into the peritoneal cavity of a guinea-pig Jan. 24th, 1900. The guinea-pig was chloroformed on April 6th. With an emulsion of its spleen two other guinea-pigs were inoculated intra-peritoneally on the same date. One of these was chloroformed on April 28th and cultures were made. Growth was observed first on June 23rd and cultures were made the same day. Growth was abundant and luxuriant.

Culture U (human) was obtained from a child, three years of age, whose death was due to tuberculous meningitis. At the necropsy the lungs and bronchial lymphatic glands were full of miliary tubercles. The anterior mediastinal glands were much enlarged. The spleen was extensively involved, but the liver less so. On the abdominal surface of the diaphragm were a number of flat yellow nodules. The mesenteric glands were enlarged and contained old yellow, cheesy nodules. One small tubercle was found in the right suprarenal body. Purulent and cheesy nodules were found in the meninges and in the encephalon. The culture was obtained from the mesenteric glands. The pathologist, Dr. Hand, was uncertain as to the origin of this case. Guinea-pigs were inoculated intra-peritoneally on June 15th, 1900. One was killed on July 23rd and with its tissues a second was inoculated intra-peritoneally. This was chloroformed on Sept. 12th and cultures were made. On Oct. 11th, no growth having taken place, the blocks of tissue were transferred to fresh serum and stirred. On Dec. 4th growth was first observed and on Dec. 15th sub-cultures were made. Growth has since been rapid and abundant.

Culture W (human). Obtained from a child nine months old, of scrofulous parentage. The cervical glands on both sides were enlarged. At the necropsy a double bronchopneumonia was found. One small tuberculous nodule was found on the surface of the left lung and several at the apex of the right lung. The bronchial glands were not enlarged. The tonsils were normal in size, but the glands on each side of the pharynx extending in front of and behind the sterno-mastoid muscle were enlarged and tuberculous, and several contained creamy pus. Three mesenteric glands were enlarged and cheesy; an ulcer was found in the jejunum and another at the ileo-cæcal valve. Peyer's patches and the lymphatic glands about the cæcum were enlarged. The spleen and the liver contained tubercles. The mesenteric glands were employed for the isolation of the culture. This case was considered by Dr. Hand as being probably of tonsillar or pharyngeal origin. Guinea-pigs were inoculated intra-peritoneally on Oct. 5th, 1900. From one which died on Jan. 4th, 1901, a second was inoculated intra-peritoneally. This was killed on March 4th and cultures were made. Growth was first observed on April 12th and sub-cultures were made the following day.

Culture BB (human) was obtained from a child 17 months of age. Death was due to tuberculous meningitis. At the necropsy the lungs were normal, except the posterior and part of the right upper lobe, which was consolidated, red on section, and had excess of connective tissue. The bronchial and mediastinal glands were not enlarged. The spleen, the liver, and the kidneys showed pearly tubercles. Two feet from the lower end of the ileum was an ulcer one centimetre by two centimetres, the long diameter of which was transverse to the axis of the gut. Nodules were seen on the peritoneal surface. Four small ulcers, two above and two below, were found in the ileum. The mesenteric glands were enlarged and cheesy and some were purulent. The meninges showed yellow tubercles, most marked along the longitudinal fissure, in the choroid plexus, and over the cerebellum. The mesenteric glands were used in obtaining the culture. This case was considered by Dr. Hand to be the clearest one of primary intestinal tuberculosis ever seen by him. Guinea-pigs were inoculated intra-peritoneally with an emulsion made from the mesenteric glands on March 9th, 1901. One was chloroformed on April 1st and cultures were made. Scanty growth on one tube was found on June 8th and sub-cultures were made.

The results given in Table IV. show for all the bovine cultures a greater virulence than for any of the human cultures. The average life of the guinea-pigs inoculated with human bacilli was more than twice that of those inoculated with bovine. All the rabbits which received human cultures gained in weight and had finally to be killed, while for the bovine they died, and presented, post mortem, extensive lesions, the lungs and kidneys being the chief seats of the disease in all animals.

(To be continued.)

