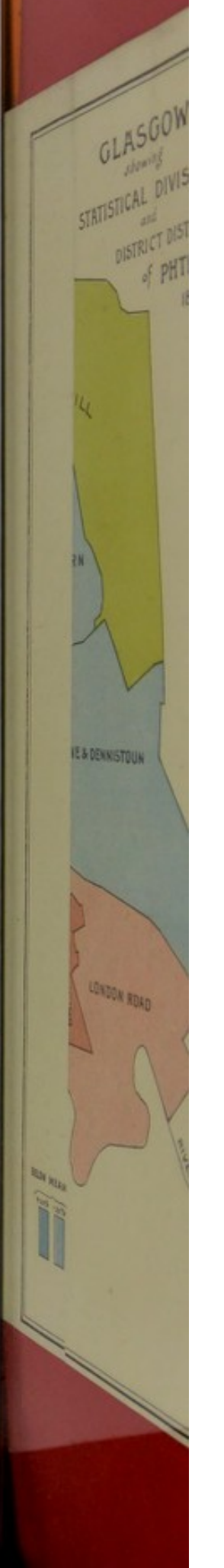
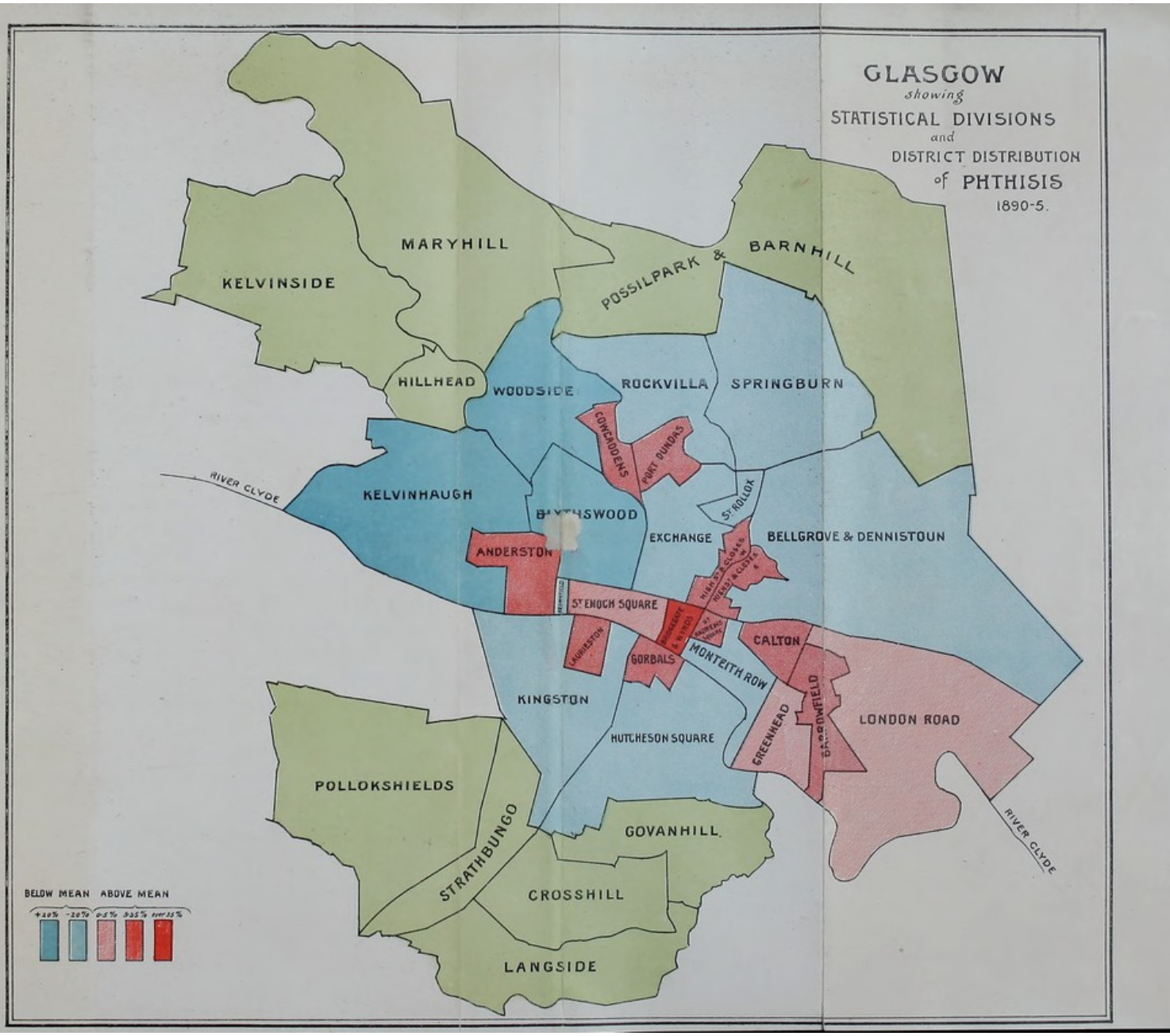
The distribution of tuberculous diseases in Glasgow ; with observations on the relation of phthisis to room-density / by A.K. Chalmers.


GLASGOW
showing
STATISTICAL DIVIS
and
DISTRICT DIST
of PHT
DENNISTOUN
LONDON ROAD


GLASGOW
showing
STATISTICAL DIVISIONS
and
DISTRICT DISTRIBUTION
of PHTHISIS
1890-5.
MARYHILL
KELVINSIDE
POSSILPARK & BARNHILL
HILLHEAD
WOODSIDE
ROCKVILLA
SPRINGBURN
CONCARDENS
PORT DUNDAS
RIVER CLYDE
KELVINHAUGH
BLYTHSWOOD
ST ROLLOX
EXCHANGE
BELLGROVE & DENNISTOUN
ANDERSTON
ST ENOCH SQUARE
CALTON
GORBALS
MONTEITH ROW
KINGSTON
HUTCHESON SQUARE
GREENHEAD
BARROWFIELD
LONDON ROAD
POLLOKSHIELDS
STRATHBUNGO
GOVANHILL
CROSSHILL
LANGSIDE
RIVER CLYDE
BELOW MEAN
ABOVE MEAN

THE DISTRIBUTION OF

Tuberculous Diseases in Glasgow,

WITH

OBSERVATIONS ON THE RELATION OF PHTHISIS TO ROOM-DENSITY.*

BY

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

Medical Officer of Health.

