

tried out by several companies along commercial lines.

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CHANGES IN LONGEVITY OF AMERICANS IN THE LAST DECADE

EVIDENCE was given by the writer in the issue of SCIENCE of July 7, 1916, in the form of abridged mortality tables to show that the average length of life has been increasing for the whole span of life for both sexes of the registration area of this country, at least ever since the federal government began to compile statistics which could be safely used in the construction of such tables. The same tables showed also, however, that this improvement in longevity was being realized in spite of a deterioration or retrogression at certain advanced ages and that the average length of life corresponding to those advanced ages was less in 1910 than it had been for at least twenty years. The record of the females seemed, however, to be a little more promising than that of the males because the retrogression of that sex was less pronounced in the decade from 1900 to 1910 than from 1890 to 1900 while in the case of the males it was a little more pronounced except that, as also in the case of the females, slight evidence appeared in the last decade of a "come back" at the extremely advanced ages.

The purpose of this paper is to extend the results of the paper just mentioned to include those of 1920. It will be noticed that the record of both sexes shows remarkable changes. Although the explanation of the method¹ of constructing abridged mortality tables and the mortality tables themselves are omitted here it should be said that whereas the populations were necessarily changed slightly during the earlier investigation in order to include the year 1890 this investigation includes only the years 1900, 1910 and 1920. The mortality tables then were constructed from the population and mortality statistics of each of the three years just mentioned for the ten registration states, Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire,

New Jersey, New York, Rhode Island and Vermont. Since the tables are constructed from the statistical data of single years and without any process of smoothing it is well to repeat the statement of the earlier paper that no claims are made in regard to the accuracy of the absolute results. Attention is called merely to the *trend* of the death rates and longevity. Moreover, it is obvious that the conclusions of this paper refer particularly to the populations of the states included in the investigation but should apply in a general way to populations of states of the same general geographical area. The abridged list of death rates and corresponding differences are as follows:

DEATH RATES PER 10,000					
AGES	1900	DIFF.	1910	DIFF.	1920
FEMALES					
10	39	— 9	30	— 4	26
20	58	—15	43	+ 3	46
30	83	—20	63	+ 6	69
40	98	—14	84	— 3	81
50	143	—11	132	—10	122
60	262	+ 2	264	—15	249
70	549	+20	569	— 1	568
80	1206	+44	1250	—25	1225
MALES					
10	39	— 7	32	— 2	30
20	60	—12	48	— 3	45
30	83	—13	70	— 8	62
40	109	— 3	106	—23	83
50	159	+ 8	167	—35	132
60	293	+22	315	—34	281
70	606	+27	633	—29	604
80	1323	+45	1368	—36	1332

There is substantial agreement of the results of this paper and of the earlier paper cited above for the decades covered by both papers although it will be noticed on comparison that the ages considered are different. Thus, the death rates of females decreased for ages 50 and below but increased at the higher ages for the decade 1900 to 1910. In the decade from 1910 to 1920, however, two remarkable results are to be noticed. First, there is a substantial decrease in death rate at that period of advanced ages at which there has always been a retrogression. Second, an unexpected retrogression in the neighborhood of ages 20 to 30 is indicated. The latter is surprising because both males and females have never before in the previous twenty years failed to register a significant reduction in the death rate at all the earlier ages. It is especially surprising that this retrogression should occur among the females when we recall that the females al-

¹ October, 1919, Bulletin of the American Mathematical Society.

most always surpass the males in longevity and general health improvement. It is to be hoped that someone can offer an explanation of this retrogression.

The apparent sudden break in the differences in death rates at age 70 for this decade is a little disconcerting and is probably due to inaccuracy in the statistical data. When, however, we consider that the death rates given above are computed practically independent of each other it is more surprising perhaps that more "breaks" are not encountered.

The record of the males is also very unusual. Although the death rates decreased at ages 40 and below and increased at higher ages in the decade from 1900 to 1910, as was found in the earlier investigation, the death rates for the decade from 1910 to 1920 not only decreased at every age but decreased the most by far at the very ages at which there has always been a retrogression before; moreover, the decrease is much greater at those ages than in the case of the females. The improvement is so great at the advanced ages that the writer investigated the mortality statistics of 1919 and found them in substantial agreement. It should be stated parenthetically that since the population statistics are collected but once in a decade the mortality tables could be constructed only for the years considered without the employment of an undesirable scheme of interpolation for the population statistics.

The table of expectations of life is as follows:

EXPECTATIONS OF LIFE					
AGES	1900	DIFF.	1910	DIFF.	1920
FEMALES					
10	50.8	+1.9	52.7	+ .2	52.9
20	43.0	+1.5	44.5	+ .1	44.6
30	35.7	+ .8	36.5	+ .4	36.9
40	28.6	+ .3	28.9	+ .4	29.3
50	21.5	0	21.5	+ .3	21.8
60	15.0	— .2	14.8	+ .1	14.9
70	9.6	— .2	9.4	+ .1	9.5
80	5.6	— .1	5.5	0	5.5
MALES					
10	49.7	+ .7	50.4	+1.9	52.3
20	41.8	+ .4	42.2	+1.8	44.0
30	34.5	— .1	34.4	+1.7	36.1
40	27.5	— .5	27.0	+1.4	28.4
50	20.6	— .5	20.1	+ .9	21.0
60	14.2	— .3	13.9	+ .4	14.3
70	9.0	— .1	8.9	+ .1	9.0
80	5.2	0	5.2	0	5.2

The values of the expectations of life afford little further information and serve mainly to show the total effect of changes in death rates at certain ages upon the prospect of

earlier ages. Thus, although both sexes show an increase in the expectation of life at earlier ages and a decrease at the advanced ages with the females far in the advance as to general improvement in the decade from 1900 to 1910 the order in improvement is completely changed in the decade from 1910 to 1920. The males increase their expectation of life by almost two years at age 10 and since the expectation of life is approximately the same in all mortality tables at the age of birth and age 10 we have here a good estimate in the increase in the whole span of life. The increase in the expectation of life at the successive ages is also very substantial. In the case of the females there is an increase in the expectation of life at all ages but the increase is almost negligible. It is important, however, that there is no period of retrogression at all and it is evident that the increase would have been really significant if it had not been for the unexpected and unusual retrogression in death rates in the neighborhood of ages 20 and 30.

The writer gladly passes on to others the problem of explaining the great improvement at the advanced ages for both males and females or the "set back" at the earlier ages of the females in the last decade. Some claim that an unusually large number of the physically unfit (tubercular, etc.) was eliminated during the period of the war and this might well explain the improvement at the advanced ages. It would be interesting to know how much credit is due to agencies—like the Life Extension Institute, the Y. M. C. A., etc.—which are definitely devoted to the task of improving the health of the mature individual. Some will give much credit to prohibition and there may be considerable justification but it should be recalled in that connection that the last amendment did not go into anything like complete effect until some time after the first of the year (1920) whose mortality statistics form the basis of the results we are just considering.

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THE OKLAHOMA-TEXAS BOUNDARY SUIT

THE Oklahoma-Texas boundary suit, in which a decision has recently been rendered by the Supreme Court of the United States, was of more than ordinary interest by reason of the large property values involved, the considerable