THE MORTALITY FROM PHTHISIS AND FROM OTHER TUBERCULOUS DISEASES CONSIDERED IN SOME ASPECTS WHICH MAY BE DEMONSTRATED BY MEANS OF LIFE-TABLES.¹

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HERE are gathered together those who are most competent to make clear the conditions under which the battle is raging between tubercle bacilli and the human race, to explain how these, it may be, originally saprophytic fungi have acquired the power of existing in, and preying upon, living animal bodies, and under what circumstances these latter may have their vital resisting power so lowered that they fall a readier prey to their assailants. Here also are those who by position and capacity are best able to plan and to arrange details of sanitary administration which shall give effect to the scientific knowledge laboriously attained by those who have made study of life and disease. Others, too, are here who in various ways have sought to throw light upon the problems involved by means of statistical methods. There is need on a field of battle for some to be told off to count the numbers of the killed and wounded, and without unduly exalting the position of statisticians it may be claimed that those who in the past as well as at present have been working at vital statistics have had some share in awakening the great public interest and attention of which this Congress is the outcome. Exact representations of the numbers of the living who year by year are being cut off by the germs of tuberculosis, together with gradually increasing certainty that phthisis and other tuberculous diseases are to a very large extent *preventable*, have brought together this great assembly. The simplest mode of statistical representation, of course, is merely to show how many die out of so many living. The next step in advance is by classifying the living population and the deaths into age and sex groups to show the special incidence of the mortality from some particular disease in the respective sexes, and at different periods of life. But instead of asking how many die from a disease out of a thousand or million living we may ask, supposing that this disease could be made extinct, *how many more would be alive at certain ages and how much longer would they live?* Now these questions can be answered by means of life-tables.

In some respects this Congress is being held at an unfortunate time. A year hence it might have been possible to utilise the data of the census recently taken and also the tabulated mortality for the decennium just completed, 1891-1900, and so to have obtained results brought down to a very recent period. As it is we have to go back to the numerical facts relating to the decennium 1881-90. What I propose to do is to show how the life-table for England and Wales for 1881-90 would have been affected supposing there had been during the period no deaths from phthisis or from the other tuberculous diseases, and that all the other causes of mortality had retained their proportional intensity. This is, of course, a mere hypothesis, but it is a necessary working hypothesis. It is possible that the extinction of one kind of disease germs might leave room for the more active development and diffusion of other kinds, but we can only work on the assumption already made that if some one disease should be eliminated those saved from dying from it will be exposed to the chances of all other diseases in the same proportion as before, and that their average exposure to these chances will be for half the year. This is not the time or place for going into details as to what a life-table is or how it is constructed. Such knowledge has to be assumed as possessed by those addressed. I would, however, desire to emphasise the fact that the work of constructing a complete or "extended" life-table—that is, one for every separate year of life—entails an enormous amount of laborious calculation, and that if the object be to have not merely one life-table but a series of life-tables to compare with each other it is practically impossible for one unaided individual to undertake the labour of doing the work by an extended method. The existing duration of life is too

¹ A paper communicated to the British Congress on Tuberculosis. Section I., State and Municipal.

short—one would need to be a Methuselah. Even the late Dr. William Farr, with his untiring industry and with the advantage of a staff of trained calculators to help him, employed for the purpose of some comparative life-tables, based on the mortality of England and Wales, for the decennium 1861–70, which were published in the Supplement

TABLE I.—Comparison of Life-table Results as regards Mean Expectation of Life obtained by (a) an Extended Method, and (b) the Modified Short Method used in the Construction of the Succeeding Tables.*

A.—Expectation of Life or Mean after Lifetime at exact age x.

Age.	Males.			Females.		
	a.	b.	Differences of b from a.	a.	b.	Differences of b from a.
0	43.28	43.32	+ 0.04	46.66	46.67	+ 0.01
5	52.24	52.30	+ 0.06	54.26	54.27	+ 0.01
10	48.59	48.65	+ 0.06	50.64	50.65	+ 0.01
15	44.28	44.33	+ 0.05	46.40	46.40	+ 0.00
25	36.28	36.34	+ 0.06	38.50	38.51	+ 0.01
35	28.91	28.87	- 0.04	31.16	31.03	- 0.08
45	22.06	22.04	- 0.02	24.05	24.01	- 0.04
55	15.74	15.71	- 0.03	17.23	17.12	- 0.11
65	10.31	10.24	- 0.07	11.26	11.17	- 0.09
75	6.10	6.06	- 0.04	6.68	6.62	- 0.06
85	3.29	3.32	+ 0.03	3.71	3.69	- 0.02
95	1.72	1.72	+ 0.00	2.05	1.97	+ 0.08

* The foundation data are those for England and Wales 1881–90, but for (a) the official life-table has been modified by the calculation of a new set of p_x values from p_5 to p_{2x} , the other p_x values having been left unaltered.

B.—Showing how the Total Expectation of Life at Birth is Distributed with Respect to the Age-periods indicated.