By a custom which has much to recommend it, the various forms which tuberculous disease assumes are classified to a large extent by the anatomical distribution of the organs affected. According to this method, the most prevalent form of tuberculous disease, characterised by a progressively destructive lesion of the lungs, is known as Pulmonary Phthisis or Consumption; tuberculous disease affecting the glands associated with the intestinal tract is Tabes Mesenterica; tuberculosis of the membranes of the brain is Tubercular Meningitis; and any form of tuberculosis not included among these just mentioned

---

* As an index of the degree of aggregation the density of a population is often expressed as a given number of "persons per acre." I have here used the phrase "density per room," or, shortly, "room-density," to express the number of "persons per room" in the average house of the city and its several districts, without regard to the varying size or number of rooms per house.

becomes "Other Forms of Tuberculosis (Scrofula)," and into one or other of these four classes every form of tuberculous disease causing death is placed. The sum of the injury inflicted on a population by tuberculous disease is not wholly represented, however, by the deaths which it causes. Much, indeed the major part, of the diseases of glands, bones, and joints, requiring surgical interference, arises from this cause, and, short of causing death, these may result in serious injury to health and permanent disablement. It is impossible at present to form any estimate of the injury to a population thus arising. It would be erroneous to apply hospital returns to the general population, because the age-proportions do not correspond. But this objection does not apply where they are used simply to indicate the prevalence of tuberculous diseases among those who seek hospital treatment.

I have gone over the records of the Royal Hospital for Sick Children in Glasgow for the last seven years, 1890-6, and find that about 24 per cent. of its admissions (4,164), and 35 per cent. of its deaths (486) were due to diseases of this class, and this proportion might have been increased by a more rigid scrutiny of the various causes of spinal disease.

And while tuberculous disease may develop in any of the organs of the body, there remains this distinction between Phthisis and certain of the other forms which tuberculous disease assumes, that while Phthisis, in adults at least, may be regarded as to a large extent determined by the surroundings of the individual (aerial infection), the forms of tuberculous

disease, which primarily have their seat in the digestive tract are believed to result from the use of infected food, and especially milk. For two reasons, a knowledge of the distribution of tuberculous disease in the city at the present time is important, for toward both sources of infection just mentioned the Health Committee are inaugurating new repressive measures. Phthisis in the individual is now being followed by disinfection of clothing and of dwellings, and effort is about to be made to exclude tuberculous animals from dairy-byres, and in time it should be possible to measure the results of both lines of action.

The theory on which all measures for the repression of infectious diseases proceed assumes more than the existence of disease in the individual. It implies the existence of certain external physical conditions which provide the infective agency with a fitting field for the development of its activity. When these conditions are removed, this activity ceases, or becomes so feeble that it ceases to be dangerous. The attenuation of Typhus Fever outbreaks is an excellent illustration of this. The physical condition necessary for the active spread of this disease consists in gross overcrowding of dwellings, and so long as this continued Typhus outbreaks were frequent and virulent. Now that gross overcrowding is rare, Typhus Fever is numbered by a few cases annually. Enteric Fever, again, is prone to attach itself to areas of dry conservancy, and Phthisis has for long been associated in its prevalence with breathing impure air. Leaving aside as

foreign to our present purpose the action of solid impurities in the atmosphere—because these predispose to Phthisis solely by exercising a local irritative action on the lungs—the history of Phthisis among masses of men so widely removed in their calling as soldiers, sailors, and artisans, and having nothing in common save exposure to an atmosphere contaminated by the products of respiration in barracks, on shipboard, and in ill-ventilated work-rooms, affords sufficient evidence for regarding respiratory impurity alone as one of the most powerful of the conditions which contribute towards its prevalence. Starting from this proposition, we would expect that Phthisis will most prevail where this impurity is greatest; and that if the varied circumstances under which the lives in a population are spent could be reduced to one term, which would express for the individual the degree of this impurity to which he is exposed, the external physical condition would be indicated which stands related to Phthisis as overcrowding is to Typhus, and as surface pollution of the soil is to Enteric Fever. But while this is unattainable for individuals, an approximation may be made, for sections of a population, on the basis of the respiratory impurity in dwellings, provided several qualifying circumstances are remembered. These are the initial cubic space provided, the frequency with which the air thereof is renewed, and the source from which it is drawn; the contrast between the air admitted to a dwelling from an indifferently kept back court or common stair and that from an open, wind-swept street being sufficiently obvious. Here again, however, we have

three variable quantities,* so that I have preferred approaching this question of respiratory impurity in dwellings from a consideration of the number of persons contributing to it; in other words, from the number of persons per room in the several statistical divisions of the city. It will be seen later that in each district of the city where the Phthisis death-rate exceeds the mean, there also the room-density of the district is in excess,† and it is probable that, when excessive room-density exists apart from excessive prevalence of Phthisis, the respiratory impurity of the dwelling is kept within limits by one or other, but most likely by a combination of all the circumstances already alluded to as influencing it. It will be observed that "room-density," as here used, does not primarily concern itself with the number of rooms per house, nor does it, except indirectly, relate to the varying cubic space per room; the question, indeed, of the care which is exercised in renewing the air of dwellings, and in keeping it as free as may be from the products of the various

* Measurements taken in 1886 of 991 houses in the Saltmarket and its vicinity showed a mean cubic space of 1,163 feet in one-roomed houses, and 930 and 927 cubic feet in the rooms of two and three-roomed houses respectively, while in two more recently built areas the one-roomed houses were larger and the rooms of two and three-roomed houses only slightly under the size of their one-roomed houses. In Laurieston, on the other hand, the average cubic space in 100 one-roomed houses measured was 156 feet less than in those of the Saltmarket area. (See "Vital Statistics of Glasgow," P. II., p. 70—Dr. Russell. June, 1886.) The minimum air space required per adult inmate was raised in 1890 to 400 cubic feet, and, by the Building Regulations Act, 1892, no newly-erected one-roomed house may have less than 1,000; no two-roomed house less than 1,600; and no three-roomed house less than 2,400 cubic feet of free air space.

† For convenience, death-rates and room-density are here spoken of as "excessive" when they exceed the mean for the city.

agencies which, under conditions of habitation, are always at work tending to render it impure, being scarcely less important than the extent of the initial air space provided in them. To many people pure air has no meaning. They rapidly exhaust its capacity for healthy respiration, and a larger cubic space means for them only a little longer time before excessive vitiation of the air of the dwelling is reached. Architectural ingenuity in house construction has hitherto been directed chiefly toward obtaining a certain cubic space per inmate, while little attention of a definite sort has been paid to the means by which the air of this space may be changed by some simple device, which will work automatically, so long as deliberate effort on the part of the inhabitant does not obstruct it. To keep air pure in a dwelling there must be movement and renewal of it; the advantage of a larger initial cubic space lying wholly in the facility which it affords for this movement being accomplished without causing draught. Earlier enquiries had made it abundantly clear that Phthisis was not uniformly distributed throughout the city, that its incidence was greater in some districts than in others, but no corresponding information had been tabulated regarding the local distribution of the tuberculous diseases which are not Phthisis.

