

# **The geographical distribution of heart disease and dropsy, cancer in females & phthisis in females, in England and Wales.**

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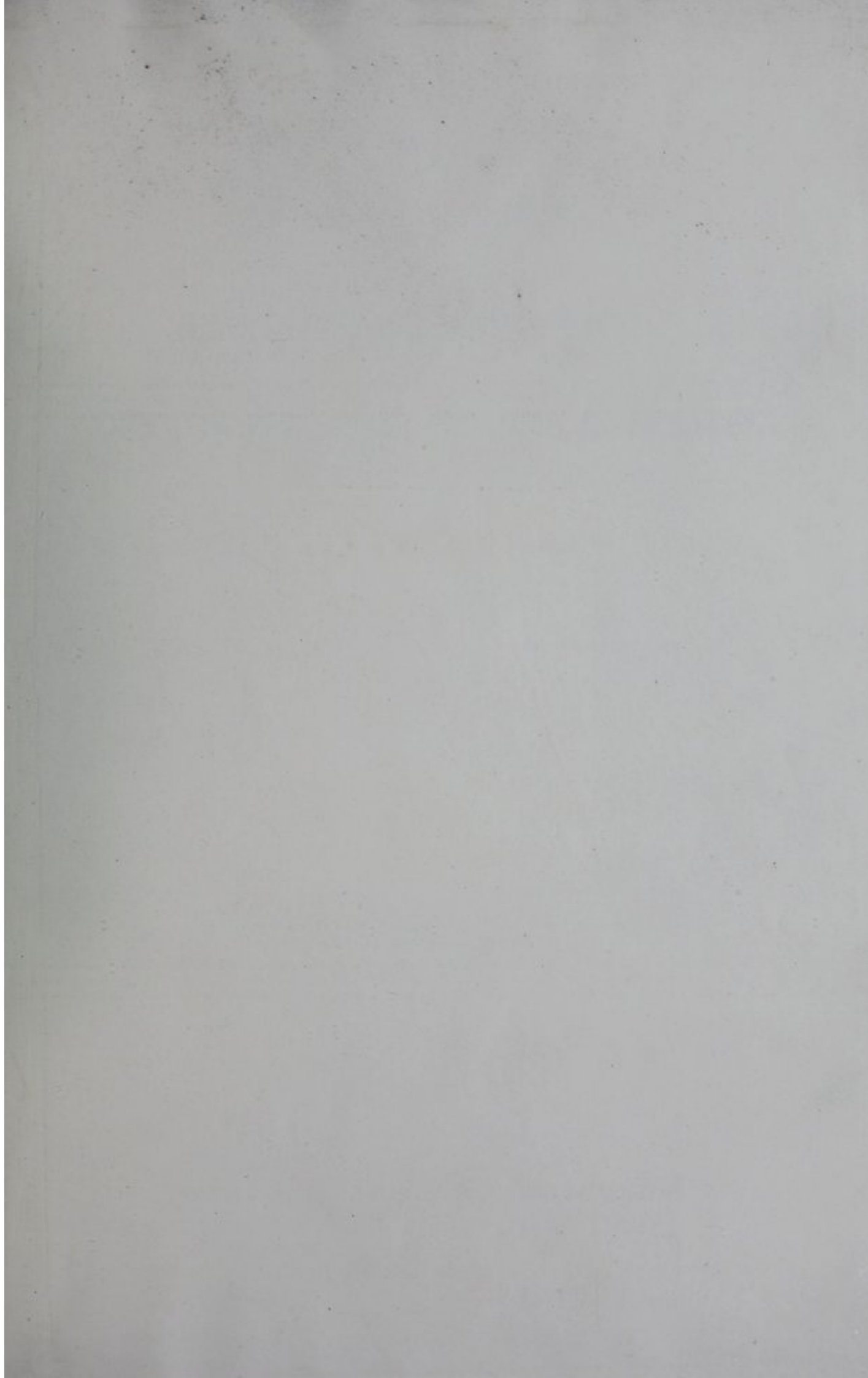
HAVILAND'S  
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OF  
HEART DISEASE, CANCER  
AND PHTHISIS

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THE  
GEOGRAPHICAL DISTRIBUTION  
OF  
HEART DISEASE AND DROPSY,  
CANCER IN FEMALES & PHTHISIS IN FEMALES,  
IN  
ENGLAND AND WALES.

*ILLUSTRATED BY SIX SMALL AND THREE LARGE COLOURED MAPS.*

BY  
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NORTHAMPTON, LEICESTER, RUTLAND, AND DUCKS:  
ETC. ETC. ETC.

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Том IV



TO

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I DEDICATE

THIS WORK

WITH EVERY FEELING OF GRATITUDE

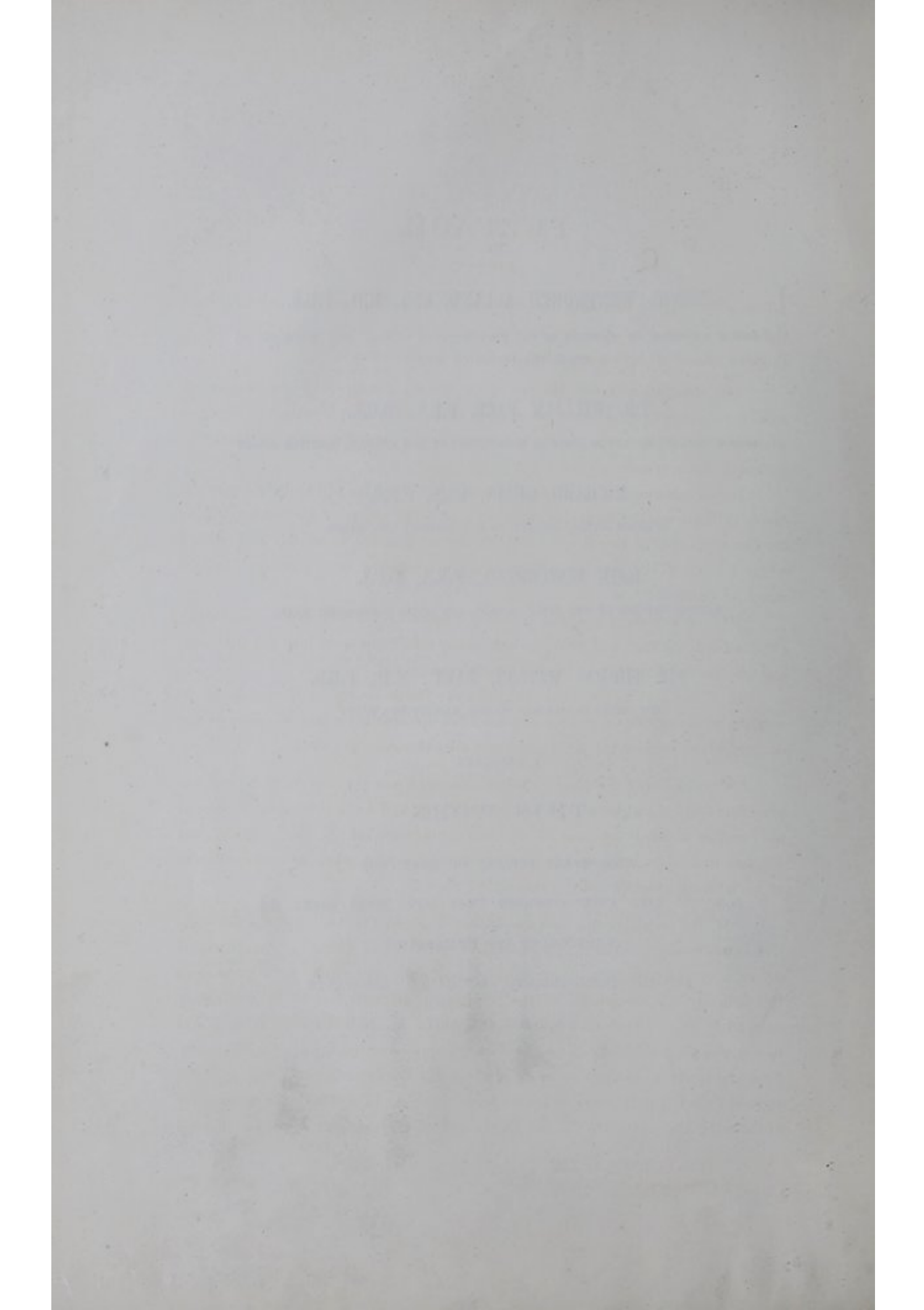
FOR THE KIND ENCOURAGEMENT THEY HAVE EVER GIVEN ME