Age-period.	Males.			Females.		
	a.	b.	Differences of b from a.	a.	b.	Differences of b from a.
0–5	4.02	4.02	+ 0.00	4.16	4.16	+ 0.00
5–15	7.33	7.34	+ 0.01	7.63	7.65	+ 0.02
15–25	7.05	7.03	- 0.02	7.35	7.33	- 0.02
25–35	6.62	6.61	- 0.01	6.90	6.89	- 0.01
35–45	5.97	5.97	+ 0.00	6.30	6.30	+ 0.00
45–55	5.10	5.10	+ 0.00	5.55	5.54	- 0.01
55–65	3.91	3.91	+ 0.00	4.49	4.48	- 0.01
65–	3.28	3.34	+ 0.06	4.28	4.32	+ 0.04
Total	43.28	43.32	+ 0.04	46.66	46.67	+ 0.01

C.—Mean Expectation of Life of the Individuals at all Ages from x to x + n comprised within the Age-groups x to x + n indicated.

Age groups x to x + n.	Males.			Females.		
	a.	b.	Differences of b from a.	a.	b.	Differences of b from a.
0–5	51.76	51.76	+ 0.00	54.07	54.07	+ 0.00
5–10	50.57	50.58	+ 0.01	52.60	52.56	- 0.04
10–15	46.43	46.49	+ 0.06	48.52	48.53	+ 0.01
15–25	40.27	40.33	+ 0.06	42.44	42.46	+ 0.02
25–35	32.60	32.61	+ 0.01	34.83	34.82	- 0.01
35–45	25.51	25.48	- 0.03	27.66	27.65	- 0.01
45–55	18.95	18.93	- 0.02	20.67	20.63	- 0.04
55–65	13.09	13.06	- 0.03	14.30	14.24	- 0.06
65–75	8.35	8.34	- 0.01	9.08	9.06	- 0.02
75–85	4.94	4.94	+ 0.00	5.41	5.41	+ 0.00
85–95	2.80	2.78	- 0.02	3.16	3.11	- 0.05
95–	1.57	1.62	+ 0.05	1.86	1.87	+ 0.01

to the Thirty-fifth Annual Report of the Registrar-General, a short or abbreviated method, details of which are given in the same supplement. Another point which I would wish to lay special stress upon is that, in order to be fairly comparable with each other the life-tables must be calculated by the same method. If the occasion permitted I could give ample proof of this by comparative figures, worked out from the same data by different methods. Now, in some experimental work on life-table calculation I happened about three years ago to hit upon some very simple modifications of Dr. Farr's original method of constructing a short life-table, which gave results approximately to those of an extended life-table with remarkable closeness.² By this method the expectation of life can be

TABLE II.—Life-table for England and Wales for the Decennium 1851–60 based on the true Mean Numbers Living deduced from the Census Returns of 1851 and 1861 and on the Deaths from all Causes during the Ten Years 1851–60.

Age.	Chance of living one year in the interval from age x.		Number of survivors at age x out of a million born.		Expectation of life, or mean after-life-time at age x, expressed in years.	
	p_x		l_x		Ex	
x	Males.	Females.	Males.	Females.	Males.	Females.
0	0.83236	0.86227	1,000,000	1,000,000	42.06	42.15
1	0.93537	0.93820	832,364	862,266	47.06	47.82
2	0.96502	0.96527	778,567	808,980	49.28	49.93
3	0.97607	0.97596	751,336	780,882	50.04	53.71
4	0.98225	0.98222	743,353	762,110	50.26	50.95
5	0.99149	0.99158	720,337	748,559	50.16	50.86
10	0.99512	0.99494	690,211	717,585	47.24	47.95
15	0.99230	0.99205	673,528	699,616	43.35	44.12
25	0.99046	0.99010	623,450	645,945	36.43	37.37
35	0.98754	0.98786	566,449	584,755	29.51	30.77
45	0.98212	0.98483	499,705	517,529	22.80	24.12
55	0.96944	0.97322	417,238	444,190	16.34	17.30
65	0.93646	0.94276	305,883	338,585	10.53	11.19
75	0.86297	0.87380	158,655	187,797	6.03	6.45
85	0.73198	0.74700	36,343	48,731	3.29	3.48
95	0.55138	0.56783	1,605	2,637	1.73	1.81

TABLE III.—Showing the Differences from Table II. produced by Excluding Phthisis as a Cause of Mortality in England and Wales during 1851–60.

