

LIFE TABLES FOR CHINESE FARMERS

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NO one can properly understand the enormous difficulties facing the introduction of Western sanitation and medicine into China, or of changing the political, economic, and cultural life of the country without taking into consideration the vital forces of birth and death which are at the roots of many of the most serious problems presented in that country. Neither is there any better way to gain an appreciation of what modern sanitation, medicine, and technical achievement have done for health in the West than to study the hazards of life among the peasants who constitute about 85 per cent of the population of China, and perhaps one-sixth of the population of the world, and who as yet are virtually untouched by these developments.

Much has been written about health in China but, due to the absence of official registration of deaths, virtually all such discussions are based on the impressions of students familiar with the country, upon isolated studies of single communities or upon data from sections of large cities into which Western culture has penetrated. It is believed that the following tables present for the first time a picture of mortality conditions for a large section of the rural Chinese population.

The opportunity to collect population and vital statistics of areas representative of rural China on a larger scale than has hitherto been possible was afforded by the study of land utilization made by Professor J. Lossing Buck of the University of Nanking for the China Council of the Institute for Pacific Relations. With the assistance of the Milbank Memorial Fund, additional data were secured relating, among other things, to the age and sex distribu-

¹ From the Milbank Memorial Fund. Acknowledgment is gratefully made to Professor Lowell J. Reed of The Johns Hopkins University for his advice concerning the statistical procedures used in this study.

tion of the living population and of the people who died during the survey year. These data, which were collected under the direction of Professor Chi-ming Chiao, were coded in China and forwarded to the Fund for tabulation and analysis.²

The material was collected during the years 1929-1931 by the sampling survey method. University students selected, from districts with which they were personally familiar, areas that they considered to be typical of the various types of rural communities. These areas, with populations ranging from 396 to 6,260 inhabitants, were then enumerated as completely as possible by residents of the districts, who had been trained for the task and whose work was supervised. Altogether the survey included 119 localities in seventeen provinces and yielded information for 46,601 families.

Examination of the crude birth and death rates for individual areas made it clear that in spite of the care taken to obtain reliable data a number of areas had been inaccurately enumerated. Some of the rates were impossibly low, indicating a failure on the part of certain enumerators to record all of the births and deaths. Such a finding is not surprising when we consider the obstacles facing the investigation of an illiterate and superstitious population by enumerators with little experience in making field studies and only a hazy idea of the use to which their reports would be put. The surprising thing is not that the survey was poor in a few areas but that it was apparently so reliable in the great majority of areas, so far as can be judged by internal evidence.

In order to secure as accurate information as possible, a somewhat arbitrary procedure was adopted by which the data were rejected for those areas in which it was most obvious that a sub-

² For further details about the study and for a preliminary analysis of the data secured from 12,456 families enumerated early in the investigation, see: Chiao, Chi-ming: *A Study of the Chinese Population*. Reprinted from the *Milbank Memorial Fund Quarterly Bulletin*, xi, No. 4, October, 1933, and from the *Quarterly*, xii, No. 1-3, January, April, and July, 1934.

stantial proportion of the births or deaths had been omitted. If, after making ample allowance for the fact that low rates might be due to specific local conditions or to chance errors arising from small numbers, the birth and death rates appeared unbelievably low, the area was rejected.³ There were eighteen such areas but with two exceptions they were ones enumerated early in the investigation on a schedule form which was later changed. The highest birth and death rates on the basis of which any area was rejected were 20.1 and 10.2 respectively.

This rejection leaves 101 areas (Fig. 1) for which we have the records of a living population of 105,427 males and 97,190 females and of 2,817 male deaths and 2,682 female deaths with which to construct the rural Chinese life tables. The lowest birth and death rates in the 101 areas retained were 10.8 and 9.7 respectively, while for all areas combined the crude birth rate was 38.3 and the crude death rate 27.1. It is probable that even these rates are lower than the actual conditions warrant since the areas were