THROUGHOUT ITS PREPARATION

AND FOR THEIR FRIENDLY ADVICE AND ASSISTANCE

ON EVERY OCCASION

A. H.





## PREFACE.

---

IT is a remarkable fact that Dr. Farr, in his very first letter to the Registrar-General in 1839, when the Act for Registering Births, Deaths, and Marriages in England came into operation, made the following statement :—

‘ The registration of the diseases of the several districts will furnish medical men with a series of valuable remedial agents. It will designate the localities where disease is most rife, and where there is the most tendency to particular classes of sickness and infirmity.

‘ In recommending a residence to patients, the physician will find the registered causes of death an indispensable directory ; and the utility of a *Sanitary Map of the Country*, such as the Returns will furnish, cannot fail to be felt in England, where a part of the population is constantly migrating from place to place in search of health.

‘ Much information has been collected respecting the influence of the British climate ; but the facts will bring to light many salubrious spots hitherto unknown, and disclose the dangers which infest others unsuspected.

‘ Invalids resort to some unhealthy places ; families carrying their children, in autumn, where small-pox and measles are often epidemical, or go into parts of the country where bowel-complaints and fevers are extraordinarily fatal.’

After completing the Map on Heart Disease, I was gratified to find that this prophetic opinion had been expressed by Dr. Farr ; and I was stimulated to extend my inquiries not only by what he wrote so many years before there were any data whereon to form such a map, but by his confirmed opinion, when he saw the figures of his office chartographically portrayed.

Whilst preparing my basis map, it was discovered that those of the Registration Districts contained in the Census Tables of 1851, and which I at first intended to use, were defective, not having been revised since that year. In order to meet this difficulty, the boundaries of the Registration Districts had to be worked out completely on the Ordnance Maps ; and thus an unexpected outlay of time and money was the result. To defray the latter, I applied to the Lords of the Treasury for a grant, which, on the recommendation of the Registrar-General, was accorded to me by the Right Honourable Robert Lowe, M.P. ; and I now take this opportunity of thanking Major Graham for the hearty and effective support which he afforded

me whilst my application was under the consideration of the Treasury, and which eventually led to its being successful.

My basis map, which is engraved on copper, is now the standard one for the Registration Divisions, Counties, and Districts, and as such was used in the Census Reports for 1871, each of the eleven Registration Divisions having been transferred on stone and printed separately.

In a similar manner could Medical Officers of Health or Sanitary Authorities have their combined areas transferred from the plate.

I believe that the mode I have adopted of studying the Topography of Disease will be found of essential service not only to Medical Officers of Health, but to all who are interested in the progress of Sanitary Science; and, having carried it out fully in my own large area, I can safely say that by its means I have derived much valuable etiological information as to its prevalent diseases, and in a shorter time than I could possibly have done by any other mode of investigation.

Whatever study gives us a clue to the Etiology of a disease, at the same time aids us in our endeavours to prevent it. It is for this reason that I look upon the investigation connected with the Geographical Distribution of Disease as essential to a practical knowledge of Preventive Medicine; for it involves the study of the physical, geological, meteorological, and other natural and social characters of the country or district, the diseases of which are the subject of inquiry.

The Maps illustrating this work, which comprises the distribution of Heart Disease, Cancer, and Phthisis, are based upon more than half a million of deaths during a period of ten years.

I now leave my work in the hands of my professional brethren, hoping that it may render them some assistance in that part of their practice upon which our knowledge has always been more or less imperfect.

During the time that I was engaged in 1868, at Somerset House, preparing the basis of my work, I received every kindness and attention from William Clode, Esq., of the Statistical Department: he was ever ready to afford me assistance, and I feel glad thus to acknowledge it gratefully.

I trust that my labours, however incomplete, may stimulate others to collect facts relative to the localisation of Disease, and record them; so that in time to come, the practical fruit, borne by the study of its Geographical Distribution, shall enable it to take that high position in Medical Science, of which it was considered so worthy two thousand years ago by the great Father of Medicine, Hippocrates.

A. HAVILAND.



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*Erratum.*

In the Maps on pages 68 and 72 the 'Mean Annual Average of Mortality of both Sexes' should be omitted.



THE  
GEOGRAPHICAL DISTRIBUTION  
OF  
HEART DISEASE AND DROPSY  
IN  
ENGLAND AND WALES.

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CHAPTER I.

SECTION I.

**DURING** the ten years 1851-60, there died in England and Wales from *all* causes, 4,210,715 persons, out of a mean population, calculated for the decenniad 1851-61, of 18,996,916.

Deaths from all causes.

During the same period 236,973 deaths were attributed to Heart Disease and Dropsy, according to the Registrar-General's Returns, which are based upon the cause-of-death certificates given by legally qualified medical practitioners: the deaths, therefore, from these combined causes, amounted to more than one-seventeenth of the whole mortality.

Deaths from Heart Disease and Dropsy.

Compared with the death rate from other causes, that from Heart Disease and Dropsy holds a high place in the order of mortality, for although Phthisis claims annually a number of victims doubly greater, yet the sum of those who succumbed to Cholera, Diarrhœa, and Dysentery, during the same period, did not exceed it, whilst that from Small-pox and Scarlet Fever fell short of it by 28,470 deaths.

Compared with other diseases.

Of those who died from Heart Disease and Dropsy, 109,527 were males, and 127,446 females: the estimated female population of the decenniad was not half-a-million in excess of the male; therefore the number of deaths among females from this cause was both absolutely and relatively greater than among males; absolutely, in the proportion above stated, and relatively, as 13·1 are to 11·8 to every 10,000 persons living.

Difference of mortality between the sexes.

Heart Disease, like some other causes of deaths, varies in its fatal effects according to the *sex* and *age* of the persons afflicted. As a general rule we have seen that females are more prone to become victims to it than males; this rule we however shall see is modified to a certain extent according to age.

Mortality varies according to sex and age.



TABLE I.

Mean Population, and Deaths from HEART DISEASE and DROPSY, in England and Wales, during the ten years 1851-60.