Age.	Chance of living one year in the interval from age x.		Number of survivors at age x out of a million born.		Expectation of life or mean after-life-time at age x, expressed in years.	
	p_x		l_x		Ex	
x	Males.	Females.	Males.	Females.	Males.	Females.
0	+0.00206	+0.00188	—	—	+3.37	+4.01
1	+0.00171	+0.00166	+ 2,053	+ 1,882	+3.92	+4.54
2	+0.00097	+0.00100	+ 3,352	+ 3,201	+4.09	+4.75
3	+0.00059	+0.00063	+ 3,987	+ 3,901	+4.19	+4.86
4	+0.00050	+0.00058	+ 4,336	+ 4,301	+4.25	+4.94
5	+0.00052	+0.00062	+ 4,629	+ 4,670	+4.30	+5.00
10	+0.00076	+0.00129	+ 6,270	+ 6,718	+4.35	+5.04
15	+0.00317	+0.00388	+ 8,712	+11,132	+4.26	+4.83
25	+0.00400	+0.00454	+28,508	+36,414	+3.16	+3.41
35	+0.00396	+0.00414	+50,256	+61,887	+2.06	+1.99
45	+0.00376	+0.00308	+66,567	+79,212	+1.14	+0.97
55	+0.00321	+0.00230	+73,966	+84,209	+0.51	+0.40
65	+0.00217	+0.00152	+66,361	+73,829	+0.16	+0.12
75	+0.00079	+0.00062	+38,951	+44,631	+0.04	+0.02
85	+0.00034	+0.00031	+ 9,433	+12,010	+0.01	+0.01
95	—	—	+ 421	+ 663	—	—

² For a description of the methods and for comparative figures, in illustration and proof, reference may be made to Public Health, vol. xi., page 330, July, 1898, and to the Journal of the Royal Statistical Society,

calculated at quinquennial age-intervals, with results differing by only from 0.01 to 0.10 of a year, from the result obtainable by what I believe to have been the most accurate extended method—that is practically only varying to the extent of from a few days to a few weeks. *Indeed, the results approximate much more closely than do those obtained by extended life-tables worked out by different methods.* It has been, perhaps, necessary to say so much in support of the claim to be made that the method which has been adopted in working out the appended tables is a sufficiently accurate instrument for statistical research. Table I., with its three divisions—A, B, and C—is intended to illustrate and support this preliminary claim. What has been hitherto published of the references already given has relation only to the results

TABLE IV.—Life-table for England and Wales for the Decennium 1881-90, based on the Data of the Official Life-table, but Calculated by the same Modified Short Method as that Used for the Other Tables in the Series.

Age. x.	Chance of living one year in the interval from age x.		Number of survivors at age x out of a million born.		Expectation of life, or mean after-life-time at age x, expressed in years.	
	px.		lx.		Ex.	
	Males.	Females.	Males.	Females.	Males.	Females.
0	0.83896	0.86887	1,000,000	1,000,000	43.32	46.67
1	0.94270	0.94729	838,964	868,874	50.56	52.66
2	0.97617	0.97700	790,891	823,072	52.61	54.56
3	0.98461	0.98487	772,046	804,142	52.88	54.83
4	0.98859	0.98898	760,167	791,973	52.70	54.66
5	0.99467	0.99475	751,494	783,244	52.30	54.27
10	0.99705	0.99689	731,669	762,910	48.65	50.65
15	0.99504	0.99504	720,942	751,135	44.33	46.40
25	0.99226	0.99265	685,947	714,724	36.34	38.51
35	0.98768	0.98946	634,654	663,880	28.87	31.08
45	0.98080	0.98500	560,634	597,164	22.04	24.01
55	0.96587	0.97192	461,836	513,384	15.71	17.12
65	0.93190	0.94132	326,327	386,134	10.24	11.17
75	0.86328	0.87726	161,189	210,907	6.06	6.62
85	0.73462	0.76126	37,056	56,934	3.32	3.69
95	0.54941	0.59522	1,696	3,721	1.72	1.97

TABLE V.—Showing the Difference from Table IV. produced by Excluding Phthisis as a Cause of Mortality in England and Wales during the 10 Years 1881-90.

