

TRENDS IN MORTALITY AND LIFE EXPECTANCY¹

by DOROTHY G. WIEHL

MOST men and women approaching the age of fifty probably believe, if they think about it at all, that their chance of living to a ripe old age is much greater than the chance their parents had and undoubtedly greater than that of their grandparents. They have heard or read about the great advances which have been made in the science of medicine and are aware of the conquest of many diseases that plagued former generations, such as cholera, yellow fever, smallpox, typhus, typhoid, and malaria. It is common knowledge that death rates have been declining in all parts of the country for periods of twenty-five to fifty years and the residents of most communities view with justifiable satisfaction this evidence of the improved healthfulness of their community. What everybody does not know is that the gross death rate is an average index of mortality for *all* ages. It does not apply to persons fifty years old because the death rate at that age differs widely from the rate at twenty-five, let us say. Even though the gross death rate is declining, it is possible for the rate among some age groups to be stationary or increasing, and that is exactly what is happening in the United States. Mortality among infants, children, and young adults has declined strikingly, but, among older adults, death rates have actually increased during the past half-century.

The records necessary for the study of mortality trends over a long period of years are not available for the entire United States. Not until 1900 was the collection of death records begun by the United States Bureau of the Census,

¹From the Division of Research, Milbank Memorial Fund.