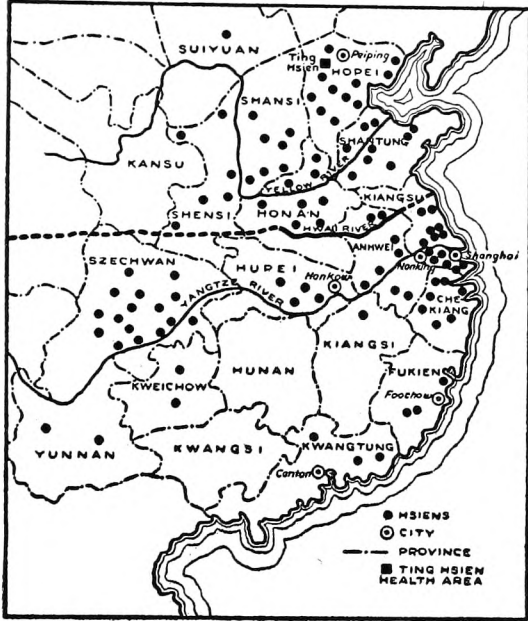


Fig. 1. Location of areas from which the population data used in this study were secured.

³ The actual procedure was to rank the areas which had been enumerated on the revised schedule in the orders of their crude birth and death rates and to select the first quartiles. Curves whose points were the first quartiles minus 3σ were then plotted for a series of n 's. When either the birth or death rate of any area fell below the curves, the area was rejected.

retained whenever it appeared possible that the low rates might be due to sampling errors. Doubtless some of them were actually due to faulty enumeration. This is also suggested by the fact that the infant mortality rate found by the survey was 156 while in Ting Hsien where the registration system is well established it was 199 in 1933.⁴ The actual infant mortalities may differ since the survey areas are scattered all over China while Ting Hsien is only a single county. However, the crude birth and death rates of 38.3 and 27.1 found by the survey were very close to those of 40.1 and 27.2 reported in Ting Hsien.⁵ In general, such evidence as there is suggests that, while the survey data present a somewhat over-optimistic picture of the mortality conditions in rural China, they are, on the whole, surprisingly reliable.

The life tables for India,⁶ Japan,⁷ the United States, and New Zealand⁸ have been selected for comparison with those for rural China. India was chosen as an Oriental country having a dense population and low standards of living in which Western sanitation and medicine still remain unavailable to the great majority of the population. However, it is more largely tropical than China. Japan is included as the Oriental country which has introduced Western sanitation, medicine, and technical procedures most rapidly. New Zealand was selected as the country with the most favorable mortality experience and the United States as the one

⁴ Ch'en, C.C., M.D., M.P.H.: *Public Health in Rural Reconstruction at Ting Hsien*. The Milbank Memorial Fund *Quarterly*, October, 1934, xii, No. 4, p. 374.

⁵ *Ibid.*

⁶ CENSUS OF INDIA, 1931. Delhi, India, Manager of Publications, 1933, Vol. I, Part I Report, pp. 173-174.

⁷ Saito, H.: *Sur la Table de Mortalité des Japonais*. No. 4, xix^e, Session de l'Institut International de Statistique, Tokio, 1930.

⁸ The life tables for the United States and New Zealand were generously furnished by the Statistical Bureau of the Metropolitan Life Insurance Company. Those for the United States relate to the white population of the 1929 Death Registration States during the period 1929-1931, and were published in abridged form in "The Longevity of Our Neighbors in Canada," *Statistical Bulletin*, Metropolitan Life Insurance Company, November, 1933, xiv, No. 11, p. 2. Those for New Zealand appeared in "New Zealand Tops the World for Longevity," *Statistical Bulletin*, Metropolitan Life Insurance Company, May, 1934, xv, No. 5, p. 6.

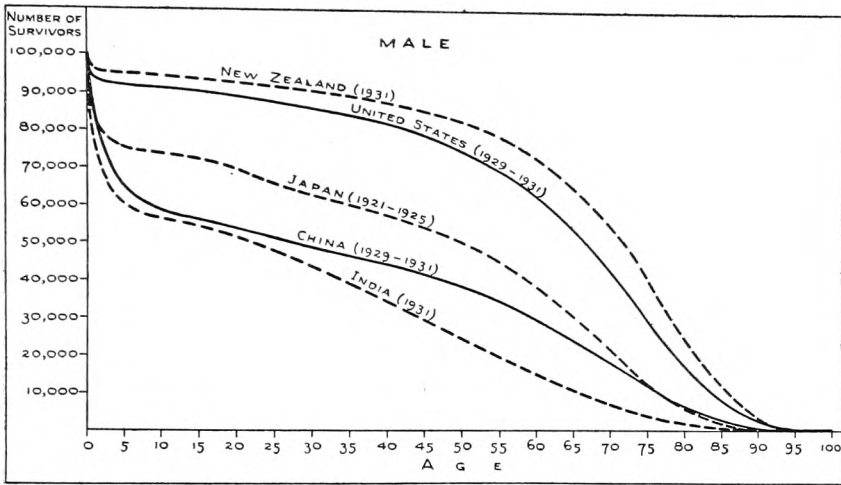


Fig. 2. Number of male survivors at each age out of each 100,000 born alive.