Age. x.	Chance of living one year in the interval from age x.		Number of survivors at age x out of a million born.		Expectation of life, or mean after-life-time at age x, expressed in years.	
	px.		lx.		Ex.	
	Males.	Females.	Males.	Females.	Males.	Females.
0	+0.00088	+0.00076	—	—	+2.58	+2.57
1	+0.00074	+0.00072	+ 874	+ 758	+3.02	+2.90
2	+0.00039	+0.00037	+ 1,442	+ 1,345	+3.15	+3.02
3	+0.00030	+0.00027	+ 1,710	+ 1,619	+3.21	+3.07
4	+0.00023	+0.00026	+ 1,883	+ 1,816	+3.24	+3.11
5	+0.00025	+0.00033	+ 2,039	+ 2,007	+3.27	+2.12
10	+0.00034	+0.00070	+ 2,912	+ 3,209	+3.29	+3.11
15	+0.00177	+0.00205	+ 4,113	+ 5,810	+3.26	+2.98
25	+0.00301	+0.00278	+16,284	+20,510	+2.58	+2.19
35	+0.00352	+0.00271	+35,065	+38,420	+1.75	+1.29
45	+0.00342	+0.00202	+52,430	+52,048	+0.96	+0.61
55	+0.00278	+0.00146	+61,072	+56,299	+0.41	+0.25
65	+0.00164	+0.00089	+53,939	+48,815	+0.12	+0.08
75	+0.00059	+0.00036	+29,988	+28,936	+0.02	+0.01
85	+0.00018	+0.00013	+ 7,195	+ 8,074	+0.01	+0.00
95	—	—	+ 334	+ 535	—	—

vol. lxii., parts 3 and 4, September and December, 1899. My friend Dr. A. Newsholme has also done me the honour to insert a description of this method in the last edition of his well-known work on "Vital Statistics" (see Chapter xxiii., page 279).

in division A; certain other simple devices, by which the short method may be made to yield the results set down in divisions B and C, have occurred to me while engaged in preparing this communication. At some time ere long I hope to publish the details of the arithmetical methods employed. The other tables will to a large extent be left to speak for themselves. The data upon which the calculations have been made are to be found in the Annual Report and Decennial Supplements of the Registrar-General. As it seemed desirable to make at least one comparison with an earlier period I have prepared Tables II. and III., which are intended to demonstrate the effect of excluding phthisis as a cause of mortality in England and Wales during the 10 years 1851-60. Table II. is one of a series as yet unpublished. Table III. has the same relation to Table II. as Table V. has to Table IV. The comparison serves to further illustrate what already was evident by the ordinary death-rate—that the mortality from phthisis has much diminished. Some of the decrease may be, of course, only apparent—we have to consider the less accuracy of diagnosis at the early period and also possible cyclical variations in the intensity of the disease; but the opinion is at least very generally held that a large proportion of the lessened mortality is real and is the result of improved sanitation and bettered conditions of life. Attention may be specially directed to the altered sex incidence of this disease, the mortality being greater among females in 1851-60, from age two to age 35, whereas, except at ages four, five, 10, and 15, during 1881-90, it was greater among males. The remaining Tables relate to the 10 years 1881-90. Tables IV., V., and VI. afford answers to these three questions—supposing that (1) phthisis

TABLE VI.—Showing the Difference from Table IV. produced by Excluding Phthisis and all other Tuberculous Diseases as Causes of Mortality in England and Wales during the 10 Years 1881-90.

Age. x.	Chance of living one year in the interval from age x.		Number of survivors at age x out of a million born.		Expectation of life or mean after-life-time at age x, expressed in years.	
	px.		lx.		Ex.	
	Males.	Females.	Males.	Females.	Males.	Females.
0	+0.01007	+0.00785	—	—	+3.86	+3.72
1	+0.00639	+0.00524	+10,062	+ 7,844	+3.94	+3.76
2	+0.00274	+0.00228	+14,910	+12,025	+3.79	+3.65
3	+0.00156	+0.00143	+16,762	+13,654	+3.72	+3.60
4	+0.00123	+0.00113	+17,734	+14,621	+3.69	+3.58
5	+0.00081	+0.00087	+18,486	+15,375	+3.66	+3.54
10	+0.00063	+0.00103	+21,062	+18,375	+3.54	+3.39 ^a
15	+0.00196	+0.00226	+23,092	+22,064	+3.44	+3.18
25	+0.00314	+0.00291	+36,087	+37,855	+2.73	+2.29
35	+0.00363	+0.00282	+54,825	+55,929	+1.81	+1.35
45	+0.00352	+0.00210	+71,201	+68,943	+0.99	+0.64
55	+0.00288	+0.00154	+77,658	+71,616	+0.42	+0.26
65	+0.00173	+0.00096	+66,416	+60,874	+0.12	+0.09
75	+0.00063	+0.00040	+36,432	+35,769	+0.02	+0.01
85	+0.00019	+0.00015	+ 8,706	+ 9,962	+0.01	+0.00
95	—	—	+ 404	+ 660	—	—