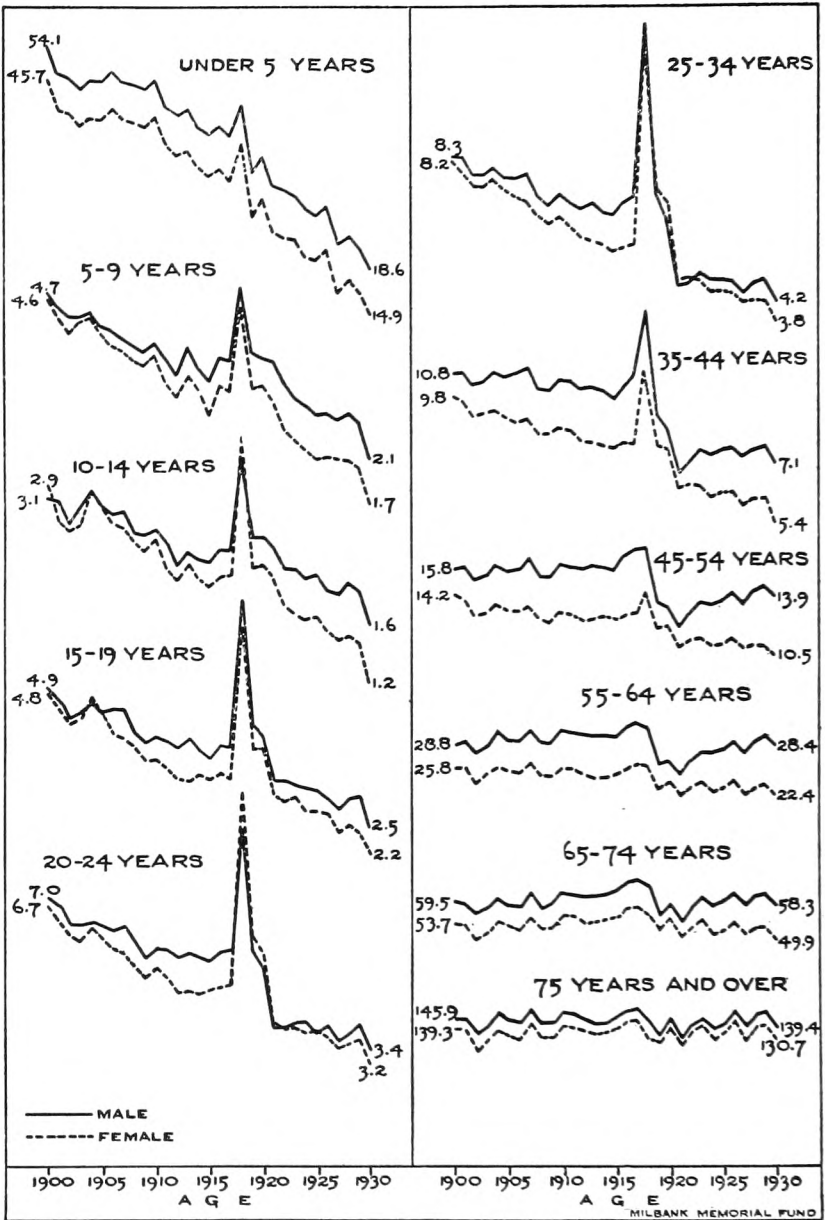


Fig. 1. Trends in mortality among persons of different sex-age groups in the registration states of 1900, 1900-1930. A logarithmic ordinate scale is used to indicate the rate of change by the slope of the line. The figures inserted are deaths per 1,000 population at the beginning and end of the period.

and then only for ten states (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Michigan, and Indiana) and the District of Columbia. For these states, death rates among specific sex and age groups are shown graphically in Figure 1 for the thirty-one years from 1900 to 1930. For longer periods, registration of deaths in a number of cities and a few states has been fairly complete. Massachusetts affords a fairly large population for which early mortality records are available and the annual death rates according to sex and age have been compiled² for the period 1868 to 1930 and are presented in Figure 2.

The series of lines in Figures 1 and 2 show the relative changes that have occurred in the death rates for various age and sex groups. The rates have been plotted in such a way (on logarithmic scales) that the slope of the line indicates a proportionate change and every line is directly comparable with every other line. We are thus able to judge whether or not the rate of decline for any group has been greater or less than that for any other.

Some of the major indications, as regards the general course or trend of mortality, especially as found in the Massachusetts charts, may be summarized briefly, as follows:

1. During the years from 1868 to about 1890, mortality rates for the younger age groups fluctuated about an approximate level, and for ages above forty the rates were increasing.
2. Since 1890, a marked decline in the rates for each age group under forty has been in progress.
3. Among *men* between forty and sixty years of age, the high mortality level reached between 1890 and 1900

²Data were taken from the *Annual Reports* of the State Department of Health of Massachusetts for the years 1868 to 1899 and 1912, 1913, and from the reports, "Mortality Statistics," of the United States Bureau of the Census for other years.