with which we are most familiar. It is unfortunate that in all four of these countries the tables relate to the whole population and not, as in China, simply to the rural groups. The tables for New Zealand and the United States are the most accurate. Those for Japan are less accurate but probably better than those for either India or China. The data on which the Indian tables are based evidently are far from satisfactory. Like those for China, they probably understate the true force of mortality.

In interpreting the life tables to follow it must be borne in mind that they merely express the mortality experience of a population observed during a short period of time *as if it were* that of a generation passing through life. Actually the two are the same only if mortality does not change for the period of a lifetime. In a country like China any generation passing through life would be exposed in some degree to the hazards of famine, floods, wars, and epidemics. The data gathered by a survey during a relatively uneventful three-year period will not reflect the decimating effects of such catastrophes.

Figures 2 and 3 and Tables 4 and 6 present the number of survivors at specified ages from 100,000 persons of each sex born

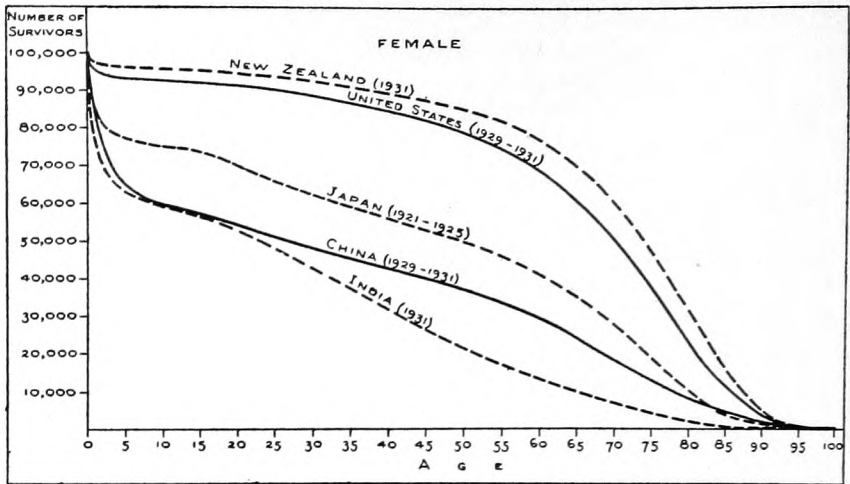


Fig. 3. Number of female survivors at each age out of each 100,000 born alive.

alive, *i. e.*, the l_x functions of the life tables. Since the number of survivors at any age is affected by the mortality hazards of all preceding ages through which they have passed, the curves for the countries start together but separate rapidly as the mortality rates of individual countries take their different tolls. From the first there are more survivors in New Zealand than in the United States and many more in the United States than in Japan. Except for the first year of life, Japan in turn has many more survivors than China, thanks to its lower child mortality. In both China and India the number of survivors is tremendously reduced during the first ten years. In the first year of life the reduction is much greater in India than in China but for the remainder of the first ten years it is apparently greater in China than in India. After thirty the numbers of survivors in India drop far below those in China.

A more definite picture of the hazards of life during the first year is given in Table 1 which shows the probability of dying between birth and the end of the first year of life. This, it will be recalled, amounts to an infant death rate expressed in terms of one instead of the usual one thousand births. Unfortunately,

the rates are likely to be among the least reliable of all, particularly in the case of China and India, because of the difficulty of securing complete enumeration of infant deaths. However,

Table 1. Probability of dying between birth and age 1, by sex, for various countries.