I shall deal first with the prevalence of Tuberculous Disease generally, and the age incidence of the deaths arising from its several forms.

Statistics.—General.

All the statistics which are available tend to show

that deaths from tuberculous diseases are decreasing. This is true for the country generally, and the Glasgow figures conform with the general experience. The year of maximum intensity of the death-rate in Glasgow from this class of diseases, according to Registrar-General returns, occurred in 1871, when it was 645 per 100,000 living at all ages, whereas for 1894, the last year for which the adjusted figures are available, it was 311, and this reduction was exceeded in 1892, when the rate was 295 per 100,000 living. One source of error in this comparison should be stated. It is customary to classify these deaths as already explained, but whereas the sub-division "Phthisis," as above defined, has been in continuous use in Scotland since registration of deaths began in 1855 (so that the deaths registered therefrom, year by year, form a continuous series subject only to variation resulting from increasing accuracy in methods of diagnosis), the other sub-divisions were rearranged by the Registrar-General in 1883, and a certain amount of displacement took place which vitiates a comparison of "all tuberculous deaths" registered before that year with those of the years following it. What has already been said, however, of the year 1871, in regard to the death-rate from "all tuberculous diseases," is equally true of Phthisis. It is the year of maximum intensity in the whole series from 1855. The Phthisis death-rate in 1871 was 434 per 100,000 living, forming 13·5 per cent. of the general death-rate, and, like the "all tuberculous disease" class, reached its minimum in 1892, when the rate was 218

per 100,000 living, or 9·6 per cent. of the general death-rate, while for 1894 it was 227. In other words, the maximum variation as indicated by the figures for the highest and lowest year was 54 per cent. for "all tuberculous diseases," and 50 per cent. for Phthisis alone.

DEATHS PER MILLION.

	Phthisis.	Other Tuberculous Diseases.	All Tuberculous Diseases.
1871, - - -	4,346	2,112	6,458
1892, - - -	2,167	769	2,956
Decrease, -	2,159	1,343	3,502

These figures show that 62 per cent. of the fall was due to Phthisis, and 38 per cent. to a reduction in other sub-divisions, *plus* the effect of altered classification, the extent of which, however, cannot be easily estimated.

It is important to remember this when we come to consider the movement in the death-rate of the several sub-divisions of tuberculous diseases in the years for which they are strictly comparable, viz., from 1883 onwards. In Table I. (Appendix) the deaths and death-rates for each of the several forms of tuberculous disease are given for these years. The comparison of individual years is open to certain objections, which are minimised by taking several years together, and the following figures are obtained

by comparing the average annual deaths of 1883-8 with those of 1889-94, the system of classification being uniform during these 12 years.

RATES PER MILLION LIVING.

	Average Annual Death-Rate, 1883-88.		Average Annual Death-Rate, 1889-94.		Reduction per cent.	
Phthisis, - - -	2849		2318·6		18·6	
Tabes Mesenterica, - - -	451·5	1089·8	306·5	883·8	32·1	18·7
Tubercular Meningitis, -	405		386·7		4·5	
Other Forms of Tuberculosis (Scrofula), - -	233·3		190·6		18·3	
All Tuberculous Diseases, - -	3938·8		3202·4		18·7	

In the 12 years, therefore (1883-94), the deaths from all classes of tuberculous disease fell nearly 19 per cent., while Phthisis and all the other forms taken together exhibit each about an equal reduction of nearly 19 per cent. Taken separately, Tabes Mesenterica fell 32 per cent., Phthisis and "Other Forms (Scrofula)" each nearly 19 per cent., Tubercular Meningitis fully 4 per cent., and if we state the reduction in each class as a percentage of the reduction over all classes, we have Phthisis contributing 72 per cent., and the other forms together 28 per cent., of which Tabes Mesenterica

contributed 20 per cent., Tubercular Meningitis 2 per cent., and "Other Forms (Scrofula)" 6 per cent.

Regarding Tubercular Meningitis it is necessary to observe that a simple non-tubercular inflammation of the membranes of the brain exists, although, in children at least, the tubercular form probably contributes about four-fifths of the whole. The difficulty of distinguishing clinically between these two forms is very great, and not infrequently finds expression in the death being certified simply as "Meningitis" or "Acute Meningitis." I am informed by the Registrar-General that his custom is to classify as "Tubercular" only those which are so certified—*e.g.*, "Tubercular Meningitis" or "Acute Hydrocephalus," while "Meningitis" or "Acute Meningitis" are placed under the class "Nervous" Diseases. For these reasons a strong impression prevails that many deaths from Tubercular Meningitis do not appear as such in the returns. This subject will be further referred to in connection with "Age Incidence" of the disease.

Age Incidence.

The figures hitherto have been derived from the Registrar-General's returns, and are applicable to the whole area of Glasgow. They represent for the years 1889-94 a death-rate for all classes of tuberculous diseases of 320 per 100,000, of which 231 are due to Phthisis alone.

In the following figures the years taken are 1890-5, in which all classes of tuberculous diseases caused 321 deaths per 100,000 living, 230 of which are due

to Phthisis. The figures for these years have been compiled from the statistics of the Health Department, and are the rates obtaining in "Old Glasgow," that is, the area of the municipality as existing before the extension of the city in 1891. They are thus the rates obtaining in an estimated mean population of 572,681. It was necessary to take the figures applicable to this area, because the intention was to ascertain the age-incidence of the deaths in the several statistical districts into which the city is divided. The Registrar-General's figures are those for the whole city, but age-incidence must be considered in relation to age-constitution, and it could only be estimated for those districts where detailed information of the numbers living at various age periods had been obtained from the census returns for 1891.

Table II. shows in what proportion the several forms of tuberculous disease contributed to the death-rate from "all tuberculous diseases" in 1890-5, as follows:—

Phthisis,	72	per cent.	
Tabes Mesenterica,	9	,,	
Tubercular Meningitis,	11	,,	Together, 28 per cent.
Other Forms of Tuberculosis (Scrofula),	8	,,	Together, 28 per cent.
	100		

This Table also contains the deaths and death-rates occurring at ten age periods from each of the several forms of tuberculous disease.

Of the total deaths from Phthisis only 12 per cent. occurred before the age of 15 years, and 88 per cent.

after that age, while of the forms which are not Phthisis 89 per cent. of the deaths occurred under 15 years of age, and of these deaths under 15, 94 per cent. occurred before the age of 10 years was reached. If we therefore confine our attention to the ages under 10, we shall deal with fully four-fifths (nearly 84 per cent.) of all the deaths which occurred from tuberculous disease other than Phthisis; but, before examining these, the following Table is introduced to show the proportion to deaths from all causes under 10 years borne by deaths from zymotic disease and tuberculous disease respectively. It shows that zymotic disease causes nearly every third death that occurs under 10 years, while tuberculous disease causes 1 death in about every 11 :—

DEATHS UNDER 10 YEARS.