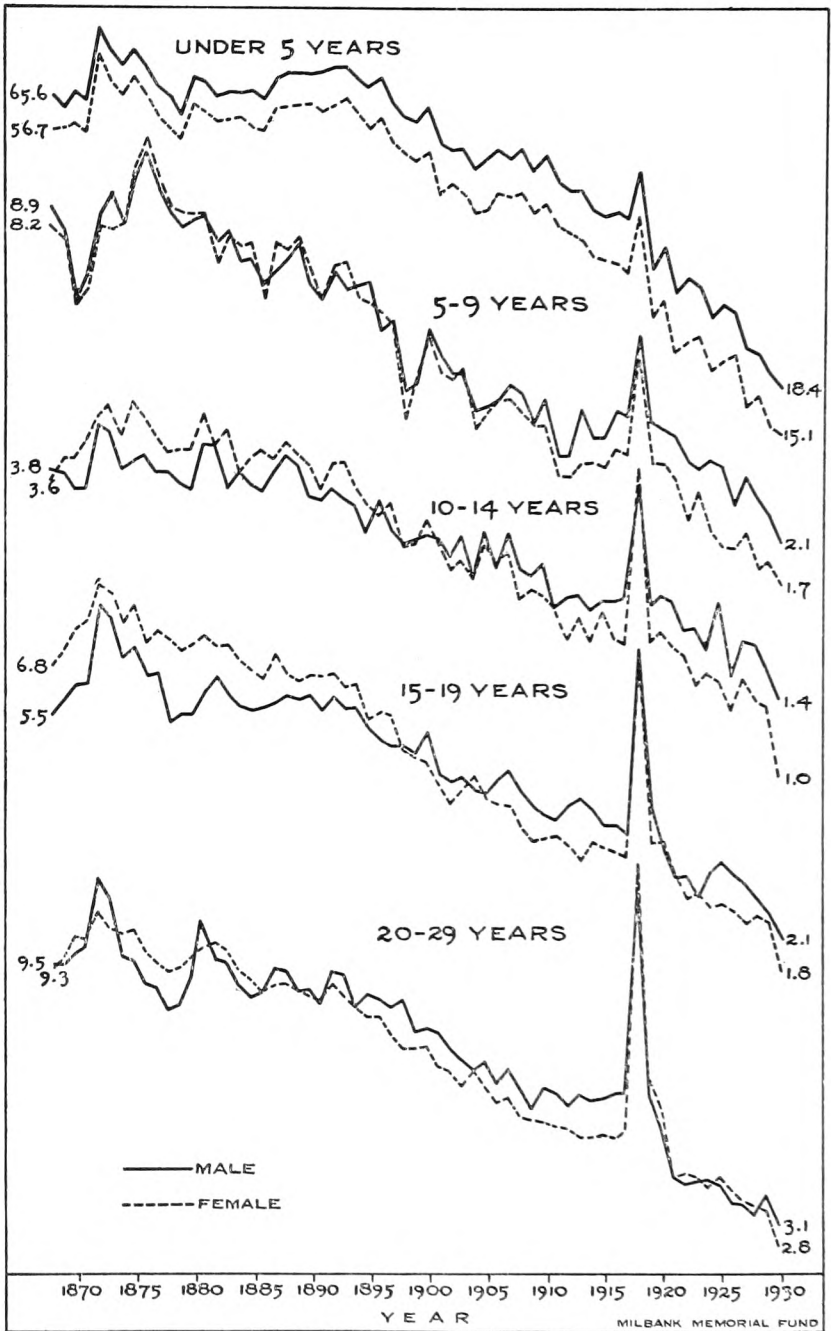
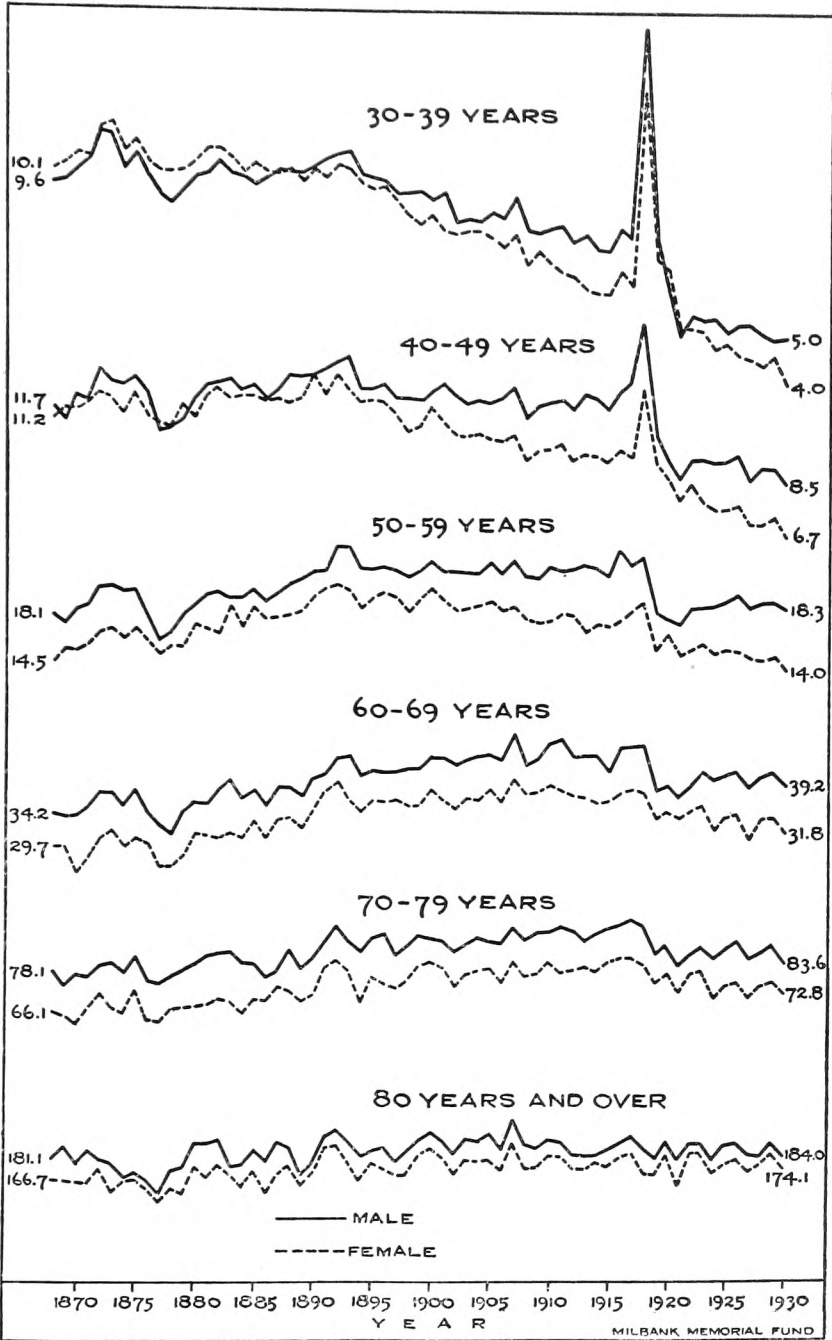