	ALL AGES.	TOTAL UNDER ONE YEAR.	1	2	3	4	TOTAL UNDER FIVE YEARS.	5—	10—	15—	20—	25—	35—	45—	55—	65—	75—	85 AND UPWARDS.
Mean Population 1851-61.	Males. 9,278,742	—	—	—	—	—	1,265,830	1,111,954	1,011,594	915,583	827,833	1,356,605	1,074,115	792,246	523,334	285,168	101,371	13,121
	Females. 9,718,174	—	—	—	—	—	1,258,614	1,106,619	997,324	929,333	920,217	1,494,666	1,133,809	830,351	565,586	332,631	128,750	20,274
Deaths from Heart Disease and Dropsy.	Males. 109,527	2,313	1,076	777	639	582	5,387	2,665	2,443	2,948	2,869	6,977	10,767	15,039	21,611	24,849	12,579	1,393
	Females. 127,446	1,969	921	634	494	468	4,486	2,378	2,715	3,275	3,592	9,007	12,673	17,141	25,781	29,657	14,846	1,895
Average Annual Ratio of Mortality from Heart Disease and Dropsy at different ages to 10,000 living last of the ten years last of.	Males. 11·8	—	—	—	—	—	4·2	2·3	2·4	3·2	3·4	5·1	10·0	18·9	41·2	87·1	124·0	106·0
	Females. 13·1	—	—	—	—	—	3·5	2·1	2·7	3·5	3·9	6·2	11·1	20·6	45·5	89·1	115·3	93·4
Mean of the Two Sexes,	12·4	—	—	—	—	—	3·8	2·2	2·5	3·3	3·6	5·6	10·5	19·7	43·3	88·1	119·6	99·7

The accompanying Table shows that during the first ten years of life, more males die from Heart Disease than females, but that after the first decade up to the one between 75 and 85, the proportional number of deaths from this cause among females is greater than that among males: in fact, during the first ten and the last twenty years of life, the male mortality exceeds that of the female.

The mean proportional mortality is greater during the first five years of existence than during any of the succeeding quinquennial periods up to fifth, which ends at 25; after which age the relative mortality in both sexes nearly doubles itself in each succeeding decade, up to that commencing at 75, when only an increase of one-fifth in the mortality takes place, which, however, falls during the last 15 years to less than one-fifth below the preceding decade.

The age when the *least* relative mortality takes place in both sexes is between 5 and 10, and that when it is *greatest* lies between 75 and 85.

Between 5 and 10 there is the *least* difference in the mortality between the sexes, and between 55 and 65 the *greatest*.

The difference in the average annual rate of mortality among males and females, being only 1·3 to every 10,000 living, I think I am justified in believing that some other cause independent of sex, operates in the production of that difference, and that the numbers, which express the mean of the average annual mortality, will answer every practical purpose in portraying the geographical distribution of Heart Disease and Dropsy; due regard being paid to any exceptions which may occur during our investigation of the subject.

When I describe the geographical distribution of Cancer, the difference between the mortality from this disease, and its seat in the two sexes, is so great, that each will have to be studied separately; and, although in Phthisis the numbers of male and female deaths are nearly equal, yet in consequence of the remarkable relation which appears to subsist between this disease and Cancer, it will be necessary to separate the males from the females, for, unless we do so, the geographical distribution of these two causes of death would not be comparable.

I will now recapitulate the leading facts which are given above:—

- 1°. The mortality from Heart Disease and Dropsy amounts to more than one-seventeenth part of the whole mortality from all causes.
- 2°. More females than males die from Heart Disease and Dropsy, both absolutely and relatively; it is not however probable that the excess arises from a purely sexual cause.
- 3°. Female mortality is less at the extremes of life than the male.
- 4°. Between 25 and 75 in both sexes, each decad has a relative mortality nearly double that of the one which precedes it.

I now proceed to the Geographical Distribution of the Statistics of Heart Disease and Dropsy.



## CHAPTER II.

## SECTION I.

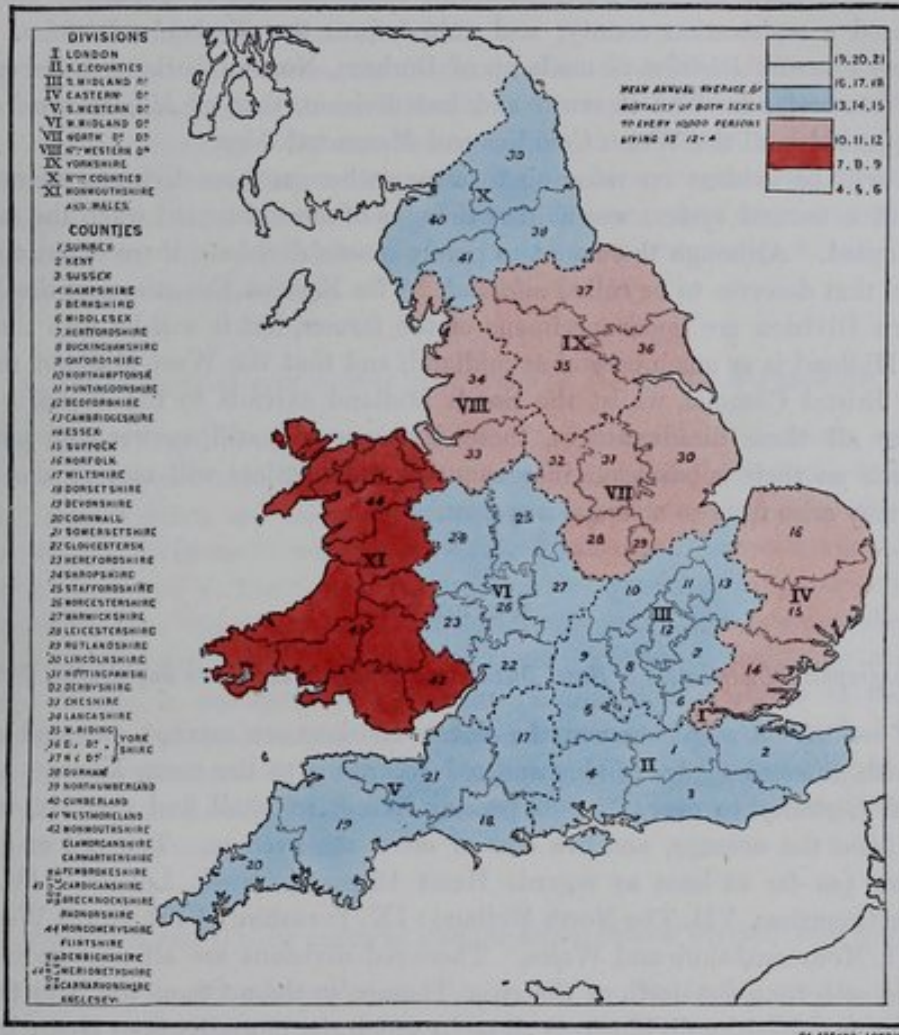
*The Geographical Distribution of the Statistics of Heart Disease and Dropsy.*

ENGLAND and WALES are divided into eleven Registration Divisions, each of which represents a group of counties, which are again subdivided into Union Districts. During the period I have selected, the ten years 1851-60, each union district had its population carefully estimated according to the death and birth-rate, between the census of 1851 and that of 1861; this estimated mean population forms in the Registrar-General's Supplement to his Twenty-fifth Annual Report a standard which enables us to calculate what proportion the deaths of any district bear to the number of those living within its boundaries: for instance, if there have died in a district, during the decennium selected, having a mean population of 10,000, a hundred persons from any one cause of death, Heart Disease for instance, by dividing the 100 deaths by the number of years over which they were spread, we arrive at the average annual rate of mortality, which would be 10 to every 10,000 living; the numbers therefore that I use are *proportionate* not *absolute*; and being so, it is all the more necessary that the gross sum from which they are deduced should be as large as possible. Until the present time it was impossible to chartographise disease, inasmuch as the numbers were not sufficiently large, and what had been collected were not in a form suitable for the purpose: of this we can complain no more.