Period.	All Causes.	Zymotics.	All Tuberculous Diseases.
1870-74, -	38,178	12,802	5,554*
1890-94,† -	32,644	9,677	2,972

DEATHS UNDER 1 YEAR per 100,000 living—

Tuberculous Diseases (Not Phthisis),	714	= 88 per cent.
Phthisis, - - - - -	100	= 12 ,,
All Tuberculous Diseases, - -	814	

* Because of altered classification the tuberculous deaths of 1870-4 are not comparable with these in the later period.

† In 1890-94, 29·6 per cent. of the deaths from all causes were due to zymotics, and 9·1 per cent. to tuberculous diseases.

1—5 Years—

Tuberculous Diseases (Not Phthisis),	434 = 82	per cent.
Phthisis, - - - - -	93 = 18	,,
All Tuberculous Diseases, - -	527	

5—10 Years—

Tuberculous Diseases (Not Phthisis),	109 = 63	per cent.
Phthisis, - - - - -	63 = 37	,,
All Tuberculous Diseases, - -	172	

This shrinking, therefore, of the volume of tuberculous deaths, which goes on during the first 10 years of life (by the Table it continues up to the 15th year), is accompanied by a lessening of the proportion contributed to the total tuberculous deaths by the tuberculous diseases which are not Phthisis.

Excluding Phthisis, and comparing all other forms of tuberculous disease with each other, we have deaths per 100,000 living as follows :—

Under 1 Year—

Tabes Mesenterica, - - -	197 = 28	per cent.
Tubercular Meningitis, - -	379 = 53	,,
Other Forms (Scrofula), - -	138 = 19	,,
Tuberculous Deaths (Not Phthisis),	714	

1—5 Years—

Tabes Mesenterica, - - -	159 = 37	per cent.
Tubercular Meningitis, - -	188 = 43	,,
Other Forms (Scrofula), - -	87 = 20	,,
Tuberculous Deaths (Not Phthisis),	434	

5—10 Years—

Tabes Mesenterica, - - -	39 = 36	per cent.
Tubercular Meningitis, - -	40 = 37	,,
Other Forms (Scrofula), - -	30 = 27	,,
Tuberculous Deaths (Not Phthisis),	109	

In the first 10 years of life all three forms are most fatal during the first year. Tubercular Meningitis is responsible for a larger number of deaths than either of the others at each period, but, while contributing more than half the total deaths from these causes in the first year of life, its proportion is reduced to 37 per cent. in the 5-10 years' period.

The prevailing impression with regard to the Mesenteric form of the disease is that it predominates in the earlier years of life, and the Meningeal form during childhood rather than infancy. But as the cause of death these figures show that the opposite is the case. Tubercular Meningitis, however, very seldom occurs as an independent malady. It is usually associated with tuberculous disease elsewhere (in the abdominal or bronchial glandular system, or in the bones for example), but the predominance of a certain class of symptoms preceding death determines its name. In this sense it may be regarded as accidental whether the final stage of the disease becomes Tubercular Meningitis, Tubercular Peritonitis, or Acute Miliary Tuberculosis. In either case it means that the infecting agent has reached the membranes of the brain, the peritoneum, or the lungs, either by the blood current, or by simple extension to adjacent structures by the lymphatics from some pre-existing focus. Indeed, Tubercular Meningitis frequently forms part of an Acute Miliary Tuberculosis.

District Death-Rates.

Phthisis.

The reason has already been given for limiting this enquiry to the 24 statistical divisions of the city existing before the extension in 1891, and Table III. has been compiled to show, in the first place, the movement of the Phthisis death-rate for each district in the 6 years, 1890-5, when compared with the decade 1881-90. The districts are arranged in order of their Phthisis death-rates, from the lowest to the highest, after correcting the district rate for the age-constitution as ascertained to exist in the city in 1891.

Taking all the districts together, the general death-rate of 1881-90 was 2,422 against 2,336 per 100,000 living in 1890-5, while the Phthisis death-rate for 1881-90 was 268, and for 1890-5, 230, and the death-rate from "All causes, excluding Phthisis," was 2,154 for the first period, and 2,106 for the second. That is, while the general death-rate fell fully 3 per cent., the Phthisis rate fell 14 per cent., and the death-rate from "All causes, excluding Phthisis," fell only 2 per cent. Moreover, while the Phthisis rate fell in all the districts save one, the general death-rate rose in nine of the districts, and the death-rate from "All causes, excluding Phthisis," in eleven of them. In Kingston and Brownfield, although the general death-rate fell, when Phthisis is excluded, the death-rate of the remaining diseases rose, while in High Street and Closes, East, the reduced general death-rate is entirely due to a reduction in Phthisis, the death-

rate, excluding Phthisis, having increased. In these years (1890-5) it will be remembered that Influenza was frequently prevalent in epidemic form, and the death-rate from Acute Diseases of Lungs rose in fourteen of the districts. (See Table III. col., 7.)

A stricter comparison would have been obtained by taking "All deaths, not Tuberculous," and comparing the movement in them with that in all other causes of death; but it will be remembered that in 1883 the rearrangement of "Tuberculous Deaths, not Phthisis," took place, and, as we have already seen in the subsequent years, Phthisis and the "Tuberculous Deaths, not Phthisis," each fell fully 18 per cent.

It has been seen that the death-rate from Phthisis fell in each of the districts except Port-Dundas, where it rose from 194 to 283 per 100,000 living, an increase of nearly 46 per cent., which is the more striking as it is associated with a decrease in the death-rate from "All causes, not Phthisis," of 3 per cent.

Before a comparison of the various districts can be made, however, two considerations must be kept in view. We must first ascertain at what age Phthisis is most fatal, and then eliminate from each district the variation in the "all age" death-rate which would arise from excess or deficiency in the proportion of its population living at that age.