Fig. 2. Trends in mortality among persons of different sex-age groups in Massachusetts, 1868-1930. A logarithmic (continued on page 65)



ordinate scale is used. The death rate per 1,000 population is given for the first and last year of the period.

Table 1. Abstract of life tables for the Original Death Registration States and Massachusetts, 1929.¹

AGE	NUMBER OF PERSONS SURVIVING TO CERTAIN AGES FROM 100,000 LIVE BIRTHS OF EACH SEX				COMPLETE EXPECTATION OF LIFE IN YEARS			
	Original Registration States		Massachusetts		Original Registration States		Massachusetts	
	Male	Female	Male	Female	Male	Female	Male	Female
0	100,000	100,000	100,000	100,000	56.81	60.36	58.11	61.36
1	92,980	94,416	93,101	94,583	60.06	62.90	61.38	63.86
2	91,952	93,510	92,015	93,715	59.72	62.50	61.10	63.43
3	91,396	93,015	91,464	93,246	59.08	61.83	60.46	62.75
4	90,996	92,667	91,132	92,901	58.34	61.06	59.68	61.98
5	90,676	92,381	90,855	92,622	57.55	60.25	58.86	61.16
6	90,403	92,146	90,606	92,390	56.72	59.40	58.02	60.32
7	90,163	91,941	90,380	92,198	55.87	58.53	57.17	59.44
8	89,951	91,759	90,173	92,030	55.00	57.65	56.30	58.55
9	89,758	91,596	89,985	91,883	54.12	56.75	55.41	57.64
10	89,581	91,447	89,810	91,744	53.22	55.84	54.52	56.73
11	89,414	91,313	89,649	91,615	52.32	54.92	53.62	55.81
12	89,255	91,184	89,497	91,490	51.41	54.00	52.71	54.88
17	88,302	90,450	88,726	90,773	46.94	49.42	48.14	50.29
22	86,830	89,060	87,470	89,582	42.69	45.15	43.79	45.93
27	85,117	87,448	85,959	88,155	38.50	40.93	39.52	41.63
32	83,226	85,680	84,277	86,510	34.31	36.72	35.26	37.37
37	80,853	83,647	82,305	84,580	30.24	32.55	31.04	33.17
42	77,921	81,263	79,806	82,445	26.29	28.43	26.93	28.96
47	74,121	78,172	76,373	79,640	22.50	24.45	23.02	24.89
52	69,081	74,196	71,801	75,874	18.95	20.62	19.30	20.99
57	62,466	68,645	65,655	70,601	15.68	17.08	15.88	17.36
62	53,966	61,258	57,203	63,233	12.74	13.83	12.84	14.08
67	43,875	51,709	46,541	53,630	10.08	10.89	10.20	11.14
72	32,303	39,821	34,607	41,879	7.79	8.39	7.84	8.54
77	20,612	26,820	21,877	28,605	5.79	6.22	5.94	6.32
82	10,201	14,205	10,969	15,429	4.27	4.59	4.50	4.65

¹Constructed by the method described in Newsholme, Sir Arthur, and Stevenson, Dr. T. H. C., The Graphic Method of Constructing a Life Table Illustrated by the Brighton Life Table 1891-1900. *Journal of Hygiene*, 1903, iii, p. 297 ff.

continued without change until 1917. In 1919 and 1920, the death rates dropped well below this level, but, in the last decade (1921-1930), the general tendency has been

upward again. The rates for men forty to forty-nine years of age are now somewhat lower than the death rates of 1870 and those for men fifty to fifty-nine years of age are about the same as in 1870.