Country	Date	Probability of Dying Between Birth and Age 1	
		Male	Female
New Zealand	1931	.0384	.0255
United States	1929-1931	.0609	.0482
Japan	1921-1925	.1620	.1440
Rural China ¹	1929-1931	.1615	.1549
India	1931	.2487	.2323

¹ The differences between these figures and those obtained by dividing the infant deaths by the number of births are insignificant.

no close scrutiny is required to see that the differences are large. The mortality during the first year of life is between one and one-half and two times as high in the United States as in New Zealand, nearly three times as high in Japan as

in the United States, and more than one and one-half times as high in India as in Japan. In China, according to the table, it is about the same as in Japan, but actually it is probably higher though by no means as high as in India. Without making any allowance for understatement in the tables, male infant mortality is about four times as high in China as in New Zealand and that for females is about six times as high.

In New Zealand and the United States the number of female survivors from 100,000 births is greater than the number of male survivors to the same age throughout the entire table (Table 4). In all three of the Oriental countries, however, there is a considerable period beginning between ages 20 and 30 when the numbers of male survivors exceed those of females. The source of this difference is clearly shown in Figure 4 which permits a comparison of the male and female probabilities of dying (q_x values) for a series of ages beginning with ten. In the two Western countries female death rates are generally a little lower than those for males, but in the Oriental countries the death rates are substantially higher for females throughout the entire childbearing period, and even longer in the case of India where the dif-

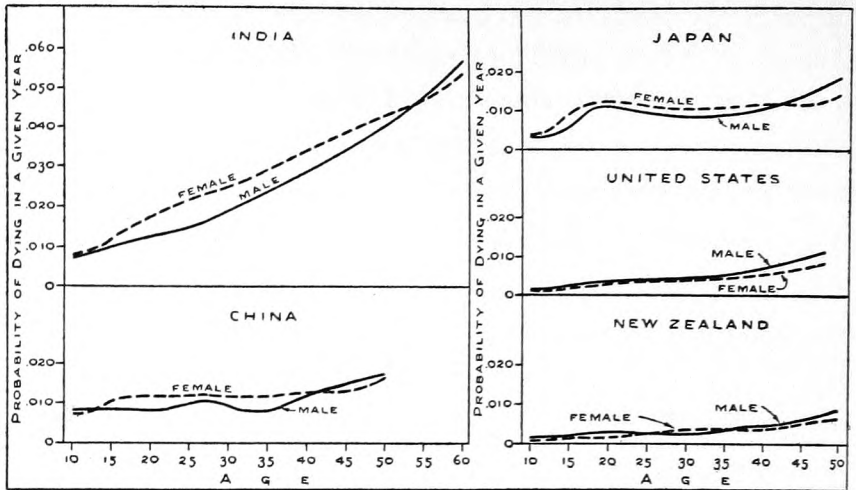


Fig. 4. Male and female probabilities of dying in a given year at selected ages.

ference is most marked. This excessive female mortality during the reproductive period arises doubtless in large part from almost continuous childbearing in an environment of abject poverty and ignorance.

Especial interest attaches to the age at which 50,000 people still survive from 100,000 born alive, that is the age to which a baby born alive has an even chance of survival; or, putting it another way, the median (middle) age at death of a group starting life. This age, which is called "the probable duration of life," is given in Table 2 for each of the countries under consideration. The differences are startling. One-half of the people born in India scarcely attain their majority, and one-half of those born in China die before they are 28. In New Zealand, on the other hand, one-half of those born surpass even the Biblical standard of seventy years. In that country the prob-

Table 2. Age to which one-half of the persons born alive survive, by sex, for various countries.

Country	Date	Age to Which One-Half of Those Born Survive	
		Male	Female
New Zealand	1931	71.6	73.9
United States	1929-1931	66.5	70.0
Japan	1921-1925	50.3	49.1
Rural China	1929-1931	28.0	26.3
India	1931	21.8	23.0