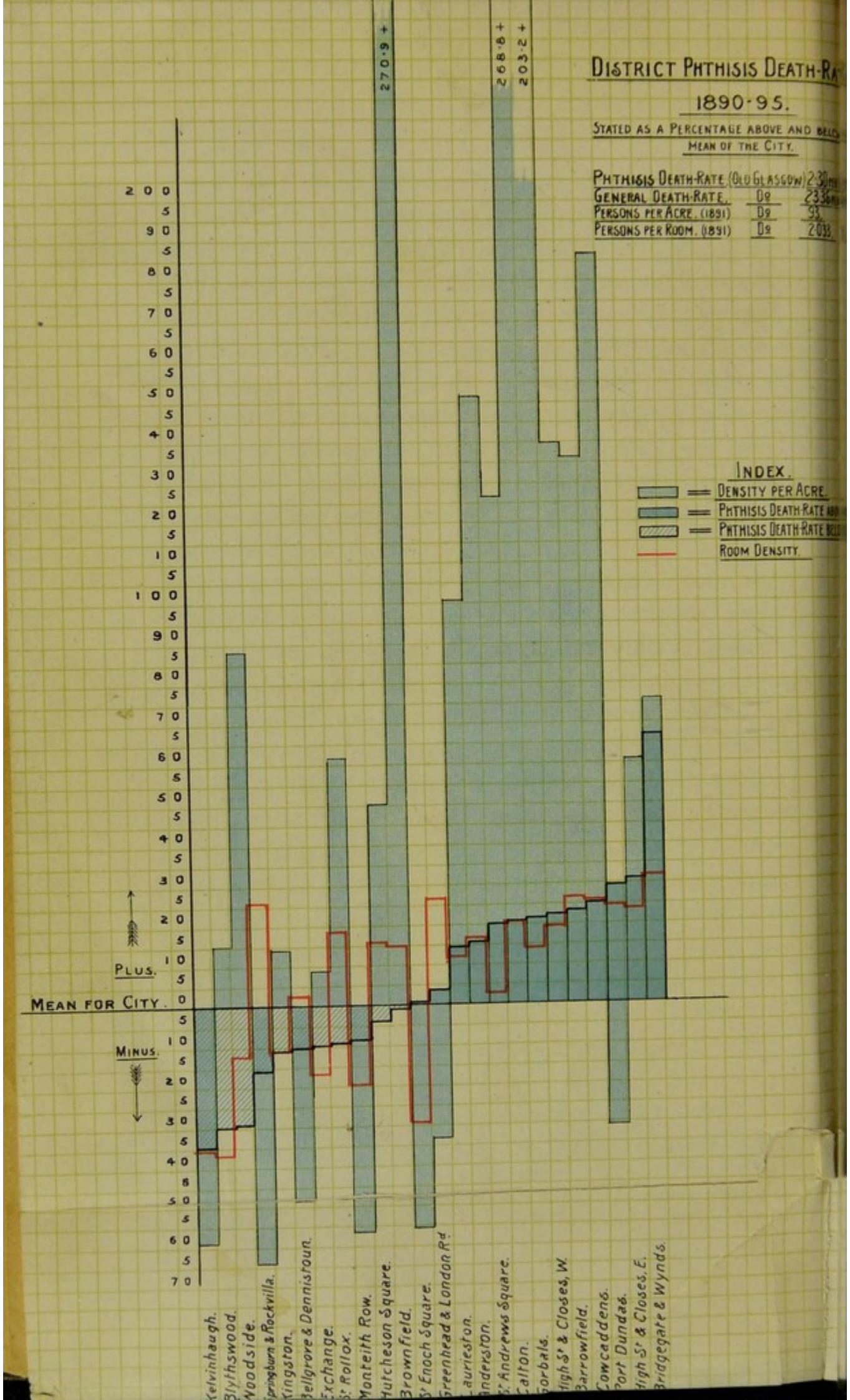
In Table IV. is given the death-rate from Phthisis in the several districts, calculated per 100,000 living at "all ages," and also at ten separate age periods. Already we have seen that 88 per cent. of all the Phthisis deaths occur after the fifteenth year, and here we find that the greatest incidence is during the 30-9

age period. According to the 1891 census the extremes of variation in the proportion of the population living at these ages were supplied by Monteith Row, which had 12·2 per cent., and Bridgegate and Wynds, which had 15·6 per cent., so that any comparison of district death-rates must be preceded by a standardising of the district populations as to age, and the age standard here adopted has been that found to exist among the population of the whole city at the census of 1891. This correction has been made, and the result is shown in the last column, where the death-rate of each of the districts at the 10 age periods given in the Table has been applied to a corrected population with age proportions corresponding with that of the whole city at the last census. Fourteen of the districts have their death-rate raised and ten are reduced by this correction. The rates as thus corrected are strictly comparable with each other, and with the whole city, in respect of age-constitution.

It has been stated in connection with Table III. that the districts are there arranged in order from the lowest to the highest of the corrected rates, and in the accompanying chart the position which each district occupies in relation to the whole city rate is expressed as a percentage above or below the city rate taken as a mean. In 11 districts the Phthisis death-rate is below the mean, and in 14 above it. The chart consists of a series of columns; each column represents a district; and, by variations in shade or colour, three facts are indicated. When the district death-rate is below the city rate, this is

represented in the chart by hatching; when above the city rate, it is indicated by shading of a uniform blue tint. It is customary to express "density of population" by the number of persons per acre, and the light-blue shading of the columns represents for each district the percentage by which this density exceeds or falls short of the average density of the city. In a general way the districts with excessive Phthisis death-rates are associated with density of population also in excess of the city mean, but the most densely-populated areas do not have the highest Phthisis death-rate, and a little reflection will show how this disparity may be explained. A district may have large tracts unbuilt or occupied for trade purposes, and the resident population housed on a comparatively small portion, while, on the other hand, an area may be wholly residential, so that it may well happen that a lower density per acre is associated with a more crowded condition of the inhabited part.* There is another aspect of density which is more truly an index of the physical environment than the number of persons distributed over an acre. In the house itself the effect of density in its most obnoxious form is present, and a third factor has been added to each of the district columns in the chart, in which this aspect of density is indicated. Taking as a standard the number of inhabited rooms in

* An excellent illustration of variation in density per acre, unaccompanied by any change in condition, is afforded by the city density before and after the extension of 1891. Old Glasgow had 93 persons per acre; Greater Glasgow, at the time of the extension, only 56.


