age Projections and Society. *Proceedings of the World Conference on Aging: A Challenge and Social Policy*, April 1977, Vichy, France. Paris: Institut de la Vie.
- . 1978b. Cross-National Trends in Mortality Rates Among the Elderly. *The Gerontologist* 18:441-448.
- Nam, Charles B. and Kathleen A. Ockay. 1978. Factors Contributing to the Mortality Crossover Pattern; Effects of Developmental Level, Overall Mortality Level, and Causes of Death. *Proceedings: International Population Conference, Mexico, 1977*. Liege: IUSSP.
- Nam, C. B., N. L. Weatherby and K. A. Ockay. 1978. Causes of Death Which Contribute to the Mortality Crossover Effect. *Social Biology* 25:306-314.
- Neugarten, Bernice L. 1974. Age Groups in American Society and the Rise of the Young-Old. Pp. 187-198 in Frederick R. Eisele (ed.), *Political Consequences of Aging*. The Annals of the American Academy of Political and Social Science, No. 415.

- Pollard, John. 1973. *Mathematical Models for the Growth of Human Populations*. Cambridge, Mass.: Cambridge University Press.
- Pressat, Roland. 1973. *Surmortalité Biologique et Surmortalité Sociale*. *Revue Française de Sociologie* 14 (Special issue):103-110.
- Pressey, S. 1977. Any Rights as to my Dying? *The Gerontologist* 17:296.
- Preston, Samuel. 1974. Demographic and Social Consequences of Various Causes of Death in the United States. *Social Biology* 21:144-162.
- Pullum, Thomas W. 1978. Parametrizing Age, Period, and Cohort Effects: An Application to U.S. Delinquency Rates, 1964-1973. Pp. 116-140 in Karl F. Schuessler (ed.), *Sociological Methodology*. San Francisco: Jossey-Bass.
- Retherford, Robert D. 1975. *The Changing Sex Differential in Mortality*. Westport, Connecticut: Greenwood.
- Rice, Dorothy P. 1978. Projection and Analysis of Health Status Trends. Unpublished paper presented at the Annual Meeting of the American Public Health Association, Los Angeles, California, October 17, 1978.
- Riley, Matilda W. 1979. Aging, Social Change, and Social Policy. Pp. 109-120 in M.W. Riley (ed.), *Aging from Birth to Death: Interdisciplinary Perspectives*. Boulder, Colorado: Westview.
- Riley, M. W., M. Johnson and A. Foner. 1972. *Aging and Society, Vol. 3. A Sociology of Age Stratification*. New York: Russell Sage.
- Rix, Sarah. 1979. Presentation before Congresswomen's Caucus, October 30, 1979, unpublished document.
- Robin, Ellen P., Gerald E. Markle and Stanley S. Robin. 1979. *Toward a Theory of Age Differences: Cohorts, Master Cohorts, and Social Generations*. Unpublished paper presented at the Annual Meeting of the Gerontological Society, Washington, D.C., November 25-29, 1979.
- Rosenfeld, Albert. 1976. *Prolongevity*. New York: Knopf.
- Ryder, Norman B. 1964. *The Process of Demographic Translation*. *Demography* 1:74-82.
- . 1965. The Cohort as a Concept in the Study of Social Change. *American Sociological Review* 30:843-861.
- . 1975. Notes on Stationary Population. *Population Index* 41:3-28, esp. pp. 16-17.
- . 1977. Methods in Measuring the Family Life Cycle. Pp. 219-226 in *Proceedings: International Population Conference, Mexico 1977*. Liege: IUSSP.
- Saboia, J. L. M. 1977. Autoregressive Integrated Moving Average (ARIMA) Models for Births Forecasting. *Journal of the American Statistical Association* 72:264-270.
- Schneider, Edward L. (ed.). 1978. *The Genetics of Aging*. New York and London: Plenum.
- Schoen, R. and K. C. Land. 1979. *A General Algorithm for Estimating a Markov-Generated Increment-Decrement Life Table With Applications to Marital Status Patterns*. *Journal of the American Statistical Association* 74:761-776.
- Schulz, James H. 1980. *The Economics of Aging*, Second edition, esp. chap. 1, *Changing Populations and Retirement Expectations*, pp. 10-11. Belmont, California: Wadsworth.
- Shanas, E. 1979. Social Myth as Hypothesis: The Case of the Family Relations of Old People. *The Gerontologist* 19:3-9.
- Sheppard, Harold L. and Sara E. Rix. 1979. *The Employment Environment and Older Worker Job Experience*. Final AIR Report for the Administration on Aging.
- Sherman, S. R. 1974. Labor Force Status of Non-married Women on the Threshold of Retirement. *Social Security Bulletin* 37:3-15. United States Social Security Administration.
- Shryock, Henry S. 1964. *Population Mobility Within the United States*. Community and Family Study Center, University of Chicago, p. 394.
