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THE MORTALITY FROM TUBERCULOSIS IN SAORSTÁT ÉIREANN. A STATISTICAL STUDY.

By R. C. Geary, *M.Sc.*

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I.—INTRODUCTION.

There were 3,774 deaths from tuberculosis in Saorstát Eireann in 1929, or 128 per 100,000 of the estimated population. For the fourth year in succession declines have been recorded. The rate in 1929 was 6.6% less than the rate in 1928, and 53.7% less than in 1904, which was the highest recorded in recent years in the present area of Saorstát Eireann.

Deaths from tuberculosis were 8.8% of all deaths in 1929. Between the ages of 15 and 45 deaths from tuberculosis were no less than 42.8% of all deaths in 1928.

In the stencilled analysis issued in connection with Vol. V., Part I., of the Census it was shown that the longevity of females compared unfavourably with that of males in this country. In fact, the difference between the female and male expectation of life was less at most ages than in nine other countries for which the figures were available. To what extent was this due to the difference between the male and female mortality from tuberculosis? The following table shows the actual expectation of life in 1925-27 (as given in Saorstát Life Table No. 1) at certain ages at which the expectation was appreciably affected by the tuberculosis mortality, and the expectation of life if there were no deaths from tuberculosis (calculated by Brownlee's abridged method).

EXPECTATION OF LIFE IN YEARS 1925-27 IN SAORSTÁT EIREANN.

	AGE					
	0	5	15	25	35	45
Actual :						
Males	57·4	59·5	50·7	42·4	34·4	26·5
Females	57·9	59·2	50·5	42·4	34·7	27·0
Female excess ...	+0.5	—0.3	—0.2	—	+0.3	+0.5
If there were no deaths from tuberculosis.						
Males	61·4	62·0	53·3	44·3	35·6	27·1
Females	61·3	62·3	53·3	44·2	35·6	27·3
Female excess ...	—0.1	+0.3	—	—0.1	—	+0.2

These figures show that the relatively low female expectation of life at the young ages is not due to any marked extent to the mortality from tuberculosis. It will also be noted that the total extinction of the disease in the Saorstát would result in an increased expectation of life at birth of 4.0 years in the case of males, and 3.4 years in the case of females.

II.—SOME INTERNATIONAL COMPARISONS.

The following table* shows the crude tuberculosis mortality rates in 1927 in twenty-four countries:—

	Rates per 100,000 population.		Rates per 100,000 population.
Chile	238 (a)		
Hungary	235	Scotland	100
Finland	202 (b)	England & Wales ..	97
Japan	187 (c)	Belgium	97
France..	174	Czecho-Slovakia ..	95
Austria	166	Netherlands ..	94
Norway	164 (c)	Germany	93
		Canada	85
**Saorstát Éireann	**145**	Denmark	82
Spain	144	United States ..	77
Northern Ireland ..	141		
Switzerland	140		
Italy	134	Australia	56
Sweden	132	New Zealand ..	49

(a) 1923, (b) phthisis, 1926; (c) 1926.

* Most of the figures have been calculated from data published in the "International Health Year Book, 1928" (published by the League of Nations), and in the "Aperçu de la Démographie des divers Pays du Monde" (published by the International Institute of Statistics). In a few cases data published in the Year Books and in the official vital statistics have been used.

The great range of variation in the tuberculosis mortality rates from Chile, with 238, to New Zealand, with 49 per 100,000, is very remarkable. The Saorstát was eighth in a list of twenty-four countries, and the rate (in 1927) was not much greater than those for the five countries following. Perhaps the most interesting features of the table are the large gaps which at certain stages separate groups of countries. Would this grouping be maintained if the statistics for other countries were available, or would the missing countries fill up the gaps?

The contrast between the Saorstát and England is rather too favourable to the former, in so far as England is predominantly urban. In English rural districts in 1927 the rate was only 77 compared with 145 in the whole Saorstát. We have still a lot of leeway to make up in this country.

The decline in the mortality from tuberculosis during the last twenty years or so seems to have been a universal phenomenon. The following table* shows the percentage declines between the years 1911 and 1927 for nineteen countries arranged in order of the magnitude of these figures:—

United States.. ..	49 (a)	Sweden	31 (b)
Scotland	44	Norway	26 (b)
Germany	41	Belgium	25
Netherlands ..	41	Italy	22
Northern Ireland ..	40	Finland	21 (c)
Switzerland	35	France	21
England and Wales ..	34	Japan	16 (b)
Australia	33	Chile	13 (d)
New Zealand	33	Spain	9
Saorstát Éireann ..	**33**		

(a) 1910-26, (b) 1911-26, (c) phthisis 1911-26; (d) 1911-23.

In view of the vast increase in its per capita wealth during the sixteen years it is not surprising to find that improvement is most marked in the United States. The Saorstát improvement is well up to the average; in fact we occupy exactly the median position, with about the same percentage as England, and only 2% below Switzerland in the sixth place. It is markedly less than the percentage declines for Scotland and Northern Ireland. The high position of Germany is in contrast with that of France, Belgium and Italy.

A most encouraging feature of the general improvement in the international tuberculosis position is that the improvement is in no way related to the magnitude of the tuberculosis mortality rate in any of the countries—the improvement is as marked in countries in which the mortality

* See previous footnote.

is relatively high as in those in which it is relatively low. It might reasonably be argued, therefore, that there is, so to speak, no saturation point in the degree of improvement, and it is likely that the disease will be completely wiped out in many countries in our own time.

A remarkable paper* by Louis I. Dublin and Gladden W. Baker on the "Mortality of Race Stocks in Pennsylvania and New York, 1910," directed attention to the appallingly high mortality from all causes, but particularly from phthisis amongst the Irish-born in the United States in 1910. The following table has been constructed from data published in this paper:—

MORTALITY FROM PHTHISIS AND FROM ALL CAUSES OF DEATH IN PENNSYLVANIA AND NEW YORK, 1910. MALES.

Birth Place	Pennsylvania		New York	
	Phthisis per 100,000 (crude)	All causes per 1000 (*a*) (standardised)	Phthisis per 100,000 (crude)	All causes per 1000 (*a*) (standardised)
U.S.A. (native parentage)	105	12.8	171	13.8
Ireland	343	23.6	589	25.9
Austria-Hungary ...	118	14.4	166	14.3
Russia	107	13.7	115	13.1
Italy	82	14.5	112	12.9
Germany	195	17.0	267	17.9
Great Britain ...	150	16.1	215	16.6

(*a*) Aged 10 and over.

As the figures are almost incredible it is necessary to explain that they refer (as far as one can judge) to complete enumerations in the single year 1910 in Pennsylvania and New York State, where about one-half of the Irish-born in the United States reside, so that the numbers on which the rates were based were quite substantial, and there can be no doubt that they represent the normal relation which the mortality of Irish immigrants bears to that of other immigrant stocks. The results for the two states were, broadly speaking, quite confirmatory. The standardised death-rates for all causes of death were twice as high amongst the Irish-born males as amongst persons born in the United States of native parentage. In both states the male phthisis mortality rate was three and a-half times as great as amongst the native-born, and more than twice as high as for any other race stock on the list.

A previous table has shown that since 1910 the tuberculosis mortality rate has halved in the United States, and

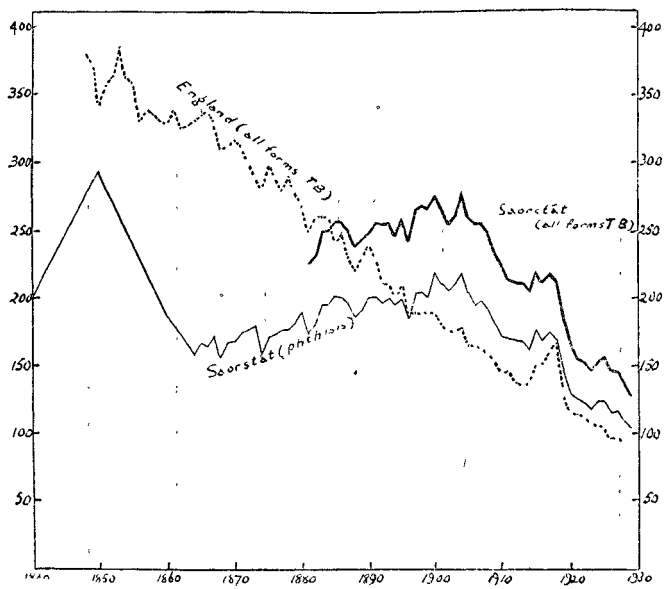
* *Journal of the American Statistical Association*, March, 1920.

presumably this improvement has extended to the poorest classes, amongst whom are the Irish-born. It is unlikely, however, that the relative position of the Irish in this matter has substantially changed.

III.—MORTALITY FROM TUBERCULOSIS SINCE 1840.

The annual report of the Registrar-General for the year 1928 contains a most useful summary of the numbers of deaths in Saorstát Eireann, and the rates per 100,000 population from 1864 to 1928 for some of the principal causes of death. The particulars for phthisis are given in Table 1, and are graphed in diagram 1, with the mortality from all forms of tuberculosis in Saorstát Eireann (from 1881) and in England and Wales (from 1848).