DISTRICT PHTHISIS DEATH-RA
1890-95.
STATED AS A PERCENTAGE ABOVE AND BELO
MEAN OF THE CITY.
PHTHISIS DEATH-RATE (OLD GLASGOW) 2.30
GENERAL DEATH-RATE. Do 23.36
PERSONS PER ACRE. (1891) Do 93.
PERSONS PER ROOM. (1891) Do 2.033
INDEX.
= DENSITY PER ACRE.
= PHTHISIS DEATH-RATE ABO
= PHTHISIS DEATH-RATE BEL
ROOM DENSITY.
270·9 +
268·8 +
203·2 +
PLUS.
MEAN FOR CITY.
MINUS.
Kelvinhaugh.
Blythswood.
Woodside.
Springburn & Rockvilla.
Kingston.
Bellgrove & Dennistoun.
Exchange.
St. Rollox.
Monteith Row.
Hutcheson Square.
Brownfield.
St. Enoch Square.
Greenhead & London Rd.
Laurieston.
Anderston.
St. Andrews Square.
Calton.
Gorbals.
High St. & Closes, W.
Barrowfield.
Cowcaddens.
Port Dundas.
High St. & Closes, E.
Bridgegate & Wynds.

the city at the 1891 census, and distributing over them the total population at that date, the average number of persons per room was 2·033. This has been taken as a mean, and the corresponding number for each district dealt with as a percentage above and below it, precisely as we have already done both with the death-rate and density per acre. The result is shown on the chart by a red line. All the districts, with the exception of St. Enoch Square, having a death-rate from Phthisis in excess of the mean for the city, have also a room-density above the mean for the city. The St. Andrew's Square district would almost seem to afford another exception to this, because its room-density is only 2·8 per cent. in excess of the city mean, while its Phthisis rate exceeds the city rate by 20 per cent. It is the third smallest district, however, having a mean annual population during 1890-5 of little over 4,000 persons, and contains lodging-houses, &c., which tend to obscure the room-density of the population living outside these places.* It is more than probable that if the true room-density of this district could be ascertained (by excluding lodging-houses, &c., and the persons living in them), it would be more in excess of the city mean. Moreover, a change is taking place in the population of this district, tending towards increasing room-density, as is shown by an increase from 1·974 at the 1881 census to 2·090 in 1891. These observations apply equally to St. Enoch Square district, where

* See observations in this connection regarding St. Enoch and St. Andrew's Square districts. Part II., "Vital Statistics," p. 55.

the Phthisis rate is slightly in excess of the city, while the room-density is nearly 30 per cent. below it.

An illustration of a different kind is afforded by Greenhead and London Road district, where the room-density exceeds the city mean by 25 per cent., while the Phthisis death-rate exceeds that of the city by only 4·3 per cent. Here the room-density was reduced from 2·615 in 1881 to 2·569 in 1891, and in the latter year the proportion of one-roomed houses was nearly 50 per cent. in excess of the mean for the city, and the proportion of its population living in them exceeded that of the city by nearly 62 per cent. There is a wide diversity in the character of the population living in this area. It is composed of two distinct parts, separated by Barrowfield district, and railway operations during 1890-5 have displaced a portion of the population, but it is impossible at present to say whether the room-density has been altered thereby.

Of the eleven districts which have a Phthisis rate below the city mean, five have a room-density in excess of it. These are Bellgrove and Dennistoun (5), St. Rollox (4), Hutcheson Square (21), Brownfield (13), and Springburn and Rockvilla.

Bellgrove and Dennistoun, St. Rollox, and Hutcheson Square Districts.—Each of these districts had in 1891 a room-density greater than at the previous census. In 1881 this exceeded the mean by ·4, 16 and nearly 13 per cent., and increased in 1891 to 1·7, 18·4 and fully 15 per cent. respectively.

Brownfield.—In 1881 the room-density was fully 15 per cent. in excess of the city, in 1891 it was

14·5 per cent. in excess; but while its Phthisis death-rate fell in the last six years, the death-rate from "All causes, not Phthisis," rose from 27·03 per 1,000 in 1881-90 to 28·10 in 1890-5, and the death-rate from "Tuberculous Diseases, not Phthisis," was 92 per cent. above the city rate during 1890-5.

Springburn and Rockvilla has maintained a uniform room-density at both periods of 26 per cent. in excess of the mean.

We may now endeavour to put in the form of a general statement the information thus obtained:—

(1) The room-density of the whole city fell from 2·040 in 1881 to 2·033 in 1891 (or a decrease of 7 persons per 1,000 rooms), and its Phthisis rate from 268 to 230 per 100,000 living.

(2) All districts, save one, having a Phthisis death-rate above the mean, have a room-density also above the mean. St. Enoch Square district is the only exception to this, and the disturbing influences there present have been stated.

(3) In all these districts, save St. Andrew's Square, the room-density was greater in 1881 than in 1891.

(4) Eleven districts have a Phthisis death-rate below the mean; five of them have a room-density in excess of the mean, which is tending toward increase in three of them.

(5) These exceptions are sufficiently large to show that the relationship between room-density and Phthisis is not a simple one, and that excessive density is not at once responded to by an increased Phthisis rate. But in nine districts where the room-density increased between 1881 and 1891 the Phthisis death-rate fell 13·5 per cent., whereas in fourteen districts where the room-density was reduced the Phthisis rate fell 16 per cent.

This difference in the rate of decrease would seem to contain a suggestion which future observation

may establish. The Phthisis rate for the present is decreasing, but *the rate of decrease is greater in districts which have a concurrent decrease in room-density.* It would be erroneous to regard the room-density ascertained in 1881 as true for the subsequent decade, and that of 1891 as correspondingly true for the following years. They can only be taken as points which indicate a movement taking place continuously throughout the intervening period, and, with fair accuracy, representing its general tendency. But the contrast in the rate of decrease just referred to points to the expectation that when excessive density is continued in any district over a term of years, the physical conditions are created which produce in the population a congenial soil for the development of Phthisis.

If we compare the proportion of one-roomed houses in the fourteen districts having a Phthisis death-rate above the mean, we find that St. Enoch Square, Laurieston, and Port-Dundas districts have each a smaller proportion of houses of this size than the mean of all the districts. The special circumstances present in the St. Enoch Square district have already been mentioned. Laurieston has 1·8 per cent. fewer houses of one apartment* than the city mean, the proportion of its population living in them is 8 per cent. below the ascertained average population of one-roomed houses in the city, yet its room-density exceeds the city mean by 11·8 per cent., and its Phthisis death-rate by 14 per cent.; and Port-

* See reference to cubic capacity of severa of these, p. 5.

Dundas, with 1·5 per cent. fewer houses of one room than the city rate, and the proportion of its population living in them 3 per cent. less than the average for the city, has a room-density which is 25 per cent., and a Phthisis death-rate 30 per cent. in excess of the mean for the city. It is probable, therefore, that room-density, like density per acre, must attain a certain degree of intensity before its effect becomes appreciable, and that it acquires ætiological value only when it also becomes the numerical expression of certain other factors, all tending, like itself, to produce impurity in the air of dwellings.

Tuberculous Diseases other than Phthisis.

In considering the district distribution of this class of tuberculous diseases all three forms have been taken together, a further sub-division being impracticable from the small number of deaths in several of the districts. In Table V. the deaths and death-rates are given for three age periods under ten years and for ten and upwards, and the last column of the Table contains the corrected rate for all ages in each of the districts, the error arising from a varying proportion of children under ten in each of the districts being thus excluded.

