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Contributors

Chalmers, Archibald Kerr.
Royal College of Surgeons of England

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A PAGE IN THE NATURAL HISTORY OF PULMONARY TUBERCULOSIS.

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BY

A. K. CHALMERS, M.D., D.P.H.,

Medical Officer of Health, Glasgow.

President of the Society of Medical Officers of Health.

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1 UPPER MONTAGUE STREET, RUSSELL SQUARE,
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A PAGE IN THE NATURAL HISTORY
OF PULMONARY TUBERCULOSIS.

By A. K. CHALMERS, M.D., D.P.H.,
Medical Officer of Health, Glasgow.

President of the Society of Medical Officers of Health.

GENTLEMEN,—It is with a most sincere appreciation of the honour which you have conferred upon me, and a most earnest desire to maintain the traditions of the office, that I gratefully accept the duty of presiding over your deliberations during the ensuing Session.

It is probably a pardonable weakness to regard the distinction as gaining something in value, from the fact that only once before have you sought your President from North of the Tweed, but it brings with it a certain misgiving, lest in your desire to do honour to a country you should have been unfortunate in your selection of one to represent it. I take courage in the recollection that your council is composed of members widely versed in the detail of Public Health administration, and in the knowledge that the Society is inspired by a common desire to further the national welfare by improving the national health.

In this purpose we of this generation can lay no claim to originality of conception. Your Society has already on its roll of past members a wealth of illustration of men whose names are as memories, but whose work remains as an inspiration. But we should fail utterly, I think, to grasp the spirit which inspired them if in rendering unquestioning homage to their labours we accepted as final conclusions what they themselves would only have claimed to be a convenient working hypothesis.

That it must ever be so is, I think, a necessity of progress. To the worker in the Mid-Victorian period the massing of populations, which even earlier had established England's claim to be regarded as the workshop of the nations, had produced results which were both obvious and urgent. Man and his environment acquired a new meaning, and much of our domestic and industrial legislation took shape as an effort to adjust the balance against environment.

It would be beside my present purpose and unnecessary before this audience to trace the improvement in health which followed.

That indeed has often been done. But speaking in the presence of those to whom disease becomes the symbol of the error which man makes in the effort to adapt himself to

his environment, it is permissible to ask whether these results are to be attributed solely to changes in external environment, and have no relation to changes in the biological factor in the equation; that is in man himself.

I am, of course, stating no new proposition. But amid the glamour of a falling death-rate it is not always easy to avoid finding an explanation in the most obvious contemporary changes, to the neglect of those silent forces which have for ages been determining man's place in nature.

To the student of demography the industrial revolution was associated with a massing of population to an extent formerly unknown to history. But it also produced a blending of peoples not only of different nationalities but of varying ethnic types. If the early results of the massing may be read in the epidemic records of last century, to what extent is the equation with environment to-day being aided by the blending which followed?

In an introductory paragraph to his volume on the Races of Britain, Beddoe, writing thirty years ago, remarked that—"The ever-increasing rapidity of local migration and intermixture, due to the extension of railways and the altered conditions of society, will in the next generation almost inextricably confuse the limits and proportions of the British races."

It would be inconsistent with what is accepted regarding migrations in the past to assume that these of later date were in any large measure indiscriminate. Urban migration may indeed discriminate between types in a lesser degree than the urban selection which follows, but the selection in the one case is from a rural and largely homogeneous people, in the other from the blended populations which inhabit our industrial centres. In relation to their resistance to disease this blending of types can scarcely be without significance, although the influence which it exerts on rates of mortality requires elucidation. But that it is a factor continuously in operation is abundantly manifest, I think, whenever we endeavour to compare the prevalence of some diseases in our urban and rural populations.

The difference in their rates of mortality have an importance we may appreciate, but differences in their rate of movement or in the direction of the movement may, I suggest, not always be problems of external environment. "In most age groups," writes the Registrar-General in 1906, "the mortality showed a greater reduction in the urban than in the

*Read at the Annual Meeting of the Society, October 17th, 1913.

rural counties." He was speaking of all forms of disease.

If, therefore, I devote the opportunity which, by your indulgence, I am now given of following in a particular illustration the suggestion which I have endeavoured to outline, it is not because I feel any particular qualification for the task, but rather because the growth of preventive medicine and the extension of research are alike demanding that some of our views regarding disease and its causes require re-adjustment.

Nor is the demand urgent only on purely academic grounds.

Rarely, if ever, have the deliberations of a Congress of Medicine been followed with so wide-spread and sustained interest as were those of the recent meeting in London.

The massed results of investigation arrested attention and stimulated thought. With an emphasis which gained much by moderation in statement, the value of research in helping man to adjust his relationship to disease was told with a wealth of illustration which became impressive. Disease was projected as a natural force disputing man's supremacy, and medicine in its widest sense became preventive. But the methods of prevention were nature's methods primarily, and man's only by adaptation.

If he could not remove the cause of disease, he must find some method of counteracting its influence.

Phthisis in Scotland.—Tubercle has a long-established relationship with civilised man, and in selecting it for some observation I have been influenced partly by the circumstances of the moment, but chiefly by the fact that its movement in Scotland presents some features which may be utilised to illustrate what I have ventured to call the natural history of the disease. One reason for this, I think, is that the concentration of our population in industrial centres began later, or at least reached its maximum of unregulated massing after the corresponding period in England. Another is that for 16 years after death registration was introduced the mortality attributed to phthisis increased in a manner which makes the swift descent of the rate after 1870 all the more striking. It is permissible to question the completeness of registration in the years following its introduction, but this leaves the steepness of descent in the rate unaffected.

It would also fail to explain a sudden and somewhat violent explosion of the disease in

the County of Selkirk during the sixties coincident with a considerable invasion of its population by persons from other counties.

Lastly, the decrease of the disease in Scotland has been associated with a displacement of its centres of greatest relative incidence from the industrial to the agricultural and pastoral counties, which is in no sense, I think, a result of diffusion, but may find explanation in the lesser degree of blending of populations, to which I have referred. The variation in distribution I have endeavoured to represent in the accompanying maps.

If one looks at a map of Scotland prepared to show the incidence of pulmonary phthisis at the present time several surprises present themselves.

The lights and shadows fall on unexpected places. Ten only of its 33 counties show rates below the mean of the country as a whole, and the densest shadows by no means cover the most thickly-populated industrial counties. Although an interval of 69 per cent. separates the highest from the lowest rate, there is a remarkable flattening in more than half of its counties—no fewer than 17 have rates between 10 and 13 per 10,000, while the lowest rate exceeds 5 and the highest is 18.