The mapping of England and Wales into 11 divisions, 53 counties, and 623 union districts, affords us the means of analysing the distribution of Heart Disease, or any other cause of death. By this threefold division we are enabled to sift our facts through three gauges of different degrees of fineness. In the first place, we see what proportion the death-rate from a cause of death bears to the population in each of the eleven divisions; we colour blue or red those divisions which are above or below the average, and then study this gross distribution carefully; our next process is to colour the counties in the same way, and observe whether the distribution at all coincides with that of the divisions; and our third process is to discover whether the proportional mortality of each county is influenced by the mortality in the districts. Having done this we again review our work, and calculate the effect of each of the many causes surrounding us in the production of the distribution, which our coloured map reveals: if during this scrutiny we discover a general law regulating the distribution in each of the three divisions, our last duty is to crucially test the effects of this law, separate the real from the apparent, study the exceptions, and examine their relation to the assumed law; I say assumed law, for we must remember that until it has been proved we ought not to regard it as a law at all; at the same time, it must be remembered that in physical investigations some hypothesis is requisite, in the first instance, to aid the imperfection of our senses; and when the phenomena of nature accord with the assumption, we are justified in believing it to be a general law; these last few lines

embody the opinion of Mrs Somerville, whose world wide fame is an honour to her sex and her country.

I shall now illustrate the principle on which I base my investigation of the Geography of Disease, by an analysis of the total deaths from Heart Disease and Dropsy during the decenniad 1851-60.



SECTION II.

*The Registration Divisions of England and Wales.*

The eleven Registration Divisions into which the fifty-three counties are grouped, with the exception of London, Yorkshire, and Monmouthshire and Wales, according to their position on our island. For instance, we have the *South Eastern Counties Division*, embracing Surrey (*extra Metropolitan*), Kent (*extra Metropolitan*), Sussex, Hampshire, and Berkshire. The *South Midland Counties Division*, including Middlesex (*extra Metropolitan*), Hertfordshire, Buckinghamshire, Oxfordshire, Northamptonshire, Huntingdonshire, Bedfordshire, and Cambridgeshire. Essex, Suffolk, and



Norfolk, constitute the *Eastern Counties Division*; whilst Wiltshire, Dorsetshire, Devonshire, Cornwall, and Somersetshire, compose the *South Western Counties Division*. The *West Midland Counties Division* is composed of Gloucestershire, Herefordshire, Shropshire, Staffordshire, Worcestershire, and Warwickshire. The *North Midland Division* includes within its boundaries Leicestershire, Rutlandshire, Lincolnshire, Nottinghamshire, and Derbyshire. Cheshire and Lancashire form the *North Western Counties Division*. The Three Ridings of Yorkshire are each considered a registration county, and united form the *Yorkshire Division*. The *Northern Counties Division* is made up of Durham, Northumberland, Cumberland, and Westmoreland. The eleventh and last division, that of *Monmouthshire and Wales*, includes all the Welsh Counties and Monmouthshire.

It will be evident on referring to a map whereon these divisions are marked out, that a natural system was neither thought of nor attempted when the scheme was adopted. Although there are two purely *coastal* divisions, there is not a single division that deserves to be called *midland*. The Eastern Counties and the North Western Division are good specimens of the former, but it will be seen that the North Midland is as much coastal as midland, and that the West Midland reaches to the Bristol Channel, whilst the South Midland extends to the Wash. With however all these disadvantages, these divisions will still answer our purpose, inasmuch as their subdivision into counties and districts will correct the errors which may arise from so artificial a system.

### SECTION III.

#### *The Geographical Distribution of Heart Disease and Dropsy in the eleven Registration Divisions.*

If we take a map whereon the eleven divisions are marked out, and colour each with different shades of blue and red according to the mean average annual rate of mortality to every 10,000 persons living, we shall find that six will be *red* or *below* the average, and five *blue* or *above* the average. The *red* or *healthy* divisions (as far at least as regards Heart Disease) are—I. London: IV. The Eastern Counties: VII. The North Midland: IX. Yorkshire: VIII. North Western: and XI. Monmouthshire and Wales. These red divisions are all contiguous, and form an arch from the north of the river Thames to the north of the river Severn. The *blue* or *unhealthy* divisions, or those in which the mortality from Heart Disease is greatest, are the V. South Western: II. The South Eastern: III. The South Midland: VI. The West Midland: and X. The Northern Counties.

Such a simple map as the one I have now described, draws our attention to several facts, which will have to be analysed in the sequel.

- 1°. Not one of the divisions is coloured so as to indicate either the greatest or least mortality; there must therefore be some parts of each *blue* division having a low rate of mortality, and in some parts of each *red* division a high rate. How these parts are disposed, and by what laws they are governed, can only be seen in the next stage of our inquiry.
- 2°. We see that all the six red divisions have an extensive sea-board, excepting London, which however lies on the bank of the largest tidal river in our country.



- 3°. The Westerly *red* divisions present themselves to the prevailing south-westerly, westerly, and north-westerly sea-winds, which have traversed a wide expanse of ocean. The Easterly look towards the German Ocean, and afford every facility for the free access of the north-easterly sea-winds.
- 4°. The five *blue* or high mortality divisions embrace a large number of really *midland* counties, which, from their very position, do not enjoy a pure and uncontaminated sea-wind.
- 5°. Like the *red* divisions, the *blue* comprehend an extensive sea-board,—the whole of the south coast, the north coasts of Cornwall, Devon, Somerset, and Kent, and the eastern coast of Northumberland and Durham.

These are the bare facts which strike the eye at once when looking at a map showing the divisional distribution of Heart Disease: there are however others which claim our attention before we leave this part of our subject, and foremost among them are the following:—

*The Mortality of each Division compared with the Density of Population.*

In Table II. will be seen the relative density of the eleven divisions, according to which it appears that the two most densely populated divisions—I. London, VIII. North Western, are coloured *red*, or have a low mortality from this cause; whilst the two divisions in which the greatest death-rate is marked, viz.—II. The South Eastern, and V. The South Western, have comparatively a sparse population. Again, if we take the thinly inhabited northern counties, and compare them with the thinly inhabited Welsh counties, we shall find that a death-rate above the average obtains in one division, and an exceedingly low mortality in the latter. So far therefore as the divisional distribution is concerned, we do not find that the mortality from this cause is in the direct ratio to density of population, but rather in the inverse proportion; the counties and the districts will either confirm or refute this proposition.

*The Mortality of each Division compared with the Annual General Mortality from All Causes.*

The three most healthy divisions, as shown by Table II., are the II. South Eastern: III. The South Midland: and the V. South Western, all of which have a mortality of 20 per 1000 as compared with the average of all England of 22; now all these divisions have a high death-rate from Heart Disease, whereas those that have the highest annual death-rate, viz.—I. London: VIII. The North Western: and IX. Yorkshire, are distinguished by their death-rate from Heart Disease being below the average. From this we should conclude that the causes regulating the General Mortality of England are not identical with those which influence the Geographical Distribution of Heart Disease: again must we refer this proposition to more delicate analysis.

TABLE II.—HEART DISEASE AND DROPSY.