Nine districts have a death-rate from these diseases lower than the city mean, and among those which exceed it the relationship with the Phthisis incidence is not preserved. St. Rollox, Monteith Row, Hutcheson Square, and Brownfield, with Phthisis death-rates below the mean, have death-

rates from the other forms of tuberculous disease above it, Brownfield having an excess, indeed, of 92 per cent; while Greenhead and London Road and St. Andrew's Square districts, which each have a Phthisis rate above the mean, have a rate from the other forms below it.

APPENDIX.

TABLE I.—Glasgow—Deaths and Death-Rates per Million

Year.	Deaths.					
	Tabes Mesenterica.	Tubercular Meningitis.	Other Forms of Tuberculosis (Scrofula).	Tuberculous Diseases (Not Phthisis).	Phthisis.	All Tuberculous Diseases.
1883,	293	186	109	588	1,758	2,346
1884,	239	228	120	587	1,614	2,201
1885,	254	254	127	635	1,584	2,219
1886,	263	215	132	610	1,552	2,162
1887,	204	197	146	547	1,361	1,908
1888,	198	223	118	539	1,285	1,824
1889,	193	232	95	520	1,292	1,812
1890,	202	239	103	544	1,403	1,947
1891,	144	258	110	512	1,371	1,883
1892,	184	229	102	515	1,463	1,978
1893,	226	237	135	598	1,500	2,098
1894,	186	226	168	580	1,560	2,140

om Tuberculous Diseases for 12 Years (1883-94).

Death-Rates per Million.						Year.
Tabes senterica.	Tubercular Meningitis.	Other Forms of Tuberculosis (Scrofula).	Other Tuberculous Diseases (Not Phthisis).	Phthisis.	All Tuberculous Diseases.	
560	356	208	1,124	3,361	4,484	1883.
452	432	227	1,111	3,054	4,165	1884.
476	476	237	1,189	2,967	4,156	1885.
487	399	245	1,131	2,878	4,009	1886.
374	362	268	1,004	2,499	3,503	1887.
360	405	215	980	2,336	3,316	1888.
347	418	171	936	2,324	3,260	1889.
360	426	183	969	2,499	3,468	1890.
254	455	194	903	2,418	3,321	1891.
275	342	152	769	2,187	2,956	1892.
333	350	199	882	2,213	3,095	1893.
270	329	245	844	2,271	3,115	1894.

TABLE II.—Old Glasgow—6 Years, 1890-95—Deaths a

Ages.	Deaths.					
	Tabes Mesenterica.	Tubercular Meningitis.	Other Forms of Tuberculosis (Scrofula).	Tuberculous Diseases (Not Phthisis).	Phthisis.	All Tubercul Disease
Under 1 year,	199	383	139	721	101	82
„ 5 years,	540	637	297	1,474	316	1,79
„ 10 „	150	154	116	420	243	66
„ 15 „	61	36	59	156	316	47
„ 20 „	19	20	42	81	971	1,05
„ 30 „	15	14	96	125	2,244	2,36
„ 40 „	8	22	50	80	1,891	1,97
„ 50 „	6	2	26	34	1,108	1,14
„ 60 „	4	—	22	26	509	53
60 years and upwards,	1	1	7	9	194	20
All ages, -	1,003	1,269	854	3,126	7,893	11,01
			Percentage supplied by each class total deaths from Tuberculous Disea			

th-Rates per 100,000 at Certain Periods of Life.

Death-Rates per 100,000.						Ages.
abes nterica.	Tubercular Meningitis.	Other Forms of Tuberculosis (Scrofula).	Tuberculous Diseases (Not Phthisis.)	Phthisis.	All Tuberculous Diseases.	
97	379	138	714	100	814	Under 1 year.
59	188	87	434	93	527	„ 5 yrs.
39	40	30	109	63	172	„ 10 „
17	10	16	43	88	131	„ 15 „
5	6	12	23	279	302	„ 20 „
2	2	15	19	340	359	„ 30 „
2	5	10	17	395	412	„ 40 „
2	1	7	10	316	326	„ 50 „
2	—	9	11	222	233	„ 60 „
·5	·5	4	5	105	110	60 years and upwards.
29	37	25	91	230	321	All ages.
9	11	8	28	72	100	

TABLE III.—Old Glasgow and Districts—Death-Rates per

1	2	3	
		All Causes.	
No.	Statistical Division.	1881-90	1890-95
17	Kelvinhaugh and Sandyford, - - - -	1,623	1,533
Bl.	Blythswood, - - - - - - -	1,645	1,674
15	Woodside, - - - - - - -	1,961	1,869
Sp.&R.	Springburn and Rockvilla, - - - -	2,212	2,118
19	Kingston, - - - - - - -	2,079	2,073
5	Bellgrove and Dennistoun, - - - -	2,219	2,182
1	Exchange, - - - - - - -	2,143	2,006
4	St. Rollox, - - - - - - -	2,265	2,174
9	Monteith Row, - - - - - -	2,085	2,192
21	Hutcheson Square, - - - - - -	2,365	2,226
13	Brownfield, - - - - - - -	3,037	3,031
12	St. Enoch Square, - - - - - -	2,433	2,570
7	Greenhead and London Road, - - - -	2,491	2,332
20	Laurieston, - - - - - - -	2,760	2,712
18	Anderston, - - - - - - -	2,788	2,683
10	St. Andrew's Square, - - - - -	2,449	2,580
11	Calton, - - - - - - - -	3,026	3,075
22	Gorbals, - - - - - - - -	2,826	2,972
3	High Street and Closes, West, - - -	2,933	3,081
8	Barrowfield, - - - - - - -	2,898	2,758
16	Cowcaddens, - - - - - - -	3,255	3,308
2	Port-Dundas, - - - - - - -	2,688	2,701
6	High Street and Closes, East, - - - -	3,359	3,256
14	Bridgegate and Wynds, - - - - -	3,954	3,812
	City, - - - - - - -	2,422	2,336

100,000 from Certain Causes for 1881-90 and 1890-95.