The coal and iron industries of the country tend to concentrate along the course of the two principal rivers—the Forth and Clyde. More than half the population is contained within five of the counties on their margins, yet our map would show Stirling (1,171) in the same grading as Nairn (1,138) and Perth (1,177), which are both agricultural counties; Dumbar-ton (1,243), Edinburgh (1,253) and Renfrew (1,273) find a place between Elgin (1,204)—a health resort in the North—and Roxburgh (1,296)—the home of our Border romance; while Lanarkshire, which has considerably over a fourth of the population of Scotland, has a death-rate from pulmonary tubercle (1,310), which is exceeded in several counties North of the Grampians, and in the almost wholly agricultural counties of Dumfries and Kirkcudbright in the South.

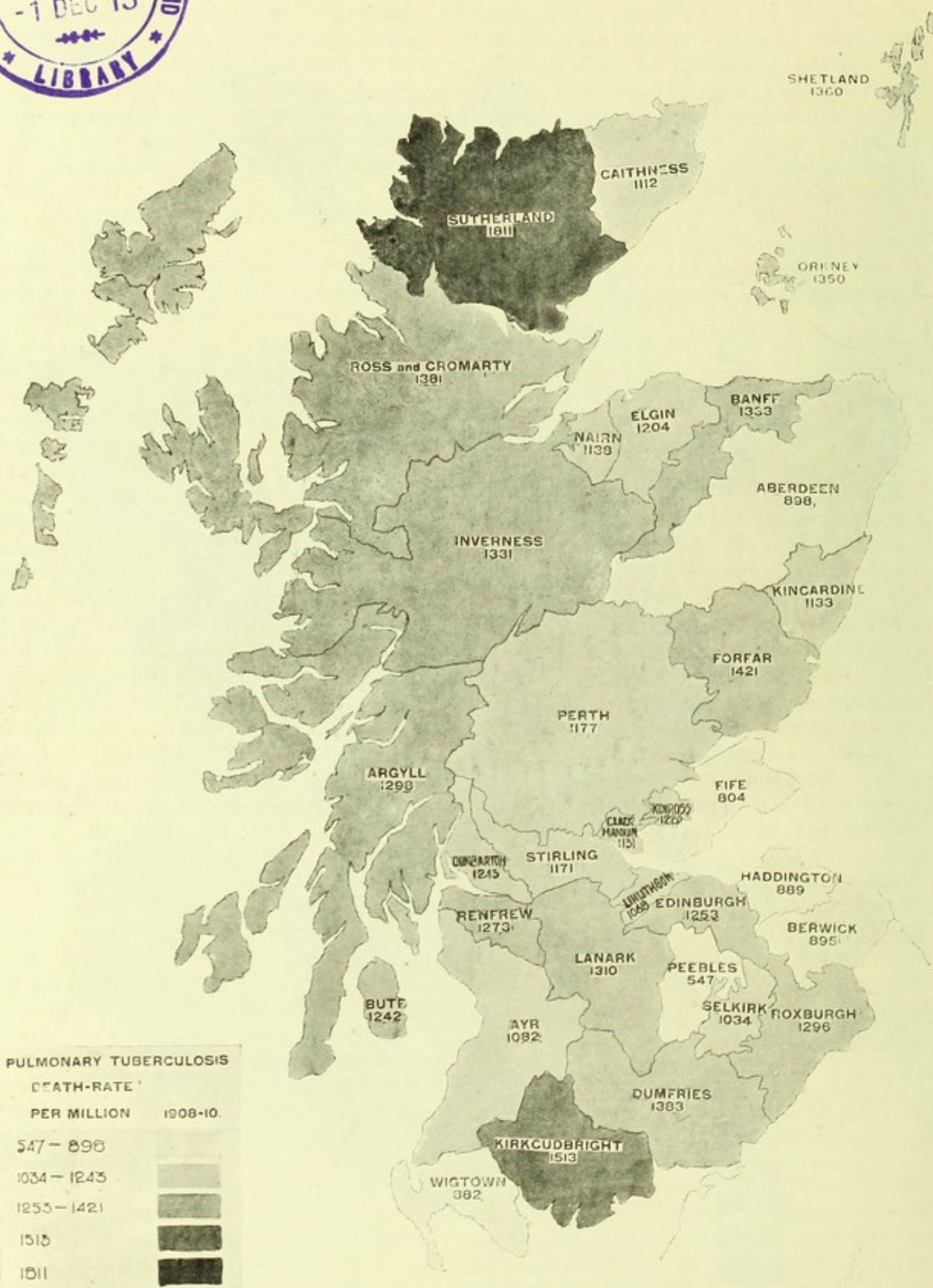
If, by way of contrast to this, one views the distribution of phthisis at the earliest point of time at which the registered deaths can be brought into relationship with a census population, the picture becomes suggestive. With one exception (Sutherland), the death-rates are on a higher level; there is a shorter interval between the extremes (46 per cent.), and the relationship of the counties to the rate for the

A map of Shetland 1630, showing the islands of Shetland. The map is a simple line drawing of the islands, with the text "SHETLAND 1630" printed below it. The map is oriented with the islands' long axis running vertically.