DIAGRAM 1.—MORTALITY FROM TUBERCULOSIS. RATES PER 100,000 OF POPULATION, 1840-1929.



It will be seen that from 1864 until about the beginning of the present century the Saorstát rate fluctuated in an irregular manner, but the general movement was unmistakably upward. About 1902, however, a break set in, and the rates have declined at a much steeper gradient than during the earlier rise, and, in fact, during the 29 years since the beginning of the century the decline in the rate has been more than twice as great as the rise in the 36 years

from 1864 to 1900. The history of tuberculosis in England and Wales has been very different. The rates have declined almost continuously throughout the whole period of statistical record, and from 1885 the Saorstát rates have always been in excess of the English rates. In all series of curves the linearity of the trends (except during the war years) is rather remarkable.

It is fairly apparent from the chart that the gradient of decline in the years immediately preceding the war was greater than in the years since 1920. In fact, on fitting straight lines (by the method of least squares) to the Saorstát (phthisis) and the English curves from 1902-14 and 1920-28 respectively, we find that the Saorstát pre-war rates were declining by 4.5 per 100,000 per annum during the years 1902-14, and by only 2.0 in the post-war years. The corresponding figures for England and Wales were 3.8 in 1902-14, and 2.7 in 1920-28.

TABLE I.—MORTALITY FROM TUBERCULOSIS IN SAORSTÁT ÉIREANN, 1840—1929.

Year	Rates per 100,000 Population		Phthisis Mortality. Deviations from, as % of, quinquennial averages	Year	Rates per 100,000 Population		Phthisis Mortality Deviations from, as % of, quinquennial averages.
	All Forms	Phthisis			All Forms	Phthisis	
1840		199 (a)	—	1896	243	185	−6.1
1850		293 (a)	—	1897	266	203	+2.4
1860		187 (a)	—	1898	268	203	+0.7
1864		157	—	1899	266	200	−2.9
1865		165	—	1900	274	218	+5.2
1866		163	+0.3	1901	266	209	+0.1
1867		171	+4.1	1902	255	204	−3.3
1868		155	−5.8	1903	262	209	+0.2
1869		166	−0 3	1904	277	217	+5.5
1870		167	−0.6	1905	259	202	−1.0
1871		174	+0.9	1906	255	195	−2.8
1872		177	+3.7	1907	255	198	+2.1
1873	[Not Available]	179	+3.9	1908	250	192	+2.4
1874		158	−8 1	1909	234	181	−0.7
1875		171	−0.7	1910	224	171	−2.9
1876		173	+1.1	1911	212	169	−1.1
1877		176	+0.6	1912	210	168	+0.3
1878		177	−0.9	1913	210	167	−1.0
1879		181	+1 4	1914	205	162	−3.5
1880		190	+5.3	1915	219	177	+4.0
1881	224	173	−6 0	1916	211	168	−1.1
1882	231	181	−3.1	1917	218	174	+4.0
1883	249	196	+3.4	1918	212	168	+6.5
1884	250	196	+0.3	1919	188	146	−0 8
1885	255	201	+1.4	1920	165	128	−6.3
1886	255	200	+2.1	1921	156	125	−1.4
1887	251	198	+1.2	1922	153	122	−1.5
1888	238	187	−4.3	1923	148	117	−4.4
1889	243	192	−1.8	1924	153	123	+2.9
1890	248	200	+2 1	1925	157	123	+3 8
1891	255	201	+1.5	1926	147	114	−2.8
1892	254	198	−0.8	1927	146	115	+2.3
1893	255	199	+0.2	1928	137	108	—
1894	246	196	+0.4	1929	128	103	—
1895	258	199	+1.1				

(a) Estimated. See Text.

Prior to 1864 mortality statistics were collected at the time of the Census, i.e., in each of the years 1841, 1851, 1861, and 1871, each householder or head of institution, etc., was asked to state particulars of deaths in his family or institution during the preceding ten intercensal years. The defects of the system are, of course, evident, and were indeed stressed in each successive Census report. The principal defect was that the records of mortality in families all of whose members had emigrated were completely lost, as were the deaths of many old people. In the year immediately preceding the Census year, however, the mortality records as disclosed at the Census might be expected to be fairly complete, and, in fact, we find an excellent correspondence in 1870 when the results of the two systems could be set side by side: in all Ireland the Census mortality statistics showed 91,683 deaths from all causes, compared with 90,462 as returned by the registration system. In consequence it is thought that the statistics of mortality from "consumption" in the years 1840, 1850, 1860 and 1870 may be used to show the trend in mortality from phthisis prior to 1864. The following are the estimated phthisis mortality rates in Saorstát Eireann in the years 1840, 1850, and 1860:—

	Per 100,000 population.
1840	199
1850	293
1860	187

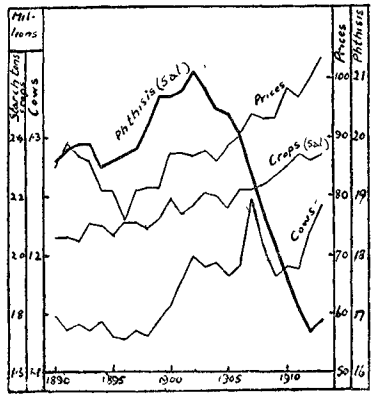
These estimates were found by linking up the all-Ireland consumption rates at the ages 15-44 in the years 1840, 1850, 1860, 1870 with the Saorstát phthisis rate in 1870. It was necessary to confine attention to these ages because it is fairly obvious from the pre-registration statistics that many deaths at the older ages, which were really due to bronchitis, were attributed to consumption.

While the higher rate in 1850 might be attributed as an after effect of the Famine, it is clear that even prior to that great catastrophe the phthisis rate was substantial, and, furthermore, that the upward trend in the rates which began in 1864 was not a continuation of an earlier trend in the same direction.

I do not intend to enter into any detailed examination of the almost sensational break in the phthisis mortality rate which occurred in Ireland at the beginning of the century. As you are aware, the reasons for the decline in other countries has been the subject of acute controversy. I submit, however, that Ireland furnishes a fruitful field of enquiry where the controversy might well be settled, on

account of the simplicity of the economic and social organisation in this country, and because the decline started well within the period of more exact and detailed statistical record.

DIAGRAM 2.—SAORSTAT RURAL ECONOMY AND PHTHISIS, 1890 TO 1913.



As the annual mortality rates in the Saorstát fluctuated in an irregular manner round about 1900, it may be well to concentrate for the moment on smoothed data. Quinquennial averages of the phthisis rates graphed at the middle year (e.g., 1888-92 at 1890) are graphed on diagram 2, with the three major indices of rural prosperity—the agricultural price index number (1911-13 = 100), the total produce in starch tons of crops (including hay), and the number of milch cows.

The following are the quinquennial mortality rates which are shown on the the diagram :—

Five years ending :	Phthisis mortality per 100,000	Five years ending :	Phthisis mortality per 100,000	Five years ending :	Phthisis mortality per 100,000
1892	196	1900	202	1908	201
1893	198	1901	207	1909	194
1894	199	1902	207	1910	187
1895	199	1903	208	1911	182
1896	195	1904	211	1912	176
1897	196	1905	208	1913	171
1898	197	1906	205	1914	167
1899	198	1907	204	1915	169

These rates show emphatically that 1902 must be regarded as the peak year, after which the rate started to fall with a gathering momentum until 1913. From about 1896 onward the trends in prices, crop production, and the number of milch cows were all definitely upward. In addition, the great Land Act of 1903 gave the farmers an increased spending power of perhaps several millions a year. It can, I think, safely be asserted that from the Famine to the present day there was no prolonged period during which the level of rural prosperity was so high and increasing at so rapid a rate as during those seventeen years before the outbreak of the European war.

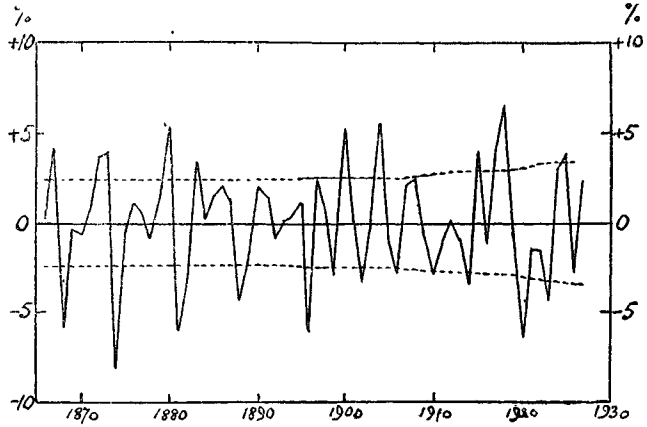
The Women's National Health Association, under the leadership of the Countess of Aberdeen, did great and useful service principally in propaganda work against the disease. This association was inaugurated at a public meeting on the 13th March, 1907. It is necessary to point out, however, that the decline in the mortality from the disease had definitely set in five years before this great organisation was started. The principal legislative measure against the disease was the Tuberculosis Prevention (Ireland) Act of 1908.*

The analysis in the previous paragraphs suggests (but does not prove) that the decline in the disease in Ireland at the beginning of the century received its first impetus either directly or indirectly from economic causes.