and (2) the whole group of tuberculous diseases had had no existence as causes of mortality in England and Wales during 1881-90, at each of the ages indicated respectively—(a) how much greater would have been the chance of surviving to the end of one year? (b) how many more would be living at each age? and (c) how much greater would be the mean expectation of life, or, in other words, the mean after-lifetime of each age? With regard to the lx columns—that is, the successive numbers of survivors at age x—it must be borne in mind that the results of the short method are more and more in excess of those obtained by the extended method from about 25 years of age onwards. However, as the three Tables IV., V., and VI. are worked out by the same method the results are fairly comparable in their proportions to each other. The Ex columns are of the greatest importance, and these, as has been shown, are practically identical with those to be obtained by the extended method. The fact which stands out from all

others is that if there had been no phthisis the average length of life for each individual born would have been increased by two and a half years. Another prominent fact is that those who have survived to the age of 15 years would have their average expectation of life increased by about three and a quarter years. Now these hypothetical results are greater than those which would be obtained by abolishing the whole group of ailments classed together as "the seven principal zymotic diseases." As regards the three diseases to combat which the expensive machinery of isolation hospitals chiefly exists—viz., typhoid fever, scarlet fever, and diphtheria—if they could be entirely exterminated the average increase in length of life of those at birth would only be increased by about a year, and those at age 15 would only have about the fourth part of a year to add to their life expectation. Table VI. brings out prominently the fact that the group of tuberculous diseases other than phthisis exert their maximum efforts at the earlier ages of life, these being more marked during the first five years, and after 15 years becoming comparatively insignificant. There is another

TABLE VII.—Showing how the Increased Expectation of Life at Birth represented in Table V. as produced by Eliminating Phthisis, would be Distributed over the Periods of Life indicated, and also a comparison with a similar Distribution of the Expectation of Life at Birth calculated in Table IV.

Life period.	Age-limits of period.	Length of period in years.	Males.			Females.		
			Values from Table IV. b.	Values from Table V. c.	Differences of c from b.	Values from Table IV. b.	Values from Table V. c.	Differences of c from b.
Infancy.	0-5	5	4.02	4.02	+ 0.00	4.16	4.17	+ 0.01
School-age.	5-15	10	7.34	7.37	+ 0.03	7.65	7.69	+ 0.04
Working-period of life.	15-25	50	7.03	7.14	+ 0.11	7.33	7.46	+ 0.13
	25-35		6.61	6.86	+ 0.25	6.89	7.19	+ 0.20
	35-45		5.97	6.41	+ 0.44	6.30	6.75	+ 0.45
	45-55		5.10	5.67	+ 0.57	5.54	6.09	+ 0.55
	55-65		3.91	4.49	+ 0.58	4.48	5.00	+ 0.52
Totals for working period of life			26.62	30.57	+ 1.95	30.54	32.49	+ 1.95
Decline	65 and upwards.	—	3.34	3.94	+ 0.60	4.22	4.89	+ 0.57
Total	All ages.	—	43.32	45.90	+ 2.58	46.67	49.24	+ 2.57

TABLE VIII.—Showing the Results of Tables IV., V., and VI., Re-worked out so as to give the Mean Expectation of Life possessed by the Individuals at all ages from x to x + n comprised within the respective Age-groups x to x + n indicated.

Age groups x to x + n.	Males.			Females.		
	b.	c.	d.	b.	c.	d.
0-5	51.76	+ 2.680	+ 3.390	54.07	+ 2.380	+ 3.070
5-10	50.58	+ 3.280	+ 3.600	52.56	+ 3.115	+ 3.465
10-15	46.49	+ 3.275	+ 3.490	48.53	+ 3.045	+ 3.285
15-25	40.33	+ 2.920	+ 3.085	42.46	+ 2.585	+ 2.735
25-35	32.61	+ 2.165	+ 2.270	34.82	+ 1.740	+ 1.820
35-45	25.48	+ 1.355	+ 1.400	27.65	+ 0.950	+ 0.995
45-55	18.93	+ 0.685	+ 0.705	20.63	+ 0.430	+ 0.450
55-65	13.06	+ 0.265	+ 0.270	14.24	+ 0.165	+ 0.175
65-75	8.34	+ 0.070	+ 0.070	9.06	+ 0.045	+ 0.050
75-85	4.94	+ 0.015	+ 0.015	5.41	+ 0.005	+ 0.005
85-95	2.78	+ 0.005	+ 0.005	3.11	+ 0.000	+ 0.000
95—	1.62	+ 0.000	+ 0.000	1.87	+ 0.000	+ 0.000