*The Average Annual Rate of Mortality in each of the Eleven Registration Divisions of England and Wales to 10,000 living, during the ten years 1851-60.*

DIVISIONS.	MALES.	FEMALES.	MEAN.	Density of Population. Acres to a Person. 1851-60.	Annual Mortality to 10,000 living.
I. LONDON, . . . . .	12·7	12·4	12·5	·03	240
II. SOUTH EASTERN COUNTIES, .	13·6	14·4	14·0	2·34	200
III. SOUTH MIDLAND „ .	12·0	14·0	13·0	2·53	200
IV. EASTERN „ .	11·1	11·8	11·4	2·85	210
V. SOUTH WESTERN „ .	13·1	15·3	14·2	2·74	200
VI. WEST MIDLAND „ .	12·4	14·1	13·2	1·69	220
VII. NORTH MIDLAND „ .	11·5	13·6	12·5	2·83	210
VIII. NORTH WESTERN „ .	10·8	12·0	11·4	·74	26·0
IX. YORKSHIRE, . . . . .	11·0	12·6	11·8	1·92	23·0
X. NORTHERN COUNTIES, . . .	12·6	13·2	12·9	3·29	220
XI. MONMOUTHSHIRE AND WALES,	8·3	10·6	9·4	4·18	210
ENGLAND AND WALES, .	11·8	13·1	12·4	1·96	220

## SECTION IV.

*The Divisional Mortality in relation to the Sea-board.*

We must remember in discussing this part of the subject that the physical and geological characters of our coastal barrier are as varied as they possibly can be. By a reference to the accompanying outline map showing the divisions of England and Wales, coloured red or blue, according to the mortality being above or below the average, it will be seen that eight of the eleven divisions have an extensive coast-line, and therefore have a large portion of their area exposed to the direct influence of sea winds; of these eight, five show that their mortality from Heart Disease is below the average, and three above it: the Western and Eastern divisions of low mortality extending from the north bank of the river Severn along the Welsh, Cheshire, and Lancashire coasts across England, through Yorkshire, and thence along the Lincolnshire, Norfolk, Suffolk, and Essex coast line until they reach the northern bank of the Thames, forming, in this manner, an arch of divisions which encompasses the West Midland (VI.), and the South Midland (III.) Counties, divisions having a high mortality. The three high mortality divisions having an extensive coast line are the Northern Counties (X.), and the South Eastern (II.), and South Western (V.), Counties. The inland division of London (I.) has a low mortality, and will be discussed separately. We have now, therefore, to see what relation subsists between these three groups of divisions, the Northern and Southern, where there is a high mortality, and the Eastern and Western, where the reverse obtains; but, before doing so, it will be necessary to make a few remarks upon some of the more prominent characters of our coast.

The Divisional Mortality in relation to sea-board.



The coast line of England and Wales, from Berwick round to the Solway Firth, if followed along the principal estuaries and other inlets, exceeds 1800 miles. Knowing therefore as we do, that almost every variety of geological formation is to be found in England and Wales, and that nearly all the strata which make up our country, are exposed, at some point of our coast, to the constant washings of the seas which surround us, we shall be prepared to find every diversity of form in the natural sea-wall within which we live: we shall find its continuity broken up by the outflow of great and small rivers; we shall see that in ages gone by, mightier rivers than any which exist in our land now, like the Thames before it shrank to its present dimensions, have scooped out immense courses, which admit not only the tidal wave, but the sea breezes to penetrate far inland up their broad vales. On the other hand, the tourist may travel for miles and scarcely discover a gap in the high rocky barrier which hems in the valley lands of the south of England. In some parts of the coast will be seen the mouths of tidal rivers, whose tributaries have traversed valleys, which, from their aspect, are favourable to the afflux of the air that sweeps from the sea into the interior; in others, we shall find tideless rivers, that have struggled through deep and tortuous defiles opening sluggishly on the strand, with their mouths and the valleys through which their streams have flowed at right angles, both to the incidence of the tidal wave, and to the full afflatus of prevailing winds. Whatever effects, therefore, we may expect to be derived from any climatic element, we must look for in those parts where the least hinderance to the full enjoyment of its advantages, or otherwise, are to be found.

Coast line of England and Wales, Extent.

The Divisional Mortality in relation to Sea-board.

From the fact that five out of the eight coastal divisions are characterised by low mortality, and that the only two really midland districts are remarkable for the large relative number of deaths which occur in them from Heart Disease, we are naturally led to inquire, What has the proximity to the sea to do with the cause of this great difference? With the sea coast we always associate sea breezes and powerful sea winds, which blow straight to us from the bosom of the ocean, either in the form of gales, or of those more gentle breathings which are so refreshing to the overworked and the weak. Sea air, however, has a variety of qualities; it may be laden with ozone, and be a powerful oxidiser; it may be mighty in its force, and sweep all air sewage before it, provided no obstruction exists to its full sway: it may be moist and warm, like the south-west, or cold and dry, like the east. All the winds, however, that blow to our coast are not truly

Sea Air.

sea winds, the east wind is a land wind, it has passed over Europe from the north before it arrives at our shores, and has become *effete*, cold, and dry; and its short passage across the narrow sea between England and the Continent is insufficient to restore its lost qualities: we must remember that some of our westerly wind has blown over Ireland before it reaches us, and that Scotland has had the advantage of a great portion of the north-westerly winds which blows from the Atlantic towards the north of England: that part of the north-west wind, however, which passes directly to us through the North Channel, and impinges on the North Wales and Cheshire coast, is a pure sea air: we shall have, therefore, in the sequel, to remember what our true sea winds are. The ozoniferous south-west wind is at once the most perfect and the most powerful sea wind that we enjoy, and its climatic influence is immense, bringing, as it does to our country, warmth ozone,

The Winds.



moisture, and force from the wide expanse of the Atlantic between our western coast and the Gulf of Mexico. The north-east wind spreads its influence over a great portion of England, and is little contaminated with land-air; unlike, however, its great antagonist, except in its purity, it is comparatively dry, and the quantity of ozone it bears is said to be not great, its force, however, is at times considerable, and thus is it a powerful cleanser of air-sewage and miasma, when these causes of disease are not protected from its purging. The north-west wind, as we have seen, comes to us through the North Channel unpolluted by land air; and another belt is enjoyed by the north-west of Cornwall; this wind also sweeps over our island at times with prodigious force, and thus has a benign influence on those parts of England which are protected from other winds. All the other winds are more or less contaminated with land air, and were it not that their dynamical element plays an important part, by occasionally sweeping up valleys which are not visited by the great prevailing sea winds, their influence on health, in consequence of their impurity, would more likely be injurious than beneficial. The north wind comes to us from Scotland, and ranks, perhaps, the highest in purity; then comes the west, which blows over Ireland from the Atlantic; the south-east arrives here warm and moist, after passing over France and the Mediterranean Sea from the coast of Africa; the south has also passed over nearly the same ground and the same sea, although it has the advantage of coming from the Atlantic; and the east we have seen to be an almost unmitigated *effete* land air which has passed over the cities of the continent.

*The Character of the Coast-line of the High and Low Mortality Divisions compared.*

It will be evident from the short sketch I have just given of the manner in which our principal winds come to us, that stress only has been laid upon those which powerfully affect our climate at different intervals. I have not attempted to describe the many local causes which operate in deflecting the general currents of the atmosphere. In many parts of England we find recorded, day after day, gentle winds from all quarters; in many instances these have local causes, for it is well known that independently of the larger circuits which the winds perform, there are smaller ones constantly travelling over the face of the country, although of a less definite character. Again, we have the land and sea breezes which, near the shore, during a great portion of the year exert their gentle influence, which is either limited to the immediate locality, or extended inland, according to the character of the coast itself. Again, we must also bear in mind that some of the chief winds do not always flow to us from the same point, but get deflected in their course before they reach our shores; this, however, is too wide a subject to be discussed here, although it is fraught with interest, especially when we consider the variable chemical qualities of the atmosphere in which we live.