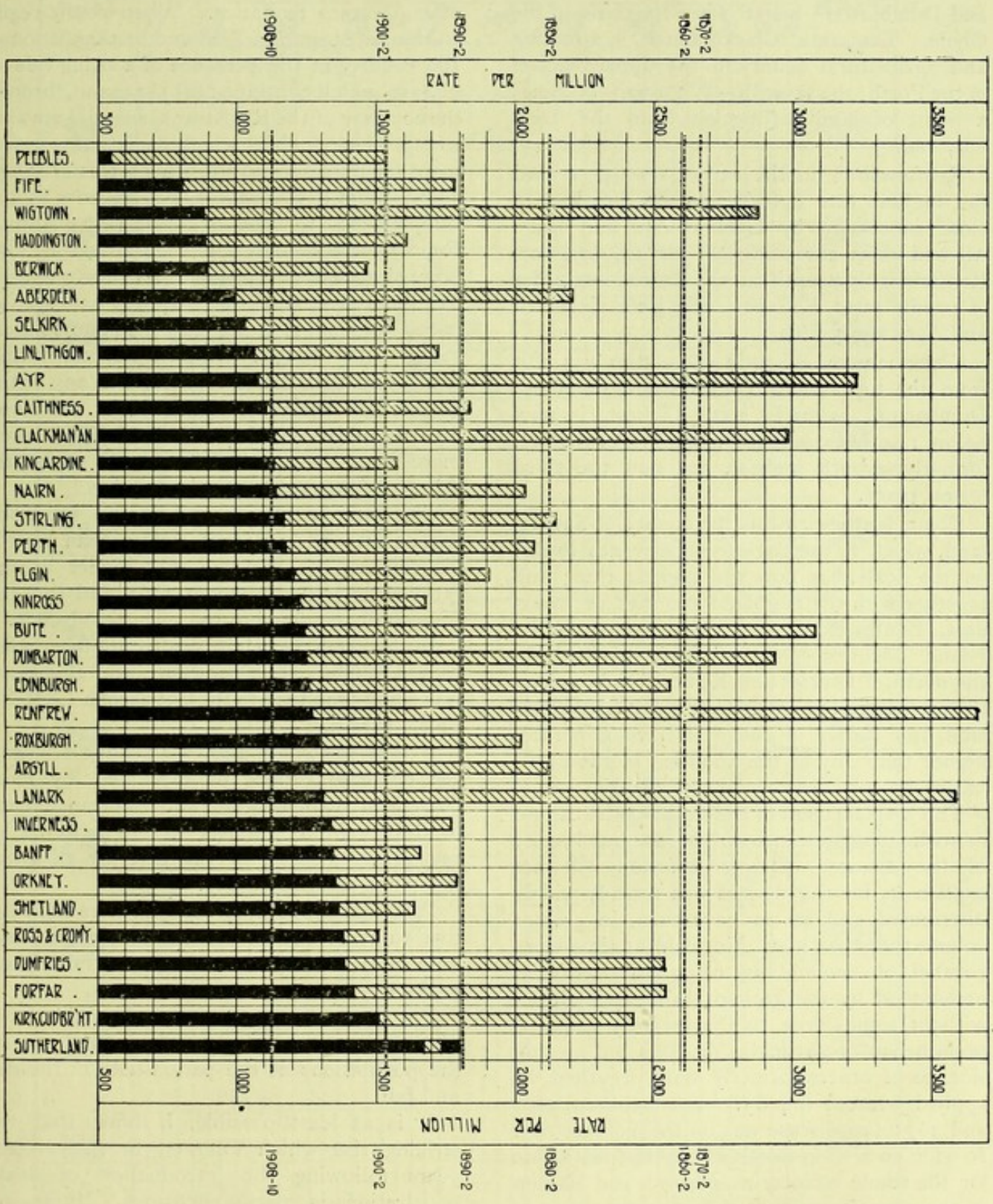




SCOTLAND.



1860-62 1870-72 1880-82 1890-92 1900-02 1908-10



whole is reversed. Seven counties only have rates which exceed that of the country as a whole, and there is no dubiety as to the area which formed the storm centre of the disease. Of the seven counties with rates in excess of the country, five—Renfrew, Lanark, Ayr, Bute, and Dumbarton—help to form the basin of the Clyde. The sixth, Clackmannan, is a mining and agricultural county in the upper reaches of the Forth; the seventh—Wigtown—occupies a point of land jutting out into the Irish Channel.

Renfrewshire in the early sixties presented the highest rate (3,666), and was followed in close succession by Lanark, Ayr and Bute. All had rates exceeding 30 per 10,000; now Renfrew is thirteenth in the descending order of county rates, Lanark tenth, Bute sixteenth and Ayr twenty-fifth.

Clackmannan, which in the sixties was fifth from the top, is now twelfth from the foot; Dumbarton, formerly sixth highest, is now below 14 other counties; while Wigtownshire, formerly seventh highest, has now the third lowest place.

Coincidentally with this the county of Sutherland, which in the sixties was eleventh lowest on the scale, has now the highest rate; and together with the Highland counties of Inverness, Banff, Ross, and Cromarty, and the Island counties—Orkney and Shetland—in the north, Dumfries and Kirkcudbright among the agricultural counties in the south of Scotland, and Forfar in the east, have now rates higher than any of the counties in the Clyde basin.

This displacement of the storm centre cannot be without significance in the natural history of the disease. Simple diffusion will not explain it, for the disease was already widely distributed, and, as we have seen, in greater volume then than now. Nor can the time-worn parallel of denudation, using the term as understood by the geologist, and applied, not without some force, to the recently acquired prominence of particular diseases on the subsidence of others formerly more prevalent, be applied without inquiry. For between 1861 and 1871 the disease was on the increase over so wide an area in Scotland that the death-rate for the whole country was raised, and sixteen of the counties presented higher rates than at the former census period.

Coincidentally the general death-rate for the whole country increased from diseases other than phthisis, and in the diminution which

has since occurred the rate of decrease in phthisis has far outstripped that of other forms of disease.

Between the two periods, however, the direction in which the death-rate was moving underwent a very striking change which it is of importance to notice. When death registration was begun in Scotland in 1855 it found the country in the presence of a rising tide of disease, which continued till 1873; and, through the courtesy of the Registrar-General, I am able to reproduce a chart which depicts this movement for phthisis and the other forms of tuberculosis from 1855 onwards, and appears in the Supplement to the Forty-eighth Annual Report for Scotland, published in 1905. This upward movement reached its maximum in the year 1870, and what requires explanation is the suddenness of the fall which immediately set in, and brought the phthisis rate within four years to a lower level than in any of the sixties, and within ten years lower than any rate formerly recorded. This, I think, even more than the continued decrease since that date, is of importance to our inquiry.

The rate in the years around the 1881 census was 18 per cent. lower than at the '61 census; but the rate was higher at the '71 census period than in 1861, and the fall was wholly confined to the seventies decade.

In the same period the death-rate from other causes fell by only 7 per cent., and this again was wholly confined to the last decade (1871-81) of the period.

I have elsewhere shown that for Glasgow the decrease cannot be explained by mere change in nomenclature, and the transference of deaths from phthisis to other forms of respiratory disease, for the rate for all forms has fallen simultaneously.

I do not propose to consider here the relative value of the several factors which have influenced the decline in the rate in subsequent years.*