The values deduced from Table IV. are headed by (b); the differences produced by eliminating phthisis are headed by (c); and the differences produced by eliminating phthisis and all other tuberculous diseases by (d).

aspect, however, under which the increased length of life brought about by doing away with phthisis may be considered. It has been seen from Table V. that those at the very outset of life would on the average have two and a half years longer to live. Now it is of importance to ascertain, if

TABLE IX.—Showing, expressed in Years, the Total Life Capital in England and Wales at the Middle of the Year 1891, and to what extent this Life Capital would have been Increased by Eliminating (1) Phthisis and (2) all other Tuberculous Disease as Causes of Mortality.

Age groups.	Males.		
	(b)	(c)	(d)
0-5	91,741,447	4,750,137	1,258,431
5-10	85,887,276	5,569,598	543,375
10-15	75,095,517	5,290,124	347,291
15-25	109,697,880	7,942,420	448,801
25-35	68,310,689	4,535,193	219,952
35-45	41,163,557	2,189,035	72,699
45-55	22,622,863	818,630	23,902
55-65	10,085,599	204,617	3,861
65-75	3,720,674	31,229	0
75-85	720,608	2,188	0
85-95	44,116	79	0
95—	642	0	0
Total at all ages	509,090,868	21,333,250	2,918,312

Age groups.	Females.		
	(b)	(c)	(d)
0-5	96,831,667	4,262,241	1,236,691
5-10	89,694,020	5,315,770	597,277
10-15	78,480,820	4,924,256	328,119
15-25	122,824,802	7,477,675	433,908
25-35	79,913,154	3,993,263	183,603
35-45	47,626,288	1,636,246	77,511
45-55	26,938,237	562,736	26,174
55-65	12,664,018	146,739	4,447
65-75	4,951,028	24,591	0
75-85	1,049,957	970	0
85-95	82,788	0	0
95—	1,793	0	0
Total at all ages	561,118,572	28,344,687	2,946,730

Sums of males and females—(b) 1,070,209,440; (c) 59,677,937; (d) 5,965,042.

Average life capital for each individual living.				Proportion per cent. of life capital expended in a year.		
—	—	Increase by eliminating phthisis.	Further increase by eliminating all other tuberculous diseases.	—	With phthisis eliminated.	With phthisis and all other tuberculous diseases eliminated
Males ...	(b) 36.13	(c) 2.22	(d) 0.21	(b) 2.768	2.608	2.594
Females	37.43	1.89	0.20	2.672	2.543	2.530
Persons	36.80	2.05	0.21	2.718	2.574	2.560

The calculations have been based (1) on the numbers given in the preceding Table VIII., and (2) on the numbers given in the census report, 1891, Vol. IV., Table 12, page 106, as representing the estimated population of England and Wales living at the middle of the year 1891, classified into age and sex groups. Life capital deduced from Table IV. is headed by (b), addition by eliminating phthisis by (c), and further addition by eliminating all other tuberculous diseases by (d).

possible, how much of this added life would be lived during the part of life extending from age 15 to age 65, which may be considered as the working period of life? This question is answered by Table VII., which shows that the *working period of life would be lengthened on the average by very nearly two years*. The matter may be illustrated in yet another way. The *Ex* values in Tables IV., V., and VI. apply to those at the exact age x , but if these values can be translated into those applying to age-groups, that is, into average values of expectation of life with relation to all the individuals at all ages from x to $x + n$ comprised within the respective age-groups x to $x + n$ (for example, from birth to age five, from age five to age 10, &c.), we shall then have a ready method of calculating what has been happily termed the "*Life-capital*" of a whole community. In Table VIII. such values have been worked out, and in Table IX. they have been used to show what was the total life-capital of the population of England and Wales as it existed at the middle of the year 1891, and to what extent the life-capital would have been increased (1) by abolishing phthisis and (2) by doing away with all other tuberculous diseases. A diagram also represents the results graphically to scale. However, the one striking and outstanding fact, which can-

The areas of the parallelograms represent to scale the life-capital of the respective age-groups numerically stated in Table IX. The columns indicate the life-capital deduced from Table IV. The transversely marked tops to the columns indicate the increase of life-capital after excluding phthisis. The vertically marked tops to the columns indicate the still further increase of life-capital after excluding all other tuberculous diseases.

not be emphasised more than by the mere statement of it, is that if phthisis had not existed as a cause of mortality in England and Wales every person living in the year 1891 would have had an average increase in life-capital of two years, and that the abolition of all other tuberculous diseases would only have increased the average life-capital by the fifth part of a year.