The Characters of  
the several Coast-lines  
compared.



*The North (X) and the South (II and V) High Mortality Coast Divisions compared.*

In all these three divisions we find certain characters as to height of coast, the directions of the rivers, and the inlets from the sea, which are remarkable for their resemblance, 1° the tract immediately bordering the sea coast of the Northern Counties' division, although low, is backed by a high range of the carboniferous formations, which protects the country behind from the direct influence of either the south-west, or the north-east wind; this character more or less obtains along the whole of the Northumberland carboniferous range until we reach the Tyne, where the geological formation of the coast changes, the direction of the rivers and valleys alter, both of which we shall find in the sequel to be coincident with a low mortality in one of the counties of this division. From the Tweed to the Tees there is no considerable inlet from the sea of sufficient magnitude to admit far inland any considerable amount of uninterrupted sea wind, and the valley lands are all protected from the north west by the high range of hills on the border land of England and Scotland. We must remember, however, that the mortality in the division, although above the average, is not greatly so, and that the whole division both as to its general altitude and width of valleys contrasts favourably with the southern coastal divisions, which I will now speak of. The northern coasts of the southern divisions form the southern boundaries of the two of the greatest sea inlets that penetrate our country, but at the same time we must observe that from the North Foreland in Kent, to Bideford or Barnstaple Bay, off Devonshire, there is but one inlet of any importance,—the Southampton Water,—along this continuous line of rocky coasts; and it is remarkable that almost without exception the smaller inlets are at right angles to the course of the tidal wave and the prevailing channel winds. The coast rocks are composed of every variety of geological formation, from the London clay to granite; as a rule they are precipitous and barrier-like, and the rivers which pass to the sea through them have, with few exceptions, their axes at right angles to the tidal current and the prevalent winds. The inlets on the north coast are those of the rivers Taw, Parrett, and Avon.

Let us now take the coastal divisions, where a low mortality from Heart Disease is registered. These divisions have a sea board which extends throughout the greater portion of the Western and Eastern coasts of England and Wales; on the Welsh side, however, the geological formations are of the oldest and most stubborn material, whilst on the east they are more or less recent and easily worn; precipitous and wall-like rocks, even on the coast of Wales, are the exception; and on the Eastern coast low and unimpeding rocks extend nearly throughout that long range of coast. Again, these two coasts are intersected by every variety of sea inlet, all of which are in the direct axis of the prevailing sea.

In Wales the mountain rivers run down to the sea through valleys which are open even up to their very sources, in many instances, to the influence of the south-west on the Western, and of the north-west wind on the Northern side. If we enumerate the many bays, all of which are to a certain extent inlets to the land within, we shall find them extending from Swansea Bay to the river Conway. The hill ranges also of Wales

The Northern and Southern Coast Counties' Divisions compared.

The Coastal Divisions having a low Mortality.

Welsh and North-Western Coasts.



facilitate the passage of a full volume of sea air from the coast far inland. On the coast of the North-Western division we see that the Cheshire and Lancashire coasts are comparatively low, and contain two considerable inlets,—the mouths of the Dee and Mersey, besides those of the Ribble and Morecambe Bay, the latter of which are open to the south-westerly gales, and the former to those from the north-west; they open also into low undulating new red sandstone vales of great width, a feature which must not be forgotten. On

*The East Coast.*

the east coast we find the East Riding of Yorkshire presenting a grand, precipitous, and protecting barrier of oolitic rocks, to the sea; but from the Chalk Cliff of Flamborough Head to the mouth of the Thames the coast is low, and admits everywhere a full play of sea air from almost any quarter that it may blow. The sea inlets on the eastern side are also considerable. Yorkshire shares with Durham the inlet of the Tees, one of great importance: it has its analogue in that of the western river Dee, opening, as it does, into a new red sandstone country, and having its course directed to the sea by the hills which form the watershed of a more southerly river system. The rivers of the Cleveland Hills north of the eastern Moorlands, nearly all open into the German Ocean, in the direct axis of its sea winds and tidal wave. The next great sea inlet is that of the mouth of the Humber, which continues into the flat alluvial, and new sandstone vale of York, where the rivers from Yorkshire and the Midland Counties meet after traversing broad vales which give access to the afflux of wind from the German Ocean, and admit of their being swept by the north-westerly and south-westerly winds. The next great inlet is the Wash, its low coast and extensive alluvial flats admit of air flushing in all directions; and lastly, we have the grand tidal Thames on which the London Division (I.) lies, whose mouth is the termination of one of the broadest and most extensive vales in England, stretching as it does from the extreme points of the coasts of Essex and Kent to the middle of Berkshire.

*Recapitulation.*

- 1°. England and Wales are divided into eleven Registration Divisions.
- 2°. Two only of these divisions are strictly Midland (III. and VI.), whilst all the other nine have an extensive coast line.
- 3°. The two Midland Divisions (III. and VI.) have a mortality from Heart Disease and Dropsy above the average.
- 4°. Of the nine Coastal Divisions three (II., V., X.) have a high rate of mortality from Heart Disease and Dropsy, and six a low rate (I., IV., VII., VIII., IX., XI.).
- 5°. The low mortality in two-thirds of the Coastal Divisions is suggestive that proximity to the sea coast, and the winds directly received from the ocean, may influence the causes of Heart Disease.
- 6°. Three of the Coastal Divisions, however, having a high mortality and an extensive sea-board, it was necessary to compare the characters of the respective coast-lines in order to ascertain what were coincident with high and what with low mortality, on the principle that the effects of a climatic element with regard to the causation of disease must be

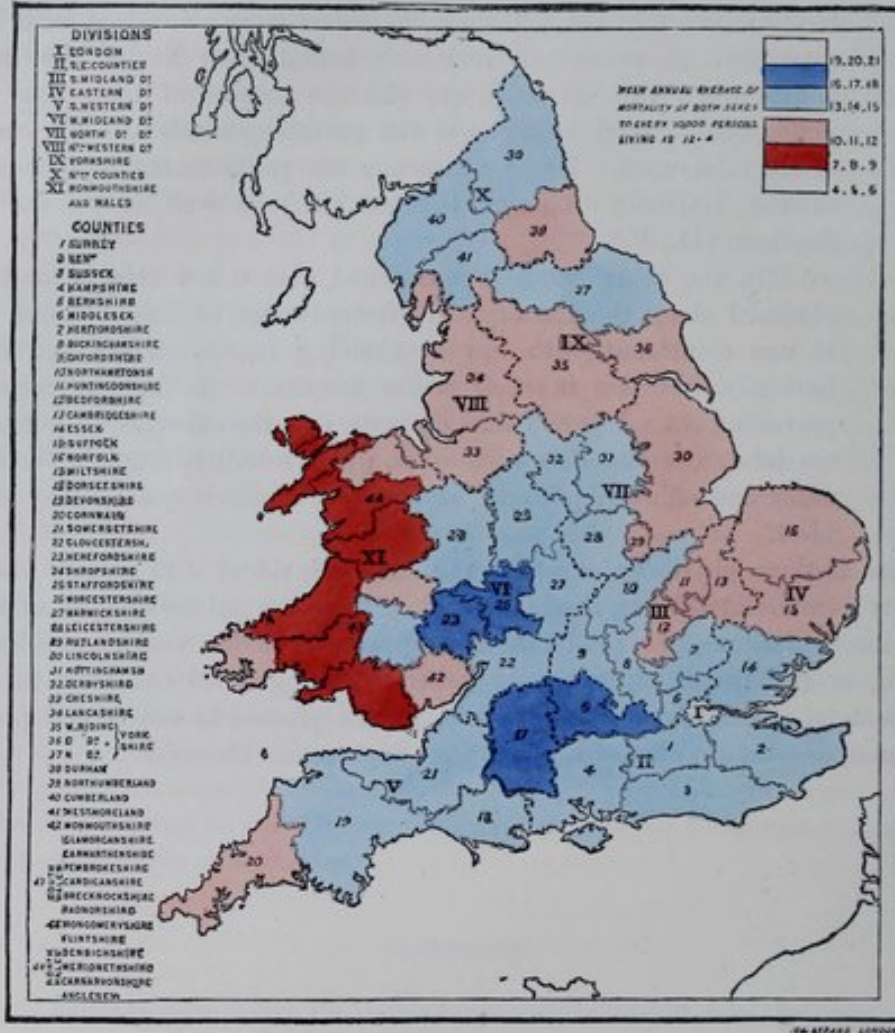
looked for in those localities where there is the least hinderance to its full operation.