- Siegel, Jacob S. 1978. Prospective Trends in the Size and Structure of the Elderly Population, Impact of Mortality Trends and Some Implications. Pp. 71-121 in *Consequences of Changing U.S. Population: Demographics of Aging*. Joint Hearings before the Select Committee on Population and the Select Committee on Aging, U.S. House of Representatives, Vol. 1, No. 9, May 24, 1978. Reprinted in U.S. Bureau of the Census, *Current Population Reports, Series P-23, No. 78, 1979*.
- . 1980a. Recent and Prospective Demographic Trends for the Elderly Population and Some Implications for Health Care. Pp. 289-315 in Susan H. Haynes and Manning Feinleib (eds.), *Proceedings of the Second Conference on the Epidemiology of Aging* (in press). Washington, D.C.: National Heart, Lung, and Blood Institute and National Institute on Aging.
- . 1980b. *Balancing the Sexes*. *American Demographics* 2(8): 4,50.
- Siegel, Jacob S. and Edwin Fonner. 1976. *Relation Between Changes in Age-Specific Death Rates and Changes in Life Expectancy*. Unpublished paper presented at the Annual Meeting of the American Public Health Association, Miami Beach, Florida, 1976.
- Smith, Shirley J. 1980. *1977 Working Life Tables: Substantive and Methodological Implications*. Unpublished paper presented at the Annual Meeting of the Population Association of America, Denver, Colorado, April 10-12, 1980.
- Soldo, Beth J. 1978. Living Arrangements of the Elderly: Future Trends and Implications. Pp. 209-230 in *Consequences of Changing U.S. Population: Demographics of Aging*. Joint Hearings before the Select Committee on Population and the Select Committee on Aging, U.S. House of Representatives, Vol. 1, No. 9, May 24, 1978.
- . 1979. *A Demographer's Overview on Aging and Health of the Elderly*. Presentation before the Congresswomen's Caucus, October 30, 1979.
- Spanier, G. B. and P. C. Glick. 1980. *The Life Cycle*

- of American Families: An Expanded Analysis. *Journal of Family History* 5:97-111.
- Spengler, Joseph J. 1978. *Facing Zero Population Growth: Reactions and Interpretations Past and Present*. Durham: Duke University Press.
- Stewart, Shelby. 1980. The Aging of Work Organizations: Impact on Organization and Employment Practice. In James Morgan, James March, and Valerie Oppenheimer (eds.), *The Elderly of the Future* (in press). Washington, D.C.: National Research Council/National Academy of Sciences.
- Strehler, B. L. 1979. Aging Research: Current and Future. *Journal of Investigative Dermatology* 73:2-7.
- Trussell, James. 1980. Social and Demographic Influences on Marriage Dissolution in the U.S.: Applications of Proportional Hazards Life Table Models. Unpublished paper presented at the Annual Meeting of the Population Association of America, Denver, Colorado, April 10-12, 1980.
- Uhlenberg, Peter. 1979. Demographic Change and Problems of the Aged. Pp. 153-166 in Matilda White Riley (ed.), *Aging from Birth to Death: Interdisciplinary Perspectives*. Boulder, Colorado: Westview.
- United Nations, Department of Social Affairs, Population Division. 1954. *The Cause of the Aging of Populations: Declining Mortality or Declining Fertility*, Population Bulletin No. 4.
- U.S. Bureau of the Census. 1977. *Projections of the Population of the United States, 1977 to 2050 by Campbell Gibson*, Current Population Reports, Series P-25, No. 704.
- . 1978a. Demographic Aspects of Aging and the Older Population in the United States by Jacob S. Siegel. Current Population Reports, Series P-23, No. 59.
- . 1978b. Geographical Mobility: March 1975 to March 1978. Current Population Reports, Series P-20, No. 331.
- . 1978c. 1976 Survey of Institutional Persons, a Study of Persons Receiving Long-Term Care. Current Population Reports, Series P-23, No. 69.
- . 1979. Reasons for Interstate Migration by Larry H. Long and Kristin A. Hanson. Current Population Reports, Series P-23, No. 81.
- U.S. Office of the Actuary, Social Security Administration. 1978. *United States Population Projections for OASDHI Cost Estimates by F. R. Bayo, H. W. Shiman, and B. R. Sobus*, Actuarial Study No. 77.
- Verbrugge, L. M. 1976. Sex Differentials in Morbidity and Mortality in the United States. *Social Biology* 23:275-296.
- Waldron, I. 1976. Why Do Women Live Longer Than Men? Part I, *Journal of Human Stress* 2:2-13, March 1976.
- Waldron, I. and S. Johnston. 1976. Why Do Women Live Longer Than Men? Part II, *Journal of Human Stress* 2:19-29, June 1976.
- Westoff, C. F. and R. R. Rindfuss. 1974. Sex Preselection in the United States: Some Implications. *Science* 184:633-36.
- Williams, Robert H. (ed.). 1973. *To Live and to Die: When, Why, and How*. New York: Springer-Verlag.
- Williamson, N. 1978. Boys or Girls? Parents' Preferences and Sex Control. *Population Bulletin*, Vol. 33, No. 1, Population Reference Bureau.
- Wiseman, Robert F. 1978. *Spatial Aspects of Aging*. 43 pp. Washington, D.C.: Association of American Geographers.