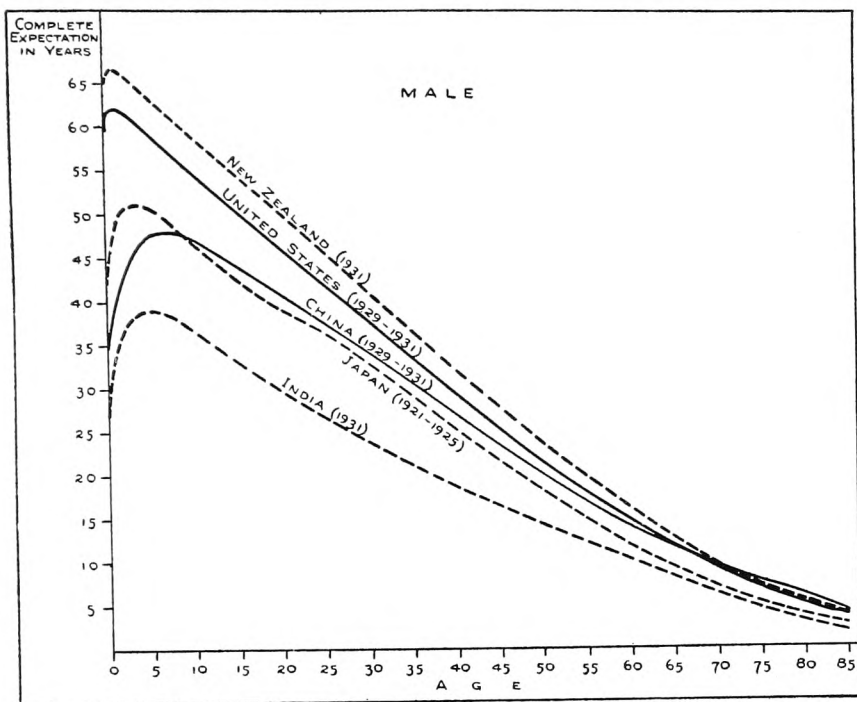


Fig. 5. Complete expectation of life in years for males at each age.

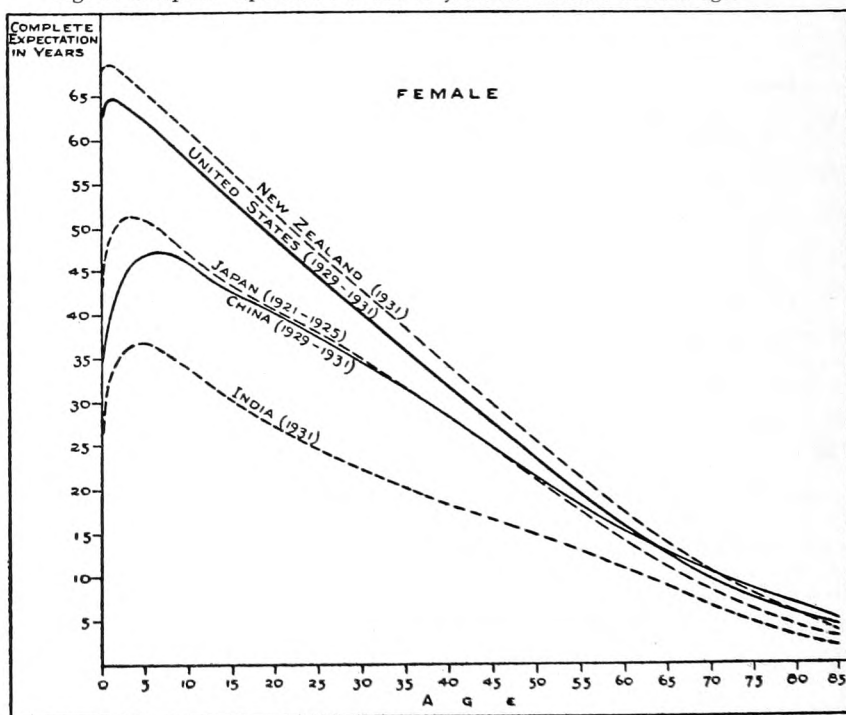
able duration of life is more than two and one-half times as long as in China, and more than three times as long as in India. When we see that in China one-half of the females born alive die before they are 26 years of age, we begin to appreciate how high the fertility of those who do survive must be to maintain a growing population.

The complete expectation of life at birth, like the probable duration of life, summarizes the mortality conditions of a country by showing the average length of life, but the average used is the arithmetic mean (common average) instead of the median. The probable duration of life is more interesting to the individual since it tells him the age to which he has an even chance of surviving, but the expectation of life is better known because of its usefulness to insurance companies which require an average that, when multiplied by the number of persons, will yield the

exact number of person-years to be lived by the insured group. The arithmetic mean which gives weight to extremes is the only average that has this property. This expectation of life, or arithmetic mean of the number of years lived, is given for the time of birth and for each succeeding age in Tables 5 and 6 and Figures 5 and 6. It must be remembered that, unlike the survival values which are influenced by mortality rates at all earlier ages, the expectation of life for any age is affected by the mortality rates of all later ages.