- 7°. On comparing the characters of the coast-line which formed the boundaries of the divisions having a high, with those that have a low mortality, it was shown that the following characters were coincident with high mortality. A precipitous and rock bound coast having few inlets, which, when they do exist, are like the courses of their river and valley system at right angles to the prevailing winds and the current of the tidal wave. These characters are predominant on the coast of the Northern Counties Division (X.) as well as on the two Southern (II., V.).

On the other hand, it was found that a low rate of mortality obtained along the Eastern and Western coasts of England, and that it was coincident with low or shelving coasts, valleys and rivers having a direction in their course favourable to the free access of prevailing sea winds and tidal currents, and the existence of numerous sea inlets opening into wide vales, which admitted freely a thorough afflux and efflux of powerful winds, from whatever quarter they might blow.

Now, if these physical characters are merely coincident with certain rates of mortality from Heart Disease, it will be evident that on a stricter analysis of these great eleven divisions, we shall find the apparent relation either considerably modified, or perhaps disappearing altogether. Having sifted our facts through the first series of coarsely defined divisions, I shall proceed to the second process of our analysis—the division of England into Registration Counties.





## CHAPTER III.

## SECTION I.

*The Geographical Distribution of Heart Disease and Dropsy in the Registration Counties.*

**E**NGLAND and WALES are divided into 53 registration counties, of these 27 are coastal, the remaining 26 being more or less inland, and divisible into inland and midland. Of the 27 coastal counties 16 have a low rate, and 11 a high rate of mortality. It will be our duty, in the next place, to see the position of these several counties in the divisions we have been discussing. In the Northern Counties Division (X.) the county of Durham stands out conspicuously as having a low mortality, and it will be remembered that at the River Tyne the geological character of the country and the direction of the rivers and valleys changed



between that river and the river Tees (p. 17). Pursuing our course along the Eastern Coast Divisions (IX., VII., IV., I.) we find the North and East Ridings of Yorkshire, and Essex, having a high mortality, whilst Lincoln, Suffolk, and Norfolk, have one below the average: in the former instance we have alluded (p. 17) to the precipitous and protecting barriers of oolite rocks which protect from the immediate effects of the North Sea winds the county of the North Riding, and, therefore, the mortality in this county is not inconsistent with the physical characters described; again, the East Riding, from Flamborough Head to the mouth of the Humber, has a low coast, and its mortality is considerably lower than that of the North Riding (13·3), being barely over the average (12·5); and with Essex, the mortality in which is not high, although above the average, has many of its river courses and sea inlets at right angles to the winds from the Northern Sea. Of the seven counties which form the sea margin of the South Coast Divisions (II., V.) one only, Cornwall, is seen to be coloured red, and its mortality is at the average of 12·4 deaths to every 10,000 living. It must be observed, however, that this county is a peninsula, and peculiarly well situated for the free access of sea-winds, which blow with considerable force over this part of the country. On the western sides of Wales and England which I have said are so favourably circumstanced with regard to their sea inlets, the direction of their valleys and river courses, and, I may add, the unbroken violence of their winds, there is not a single county from Monmouth to Lancashire having a mortality above the average, Cumberland alone forming an exception, and although its south-west boundary has every advantage of being thoroughly exposed to the south-west wind from the Irish Channel, we must remember that the greater portion of this beautiful county is protected by the lofty range of the Cumbrian Hills, which protect its deep and luxuriant valleys.

With regard to the 26 Inland Counties, 6 only have a mortality below the average; and it is noteworthy that all these, without exception, are contiguous to coastal counties, which have free access from the sea through inlets such as the Wash, on the eastern side, and on the Welsh side the inlets of the Dovey and other rivers from Cardigan Bay, or else are so elevated as to receive the full afflatus from the sea without interruption. The remaining 20 counties in which the death rate from Heart Disease is great, are all more or less protected; those counties whose towns and villages lie in deep and well sheltered valleys, such as Herefordshire, Berkshire, Derbyshire, and Wiltshire, being characterised by the highest degree of mortality.

We therefore see that the death rates from Heart Disease and Dropsy in the several counties are still coincident with certain physical characters of the country, in the same manner that we observed they were when discussing the divisional mortality; the coincidence, however, is in the county divisions of a more definite character.

Eastern  
Coastal Counties.

Southern  
Coastal Counties.

Cornwall.

Western  
Coastal Counties.

Inland Counties.

The coincidence between  
the death rate and the  
physical character  
of Counties.

*Recapitulation.*

- 1°. The coastal counties in which a low mortality from Heart Disease is registered, are more numerous than those where the death rate from this cause is above the average.
- 2°. Those coastal counties most exposed to the prevailing winds and most free from obstructions to their full operation, have the least mortality.
- 3°. Those coastal counties such as those along the south coast which have barrier like rocks, and other characters which tend to interfere with the full sweep of the sea winds, are those only which have a high mortality.
- 4°. Out of the 26 inland counties which are all more or less protected by those bordering the coast, 6 only have a mortality below the average, and these are contiguous to coastal counties.
- 5°. The counties in which the mortality from Heart Disease is greatest, are those that are the most inland or the most protected by their physical surroundings.

## SECTION II.

*The Relative Mortality of the Coastal, the Inland, and Midland or Central Counties.*

If we group the counties in the following manner, we shall find that a high death rate from Heart Disease and Dropsy is also coincident with an inland or sheltered position, and that there is a certain progressive increase of mortality from the circumference of our peninsula toward its more central localities.

The mean annual mortality of the entire series of the 27 *Coast Counties* is 11·9 to every 10,000 living.

*Coast Counties.* The mean annual mortality of the 20 *Inland Counties*,—viz.: those which are situated between the coastal and the midland counties, is 12·5 to every 10,000 living.

*Inland Counties.* The mean annual mortality of the 6 *Midland or Central Counties* is 15·1 to every 10,000.

*Midland Counties.* We therefore remark from the above figures that coincident with the lowest amount of exposure to the sea air, as in the Midland Counties, is the highest amount of mortality in those counties; and that, on the other hand, the lowest amount of mortality is coincident with the greatest amount of exposure; and again, that the counties which lie intermediately between these extremes, have also an intermediate death rate within a decimal of the average.