4			5		6		7		1
Phthisis.			Tuberculous Diseases (Not Phthisis).		All Causes (Not Phthisis).		Acute Diseases of Lungs.		
	1890-95		1890-95						
1881-90	(a) Crude.	(b) Corrected for Age Distribution.	(a) Crude.	(b) Corrected for Age Distribution.	1881-90	1890-95	1881-90	1890-95	No.
190	156	150	47	55	1,433	1,377	283	317	17
180	174	160	55	78	1,465	1,500	329	348	Bl.
193	164	163	70	70	1,768	1,705	420	456	15
261	191	192	67	61	1,951	1,927	526	480	Sp.&R.
238	208	204	70	77	1,841	1,865	447	458	19
237	201	206	87	83	1,982	1,981	471	445	5
252	214	207	70	78	1,891	1,792	405	399	1
266	207	208	100	94	1,999	1,967	505	495	4
239	213	210	71	93	1,846	1,979	439	505	9
260	219	222	112	100	2,105	2,007	573	550	21
334	221	228	172	175	2,703	2,810	782	796	13
302	249	232	107	125	2,131	2,321	488	691	12
300	233	240	88	79	2,191	2,099	518	547	7
264	263	264	95	96	2,496	2,449	711	736	20
333	265	267	147	139	2,455	2,418	746	706	18
279	269	276	75	85	2,170	2,311	649	683	10
291	274	278	118	116	2,735	2,801	812	854	11
283	279	281	95	95	2,543	2,693	825	910	22
334	288	283	101	108	2,599	2,793	696	743	3
329	276	284	109	104	2,569	2,482	665	698	8
335	283	288	147	137	2,920	3,025	837	886	16
194	283	298	128	121	2,494	2,418	722	617	2
429	323	304	140	145	2,930	2,933	902	927	6
448	408	383	90	111	3,506	3,404	1,233	1,169	14
268	230	230	91	91	2,154	2,106	562	564	

TABLE IV.—Old Glasgow—6 Years, 1890-95—District

	Districts.	Under 1 Year.	1—4	5—9
Bl.	Blythswood,	33	54	14
1	Exchange,	64	68	8
2	Port-Dundas,	110	—	146
3	High Street and Closes, West,	70	140	107
4	St. Rollox,	95	69	38
5	Bellgrove and Dennistoun,	116	95	49
6	High Street and Closes, East,	98	148	82
7	Greenhead and London Road,	120	118	56
8	Barrowfield,	223	144	83
9	Monteith Row,	399	51	38
10	St. Andrew's Square,	169	394	39
11	Calton,	24	131	82
12	St. Enoch Square,	235	—	178
13	Brownfield,	—	96	87
14	Bridgegate and Wynds,	406	40	107
15	Woodside,	57	50	52
16	Cowcaddens,	127	108	88
17	Kelvinhaugh and Sandyford,	119	76	28
18	Anderston,	159	142	79
19	Kingston,	63	57	50
20	Laurieston,	68	133	51
21	Hutcheson Square,	82	88	76
22	Gorbals,	81	117	132
Sp.&R.	Springburn and Rockvilla,	65	48	85
	City,	100	93	63

Death-Rates per 100,000 from Phthisis at Certain Ages.

10—14	15—19	20—29	30—39	40—49	50—59	60 and Up.	All Ages.	All Ages corrected for Age Distribution.	
31	150	261	318	279	128	44	174	160	Bl.
16	218	349	403	308	231	59	214	207	1
30	556	492	541	250	349	—	283	298	2
38	146	328	768	390	305	117	288	283	3
89	287	310	373	308	131	69	207	208	4
92	263	306	344	290	166	72	201	206	5
62	242	493	579	418	361	270	323	304	6
99	351	385	385	296	186	39	233	240	7
132	352	414	447	430	216	90	276	284	8
72	317	248	457	145	267	110	213	210	9
79	267	449	345	400	147	130	269	276	10
37	312	499	443	373	289	117	274	278	11
111	89	261	528	438	264	96	249	232	12
93	230	349	593	124	200	—	221	228	13
147	508	501	738	485	525	92	408	383	14
56	197	268	278	205	141	79	164	163	15
105	292	430	529	373	315	151	283	288	16
52	218	229	273	175	73	63	156	150	17
146	330	395	417	371	218	73	265	267	18
95	277	313	317	269	223	113	208	204	19
153	447	435	413	199	198	139	263	264	20
114	323	323	352	306	183	58	219	222	21
72	309	413	630	247	182	163	279	281	22
105	281	293	315	233	245	—	191	192	Sp.&R.
88	279	340	395	316	222	105	230	230	

TABLE V.—Old Glasgow and Districts—Deaths and Death-Diseases (Not Phthisis) during 6 Years, 1890 to 1895;

	District.	Deaths.				
		Under 1 Year.	1—5.	5—10.	10 Years and over.	All Ages.
Bl.	Blythswood, - - -	24	38	14	20	96
1	Exchange, - - - -	15	45	6	21	87
2	Port-Dundas, - - -	5	13	8	9	35
3	High Street and Closes, West,	12	21	7	16	56
4	St. Rollox, - - - -	22	47	11	15	95
5	Bellgrove and Dennistoun, -	91	144	39	62	336
6	High Street and Closes, East,	15	25	5	5	50
7	Greenhead and London Road,	59	139	40	38	276
8	Barrowfield, - - -	37	83	29	28	177
9	Monteith Row, - - -	3	12	2	2	19
10	St. Andrew's Square, - -	2	12	1	3	18
11	Calton, - - - -	30	76	24	23	153
12	St. Enoch Square, - -	5	7	3	6	21
13	Brownfield, - - -	8	17	5	5	35
14	Bridgegate and Wynds, -	6	16	3	4	29
15	Woodside, - - - -	61	115	30	47	253
16	Cowcaddens, - - -	36	70	18	17	141
17	Kelvinhaugh and Sandyford,	16	37	13	19	85
18	Anderston, - - - -	59	130	38	29	256
19	Kingston, - - - -	43	80	19	28	170
20	Laurieston, - - - -	9	24	7	10	50
21	Hutcheson Square, - -	118	204	62	53	437
22	Gorbals, - - - -	11	37	15	13	76
Sp.&R.	Springburn and Rockvilla, -	32	62	21	23	152
	Institutions, - - -	2	20	—	15	23
	City, - - - -	721	1,474	420	511	3,126

Rates per 100,000 at Certain Ages from Tuberculous also Death-Rates Corrected for Age Distribution.

Death Rates per 100,000.						
Under 1 Year.	1—5.	5—10.	10 Years and over.	All Ages.	All Ages Corrected for Age Distribution.	
788	339	97	14	55	78	Bl.
479	435	48	21	70	78	1
551	453	234	45	128	121	2
837	421	125	37	101	108	3
698	467	102	21	100	94	4
754	350	82	22	87	83	5
1,466	740	137	18	140	145	6
544	390	102	17	88	79	7
750	478	151	23	109	104	8
599	608	77	9	71	93	9
338	591	40	16	75	85	10
724	588	163	24	118	116	11
1,176	426	178	38	107	125	12
1,559	814	217	32	172	175	13
812	646	107	15	90	111	14
584	319	74	17	70	70	15
1,147	687	158	24	147	137	16
381	257	74	13	47	55	17
1,042	712	188	22	147	139	18
674	382	74	15	70	77	19
620	455	120	25	95	96	20
878	459	131	19	112	100	21
467	479	165	21	95	95	22
499	278	86	13	67	61	Sp.&R.
—	—	—	—	—	—	
714	434	109	20	91	91	