In the analysis of "time series" (but more commonly in the case of economic than of vital statistics) it is customary to distinguish between long-term and short-term trends. The long-term trends in the Saorstát phthisis rates have already been discussed. In order to bring the short-term (including the year to year) trends into relief the deviations from the quinquennial moving averages in the numbers of deaths from phthisis have been expressed as percentages of these moving averages, and the results shown in diagram 3. For example, the +0.3% at the year 1866 means that the 6,799 deaths from phthisis in 1866 in the present area of Saorstát Eireann exceeded the annual average number of deaths in 1864-68 (6,778) by 0.3%.

* A useful account of the administrative measures against tuberculosis will be found in Appendix G to the Interim Report of the Committee on Health Insurance and Medical Services.

DIAGRAM 3.—PHTHISIS MORTALITY. DEVIATIONS FROM, AS PERCENTAGES OF, QUINQUENNIAL AVERAGES, 1866-1927.



These calculations bring out a rather curious periodicity in the series prior to 1900, i.e., during the period when the general trend in the rates was upward, but at a slow gradient. Starting with the high point at the year 1867, it will be seen that from 1868 to 1896 there are four clearly-marked periods—from 1868 to 1874, from 1874 to 1881, from 1881 to 1888, and from 1888 to 1896, during each of which the trend may be described in the following terms—"steep fall, partial recovery, slight recession, rise." I do not wish to stress this matter unduly. It would appear to merit further study, and so the actual percentage deviations are given in Table 1.

Before proceeding to analyse the causes underlying the year-to-year changes in the phthisis mortality rate, it is essential to observe that year-to-year changes in "external" causes (weather, economic conditions, etc.) do affect the phthisis mortality to a very marked extent, and that the variation in the mortality from year to year cannot be attributed solely to the operation of the multiplicity of small causes which go by the name of Chance. For if chance only were operating we should find approximately the same mortality over a series of years, and the year to year variation from the mean annual mortality, if the individual's chance of dying of the disease were small, would be in the neighbourhood of $\sqrt{n}$ (the "standard deviation") where n is the mean annual mortality, and only about once in 20 years would twice this deviation be exceeded, or about once in 360 years would it exceed $3\sqrt{n}$.

In consequence we may find a measure of the extent of the

operation of external causes on the phthisis mortality rate by comparing the actual deviations with $2\sqrt{n}$ where n is the quinquennial moving average number of deaths, or the corresponding percentage deviations. It will be seen from diagram 3 that the deviations far exceed the limits (shown by dotted lines) allowed by the operation of chance, and in fact the limits are exceeded in 24 cases where the law of chance would allow only about 3 out of 62. Over the whole period the actual standard deviation, as found from the observations, is no less than 2.48 times the standard deviation which would be found if the year to year fluctuation were due solely to chance. We conclude that the effects of these external causes on the mortality from phthisis are quite substantial. It is interesting to note that a corresponding calculation for the mortality from cancer during the years 1883-1926 shows a ratio of 1.32 compared with the 2.48 in the case of phthisis. It follows that external causes also affect year to year changes in the mortality from cancer, but not to nearly so great an extent as they do from phthisis.

The first external causes which suggest themselves as affecting the year to year fluctuations in phthisis mortality are, of course, weather and economic conditions. Supporting this view we perceive from diagram 3 that prior to 1900 the highest point in the series is at the year 1880, which obviously corresponds with the appalling weather conditions of 1879, the worst year since 1847, when agricultural prices were also bad. But as workers in this field are aware, it is difficult to devise a single statistic (a function of temperature, rainfall, hours of sun, etc.), which represents "weather." The most convenient index in all the circumstances, both of weather and economic conditions, would appear to be the annual yield of crops. Working with the annual yield in starch lbs. per acre crops and pasture of corn crops, green crops, roots and hay (given in "Agricultural Statistics, 1847-1926," pp. 6-9), and calculating the percentage deviations from trend, as in the case of phthisis mortality, it was found that the coefficient of correlation (r)* between these deviations and the phthisis

* Just as the average of a number of quantities gives an approximate idea of the size of the quantities, the coefficient of correlation r, an empirical measure, gives an idea of the degree of relationship between pairs of quantities. When there is a rigid linear relationship between the pairs then r is $+1$ or -1: it assumes the plus value when high values of one quantity are associated with high values of the other, and low with low; and it assumes the minus value when high values of one quantity are associated with low values of the other. For instance, the pairs (1, 3), (2, 6), (3, 9), (4, 12), etc., have a coefficient of correlation of $+1$, and the pairs $(-1, 3)$, $(-2, 6)$, $(-3, 9)$, $(-4, 12)$, etc., have a coefficient of correlation of -1. The coefficient of correlation cannot in any case assume values greater than $+1$ or less than -1. When there is no relation, or, at all events, no simple relation between the quantities, r will have a value near zero.

deviations *in the following year* was —0.37, which is probably significant, as it has been calculated from 60 observations. If mortality data from phthisis had been available by quarterly or monthly periods, it is probable that the crop yields might be associated with twelve monthly phthisis mortality periods, so as to yield a higher negative correlation coefficient. In any case, we may conclude that year-to-year fluctuations in the phthisis mortality rate are likely to follow variations in the opposite sense in crop yields one year previously, when both series have been divested of their long-term trends. It may be added that the correlation between crop yields and phthisis mortality in simultaneous years is not significant ($r = +.003$).

In the Dublin Registration Area the decline in the mortality from tuberculosis started definitely in 1901, i.e., about two years before the decline in the whole Saorstát. In a general way the year to year fluctuations in Dublin correspond with those for the rest of the Saorstát, for when the annual deviations from the five-yearly averages in the two areas were correlated for the years 1866 to 1926 a correlation coefficient $r = +.44$ was found.

The Dublin phthisis mortality statistics are available by quarters since 1864. Almost invariably the deaths *registered* in the first and second quarters are high, and in the third and fourth quarters low. The question arises: if registrations in the first half-year are comparatively low, are they compensated by many deaths registered in the second half-year, or vice-versa? In other words, does a good half-year only postpone mortality from phthisis to the second half-year? To answer this question, deviations from the five-yearly averages were calculated separately for the first and second half-years, and correlated for the years 1866 to 1912. A correlation coefficient $r = -.12$ was found, showing that if such a tendency exists it must be very slight.

IV.—AGES AT DEATH.

It is well known that in this country the tuberculosis mortality rate reaches a peak at the young adult ages. This is by no means a general feature of the disease, as the following table* shows:—

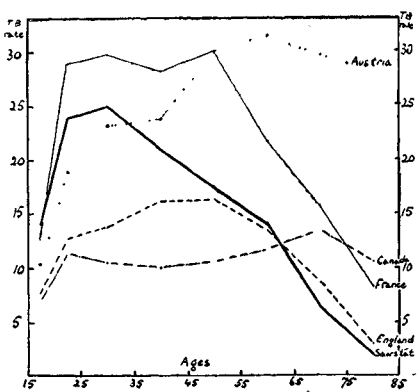
* Calculated from statistics published in the *International Health Year Book*, 1928, published by the League of Nations, and in Annual Reports of Registrar-General of Saorstát Éireann and of Northern Ireland.

MORTALITY FROM TUBERCULOSIS PER 100,000 POPULATION IN EACH GROUP. MALES.

Country	Year	AGES											All Ages
		0–	5–	10–	15–	20–	25–	35–	45–	55–	65–	75–	
Saorstat Éireann .	1925–7	113	45	47	141	238	**249**	210	175	142	65	21	146
Northern Ireland .	,,	135	44	44	141	**239**	214	189	179	133	69	25	142
England and Wales	1926	103	34	28	76	127	138	162	**163**	135	87	30	111
Scotland . .	,,	**158**	41	38	96		138	123	132	134	95	46	106
Austria	,,	176	39	33	104	188	231	237	306	**314**	289		193
Sweden	1924	129	43	47	166	**262**	215	148	125	140			146
France	1926	130	39	30	127	289	297	282	**300**	216	156	82	199
U. S. A.	1925	41	11	15	57	109	120	132	135	143	**171**	134	87
Canada	1926	68	23	33	70	113	106	101	106	117	**134**	105	82

If age at death be regarded as a criterion of type of tuberculosis, the foregoing table (and diagram 4 constructed from it) shows that the type of tuberculosis varies in the most extreme manner in the different countries tabulated. For instance, we note that the maximum rate (picked out in black type) is found at the age group 0-4 in Scotland, and at the age group 65-74 in the United States and Canada. In Saorstát Eireann and in Northern Ireland, where the types of tuberculosis are otherwise strikingly similar, the highest rate is reached at the young adult ages, and then recedes regularly to the latest age. In the United States the rates increase as regularly from the ages 5-9 to the age group 65-74. The Saorstát rate is second highest of the nine at age group 25-29, and lowest at ages 65 and over.