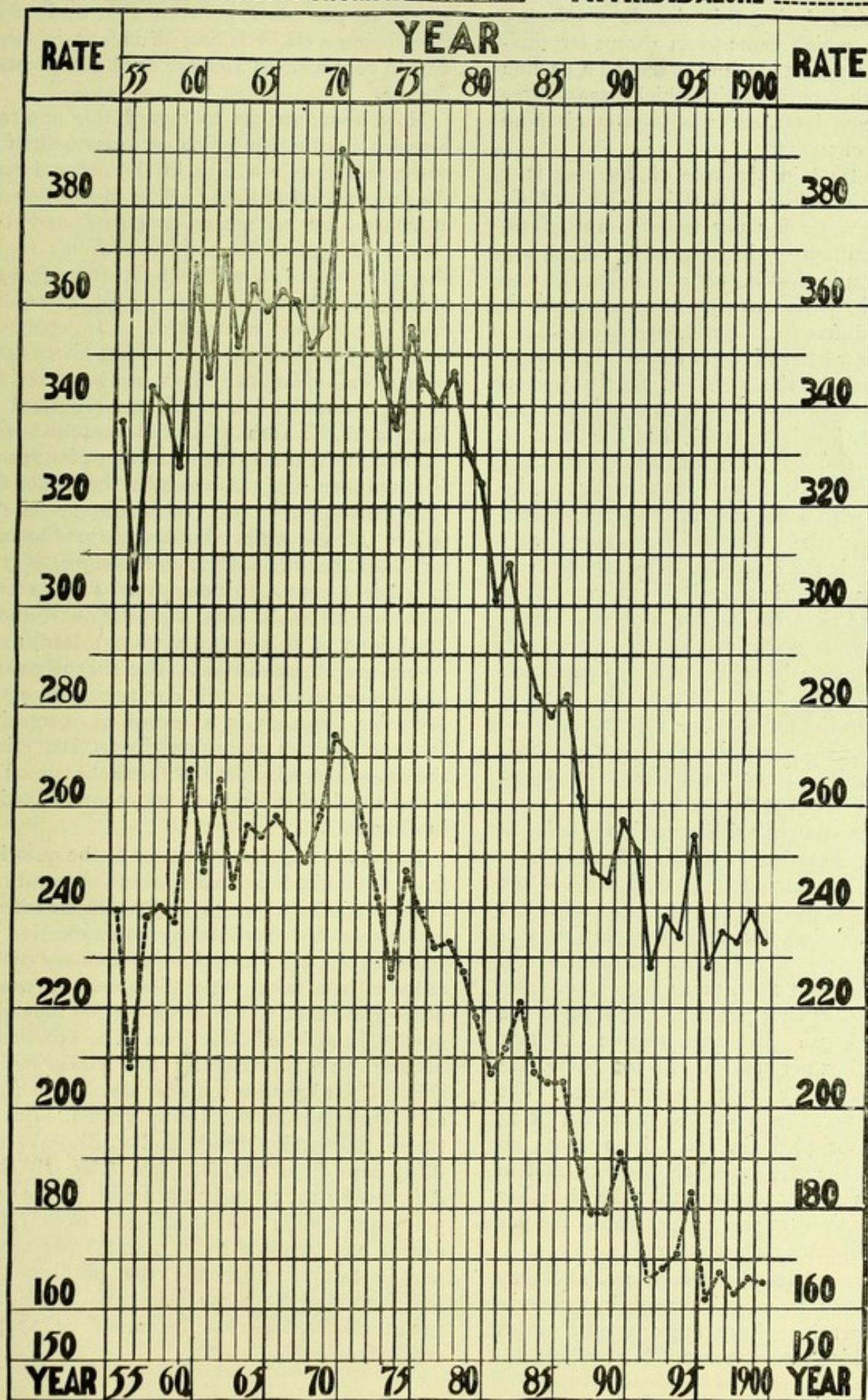
I propose confining myself to a consideration of the changes which were occurring among the populations at the period both of the rise and fall.

It is at least possible, I think, that the striking rise which followed in the sixteen years following the introduction of death registration is partly fictitious. Increased observance of its requirements is pretty sure to have been a gradual process, and the rates recorded in the late fifties should probably be

* Dr. Newsholme's paper (Trans. Epidem. Soc., Vol. xxv., 1905-6) contains an exhaustive discussion of their relative importance.

DEATH-RATE PER 100000 FROM TUBERCLE, 1855 TO 1900

TUBERCLE INCLUDING PHTHISIS _____ PHTHISIS ALONE _____



more nearly on the level attained during the sixties decade, although the quite phenomenal experience of Selkirk will scarcely be explained thereby. This apart, however, the death-rate from phthisis during this decade reached a high level, which came to an abrupt termination in the year 1870, and preceded a decline in the death-rate otherwise which began three or four years later, and has been much more gradual in character.

This contrast in the rate of decrease is, I think, worth noting. In 1860-2 the phthisis death-rate was 2,607 per million, in 1908-10, 1,125 per million—a decrease of nearly 57 per cent. For all other causes of disease the rate in the earlier period was 18.9 per 1,000, now it is 14.6—a difference of barely 23 per cent.

It is also worthy of note, I think, because it is illustrated by the rate for Scotland as a whole, although there are more striking examples in individual counties, that the decrease in the death-rate from causes other than phthisis does not appear necessarily to be associated with a decrease in the phthisis rate. Phthisis and the other rates do not always synchronise in the direction of their movement.

For example, during the sixties the rates from phthisis and all other causes increased simultaneously, while in the seventies they decreased, but the decrease in other causes began later, and was less marked. During the eighties decade again the phthisis rate still continued to decrease, but that of other causes was arrested, and was indeed fractionally higher in 1890-2 than it had been ten years earlier.

This suggestion of a difference in the value of the factors operating at a given time in controlling the movement of phthisis and of the other forms of disease appears even when the rate is increasing, for while the phthisis rate rose by almost 3 per cent. in the interval between 1861 and 1871, that for other diseases increased by about 4 per cent., and when the decrease began in the decade 1871-81 phthisis fell 21 per cent. in the ten years, but other diseases by only 10 per cent. The decade 1881-91 saw a further reduction of 15 per cent. for phthisis, but there was no decrease in the rate for other diseases, and in the decades ending 1901 and 1911 the decreases for phthisis were 15 and 27 per cent., but for the other diseases only 9 and 11.

These are substantial differences, and they cannot, I think, be explained solely by reference to the general sanitary improvement which these decades have witnessed. Nor will change

in the age constitution of the population explain the decrease for the proportion living at ages 15-45 (when the highest rates of morbidity occur) was fairly maintained at about 44 per cent. between 1861 and 1891, there being a slight falling-off indeed in 1871, and no very marked increase until the nineties decade.

How, then, are we to regard this contrast between a reduction which exceeds one-half in one case but only a fifth in the other during the same period of time? The illustration is, of course, by no means singular, and the history of typhus fever appears to me to be singularly apposite, although in every feature of their incidence and movement these diseases are widely contrasted. In epidemic form typhus fever is coincident historically with periods of famine, privation, overcrowding, filth. It found these conditions prevalent in Europe in the 16th and 18th centuries, and became the War and Famine Fever of the time. It found them again in Ireland at the end of the 18th, and also in the 19th century on the failure of the crops there, and in the unregulated growth and overcrowding of the industrial towns in this country. There seems no reason to doubt that a repetition of these conditions in this country would lead to a recurrence of the disease. But the behaviour of pulmonary tubercle in our towns from the seventies onwards is a record of increasing freedom from its more fatal forms, and raises the question whether the tolerance which is being acquired is likely to prove more lasting in character.

I can only suggest an answer to the question from the limited area which these observations cover. We have seen that the causes operating to protect life have been more effective in reducing the death-rate from pulmonary tuberculosis than from other diseases. It would also appear that within given periods they may operate in different directions. The experience of four Scottish counties has a bearing on this. Each has now a higher death-rate from all causes than in the 1860-2 period. But in three—Shetland, Orkney and Caithness—the death-rate from phthisis (*see table B*) has decreased by 17, 25 and 39 per cent. in the past 50 years, while the death-rate from other causes has increased by 3, 9 and 8 per cent.; and in Sutherland, while the phthisis rate has increased by 4 per cent., the death-rate from other causes has increased by 17 per cent (*see table A*).