The expectation of life at birth (Table 3) is particularly interesting because it summarizes the effect of the mortality experience of all ages. Unfortunately, it is also less reliable than the expectancy for later ages, because of the difficulty of securing accurate data on infant mortality. However, it appears probable that the expectancy of females at birth does not exceed that of males

Fig. 6. Complete expectation of life in years for females at each age.



in China and India, as it does in the other countries. This is due principally to the excessive female mortality occurring, as we have already seen, in the childbearing period. It also is clear that

Table 3. Complete expectation of life at birth in years, by sex, for various countries.

Country	Date	Complete Expectation of Life at Birth in Years	
		Male	Female
New Zealand	1931	65.04	67.88
United States	1929-1931	59.31	62.83
Japan	1921-1925	42.06	43.20
Rural China	1929-1931	34.85	34.63
India	1931	26.91	26.56

life expectancy at birth in China is more favorable than in India and less favorable than in Japan, where, in turn, it is much less favorable than in either the United States or New Zealand.

In Japan today it is about the same as it was in Massachusetts forty-five years ago; while in China today it is not much different than it was in Massachusetts and New Hampshire nearly 150 years ago.⁹

In all three of the Oriental countries the maximum expectation of life occurs at a later age than in New Zealand and the United States due to the very high death rates of childhood. In China, apparently, this maximum is not reached until about age seven. After age ten the curves for China and Japan differ little. In fact, in the case of the males, the Chinese expectancies exceed the Japanese. Probably this difference is not real since, as has already been pointed out, the Chinese data tend to exaggerate the actual expectancies. However, it is clear that for ages after ten the expectations of life in China are greater than in India, not radically different than in Japan, and throughout the early adult ages much less than in the United States and New Zealand.¹⁰

⁹ Sydenstricker, Edgar: HEALTH AND ENVIRONMENT. New York and London, McGraw-Hill Book Company, Inc., 1933, p. 164.

¹⁰ The life expectancies shown here for ages after twenty are higher than those found by Dr. I-chin Yuan in his "Life Tables for a Southern Chinese Family from 1365 to 1849." (*Human Biology*, May, 1931, iii, No. 2, pp. 157-179.) However, the two studies are scarcely comparable. His most recent tables which are based on genealogical records and begin at age twenty, relate to persons born between 1800 and 1849 and to a population living near Canton, a district from which little of the material of the

(Continued on page 235)

Table 4. Number of survivors out of 100,000 born alive for each sex at selected ages for various countries.

AGE	NEW ZEALAND 1931 ¹		UNITED STATES 1929-1931 ²		JAPAN 1921-1925 ³		INDIA 1931 ⁴	
	Male	Female	Male	Female	Male	Female	Male	Female
0	100,000	100,000	100,000	100,000	100,000	100,000	100,000	100,000
1	96,165	97,452	93,914	95,179	83,796	85,600	75,126	76,766
2	95,730	97,090	92,986	94,350	79,736	81,528	68,230	70,127
3	95,442	96,876	92,490	93,911	77,654	79,386	64,380	66,576
4	95,242	96,679	92,145	93,601	76,369	78,004	61,856	64,314
5	95,086	96,491	91,869	93,362	75,567	77,110	60,161	62,817
10	94,466	95,934	90,973	92,629	73,749	75,102	56,467	59,369
20	92,956	94,868	89,099	91,125	69,336	69,379	51,203	52,833
30	90,580	92,522	85,944	88,195	62,950	61,885	43,931	42,675
40	87,388	89,288	81,685	84,468	57,618	55,536	34,563	31,778
50	82,240	84,959	74,528	78,795	50,267	49,411	24,348	21,464
60	72,353	76,884	62,170	68,643	38,517	41,055	14,933	13,210
70	54,007	59,969	42,091	50,073	21,591	27,465	7,036	6,627
80	24,727	30,960	17,339	23,094	5,806	10,109	1,514	1,631
90	3,268	4,410	2,371	3,756	279	727	17	22

¹ See footnote 8.³ See footnote 7.² See footnote 8.⁴ See footnote 6.