DIAGRAM 4.—MORTALITY FROM TUBERCULOSIS (ALL FORMS) PER 10,000 POPULATION IN EACH AGE GROUP IN FIVE COUNTRIES. MALES.



From the marked difference between the types of the disease in Ireland, which is largely rural, and England, which is largely a town-dwelling community, it was thought that similar differences might obtain between urban and rural types of the disease within the boundaries of the Saorstát. The following table shows that this is very markedly the case. The Saorstát rates have been calculated from published data. The rates for the urban areas have been calculated from unpublished records in the General Register Office, to which I was kindly allowed access. Note that the following table refers to phthisis only, the foregoing to all forms of tuberculosis (phthisis rates not being available for all the countries).

MORTALITY FROM PHTHISIS PER 100,000 MALES AND FEMALES.

	Year	Ages						All Ages
		15–	20–	25–	35–	45–	55–	
				MALES				
Saorstát Éireann	1925–7	105	198	**221**	183	151	83	113
Dublin Co. Boro' . ..	1923–8	159	207	245	**340**	284	195	181
Three other C B 's	,,	143	204	252	**326**	261	133	165
Dublin Extern *	,,	140	208	190	**214**	132	88	121
				FEMALES.				
Saorstát Éireann	1925–7	182	**252**	233	182	119	53	121
Dublin Co. Boro' . ..	1923–8	243	**255**	221	208	149	111	165
Three other C B.'s ..	,,	188	202	**281**	252	178	96	158
Dublin Extern*..	,,	141	**198**	167	120	98	51	105

* Rathmines and Rathgar, Pembroke, Blackrock, and Dun Laoghaire Urban Districts.

On account of the fewness of the deaths at the later ages it has been found convenient to use a single group for 55 years and over. It is quite clear that the types of phthisis in Dublin and the two urban groups of areas, both for males and females, are distinct from one another and from other Saorstát types. At the age group 20-24 the male rates are nearly the same in all four cases, whereas at ages 55 and over the rates range from 83 for the Saorstát to 195 for Dublin City. The male rates at all age groups are rather similar in Dublin and the aggregate of the three other Co. Boroughs. The rates for females are quite dissimilar.

Since 1923 the numbers of deaths in administrative areas from phthisis and other main causes have been published in the age groups 0–, 1–, 5–, 15–, 45–, 65–, without distinction of sex. May it be suggested that in future the age group 15-44 be sub-divided, for phthisis at least? However, the existing published data will suffice to show that there is a marked variation in the age type as well as the quantity of phthisis throughout the country.

DEATH RATES FROM PHTHISIS IN 1923-8 AS PER CENT. OF THE SAORSTÁT (EXCLUDING THE CO. BOROUGHS) RATES. MALES AND FEMALES.

	AGES				All ages
	0–	15–	45–	65–	
Saorstát Éireann (*a*) ...	100	100	100	100	100
Dublin County ...	121	95	93	130	104
Wexford	151	131	108	122	129
Cork County	113	101	107	129	106
Mayo	89	98	96	54	90
Donegal	96	113	88	90	102

(*a*) Excluding Co. Boroughs.

The Wexford excess is most marked at the age group 0-14, when the phthisis rate was 51% over the Saorstát average, and the rates receded until the age group 65 and over, where the increase may be accidental, as the numbers of deaths on which it was based was only 20 in the six years. The figures indicate that in Wexford and Donegal the younger type of phthisis predominates. Probably if the figures were available for a more detailed age gradation the differences in types of the disease would be more pronounced in different parts of the country.

Reference may here be made to the remarkable theory which the late John Brownlee, M.D.* based on differences in the phthisis death rates by age groups in different parts of Great Britain. According to this theory these differences indicated the presence of two or more distinct types of the disease. Having decided on three series of death rates by ages as characteristic of three separate types of the disease, called "young adult," "middle-age," and "old-age" phthisis, the proportions in which the three types were present in various parts of England and Wales were determined. Dr. Brownlee inclined to the view that these types correspond with separate types of the infecting bacillus. What is most interesting is that Brownlee showed that these three types were quite distinct in their relations with associated phenomena. Thus he found that the amount of young adult phthisis was negatively correlated with the amount of middle-aged phthisis, or, in other words, where young adult phthisis occurs the middle-aged type is less likely to be found. Young adult and old-age phthisis, on the other hand, tend to occur in the same areas. He also found that in England young adult and old-age

* An Investigation into the Epidemiology of Phthisis in Great Britain and Ireland.—Medical Research Committee.

phthisis vary independently of the hygienic surroundings, while middle-aged phthisis is closely related to the general standard of health. Where young adult phthisis occurred there was less tuberculosis amongst children aged 0-4. Another important result was that young adult phthisis was likely to occur in areas situated on boulder clay, a conclusion which we shall have occasion to consider later in connection with Co. Wexford. Brownlee used the Irish phthisis rates, 1891-1900 (with some modifications) as characteristic of young adult phthisis.

The age type of phthisis in Ireland has undergone a marked change with the passing of the years. The following table shows, in fact, the percentage declines in the rates between 1871-80 and 1925-7.

PERCENTAGE DECLINES IN ANNUAL AVERAGE PHTHISIS MORTALITY RATES BETWEEN 1871-80 AND 1925-27 ALL IRELAND.

	0–	5–	10–	15–	20–	25–	35–	45–	55–	65–	75–	All Ages
Males	11	77	68	51	48	46	37	34	51	52	67	42
Females ..	32	75	55	42	26	31	35	44	62	59	56	39

First of all it will be noted that at all the age groups with the highest phthisis mortality rates (ages 15-34) the declines in the male rates are much higher than the female. At the age groups 0-4 and 45-54, 55-64 and 65-74, the female percentage declines exceed the male, and there is not much difference in the general rate—42% for males and 39% for females. There has been a marked movement towards an older type of phthisis amongst males, for we note that between the age groups 5-9 and 45-54 the declines range in an unbroken sequence from 77% to 34%. The percentages for females vary irregularly. The declines range from 75% at the age group 5-9 to only 26% at the group 20-24.

Statistics of the mortality from phthisis amongst the Irish-born in Pennsylvania and New York* seem to have an important bearing on Dr. Brownlee's theory of different types of the disease.

* "The Mortality of Race Stocks in Pennsylvania and New York.' By Louis I. Dublin and Gladden W. Baker. *Journal of the American Statistical Association, March,* 1920.

DEATHS PER 100,000 FROM PHTHISIS AMONGST MALES IN 1910.

	AGES			
	15—	20—	25—	45—64
Died in Ireland	170	321	310	202
Born in Ireland—				
Died in Pennsylvania	428	128	376	409
,, ,, New York State ...	312	327	663	682
Born in U.S.A.—				
Died in Pennsylvania	61	148	185	174
,, ,, New York State ...	102	216	352	262

The age types of the disease are totally different for deaths amongst the Irish-born in Ireland and in the United States, and the latter are quite different from the U.S.A.-born deaths. We note, in fact, that from age 20 the ratio of the rates of the Irish-born in U.S.A. to the corresponding rates for Ireland or for U.S.A.-born increases steeply with age. It is obviously environment and not race which determines the type of disease.

V.—MORTALITY IN SAORSTÁT COUNTIES.

In 1923 a change of fundamental importance was introduced by the Registrar-General into the compilation of vital statistics when deaths in institutions were allocated to the areas from which the deceased were admitted, not as heretofore, to the areas in which the deaths occurred. Prior to 1923, while the institutional deaths occurring in urban areas were known, there was always a certain amount of conjecture in allocating these deaths to their correct areas. The statistics are now on a sure foundation.