Table A.—Movement of "Phthisis" and "All Other Causes" of death in Counties with General Death-Rate Higher in 1908-10.

		RATE PER MILLION.	
		1860-2.	1908-10.
Shetland	All Causes	15,120	15,270
	Phthisis	1,630	1,360
	Not Phthisis	13,490	13,910
Orkney	All Causes	15,190	16,010
	Phthisis	1,790	1,350
	Not Phthisis	13,400	14,660
Caithness	All Causes	15,100	16,450
	Phthisis	1,833	1,112
	Not Phthisis	13,267	15,338
Sutherland	All Causes	14,520	16,760
	Phthisis	1,739	1,811
	Not Phthisis	12,781	14,959
Scotland	All Causes	21,520	15,747
	Phthisis	2,607	1,125
	Not Phthisis	18,913	14,622
Scotland Reduction %		{ Phthisis 56·8 Other Causes 22·6	

I am, of course, speaking of the overhead death-rate without discriminating between changes in age and sex, because I am disposed to attach more importance to the fact that these are counties with a decreasing population—counties with few recent immigrants—largely monotypic in the sense in which, I think, Ripley uses this term, and not even retaining the population which a surplus of births would give them.

Table B.—SCOTLAND.—Death-Rate "All Causes" and "Phthisis" compared.

	1860-2	1870-2	1880-2	1890-2	1900-2	1908-10
All Causes ..	21,520	22,289	19,731	19,717	17,915	15,747
Phthisis ..	2,607	2,675	2,126	1,804	1,539	1,125
Other Causes ..	18,913	19,614	17,605	17,913	16,376	14,622
% DIFFERENCE						
Phthisis ..		+ 2·6	- 20·5	- 15·1	- 14·7	- 26·8
Not Phthisis ..		+ 3·7	- 10·2	+	- 8·6	- 10·7

Divergence in the direction of the movement of these rates is not, however, confined to counties with a decreasing population or a refractory death-rate. It finds some illustration even in the counties where the phthisis rate has been reduced; indeed there are few counties where illustration may not be found in one or other decade of the period.

To unravel the question I propose to consider the movement of the rate for the whole country, and some of the setting in which it was occurring. Selecting for comparison the three

years surrounding each census since 1861,* the phthisis death-rates per million are respectively 2,607, 2,675, 2,126, 1,804, 1,539 and 1,125. The already high rate of 1861 was exceeded by 2½ per cent. in 1871, to be followed by a sharp drop of 20·5 per cent. in 1881; which was again followed by a further decrease of 15 per cent. during the eighties decade, 14·6 per cent. during the nineties, and almost 27 per cent. in the first decade of this century. The phthisis rate for 1908-10 is 58 per cent. (57·9) below that of 1870-2. The death-rate from all causes in 1870-2 was 22,289 per million, and if we eliminate the phthisis deaths from each period the reduction in other causes was only 26 (25·5) per cent.

Movements of Population in the Sixties Decade.

—During the sixties decade the population of Scotland increased by rather less than 10 per cent. But the surplus of births would have given an increase approaching 14 per cent., so that almost 4 per cent. was lost through emigration.

It is more important for our present purpose to observe that in addition to this movement outwards certain internal migrations were in progress, which resulted in increasing aggregations in several groups, and represented the urban migration of the period. In Scotland the proportion of population occupying large towns rose from 53 (52·78) to 57 per cent., and in the larger villages from 11 to 13 per cent., representing together a transference of something like 7 per cent. of the whole population from rural to urban conditions.

Certain other changes had taken place in the previous decade, which it is desirable also to notice. The urban immigration would appear to have begun at a later period than in England. At each census between 1801 and 1851 the actual increase of the total population always exceeded 10 per cent., but by reason of emigration during the fifties decade the actual increase in this period fell to 6 per cent.† In the sixties decade it regained something of its old rate, and the massing of some 70 per cent. of its population in industrial centres represented for this period the sum of the changes, and particularly the ebb of the rural population to the towns, which had first declared itself in the fifties in the north-western counties of Ross and Cromarty and Inverness, and in the southern counties of Roxburgh, Dumfries, Kirkcudbright and Wigtown. Up till this period

* As the deaths surrounding the 1911 census are not available, I have taken the deaths of 1908-10, and applied them to the census population.

† See Registrar-General's Census Report, 1861, pp. xviii.-xix.

there has been a progressive increase of population in each of the eight geographical divisions into which the Registrar-General divides the country, but the changes which began in the fifties in the north-west or south spread in the next decade (beginning 1861) to the northern counties of Shetland, Orkney, Caithness and Sutherland.

In all the other divisions of Scotland, representing 23 of its counties, the growth has since been continuous, although fluctuating in rate, and the changes in the biological factor which industrialism was creating had already assumed fairly definite lines.

The population was, in fact, re-arranging itself into two well-defined groups, unequal in number and in the areas occupied; contrasted also in this respect, that while one was maintaining a relative purity of type by reason of its diminishing numbers and absence of immigration, the other was absorbing the elements of a blended population, from which its future inhabitants were to be largely recruited.

It is, I think, capable of demonstration that in the mixed population of the industrial counties in the middle of last century, mixed in the sense that the resultant groupings were composed of elements not from one county only, but from many, many elements were supplied which contributed to the explosion which followed.

Unconsciously, or perhaps one should rather say unwittingly, new factors were being introduced into the problem of man and his environment, and the results were swift and striking. Round the census period of 1871 the phthisis death-rate reached 2,675 per million, and the county of Selkirk, which had been developing its manufactures at Galashiels in the midst of agricultural surroundings, doubled its death-rate from phthisis in ten years, and from being third lowest in 1861, with a rate of 1,534 per million, became second highest ten years later, with a rate of 3,380.

The rise in the Selkirk rate is quite phenomenal. No increase elsewhere approached it. Lanarkshire alone, with a rate of 3,888, exceeded it; but in 1860 it had been 3,589.

Another striking feature peculiar to Selkirk in this decade is the change which took place in the nativity of its population. It is, indeed, the only Scottish county which in '71 had a markedly lower proportion of native-born inhabitants than at the 1861 census. The proportion fell from 50 to 40, whereas all the others presented higher proportions, or were only fractionally affected. Three-fifths of its population were foreign to its soil in the sense

that they were immigrants from other counties. *County of Selkirk.—Proportion of Population Born in County and Death-rate from Phthisis at Census Periods.*

	1861.	1871.	1881.	1891.	1901.	1911.
Proportion per cent.						
Natives of County	50	40	48	45	59	54
Phthisis death-rate per million	1,569	3,380	2,165	1,840	1,743	1,034

The Movement of the Phthisis Death-rate after 1871.