Table 5. Complete expectation of life in years for each sex at selected ages for various countries.

AGE	NEW ZEALAND 1931 ¹		UNITED STATES 1929-1931 ²		JAPAN 1921-1925 ³		INDIA 1931 ⁴	
	Male	Female	Male	Female	Male	Female	Male	Female
0	65.04	67.88	59.31	62.83	42.06	43.20	26.91	26.56
1	66.61	68.64	62.12	64.99	49.14	49.42	34.68	33.48
2	65.91	67.89	61.73	64.55	50.62	50.86	37.14	35.60
3	65.11	67.04	61.06	63.85	50.96	51.22	38.33	36.48
4	64.24	66.18	60.29	63.06	50.81	51.12	38.88	36.75
5	63.35	65.30	59.47	62.22	50.35	50.71	38.96	36.61
10	58.75	60.67	55.03	57.70	46.53	47.00	36.38	33.61
20	49.61	51.28	46.07	48.55	39.10	40.38	29.57	27.08
30	40.78	42.45	37.57	39.99	32.59	34.69	23.60	22.30
40	32.07	33.80	29.25	31.53	25.13	28.09	18.60	18.23
50	23.73	25.24	21.54	23.41	18.02	20.95	14.31	14.65
60	16.22	17.30	14.73	16.05	11.87	14.12	10.25	10.81
70	9.87	10.63	9.22	9.98	7.11	8.44	6.35	6.74
80	5.45	5.63	5.27	5.66	3.87	4.41	3.13	3.25
90	1.89	2.00	2.88	3.11	1.95	2.04	1.12	1.18

¹ See footnote 8.³ See footnote 7.² See footnote 8.⁴ See footnote 6.

AGE	NUMBER OF SURVIVORS		COMPLETE EXPECTATION OF LIFE IN YEARS	
	Male	Female	Male	Female
0	100,000	100,000	34.85	34.63
1	83,850	84,506	40.28	39.70
2	75,392	75,658	43.63	43.17
3	70,452	70,639	45.58	45.13
4	67,065	67,316	46.81	46.29
5	64,541	64,909	47.58	46.95
6	62,636	63,123	47.98	47.23
7	61,206	61,748	48.07	47.25
8	60,093	60,729	47.93	47.02
9	59,272	59,960	47.57	46.60
10	58,670	59,431	47.05	46.00
15	56,232	57,020	43.93	42.80
20	53,834	53,885	40.74	40.08
25	51,531	50,814	37.40	37.29
30	48,983	47,840	34.16	34.40
35	46,925	45,064	30.51	31.30
40	44,716	42,395	26.84	28.05
45	41,880	39,732	23.41	24.70
50	38,715	37,000	20.04	21.26
55	34,865	33,581	16.85	17.96
60	29,642	29,207	14.19	15.22
65	23,908	24,103	11.75	12.69
70	18,050	18,200	9.42	10.67
75	11,602	12,806	7.71	8.72
80	6,557	8,071	6.08	6.80
85	3,116	4,073	4.02	5.16
90	584	1,508	2.34	3.32

Table 6. Number of survivors out of 100,000 born alive and complete expectation of life in years for each sex at selected ages, for rural China 1929-1931.

In the adult ages the life expectancies of the various countries come closer together until by age fifty they are much the same in all of the countries except India. The triumph of Western science over the mortality of childhood and youth has been so dramatic that we often forget in our enthusiasm that today life expectancy at fifty remains about the same as it was 150 years ago. The Chinese who survive the hazards of youth and early adult life

present survey was drawn. Moreover, it relates to the mortality experience of a generation while that in this study deals with the experience of persons of different ages during a survey year. Mortality from catastrophes such as famine, flood, war, and epidemics is more likely to be reflected in genealogical than in survey data.

can look forward to nearly as many additional years of life as the residents of the healthiest Western countries.¹¹

The general picture of rural China presented by these tables, although probably more optimistic than the situation warrants, is anything but encouraging. Extremely high mortality rates in infancy, childhood, and early adult ages make life at best precarious. Of the countries considered, only tropical India presents a worse situation.

¹¹ Sydenstricker, Edgar: *Op. cit.*, p. 164.