TABLE 2.—MORTALITY FROM TUBERCULOSIS IN SAORSTÁT COUNTIES. RATES PER 100,000 PER ANNUM, 1923–8, AND PERCENTAGE DECLINES BETWEEN 1901–10 AND 1924–6

	Standardised rates all T.B., 1923–8	Crude Rates, 1923–8							Per cent. decline all T.B., 1901–10 to 1924–6
		Persons	Males	Females	Urban	Rural	Phthisis	Other T.B.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Carlow	150	150	119	184	214	134	117	33	35
Dublin County Boro'.	202	215	233	199	215	—	167	48	54
Dublin	142	150	150	151	141	163	112	38	41
Kildare	148	151	137	168	150	151	119	32	42
Kilkenny	148	147	130	167	202	138	111	36	30
Laoigheas	153	151	139	164	—	151	123	28	19
Longford	103	100	94	106	141	94	74	26	48
Louth	168	169	164	174	184	158	134	35	22
Meath	146	147	142	152	198	140	109	38	42
Offaly	152	152	152	151	216	139	119	33	39
Westmeath . ..	156	159	166	151	190	154	124	35	24
Wexford	183	183	166	201	226	170	139	44	31
Wicklow	151	151	157	144	177	140	122	29	38
LEINSTER ..	165	170	169	171	196	148	131	39	41
Clare	133	131	125	137	188	125	112	19	33
Cork Co. Boro' ..	207	220	232	210	220	—	169	51	45
Cork	139	140	132	148	198	131	115	25	
Kerry	139	135	138	131	215	123	109	26	38
Limerick Co. Boro.'	161	172	180	164	172	—	147	25	49
Limerick	127	126	135	117	—	126	99	27	
Tipperary	137	138	134	151	197	125	107	31	37
Waterford Co. Boro'	187	195	203	186	195	—	158	37	41
Waterford .. .	147	147	131	164	205	141	118	29	
MUNSTER .	146	147	144	150	202	128	119	28	42
Galway	133	129	117	142	187	121	106	23	29
Leitrim	120	114	119	108	—	114	89	25	41
Mayo	128	121	123	118	180	116	97	24	30
Roscommon ..	97	93	94	92	—	93	78	15	59
Sligo	123	119	118	120	207	102	92	27	47
CONNACHT ..	123	118	116	121	191	112	95	23	37
Cavan	104	100	98	102	141	97	76	24	39
Donegal	147	140	121	161	160	140	110	30	16
Monaghan	118	115	104	126	138	110	86	29	40
ULSTER (3 Co.s)	129	124	111	138	143	122	96	28	27
SAORSTÁT ÉIREANN ..	148	148	145	152	196	129	117	31	40

In Table 2 will be found eight series of county mortality rates based on the experience of six years of these statistics. The standardised rates in column (1) were calculated by the "indirect" method.* Comparing columns (1) and (2) it will be seen that the corrections introduced by standardisation into the crude rates are important in only a few cases, notably, in the County Boroughs, where there are proportionately large numbers of young adults amongst whom the ravages of the disease are most severe in this country. Outside of these, Leitrim, Mayo and Donegal (amongst whose population are large numbers of very young and old people not liable to die of the disease) are the only counties materially affected by standardisation. In view of the fact that all the remaining series of rates in the table are crude it is important to emphasise that the general picture presented by the crude and standardised series of rates is the same in all essentials.

The highest (standardised) rates of mortality occur in Cork County Borough, 207; Dublin County Borough, 202; Waterford County Borough, 187; Wexford, 183; Louth, 168; Limerick County Borough, 161. We note that all the Leinster county rates (with the emphatic exception of Longford's, in this as in many other statistics, a "Connacht" county) and those of Waterford and Donegal are in excess of 140, while the rates for Connacht and Ulster (3 counties), except those for Galway and Donegal, do not exceed 130.

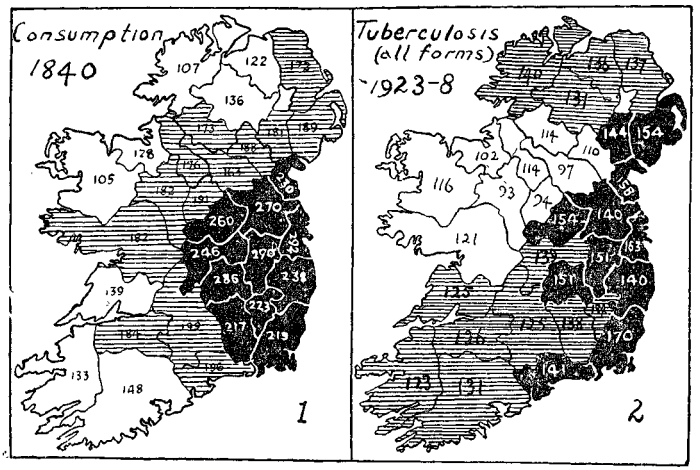
Comparing the male and female rates it is remarkable that the nine counties in which the relative excess for females is most marked include six in the south-east. In fact, the female rate per cent. of the male is highest in the following counties: Carlow, 155; Donegal, 133; Kilkenny, 128; Waterford, 125; Kildare, 123; Galway, 121; Monaghan, 121; Wexford, 121; and Laoigheas, 119. While the very high excess may be due in some measure to the fewness of the deaths in the smallest county, the contiguity of the six south-eastern counties is evidently due to some definite cause. It will be noted that there is a well-marked male excess in each of the County Boroughs, most marked in Dublin.

The crude mortality in Saorstát urban districts is more

* *I.e.*, from the Census age and sex constitution of counties, the expected death rates from tuberculosis were first calculated on the hypothesis that the rates of mortality at each age group were the same as for the whole Saorstát in 1925–7. These rates were a measure of the effect of differences in county age and sex constitution on tuberculosis mortality. The county rates were divided by the Saorstát rate and the resulting quotients divided into the crude rates to give the rates standardised for age and sex.

than 50% in excess of the rural mortality. In only two counties (Dublin, excluding Dublin County Borough, and Kildare) does the rural mortality exceed the urban. The important fact also emerges that there is no apparent relation between urban and rural mortality from tuberculosis, for we note that in Leinster Munster and Connacht, where the rural rates vary widely, there is little or no difference in the urban rates. The urban rates, relatively to those in their rural areas, are worst in Sligo and Kerry. To Wexford belongs the melancholy distinction of having the highest urban and rural tuberculosis rates in the country.

MAPS 1 AND 2.—MORTALITY PER 100,000 PER ANNUM IN THE RURAL DISTRICTS OF IRISH COUNTIES FROM CONSUMPTION (1840) AND FROM ALL FORMS OF TUBERCULOSIS (1923-8).



Map 2 shows that there is a remarkable homogeneity in the geographical distribution of the disease over large contiguous areas of the country. It will be seen that all Ireland may from this point of view be parcelled out into four main areas: eleven eastern counties in which the rural rate is 140 or more; a midland and western group of nine counties comprising the five Connacht counties, Longford and three Ulster counties, in which the rate does not exceed 121, and a northern and southern group of four and eight counties respectively, in each of which the rates are medium. (Donegal, on the border-line, has been allocated to the medium group).

The high rates in the eastern littoral have often been commented upon, but perhaps it required these fully distributed mortality statistics to bring the other geographical features of the distribution into full relief.

The other map showing the mortality rates (compiled from statistics published in connection with the Census of 1841) from " consumption " in 1840 brings out the important fact that while the eastern phthisis rates were always high the general geographical distribution of mortality has undergone a marked change since 1840. The distribution is not nearly so homogeneous as in 1923-8 on account, perhaps, of the vast improvement in the quality of the statistics. In presenting the map and the rates which are shown on it, it has been assumed that even if there was a bias in the statement of numbers or causes of death that it operated in the same manner in all counties. In those days there were seven counties in which the mortality from consumption in rural districts was far lower than in the remaining twenty-five counties: Mayo, 105; Donegal, 107; Derry, 122; Sligo, 128; Kerry, 133; Tyrone, 136; Clare, 139; Cork, 148. Since 1840 Donegal has fallen from the second to the twenty-first place in ascending order of mortality rates. The retardation in the improvement of the Donegal rate is borne out in Table 2, column (9), which shows that the Donegal rate declined by only 16 % between 1901-10 and 1924-6 compared with 40 % for the whole Saorstát. A special anti-tuberculosis " drive" is surely needed in this county.

The high mortality from tuberculosis on the east coast was observed and commented on at an early stage in the records of vital statistics in this country. Thus the 1851 Census Commissioners wrote (Census of Ireland, 1851, Vol. V, Part I, page 448) :—

> " But when we enter into a more minute examination of the subject we find some very remarkable irregularities. Thus of the seaboard baronies the proportion of deaths registered under the head of pulmonary consumption to the total of all causes in those of the east coast, extending from the junction of the baronies of Forth and Bargy, in the county of Wexford, to Upper Glenarm, in the county of Antrim, was as high as 1 in 5.88, possibly the result of the trying east winds which play upon this part of the island during a large portion of the year."

It should be pointed out that the rates in column (9) relate to the numbers of deaths *registered* in the counties.

These, for 1924-6, were obtained from the quarterly returns of the Registrar-General, which showed the numbers of deaths from tuberculosis as returned by the registrars. These had to be adjusted in a minor degree to allow for the slight discrepancy which always occurs between the quarterly returns (which have to be issued promptly) and the definitive figures of the Registrar-General.

I had at first hoped to be able to relate these declines in mortality rates with the magnitude of the public health effort in the different counties or with the differential changes in the economic condition, etc., but found the task beyond my powers. It would be extremely valuable for future guidance in combating this or other diseases to be able to show that the counties which exhibit the greatest declines in mortality are just those counties in which the public health activities were most pronounced. Perhaps some enquirer with special knowledge will examine these statistics in this sense. At any rate, the counties showing the greatest improvements were Roscommon with a decline of 59 %, Dublin Co. Borough with 54 %, Limerick County and Co. Borough 49 %, Longford 48 %. And (more important) the counties where the improvements were least marked were Donegal with 16 %, Laoigheas 19 %, Louth 22 %, and Westmeath 24 %.