The course followed by the death-rate from phthisis since 1871 has already been indicated. Taking 100 as representing the rate for Scotland during 1860-2, the subsequent census periods show the following relationship:—

1860-2.	1870-2.	1880-2.	1890-2.	1900-2.	1908-10.
100	102.6	81.5	69.1	59	43

If we accept this as the type of movement for Scotland as a whole, I now propose comparing with it two groups of counties—the first, containing these in which the rate for 1860-2 was above that of Scotland, and all of which save one (Wigtown) have increasing populations; and another, consisting of those counties where the populations are decreasing.

Movement of Phthisis Death-rate in Counties where it Exceeded the Mean in 1860-2.

	1860-2.	1870-2.	1880-2.	1890-2.	1900-2.	'08-10.
Wigtown, 2,874	100	80	74	52	52	31
Dumbarton, 2,935	100	113	69	63	47	42
Clackmannan, 2,982	100	91	66	45	50	38
Bute, 3,082	100	105	89	58	55	40
Ayr, 3,230	100	97	74	56	43	34
Lanark, 3,589	100	108	79	61	46	37
Renfrew, 3,666	100	85	75	50	48	35

In contrast with these is the movement in the rate for counties with decreasing populations.

Movement of Phthisis Death-Rate in Counties with Decreasing Populations.

	1860-2.	'70-2.	'80-2.	'90-2.	'00-2.	'08-10.
Dumfries, 2,543	100	111	87	75	73	54
Kirkcudbright, 2,431	100	114	97	80	62	62
Argyll, 2,127	100	111	99	86	69	61
Perth, 2,070	100	106	85	78	70	57
Roxburgh, 2,023	100	100	82	81	71	64
Caithness, 1,833	100	110	99	70	59	61
Orkney, 1,790	100	70	83	84	92	75
Sutherland, 1,739	100	77	77	85	95	104
Kinross, 1,680	100	77	101	57	63	73
Shetland, 1,630	100	91	94	131	112	83
Ross and Cromarty, 1,511	100	104	83	95	105	91
Berwick, 1,471	100	90	87	89	67	61

* These figures represent the death-rates per million in 1860-2 for the several counties named.

These two groups of counties may be contrasted by describing the first as being composed largely of industrial centres, and the second as mainly agricultural and pastoral. On an average the industrial group of counties fell by over 60 per cent., whereas the agricultural fell on an average little more than 30 per cent., even if we include Wigtown.*

This is, of course, only another way of saying that the rate of decrease in the towns has greatly exceeded that of the rural districts, but it also expresses, I think, a contrast in the movement of the disease among the blended populations of industrial centres and the more homogeneous inhabitants of rural areas.

It might be suggested as illustrating the rapid transmission of a disease where the facilities of intercourse were frequent and its slow progress through widely scattered communities, but the rapid and sustained character of its decrease in towns seems to require some further explanation.

The maximum rate for the industrial group was reached without exception not later than the 1871 period, in the agricultural group it was reached at different periods.

In three of them (Orkney, Berwick and Roxburgh) the rate for 1861 has not since been exceeded; in five of them (Caithness, Perth, Argyll, Dumfries and Kirkcudbright) it was reached in 1871, while Kinross, Shetland, Ross and Cromarty and Sutherland only reached their maxima in the order named—in the years 1881, 1891, 1901 and 1911.

The Question of Nativity.—With regard both to the rise and fall of the phthisis rate round the period we are considering it is important to keep in view the elements contributing to the populations which the centres of industry were attracting. Early in the century—earlier, indeed, in London—the towns had already wrested from Nature the secret of recruiting their populations from within their borders. Their deaths had ceased to exceed their births, so that wherever industrial development took place round an existing centre of population there was already a nucleus tolerant in some degree of the conditions as then existing. But the conditions were changed and the urban drift was from populations susceptible to phthisis, as is illustrated by the county rates then prevailing, even in our remoter islands. That phthisis should become widely prevalent in the effort at readjustment to the new sur-

roundings which followed is, I think, illustrated by what may be observed to-day.

During an enquiry into the incidence of phthisis in Glasgow, in the light of the information yielded by the first year of compulsory notification (1910),* I was led to consider the incidence of the disease in relation to the birthplace of the patient and his parents. Into the suggestions arising from that analysis I need not at the moment go, save to note that the relatively greater prevalence of the disease among immigrant families at once arrested attention.

It was possible to arrange the cases (2,477) then analysed into five groups, which were determined by the birthplace of the patient and his parents. This gave the somewhat striking result that cases occurring among patients, who with their parents were all born outwith the city, were twice as numerous as those occurring in persons whose parents were born within the city; and six times more frequent than among the offspring of a marriage between a city-born father and a mother who was not.

In the present enquiry it seemed to me that the principle might be capable of wider application, and I endeavoured to apply it to the rising tide of phthisis in the sixties decade. Here, of course, it is impossible to adapt the information to a family relationship, but it is possible, I think, to put the question in such form that the Census Report of that period can answer.

Having in view the very considerable migrations which were then in progress, it was necessary first of all to ascertain what proportion of the county populations was native and what immigrant, and then to recast the phthisis deaths of the period into the groupings which these suggested. In the three years round the census of 1861 nearly 24,000 (23,947) deaths were registered as due to pulmonary tuberculosis in a population of over three millions. This, as we have seen, gave an aggregate death-rate from phthisis of 2,607 per million. If we now arrange the population by counties according to the Registrar-General's geographical groups, and on the basis of the native-born among them at the census, and then recast the deaths into the groupings which their nativity-proportion indicates, they show a definite gradation in the phthisis rates in relation to the degree of penetration by immigrants. In other words, the groups with the highest proportion of immigrants in 1861 had also the highest death-rates from phthisis at that period.

* Wigtown is an agricultural county, but is included in the first group because of the level of its rate in 1860-2. Bute also is agricultural, but largely influenced by interchange of population with other counties on the Clyde.

* See Report on the "Administrative Treatment of Pulmonary Phthisis in Glasgow." M.O.H. Annual Report, 1911, p. 67.