4. Among *women* between forty and sixty years of age, the trend in mortality during the past thirty years has been slightly downward, but at a much slower rate than among women in the younger age groups. The mortality experience for women aged forty to fifty-nine years is in striking contrast to that of men.

5. Above sixty years of age, the general trend of mortality throughout this sixty-year period has been slightly upward for both men and women.

What is the influence of these changes in mortality on the length of life of the population? The answer is best obtained from a comparison of early and recent life tables and is made possible by the construction of 1929 tables for Massachusetts and the Original Registration States given in Table 1. The first part of the table shows for each sex the number of persons which would survive to certain ages from 100,000 born alive, if they were subjected to the mortality hazards of 1929. The survivors at each age obviously depend on the specific mortality of all younger ages. The second part of the table relates to the expectation of life and indicates simply the *average* number of additional years persons of given ages would live if they were subjected to 1929 mortality risks. Unlike the number of survivors, the expectation of life for any age depends on the specific mortality rates of all older ages.

The effect of the declining death rates for young persons on the number of survivors at various ages is readily seen from Figure 3 which compares the survival curves for the Original Registration States for 1929 and for the three-year period centering on 1901. The sharp drop in infant and child

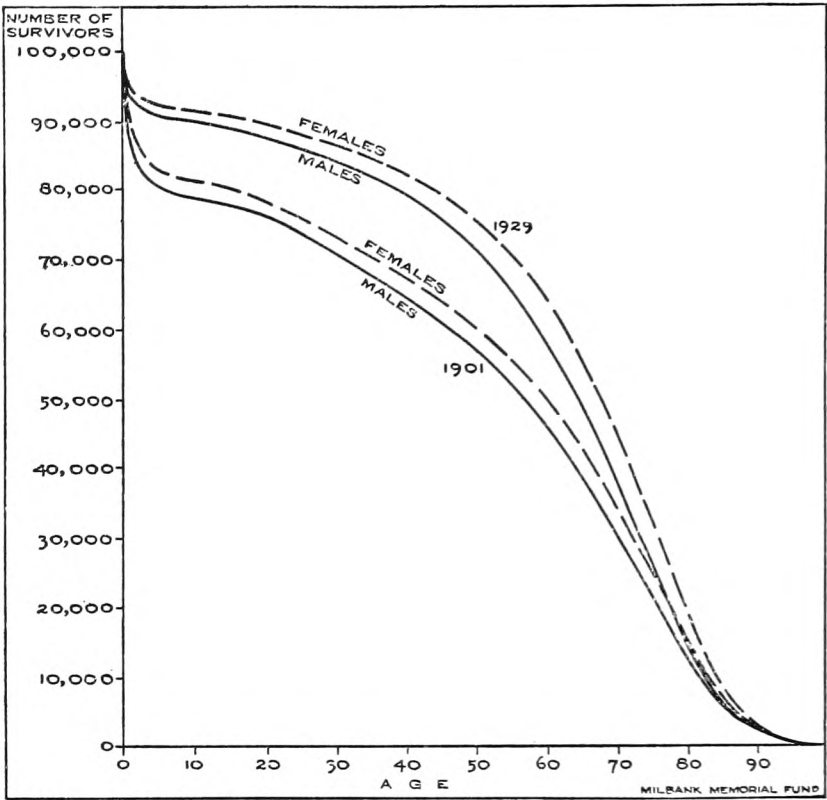


Fig. 3. Number of survivors to each age from 100,000 liveborn persons of each sex, for the Original Death Registration States in 1901 and 1929.

The data for 1901 are from *United States Life Tables, 1890, 1901, 1910, and 1901-1910*, and those for 1929 are from Table I.

mortality during this time resulted in 10,128 more of our initial 100,000 male "life table babies" reaching their fifth year, and the same changes, together with the favorable mortality trends in late childhood and the early adult years, brought 14,545 more of them to their fiftieth year. Similar increases in the number of female survivors were 9,262 and 15,519 respectively. The improvement continued to the advanced ages but became rapidly smaller, due partly to the absence of further favorable changes in mortality, but prin-

cipally to the fact that more people had to die in the older ages, since more survived to them.