In the 1928 Report of the Registrar-General the standardised rates of mortality from all causes in the rural districts of each county in 1928 are given. It was found that the coefficient of correlation between these standardised rates and the crude tuberculosis rates in rural areas, 1923-28, was + .67. It follows that in rural areas where the general level of public health is high there is relatively little tuberculosis, and vice versa. This is at variance with a result of Dr. Brownlee, who showed that in England there is no significant correlation between "young adult" phthisis (the predominant type in rural Ireland) and the general level of health.

VI.—TUBERCULOSIS IN WEXFORD.

Whatever is the underlying cause of the high Wexford rate it is obviously not economic, for Wexford is one of the most prosperous rural communities in the country. Nor is it housing, for as it happens rural housing is far better in Wexford than in any other county—only 13.6% of the rural population are living in dwellings having more than two persons to a room compared with 27.1% for all Saorstát rural districts. Contrast rural Mayo and rural Wexford.

In the former county there were 133 cattle to every 100 of country population in 1926, compared with 207 in the latter county; 43.7% of the rural population were living more than two persons to a room in Mayo compared with 13.6% in Wexford, and yet the tuberculosis rate in rural Mayo was only 116, compared with 170 per 100,000 in Wexford.

Of course, it is likely that within the boundaries of the county the poorer classes have a higher mortality rate. This is borne out by the rates in the rural portions of the four Superintendent Registrar's Districts in Wexford during the years 1923-28. The numbers on which these rates are based have been fully corrected for institutional deaths:—

	Tuberculosis Mortality per 100,000 per annum	Small farmers (1–15 acres) and relatives and agricultural labourers living out as % of total in agriculture, 1926
Rural portion of—		
Enniscorthy S.R.D.	165	32
Gorey ,, ...	162	29
New Ross ,, ...	167	30
Wexford ,, ...	182	43
Total ...	170	34

We note that in the Wexford rural S.R.D., where there is a much higher percentage of small farmers and agricultural labourers than in the other three, the mortality from tuberculosis is significantly higher. Furthermore, there is no very significant difference between the three tuberculosis rates nor the percentages of small farmers and labourers in the three other S.R.D's.

TABLE 3.—DEATHS FROM TUBERCULOSIS (ALL FORMS) IN THE REGISTRAR'S DISTRICTS IN CO. WEXFORD, 1906–26.

Superintendent Registrar's District and Registrar's District	Total number of Deaths from Tuberculosis 1906-26		Annual Average per 100,000 of Population	Valuation of land per 100 acres of crops and pasture
	As Recorded	As Distributed		
				£
Enniscorthy S.R.D.	1,294	1,332	207	52
Clonroche Reg. D.	137	183	204	49
Enniscorthy (w) ,, ,,	706	546	234	63
Ferns ,, ,,	108	144	222	50
Killann ,, ,,	112	150	204	39
Newtownbarry ,, ,,	105	140	176	43
Oulart ,, ,,	126	169	166	61
Gorey S R.D.	631	649	203	58
Camolin Reg. D.	106	138	201	48
Coolgreany ,, ,,	70	92	163	54
Gorey (w) ,, ,,	312	233	193	62
Killenagh and Wells ,, ,,	143	186	251	67
New Ross S.R.D.	907	933	210	54
Carrickbyrne Reg. D.	116	155	182	45
Fethard No. 1 ,, ,,	89	119	197	60
Fethard No. 2 ,, ,,	103	138	229	53
New Ross (w) ,, ,,	433	299	240	99
Old Ross ,, ,,	121	162	213	58
Templeludigan ,, ,,	45	60	158	46
Wexford S.R D.	1,661	1,710	254	65
Bannow Reg. D.	92	113	161	62
Bridgetown ,, ,,	165	202	209	66
Broadway ,, ,,	147	180	196	73
Crossabeg ,, ,,	124	152	295	62
Taghmon and Glynn ,, ,,	131	161	251	52
Wexford (w) ,, ,,	1,002	902	301	84
Total of County ...	4,493	4,624	222	57

(w) Registrar's District containing Workhouse.

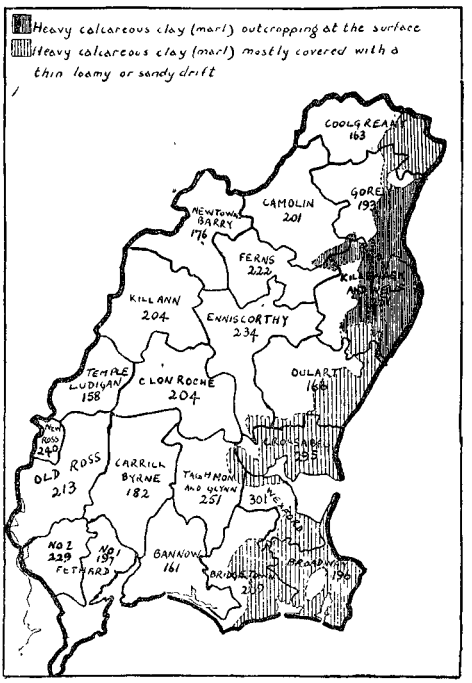
But in order to study causes it is necessary to deal with smaller and more numerous units of area than S.R.D.s. From the third quarter of 1905 on, the quarterly returns of the Registrar-General showed the numbers of deaths from all forms of tuberculous disease in each Registrar's District, of which there are twenty-two in Wexford. I

have compiled the deaths during the twenty-one years, 1906-26, in each of these districts and show the results in table 3. It should be explained that these deaths referred, in the first instance, to deaths occurring within the borders of each district, i.e., institutional deaths were not allocated to the areas from which the deceased were admitted. These allocations were effected by deducting certain proportions of the deaths in the Reg. D.'s which contained the workhouses and distributing them over the constituent districts in each S.R.D. I will not burthen this already long paper with a description of the methods by which these proportions were estimated: it may suffice to state that they were taken to be 23% for Enniscorthy S.R.D., 21% for Gorey S.R.D., 23% for New Ross S.R.D. and 16% for Wexford S.R.D. Finally, as it was found that the Registrars' returns understated the total mortality from tuberculosis in Wexford (as given in the annual reports) by 131, or just 3%, during the twenty-one years all the Reg. D. rates were raised pro rata. The original and the adjusted statistics are shown in table 3. It is thought that the final figures adopted for the eighteen Reg. D's, other than the four containing the workhouses, are fairly reliable. A certain doubt attaches to the latter on account of the substantial element of estimate.

As economic and climatic reasons do not appear to explain the high tuberculosis mortality in Wexford, it was thought that the quality of the soil might be a contributory cause. In England certain enquiries have been made into the relationship between subsoil and phthisis. Dr. Brownlee* showed that there is a positive correlation ($r = +.40$) between the percentage of the total area of the Reg. D's in Norfolk and Suffolk lying upon boulder clay and the mortality from "young adult" phthisis in the years 1850-70, in other words, persons living on such areas were more likely to die of the disease. The result was confirmed in Essex.

* Medical Research Committee. An Investigation into the Epidemiology of Phthisis in Great Britain and Ireland. Part III. p.64.

MAP 3.—MORTALITY FROM TUBERCULOSIS (ALL FORMS) PER 100,000 PER ANNUM IN THE REGISTRARS' DISTRICTS OF CO. WEXFORD, 1902-26, AND THE LITTORAL MARL AREA.



I discussed the possibility of applying Dr. Brownlee's method of enquiry to the Wexford problem with Mr. T. Hallissy, of the Geological Survey, who suggested that the famous marl areas of Wexford might furnish a suitable region for investigation. I am also indebted to Mr. Hallissy for mapping these areas on a ¼-inch Townland Index Map, from which the map on this page (which also shows the Reg. D. boundaries) was reproduced. With his permission I quote the following explanatory matter from his covering letter:—

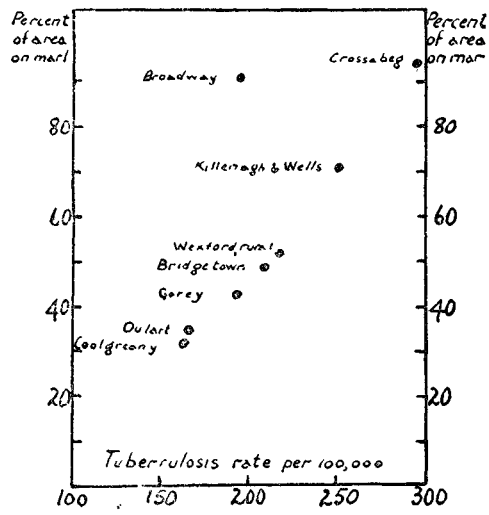
"I am returning your map on which I have indicated in colour the areas where the marine boulder clay lies at or near the surface. The area represented by the heavier colour includes the so-called Macamore land, the soils of which are so stiff and impervious. Having mapped this

district myself, I am satisfied that the boundaries are sufficiently accurate for all practical purposes. Unfortunately I cannot say the same for the remaining boundaries. They are or more or less conjectural, having been drawn partly from my personal knowledge of the ground, and partly from inference based upon the distribution of marl-holes, the run of the contours, notes on the original field maps, etc."