**SCOTLAND.—DEATH RATES PER MILLION FROM "ALL CAUSES," "PHTHISIS,"
AND "OTHER CAUSES" IN COUNTIES.**

DIVISION.	COUNTIES.	1860-2	1870-2	1880-2	1890-2	1900-2	1908-10	Per cent. Increase or Decrease. 1860-2/1908-10.	
								+	-
Northern ..	1 Shetland All Causes	15124	13625	16383	17577	17539	15270	9	
		1630	1487	1526	2136	1821	1360		16.6
		Difference	13494	12138	14857	15441	13910	3.1	
	2 Orkney All Causes	15188	14464	14033	15948	16006	16010	5.4	
		1790	1258	1488	1500	1638	1350		24.6
		Difference	13398	14206	12547	14448	14660	9.4	
	3 Caithness All Causes	15995	15370	17351	18452	18045	16450	2.8	
		1833	2009	1818	1291	1073	1112		39.3
		Difference	14162	13361	15533	17161	16972	15338	8.3
	4 Sutherland All Causes	14516	14284	15404	16837	16860	16760	15.5	
		1739	1343	1341	1477	1655	1811	4.1	
		Difference	12777	12941	14063	15360	15205	14049	17.0
North-Western	5 Ross and Cromarty All Causes	16888	15321	15481	17260	17229	15190		10.6
		1549	1569	1260	1435	1592	1381		10.8
		Difference	14977	13752	14221	15825	15637	13799	8.5
	6 Inverness All Causes	17365	16585	15141	16809	17465	15920	8.3	
		1771	1599	1330	1299	1534	1331		24.8
		Difference	15594	14986	14111	15510	15931	14589	6.4
North-Eastern	7 Nairn All Causes	18809	13888	12530	14739	15822	16540		12.1
		2037	1434	829	998	933	1138		44.1
		Difference	16772	12454	11701	13741	14889	15402	8.2
	8 Elgin All Causes	17180	16226	17432	18464	17244	15270		11.1
		1906	1918	2002	1649	1756	1204		36.8
		Difference	15274	14308	15430	16815	15488	14066	7.9
	9 Banff All Causes	17065	15424	15339	15745	15597	14500		15.0
		1660	1645	1350	1283	1361	1333		29.7
		Difference	15405	13779	13989	14462	14236	13167	14.5
	10 Aberdeen All Causes	19481	18065	16510	17719	16256	14790		24.5
		2210	1964	1602	1441	1252	998		54.8
		Difference	17271	16101	14907	15278	15004	13792	20.7
	11 Kincardine All Causes	16421	16104	15523	15466	14492	12480		24.0
		1577	1569	1219	1281	1255	1133		28.2
		Difference	14844	14535	14304	14185	13237	11347	23.6
East-Midland	12 Forfar All Causes	23222	23802	19734	20252	18893	17410		25.0
		2546	2590	2193	1985	1612	1421		44.2
		Difference	20676	21212	17541	18267	17281	15989	22.7
	13 Perth All Causes	19219	19687	18343	18505	16466	14830		22.8
		2070	2197	1749	1619	1439	1177		43.1
		Difference	17149	16490	16594	16886	15027	13653	20.5
	14 Fife All Causes	18531	18975	17600	18344	15734	14360		21.5
		1783	1935	1619	1537	1144	804		54.9
		Difference	16748	17040	15981	16807	14590	13556	21.1
	15 Kinross All Causes	17371	17366	19461	19127	16476	13950		21.5
		1680	1297	1691	955	1051	1220		27.4
		Difference	15691	16069	17770	18172	15425	12770	18.6
	16 Clackmannan All Causes	19671	19722	16056	16097	14835	14140		28.1
		2982	2709	1972	1348	1510	1131		62.1
		Difference	16689	17013	14083	14749	13325	13009	22.1
West-Midland	17 Stirling All Causes	20437	20831	17861	18531	17325	14940		26.9
		2147	2308	1746	1526	1438	1171		45.5
		Difference	18290	18523	16115	17005	15887	13769	24.7
	18 Dumbarton All Causes	21004	22880	19496	19542	16850	14810		9.5
		2935	3319	2013	1838	1390	1243		57.7
		Difference	18069	19561	17483	17704	15460	13567	24.9
	19 Argyll All Causes	17983	19407	18744	18319	16473	15210		15.3
		2127	2352	2110	1818	1462	1298		39.0
		Difference	15856	17055	16634	16501	15011	13912	12.3
	20 Bute All Causes	20656	22874	21597	20394	17797	15420		25.3
		3082	3220	2756	1793	1703	1242		59.7
		Difference	17574	19654	18841	18601	16094	14178	19.3
	21 Renfrew All Causes	24552	23364	19443	17302	20307	16090		34.5
		3666	3111	2379	1826	1756	1273		65.3
		Difference	20886	20253	16704	15476	18551	14817	29.1
	22 Ayr All Causes	22057	21978	19119	19053	16676	14440		34.5
		3230	3122	2389	1810	1390	1082		66.5
		Difference	18827	18856	16730	17243	15286	13358	29.1

SCOTLAND.—DEATH RATES PER MILLION FROM "ALL CAUSES," "PHTHISIS," AND "OTHER CAUSES" IN COUNTIES.—*contd.*

DIVISION.	COUNTIES.	1860-2	1870-2	1880-2	1890-2	1900-2	1908-10	Per cent. Increase or Decrease, 1860-2/1908-10.	
								+	-
South-Western <i>cont.</i>	23 Lanark All Causes Phthisis Difference	26528 3589 22939	29003 3888 25115	24470 2825 21645	23167 2179 20986	19513 1653 17860	16910 1310 15600		36.1 63.5 31.9
	24 Linlithgow All Causes Phthisis Difference	20386 1725 18661	22597 1578 21019	19222 1532 17690	18255 1262 16993	16068 1005 15063	13790 1068 12722		32.4 38.1 31.8
	25 Edinburgh All Causes Phthisis Difference	27771 2562 25209	25108 2439 22669	20798 2038 18760	20543 1838 18705	17990 1731 16259	15720 1253 14467		43.4 51.1 42.6
South-Eastern	26 Haddington All Causes Phthisis Difference	18613 1611 17002	18471 1650 16821	15809 1333 14466	17147 1281 15866	15209 1719 13490	13350 889 12461		28.3 44.8 26.7
	27 Berwick All Causes Phthisis Difference	16124 1471 14653	15897 1316 14581	16526 1281 15245	15563 1306 14257	15198 984 14214	13640 895 12745		15.4 39.2 13.0
	28 Peebles All Causes Phthisis Difference	16224 1534 14690	17113 1919 15194	13626 1206 12420	15604 1445 14159	12961 1128 11833	11350 547 10803		30.0 64.3 26.5
	29 Selkirk All Causes Phthisis Difference	16842 1569 15273	26729 3380 23349	16677 2165 14512	16208 1840 14368	13854 1743 12111	13990 1034 12956		16.9 34.1 15.2
	30 Roxburgh All Causes Phthisis Difference	19744 2023 17721	16372 2019 14353	16279 1653 14627	17206 1644 15562	15473 1441 14032	15060 1296 13764		23.7 35.9 22.3
Southern	31 Dumfries All Causes Phthisis Difference	20139 2543 17596	19735 2812 16923	18724 2202 16522	20282 1918 18364	17583 1856 15727	15840 1383 14457		21.3 45.6 17.8
	32 Kirkcudbright All Causes Phthisis Difference	18739 2431 16308	18069 2771 15298	17360 2358 15002	17898 1951 15947	15454 1514 13940	14240 1513 12727		24.0 37.8 22.0
	33 Wigtown All Causes Phthisis Difference	19210 2874 16336	17478 2309 15169	16714 2115 14599	18385 1488 16807	16767 1489 15278	15650 882 14768		18.5 63.3 9.6
	Scotland All Causes Phthisis Difference	21520 2607 18913	22289 2675 19614	19731 2126 17605	19717 1804 17913	17915 1539 16376	15747 1125 14622		26.8 56.8 22.7