The question may now be asked, Are there any practical conclusions and deductions to be drawn from the statistical points which it has been sought to establish and to represent? Now years of human life are capable of being translated into terms of pounds, shillings, and pence, and it is evident that the ravages of phthisis must entail a very serious financial loss to the community. About 10 years ago, after reading a paper upon Life-table Construction before the Royal Statistical Society, I was met by a criticism, good-humouredly, but at the same time pointedly, made, by a member of the actuarial profession present, that it would be better for a medical man to stick to his stethoscope and not to meddle with matters which properly belong to actuaries. My reply was to the effect that, whatever might be the case

with medical men as practitioners, it was certainly open to a medical officer of health to utilise such little mathematical knowledge as he might possess in demonstrating the relations between lives and deaths. Should he, as only too probably he may, come short of the mathematical skill of the actuary he may gratefully accept such correction as the latter may be able to give. But when it comes to translating years of life into pecuniary value the writer gladly concedes that this is the special work of the actuary and one for the dealing with which the community owes to him a debt of gratitude. Therefore I can make no attempt to measure the financial loss due to phthisis or the possible gain by abolishing or considerably mitigating the effect of this disease. I would simply desire to represent to those concerned with the management of the industrial and other life assurance societies that it might be not merely an act of benevolence and charity, but one of self-interest and profit, to subscribe something towards the establishment and maintenance of sanatoria for the treatment of phthisis, so as to aid in the restoration to health and the prolongation of life of those who are stricken with this disease and at the same time to be limiting the diffusion of the infective germs to others. This course would not be without precedent for such exists and is already given in Germany. It is only the adoption of a similar principle to that long ago acted upon in their own self-interest by companies insuring against loss by fire—viz., either to maintain fire brigades of their own or to subscribe largely to those established by municipal enterprise.

ON THE PHYSIOLOGICAL CURE OF THE MORPHIA HABIT.

BY W. OSCAR JENNINGS, M.D. PARIS, M.R.C.S. ENG.

IN 1890 I published a little book on the cure of the morphia habit, giving an account of different means of treatment, based upon my researches concerning the craving that had enabled me to wean a considerable number of *habitues* from their addiction, with a minimum of distress and suffering. It may seem an invidious thing to say, but I have no hesitation in declaring that before this there existed no treatment of the morphia craving founded upon therapeutic indications. There was, in fact, no treatment of the craving at all, which is tantamount to saying that there was no systematic treatment of the morphia habit.¹ The so-called "methods" described by contemporary writers consisted of suppressing the morphia suddenly, slowly, or semi-brusquely, and those who could be persuaded to give up their liberty, when they did not die suddenly or commit suicide, were sometimes cured temporarily after indescribable sufferings,² but the same ignorance, or rather indifference, concerning the means of alleviating the craving, extended to the means of preventing the discomforts that are liable to occur to those who are left to their own devices after the suppression, and in nine cases out of ten the temporary suppression was followed by a speedy relapse.

I would say at once—for I have long ceased to make any secret of the matter—that my first observations were made in my own case. I endeavoured to analyse and to dissociate the different factors of the miserable wretchedness known as the morphia craving, and I was able to satisfy myself that they were always intensified by a certain number of errors and imprudences that the morphine

¹ I except that of Dr. Mattison of Brooklyn, who treats his patients by bromides, codeine, and cannabis indica.

² A physician, quoted by Dr. Mattison, expresses himself as follows: "Let him (the patient) quit it short, absolute, and entirely. If he have the will power, trust him; if he cheats, lock him up; put a Hercules over him as a nurse." As it is absolutely certain that no one whose addiction is of sufficient standing to warrant the expression "*morphia habitue*" could leave it off suddenly by an effort of the will the Herculean nurse would become a necessity. Here is a picture of the treatment by the same authority. "All substitutes are simply a prolongation of the agony he must go through. . . . The patient who quits morphia, after a long-established habit, suffers from insomnia, diarrhoea, nausea, vomiting, aching all over, and debility to such a degree that it is a marvel how he lives. . . . All this suffering will last from five to ten days. No medicine will do any good, the stomach rejects everything, even a mouthful of cold water. . . . At last, after several centuries of torture, little by little, and without medicine or substitutes, nature accomplishes the cure. This terrible treatment, I am sure, is not only the best, but the only safe one to cure, and secure the patient from relapse."