The expectation of life at birth summarizes more effectively the mortality at specific age periods throughout life. A boy baby born in 1929 has, according to this computation, an expectation of life of 56.81 years, and a girl baby 60.36 years. These babies had prospects of 8.93 and 9.66 more years of life respectively on the basis of the 1929 experience than on that of 1901 (Fig. 4), the gains representing in each case an increase of about 19 per cent in the twenty-eight years.

At no age after birth were the increases in the expectation of life so great, although they remained exceptionally large during the first five years and important during the first thirty. This is the result of two facts: (1) the largest improvement in mortality occurred in the ages of infancy and early childhood, and (2) deaths avoided in infancy raise the average expectation of life much more than those avoided later in life. At age forty-two, the 1929 expectation of life for men was about the same as that for 1901, and at each older age, it was somewhat lower than in 1901, reflecting the slight rise in mortality rates for all ages over fifty-five. The 1929 expectations of life for women remained higher than those in 1901 through the fifty-sixth year, and then declined only a little below the corresponding figures for the beginning of the century, as a result of favorable mortality trends in all groups under seventy-five years of age. Since the mortality rates of 1929 were somewhat higher than those of either 1928 or 1930, attention should be centered in the case of both sexes on the absence of an improvement in the length of life of middle-aged and older persons, rather than on its slight decline.

Changes in the expectation of life since the beginning of the past decade are also shown in Figure 4, but since the years 1919 and 1920 experienced a relatively low mortality

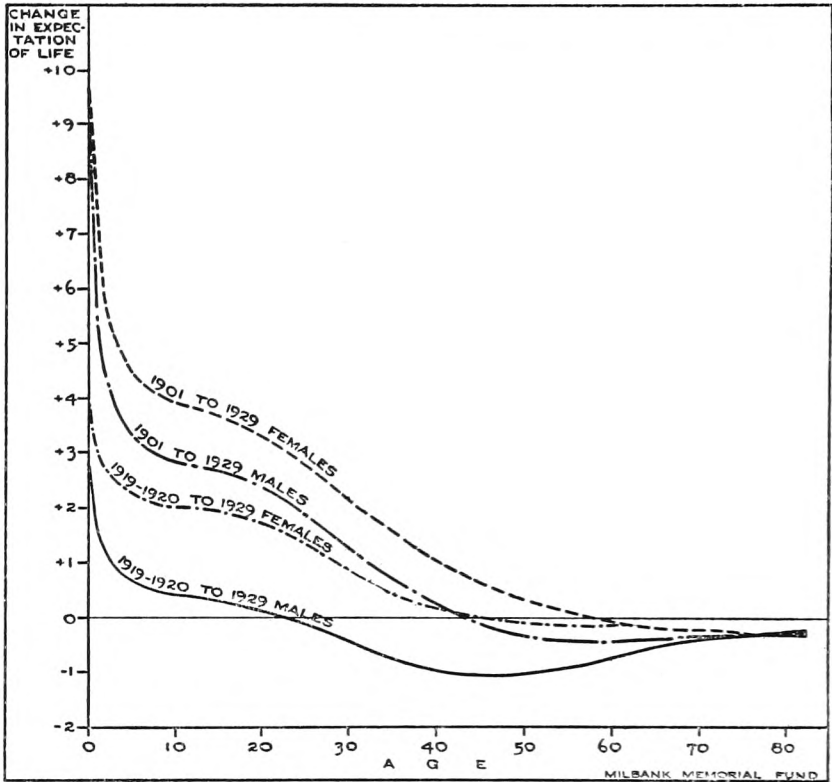


Fig. 4. Changes in the expectation of life of each age and sex between 1901 and 1929, and between 1919-1920 and 1929, for the Original Death Registration States.¹

and 1929 had higher death rates than either 1928 or 1930, the comparison tends to minimize the gains and maximize the losses. Even under these circumstances, the expectation of life at birth increased remarkably for both sexes, and that for women of each age up to thirty showed substantial gains. In the case of men, however, all the important gains took

¹The years of increase in the expectation of life are shown by the distance above the base line and those of decrease by that below. After the first year, the lines representing changes between 1919-1920 and 1929 are graphic interpolations between the ages ending in two and seven, for which the expectations are shown in Foudray, Elbertie: *United States Abridged Life Tables, 1919-1920*. The source of the remaining data employed in this figure is given in the caption for Figure 3.