For example, three divisions of Scotland, comprising the northern, north-western, and north-eastern counties—that is, all the country north of the Grampians, and towards the north-east of Scotland—had in 1861 a native-born population of between 91 and 95 per cent.; two divisions, the East Midland—or the counties between the Grampians and the Forth—and the Southern (Border) counties, had a native-born population of between 81 and 85 per cent.; three divisions, the West Midland, South-Western, and South-Eastern—the counties between the Forth and the Border Counties and forming the Clyde basin—had a native-born population of 70 per cent.

These districts of the country in the order named had death-rates from phthisis, of 1881, 2,275 and 3,045 per million (*see table C*).

If we take the same groups of population 40 years later the phthisis rates have become 1,397, 1,461 and 1,598, or in other words, not only was the incidence of phthisis originally greatest in the groups where the rate of inward migration was greatest, but the reduction in the death-rate in subsequent years has also

been greatest among them. These may be set out more clearly in tabular form.

*Relation of Death-rate from Phthisis to Proportion
"Native-born" in Several Groups of Population.*

Proportion of Population "Native-born" in 1861.	1860-2.		1900-2.	Per Cent. decrease in 40 years.
	Deaths.	Rate per Million.	Rate per Million.	
Over 70 %	15,160	3,045	1,598	47.5
„ 80 %	5,037	2,275	1,461	35.9
„ 90 %	3,750	1,881	1,397	25.7

Census population, 1861—3,052,294 1901—4,472,000
 Over 70 % } „ „ 4,979,166 70 + } „ 8,620,641
 „ 80 % } Census popltn. 2,214,114 80 + } „ 2,575,902
 „ 90 % } X 3 1,993,602 90 + } „ 2,219,457

To ascertain the degree of blending which has taken place between the native and immigrant population in the interval is an extremely elusive form of enquiry.

But in connection with the contrasted rates of decrease shewn in the last column of the table, it is of interest to note that the proportion of native-born in 1901 had increased most in the group which in 1861 shewed the highest

Table C.—Phthisis in Scotland in relation to proportion of population born in Geographical Divisions, 1860-2.

Divisions having over 90% of population native-born.				Divisions having over 80% of population native-born.				Divisions having over 70% of population native-born.			
	Total Population.	Phthisis Deaths.			Total Population.	Phthisis Deaths.			Total Population.	Phthisis Deaths.	
NORTHERN:				EAST MIDLAND:				WEST MIDLAND:			
Shetland	95,010	155		Forfar	620,250	1,579		Stirling	264,414	568	
Orkney	97,185	174		Perth	399,594	827		Dumbarton ..	162,537	477	
Caithness	126,600	232		Fife	465,063	829		Argyll	251,577	535	
Shetland	72,471	126		Kinross	26,193	44		Bute	48,993	151	
				Clackmannan ..	60,366	180					
NORTH-WESTERN:				SOUTH-WESTERN:				SOUTH-EASTERN:			
Ross and Cromarty	247,281	383						Renfrew	506,238	1,851	
Inverness	254,706	451						Ayr	597,189	1,929	
								Lanark	1,921,332	6,896	
NORTH-EASTERN:				SOUTHERN:							
Nairn	25,041	51		Roxburgh	161,166	326		Linlithgow ..	117,135	202	
Elgin	132,654	253		Dumfries	227,712	579		Edinburgh ..	822,279	2,107	
Banff	168,060	279		Kirkcudbright ..	127,485	310		Haddington ..	112,878	182	
Aberdeen	670,932	1,481		Wigtown	126,285	363		Berwick	109,464	161	
Kincardine	104,562	165						Peebles	33,900	52	
								Selkirk	31,230	49	
Total	1,993,602	3,750		Total	2,214,114	5,037		Total	4,979,166	15,160	
Rate per million ..		1,881		Rate per million ..		2,275		Rate per million ..		3,045	

proportion of immigrant population, the heaviest incidence of phthisis, and subsequently the greatest decrease in its death-rate.*

So far we have been considering the influence of blending in geographical divisions, but the question becomes more complex when the effect of migration to adjacent counties is considered.

The proportion of native-born in a division is more frequently greater than in the counties composing it; in other words, the degree of migration to adjacent counties is, as we would expect, greater than towards those which are more distant.

When, therefore, migration in this restricted sense occurs to an extent which brings the nativity rate of individual counties appreciably below that of the division within which they are contained, we should expect the phthisis rate also to vary in the direction of those divisions with which its nativity rate corresponds.

To an appreciable extent this would seem to be what occurs, but the exceptions are numerous enough to prevent any such grading of counties, as we have seen may be done for wider geographical areas.

It is possible indeed that some of the exceptions would be explained by movements of the population in earlier decades than we are dealing with, for at the 1851 census, and still

more in 1841, the proportion native-born among the county populations was almost uniformly greater than at the period when we can compare them with the registered causes of death.

Conclusion.—I fear I have already exhausted your interest in an aspect of disease which may appear academic rather than practical, and to lead to nowhere in the realm of applied hygiene. But movements in population—which are very different from popular movements—are not accidents in human history, and disease becomes one of the factors which determine their success or failure.

If we accept the city as the type of community which civilization at present demands, the rise and fall of phthisis round the beginning of the seventies decade is both significant and hopeful. I suggest that whatever effort man has made to stem the tide of disease he is being powerfully aided by natural forces—that Nature indeed had begun to “adjust the balance” before man was conscious of his danger. This is, I think, the lesson of the blending of populations I have endeavoured to indicate.

And, if I may be permitted one word of practical application, it would be to plead for a more extended study of disease in its demographical aspect. In one sense it is a reproach to British preventive medicine that we should know more of the contrasted susceptibility to phthisis among the natives of China and Japan* than we do of any of the inhabitants of our own country.

* The group with 70+ per cent. only native-born in 1861, includes the west-midland, south-western, and south-eastern divisions; the differences between them were then fractional only. In 1901, they were respectively 63, 84, and 74. Group 80+ includes the east-midland and southern divisions with 85 and 81 per cent. respectively. In 1901, these were 85 and 86. Group 90+ includes the northern, north-western, and north-eastern divisions formerly with 95, 92, and 91 respectively. In 1901, these were 93, 88, and 93.

* Ripley—“Races of Europe,” p. 565.