Confining our attention to the eight littoral Reg. D's traversed by marl, the map shows at a glance that the tuberculosis mortality rates are high where a large proportion of the area of the district lies over marl, and vice versa. For instance, Oulart, with a low mortality rate and a low proportion of marl area, lies between Crossabeg and Killenagh and Wells, with high rates and high proportions of marl area. The result is extremely striking when these proportions are expressed in figures. This was done roughly by drawing the boundaries on transparent paper, depositing the resulting map on 1-10-inch meshed squared paper and counting the squares. The following are the eight "marl" Reg. D.'s arranged in order of the proportion of marl area:—

Registrar's District	Approximate percentage of area on marl	Tuberculosis Mortality per 100,000, 1906–26
Crossabeg	94	295
Broadway	91	196
Killenagh and Wells	71	251
Wexford, rural	52	218
Bridgetown	49	209
Gorey	43	193
Oulart	35	166
Coolgreany	32	163

DIAGRAM 5.—PERCENTAGES OF AREA ON MARL AND TUBERCULOSIS MORTALITY RATES IN WEXFORD REGISTRAR'S DISTRICTS, 1906-26.



The Wexford rate is for the rural part (i.e., outside of Wexford U.D.) of the Reg. D. It will be seen that with the interesting exception of Broadway the mortality from tuberculosis follows exactly the same sequence as the proportion of area on marl, and as diagram 5 shows, the seven points graphing the two statistics almost lie on a straight line. Even if we could not account for the low Broadway rate, there could be no doubt that the marl has a dominating influence on the mortality from tuberculosis in the littoral Reg. D.'s of Wexford.

That Broadway Reg. D. with a high proportion of the land lying on marl has a relatively low tuberculosis mortality rate is probably due to the fact that here the marl is normally covered with from five to seven feet of drift containing many angular fragments of local rocks,* and therefore there is a better natural drainage. The valuation of the land in Broadway (£73 per 100 acres, crops and pasture, compared with £57 for all Wexford) is higher than in any other Wexford Reg. D. with the exception of New Ross and Wexford, both of which contain urban districts.

* Hallissy.—"On the Superficial Deposits of Co. Wexford."—*The Irish Naturalist* Vol. XXI, 1912, page 175.

VII.—MORTALITY FROM TUBERCULOSIS IN SAORSTAT TOWNS.

Table 4 shows the annual average rates of mortality from all forms of tuberculous disease during the twenty-one years 1906-26 in county boroughs and urban districts. In the compilation of these statistics deaths of persons which occurred in institutions situated within the boundaries of the towns but who were admitted from outside have been excluded. All the rates, therefore, understate the real mortality by an amount which may, generally speaking, be presumed to be too small to affect the comparability of the statistics.

TABLE 4.—DEATHS FROM TUBERCULOSIS (ALL FORMS) IN SAORSTÁT COUNTY BOROUGHS AND URBAN DISTRICTS, 1906–26.

(Towns arranged in order of population in 1926. Institutional deaths of persons admitted from outside each town boundary are excluded).

Town	Actual deaths in 21 years	Rate per 100,000 average popltn. per annum	Town	Actual deaths in 21 years	Rate per 100,000 average popltn. per annum
Dublin, C.B. ...	21,747	333	Tipperary ...	268	209
Rathmines and Rathgar	1,497	183	Enniscorthy ...	349	301
Pembroke ...	1,216	185	Ennis	228	198
Blackrock ...	370	185	Youghal ...	290	251
Dun Laoghaire	676	178	Killarney ...	349	299
			Ballinasloe ...	136	124
			Dungarvan ...	244	228
			New Ross ...	304	274
Dublin and 4 U.D.'s. ...	25,506	297			
			Tullamore ...	346	334
			Ballina ...	244	244
Cork ...	5,491	337	Thurles ...	154	157
Limerick ...	2,111	258	Carrick-on-Suir	340	327i
Waterford ...	1,799	317	Monaghan ...	136	145
			Mallow ...	146	154
Galway ...	706	245	Arklow ...	161 (*a*)	210 (*a*)
Dundalk ...	628	220	Nenagh ...	198	203
Drogheda ...	504	190	Fermoy ...	249	209
Wexford ...	785	319	Castlebar ...	133	159
Sligo	550	232	Dalkey ...	116	144
Tralee	635	290	Howth ...	19 (*b*)	65 (*b*)
Kilkenny ...	571	264	Longford ...	123	157
Clonmel ...	482	238	Navan ...	204	256
Bray ...	268	156	Westport ...	115	153
Athlone ...	367	233	Athy ...	142	193
Carlow ...	327	226	Naas	212	277
Cobh ...	442	275	Birr	201	257

TABLE 4—*Continued.*

TOWN	Actual deaths in 21 years	Rate per 100,000 average popltn. per annum	TOWN	Actual deaths in 21 years	Rate per 100,000 average popltn. per annum
Kilrush ...	174	236	Letterkenny ...	90	191
Cavan	82	130	Templemore ...	59	140
Wicklow ...	130	198	Kells	82	170
Passage West ...	26 (*c*)	148 (*c*)			
Cashel	111	183			
Listowel ...	198	298	Killiney and Ballybrack.	79	157
Clonakilty ...	131	218	Carrickmacross	68	160
Kinsale ...	234	329	Castleblayney ...	48	141
Midleton ...	144	232	Cootehill ...	39	121
Skibbereen ...	155	260	Bundoran ...	12 (*e*)	58 (*e*)
Macroom ...	125	232	Trim	52	176
Clones ...	66	132	Belturbet ...	38	135
Buncrana ...	36 (*d*)	132 (*d*)	Granard ...	35	119

(*a*) 1911–26; (*b*) 1919–26; (*c*) 1921–26; (*d*) 1914–26; (*e*) 1915–26.

The following are the twenty towns in which tuberculosis mortality exceeded 250 per 100,000 during the twenty-one years and the rates per 100,000:—Cork 337, Tullamore 334, Dublin 333, Kinsale 329, Carrick-on-Suir 327, Wexford 319, Waterford 317, Enniscorthy 301, Killarney 299, Listowel 298, Tralee 290, Naas 277, Cobh 275, New Ross 274, Kilkenny 264, Skibbereen 260, Limerick 258, Birr 257, Navan 256, Youghal 251.

It will be noted that the three Wexford urban districts are amongst the number. It will also be noted that fourteen of the twenty towns are amongst the thirty-five largest and only six amongst the thirty-five smallest. There appears, therefore, on this rudimentary analysis, to be a relationship between size of town and mortality.

The following are the ten towns in which the rates during the twenty-one years did not exceed 150:—Granard 119, Cootehill 121, Ballinasloe 124, Cavan 130, Clones 132, Belturbet 135, Templemore 140, Castleblayney 141, Dalkey 144, Monaghan 145. It is extremely remarkable that six of the ten are situated in Cavan or Monaghan and that nine of the ten are inland towns.

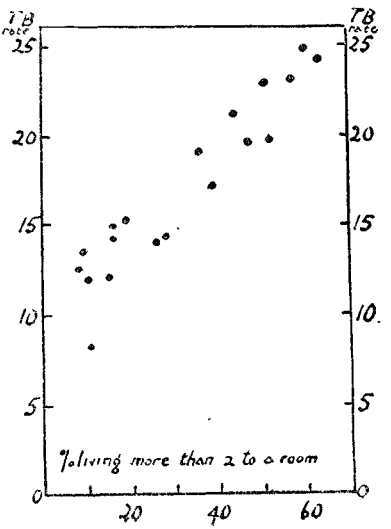
The relationship between the mortality rate, housing conditions, density of population and size of population is most conveniently shown by the method of correlation. Leaving Dublin City and the four adjoining urban districts (where special considerations apply) out of account, and also Howth and Passage West, for which statistics are available

only for the last few years, the following are the values of the coefficient of correlation between (*a*) the mortality rate from tuberculosis (all forms), and (*b*) percentage of persons living more than two persons per room; (*c*) persons per acre, and (*d*) the logarithm of the average population calculated for the remaining 63 towns. In the latter case the logarithm was used in preference to the absolute figure, on account of the unmanageably large variation in the magnitude of the latter. The following were the values of r:—

$r_{ab} = + .29$ (Housing).
$r_{ac} = + .43$ (Density of Population).
$r_{ad} = + .56$ (Logarithm of Population).

It is remarkable that the most pronounced relationship is found between mortality from tuberculosis and population: the larger the town the more the tuberculosis. There is also a marked relationship between tuberculosis and density of population per acre, notwithstanding the fact that this latter statistic, as its wide range of variation from town to town shows, is very defective from the present point of view. It would appear that in many cases large areas of land outside the town proper are included in the area of the urban district. If the densities of the towns proper were available it is likely that a much higher coefficient would be obtained.

DIAGRAM 6.—MORTALITY FROM TUBERCULOSIS (ALL FORMS) AND HOUSING IN THE REGISTRARS' DISTRICTS OF DUBLIN CITY AND IN THE URBAN DISTRICTS OF DUBLIN COUNTY, 1922-8.