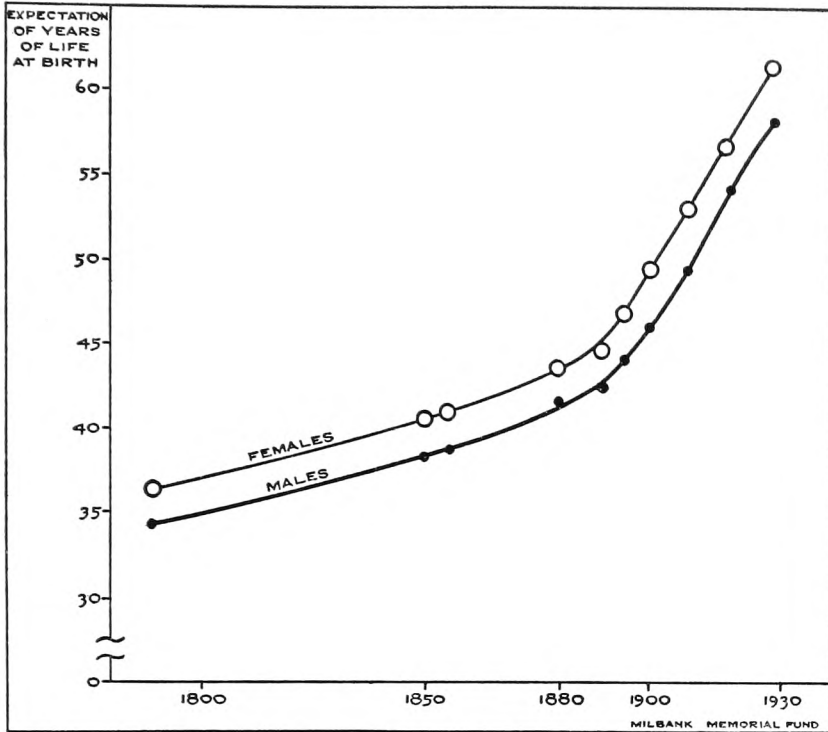


Fig. 5. Trend in the expectation of life at birth in Massachusetts, 1789 to 1929, as shown by various life tables.¹

place at ages under ten years, and after thirty there were severe losses, resulting from the rise during the decade of the mortality of males over thirty-five years of age.

Thus far, attention has been confined to the life tables for the Original Registration States which only carry us back to the beginning of the century. The tables for Massachusetts, however, go back to 1789, and permit us to view the more recent increases in the expectation of life at birth in a

¹The data for 1850, 1878-1882, and 1893-1897 are taken from a compilation of life tables presented in "A Historical Retrospect on the Expectation of Life—II," *Statistical Bulletin*, Metropolitan Life Insurance Company, March, 1928, ix, No. 3, pp. 5-8, and those for 1789 and 1855 are estimated from the expectations given in the same article for the population undifferentiated by sex. The expectations for 1890, 1901, and 1910 are taken from the *United States Life Tables, 1890, 1901, 1910, and 1901-1910*, and those for 1919-1920 from Foudray, Elbertie: *United States Abridged Life Tables, 1919-1920*. Data for 1929 are from Table 1.

larger perspective. Figure 5 assembles the material from the available tables of the eighteenth, nineteenth, and twentieth centuries. The early tables were doubtless inexact, but they serve well enough to give us the general picture. From 1789 until approximately 1890, there appears to have been a gradual increase in the average length of life, but, at the end of the century, a rapid acceleration began which developed by 1900 into an upward sweep that thus far shows no definite signs of breaking. That so rapid an increase in the average length of life will continue for another decade is not at all probable. Progress thus far has come largely from the tremendous improvements in infant and child mortality. As the death rates in these ages approach a minimum, further gains will probably come more slowly and, unless present trends are reversed, even these gains will be offset to some extent by the rising mortality rates of the middle and older ages.