There is but little relationship between overcrowding and tuberculosis in Saorstát towns outside Dublin. Another striking result is that there is no correlation between density and overcrowding—in fact, $r_{bc} = +.08$, so that the correlation between tuberculosis and density and tuberculosis and housing are independent phenomena.

TABLE 5.—MORTALITY FROM TUBERCULOSIS (ALL FORMS) AND HOUSING IN THE REGISTRARS' DISTRICTS OF DUBLIN CITY AND IN THE URBAN DISTRICTS OF DUBLIN COUNTY, 1922–8.

City of Dublin	Tuberculosis per 100,000 per annum	% living more than 2 to a room	Urban Districts in Dublin County	Tuberculosis per 100,000 per annum	% living more than 2 to a room
North City :					
No. 1 East ...	196	47	Blackrock ...	150	16
No. 1 West ...	232	57	Dalkey ...	121	15
No. 2 ...	243	63	Dunlaoghaire ...	144	28
No. 3 ...	190	36	Howth ...	82	11
Clontarf and Howth (Pt.)	120	10	Killiney and Ballybrack.	152	19
Coolock and Drumcondra (Pt.) ...	125	8	Pembroke ...	140	26
			Rathmines and Rathgar.	142	16
Finglas and Glasnevin (Pt.)	135	9			
South City, No. 1	212	44			
,, ,, ,, 2	249	60			
,, ,, ,, 3	197	52			
,, ,, ,, 4	229	51			
New Kilmainham	171	39			

There is, however, a strong positive correlation between bad housing and mortality in Dublin and adjoining urban areas. Table 5 shows the rates during 1922-28 for the Dublin City Registrar's or dispensary districts and for the seven Dublin urban districts. Each of these nineteen areas is represented by a point on diagram 6, which shows clearly that in these areas the worse the housing the more the tuberculosis. The result is of doubtful value as showing that bad housing is a cause of tuberculosis, in so far as the worse the housing in a given area the lower the social condition, generally speaking, and hence the greater the mortality from tuberculosis, Or, of course, the operative cause may be density of population, in view of the correlation found in other Saorstát towns.

VIII.—OCCUPATIONAL MORTALITY.

The only statistics available on this matter are for the Dublin Registration Area (i.e., Dublin City and the four adjoining urban districts) and these extend over a considerable period. Each of the Census abstracts of 1841, 1851, 1861 and 1871 show, in fair detail, the numbers of deaths by occupations and principal causes. The value of these statistics was considerably lessened by the curious fact that the numbers of persons living in Dublin were not tabulated by occupation at these remote Censuses, so that mortality rates could not be calculated.

Occupational mortality statistics were published weekly and summarised annually for the years 1880, 1881 and 1882. The classification was admirably detailed. A feature with the most interesting possibilities, if it had been continued over a series of years, was that under each occupation the mortality amongst wives and children, in addition, of course, to the mortality amongst occupied persons, was shown. Rather unfortunately this system was discontinued after 1882, and from 1883 to 1921 the statistics were tabulated in five main and eighteen subsidiary occupational grades, and the mortality amongst dependents was included with the mortality amongst occupied persons in each grade. The following table has been constructed from these statistics. The Registrar-General's list has been modified slightly and mortality rates standardised for differences in age constitution calculated. Deaths in workhouses (the Registrar-General's Grade V.) have been excluded.

Numbers on R.-G.'s List	Occupation or Social Position	Years 1901–10			Percentage decline in phthisis mortality rates 1883–89 to 1908–14 (4)
		Mortality from phthisis (per 100,000 per annum)		Mortality from all causes (per 1,000 per annum) Standardised (3)	
		Crude (1)	Standardised (2)		
I.	**Professional and Independent**	102	98	16 0	41
II.	**Middle Class** . .	171	165	15.2	44
4	General body of officials	107	109	13 5	44
5	Traders, business managers, etc.	120	130	15.2	62
6	Clerks, commercial assistants	232	208	18 9	34
7	Others	164	156	13 5	44
III.	**Artisan Class and Petty Shopkeepers.**	249	256	19.0	30
8	Working engineers, engravers, printers, watchmakers, jewellers.	270	284	19 3	44
9	Building and furnishing trades.	234	246	19.2	34
10	Clothing trades	236	216	14.2	19
11	Food supply trades .	180	191	16.0	46
12	Other trades .	301	314	22.9	27
13	Petty shopkeepers	184	193	18.5	13
IV. (less 15)	**General Service (except domestic).**	291	316	25.0	30
14	Army, police, posts, prisons	212	209	24 5	44
16	Car drivers, vanmen	275	301	25.0	30
17	Hawkers, porters, labourers,	305	334	25.2	20
15	Domestic servants	129	106	10.7	27
Total (except workhouse inmates)		226	226	19.4	31

The social or economic grade has a very considerable influence on mortality from phthisis, and in fact from the Registrar-General's grade I to grade 17 the standardised phthisis rate increases from 98 to 334. The range in the standardised mortality rates from all causes is not nearly so marked: from 13.5 to 25.2 per 1,000 population. As might be expected, the phthisis rate for domestic servants is more closely akin to that of the grades in which they work than that to which they belong. Their general standardised mortality rate is also surprisingly low. The phthisis and general mortality rates for clerks are much higher than for others in their social grade. Comparing the rates in columns 2 and 3 we see that the proportion of deaths from phthisis to total deaths is highest in the clothing trades (10) and amongst engineers, etc. (8), and is lowest amongst the professional and independent classes.

With regard to the improvements which have been effected

in the quarter century which elapsed between 1883-89 and 1908-14, generally speaking the greatest percentage declines have occurred in the higher grades, although within the grades the changes are irregular. The most substantial decline (62%) is in the families of traders, business managers, etc. (5), and was least in the case of the clothing trades (10) with 19%. It will be noticed, however, that in all classes, without exception, considerable declines have occurred.

It has already been stated that mortality statistics of persons actually occupied are available for the years 1880 to 1882. Only in a few of the larger occupational groups were the deaths from phthisis sufficiently numerous in the three years to give any indications of how occupations affect mortality. The following were the occupations in which twenty deaths or more occurred in the three years.

DUBLIN REGISTRATION AREA 1880–2

Occupation	No. of deaths from phthisis 1880–2	Rate per 100,000 population per annum
Bootmakers	32	306
Carpenters	30	332
Car, van drivers	48	536
Clerks	130	518
Glaziers, painters	31	526
Grocers, vintners and assistants	22	229
Labourers	194	353
Milliners, dressmakers	65	215
Pensioners	42	1,157
Police	20	502
Porters, messengers	66	380
Printers	30	594
Servants	193	219
Soldiers	26	169
Tailors	38	427
Teachers	25	382

The rates, for what they are worth, are unexpectedly high in many cases. The rate is highest for pensioners with 1,157 per 100,000 per annum, presumably because many persons were pensioners because of delicacy of health. Then follow printers, with 594 per 100,000; car drivers, with 536; painters, etc., 526; clerks, 518. Soldiers, with 169 per 100,000, are the lowest on the list. The foregoing rates are crude: but it can be taken that standardisation does not affect their general aspect to any marked extent.

For the reasons already explained, any deductions drawn from the last table must be tentative. It will suffice if it shows the necessity for an exhaustive enquiry into occupational mortality for the whole Saorstát extending over a sufficient period of years to yield significant results.

IX.—SUMMARY.

The following are the more important points which emerge from this study:—

1. The Saorstát mortality rate in 1927 was the seventh worst on a list of twenty-four countries. Since before the European War tuberculosis has diminished in all countries for which statistics are available. The Saorstát rate of decline is well up to the average.

2. The mortality from tuberculosis started to fall in 1902. The decline was arrested during the years of the European War, but recommenced in 1919. The annual average rate of decline since then is slower than before the war.

3. It is shown that the Saorstát age-type of tuberculosis is very different from what it is in other countries. Here the "young adult" type of disease predominates. There is also a considerable difference between the urban and rural types of disease within this country.

4. County rates during the past few years are analysed in detail. It is shown that all Ireland may be partitioned into four homogeneous tuberculosis zones: an eastern zone in which rates are high, northern and southern zones in which rates are medium, and a midland and western zone in which rates are low.

5. The ravages of the disease are worse in Wexford than in any other Saorstát county. It is shown that the marl areas in Wexford exercise a dominating influence on the amount of tuberculosis in the littoral registrars' districts.

6. There is a high correlation between housing and tuberculosis in Dublin City and in the urban districts of Dublin County. In other towns the correlation is not so marked. There is a high positive correlation between the tuberculosis mortality rate and the size of the town in Saorstát Eireann.

7. A brief enquiry into the occupational mortality from the disease in Dublin has shown that there is a great disparity between the mortality rates in the richest and poorest classes. All classes have participated in the decline in mortality.

I have already expressed by indebtedness to Mr. T. Hallissy, M.R.I.A., of the Geological Survey, for

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