*Recapitulation.*

- 1°. By a map of England and Wales, on which the relative mortality was coloured blue and red, according to its being above or below the average, it was shown that of the eleven great divisions two-thirds of those divisions which had an extensive sea-board, had a low mortality coincident with their marine boundaries.



- 2°. It was also shown that the two divisions which had little or no sea-board, but on the contrary were surrounded on all sides by other divisions, had a high mortality.
- 3°. It was also shown that the coastal divisions which had a high mortality, had also coincident with it certain physical characters which obstructed the free passage of the prevailing winds up the inhabited valleys and river course.
- 4°. On separating these divisions into counties, we found that the same facts were still coincident, although, from a minuter division, they were more defined, and admitted of a more careful analysis.

It remains for us now to test these coincident facts, by submitting the counties themselves to a similar analysis,—viz.: by estimating the relative amount of mortality in each of their 625 union districts, after which we shall be enabled to see if the remarkable coincidences we have noted in the divisions and counties, between their mortality and their free exposure to, or seclusion from, the sea air, are still existing: if they are, we shall be enabled to follow them as minutely as the division of England into 625 parts will enable us; beyond this we have no further data to go, and no minuter division on which to depend.

## CHAPTER IV.

## SECTION I.

*The Geographical Distribution of Heart Disease and Dropsy in the six hundred and twenty-three Union Districts of England and Wales.*

WE now come to the last analytical process—the division of the counties into Districts; here again the artificial system of boundary lines is more perplexing than in either of the other two; still, we cannot help it, but only regret that so much valuable information should be wasted, which, had a natural system been adopted, would have been a grand acquisition for the student of the Medical Geography of England. It will be well however to point out a few of the obstacles to portraying the distribution of disease in our country, the artificial and irrational system throws in our path. Let us take Chichester for instance: the city itself is in the Westhampnett District, whilst the district called Chichester lies to the north-east of Westhampnett, between Worthing and Midhurst; again, Bognor belongs to Chichester district, and lies in Westhampnett; another portion lies in the Midhurst and a fourth in Worthing district,—nothing can be so absurd as to call these outliers Chichester—villages and towns so circumstanced cannot be called allied in any way except through the medium of the rate-collector—they are not like geological outliers, which are recognised by well defined characters—geographically speaking, they belong only to those places where they are situated.

The same system obtains in the London Division: the district of St George's, Hanover Square, intersects that of Westminster, cutting it entirely into two; again, Clerkenwell separates one part of the Holborn district from the other. East London is separated by the City of London; and Greenwich is cut into two by Lewisham, and again by its natural boundary, the Thames. The river system of England, instead of being a guide, seems to be neglected in every instance where advantage could be taken of it. In France,

the Departments have at all events some reference in many instances to the watershed, and this alone is valuable, as by it we are enabled not only to remember the position of the Departments, but we obtain a general idea of the aspect of the watershed whereon these divisions lie. To exemplify this: The river *Loire* gives a name to several departments—*Haute Loire*, where it rises; *La Loire*, through the middle of which it winds as a fully formed river; *Soane et Loire*, where it forms the western boundary of the department traversed by the Soane; *Du Loiret*, where it receives the little Loire, or Loiret; *Du l'Indre and Loire*, where the first now falls into it; *Le Maine and Loire*; and lastly, that of *La Loire Inferieure*, where it comes to the end of its course and falls into the ocean. The French have also Departments called *Les Bouches du Rhone*, *Bas Rhin*, and *Haut Rhin*, in fact, a large proportion of their divisions are named after rivers, which is far nearer a natural system than anything we can produce in the registration maps of this country. We certainly meet with every now and then such descriptions as *Upton-on-Severn*, or *Henley-on-Thames*, or *Burton-on-Trent*;

Boundaries of Districts  
Artificial.

The System obstructive  
to the Geography of  
Disease.

London.

French System of  
Departments more  
natural.



but these are names given to districts from towns, the French would have called the last district the Dore and Trent district, for here these become confluent. Upton-on-Severn would be called the Lower Severn. Gloucester the Leddon and Severn, Wheatenhurst the Stroud and Severn. Other difficulties are also presented to the Medical Geographer of England. The city of Chester, with its population of over thirty thousand persons, is included in the Flintshire and Cheshire district of Great Boughton; in this case the city contains more than half the population of the whole district, and whatever may be its mortality, whether climatic or social, the whole of Great Boughton has to be coloured in accordance with it; it is evident that every town like Chester, Bridgewater, Chichester, Bath, Taunton, Margate, Ramsgate, etc., should have a separate district, with union-house included, so as to enable the public to see the exact mortality and its relative proportion to the neighbourhood.

In Thanet, the union-house is situated in the parish of Minster, and to this place the poor are sent in good time, so as to prevent them dying within the precincts of Margate and Ramsgate; the consequence of this is that this little parish has an unnaturally large death rate, and Margate and Ramsgate are held up as good specimens of excessively low mortality. Places of public resort for health sake, ought to be the very first to be made into separate districts, for, constituted as they now are, a place redolent with the effects of cess-pools and defective drainage may be made to look quite healthy when its excess of mortality from these causes, both among the natives and the visitors, are averaged with the healthy returns of the surrounding parishes, or by the forced exodus of dying paupers to a neighbouring workhouse.

Thanet illustrates the bad System.

## SECTION II.

### *Arrangement of the Union Districts of England and Wales.*

The Divisions and the Counties, although their boundaries are frequently of a most artificial kind, undetermined by any natural physical character, except the sea coast, and the courses of a few of the largest rivers, have however given us some clue to the distribution of the disease under discussion, it only now remains for us to see if the coincident facts displayed in our two first chapters are also to be found in this, our third, wherein the general facts elicited during the examination of the divisions and the counties will be dissected by the minuter division of the counties into districts, of which there are in all 623.

We have seen how the death rate in the counties modified that of the divisions; we shall now see how it is affected in the counties by that of the registration districts. When speaking of the coast-line, both in our first and second chapters, I particularly mentioned the fact, that our western and eastern coasts were characterised by the number and the size of their sea inlets; whilst, on the contrary, the south coast had but one of any importance. The general effect of these sea inlets upon the health of the country, would perhaps be more prominently seen in the great divisions than in the counties themselves, for, as I have just said, the boundary lines of the counties have been determined

Introduction.

Sea Inlets.



generally, in a most arbitrary manner, although some of the largest rivers have been made to divide one county from another; the sea inlets, however, are precluded from showing anything but a general effect. The sub-division of the counties into districts admit of another element, and allow us to follow up the great rivers, as they divide counties, and give access through their valleys of the sea air and tidal wave, to inland parts. These sea inlets may be considered extensions of the coast-line along the banks of rivers; we should therefore expect to find, if the coastal districts corroborate the coincident facts which we have observed to obtain in the distribution of Heart Disease both in the divisions and counties, that the lower rate of mortality observed in the former instances, will now be seen to follow up these sea inlets, modified of course by their position with regard to the axes of the prevailing winds and tidal wave, as well as by the physical characters of the country through which the rivers wind. I shall now proceed to divide the districts into Coastal, Inland, and Midland, as I have done the counties, in addition however to these we are enabled to add a peninsular and insular series.

*The Relative Mortality in the Coastal Registration Districts.*

In England and Wales, out of the 623 Registration Districts, there are 133 which are washed by one of the three seas that surround Great Britain, therefore there is nearly one Coastal District to every five inland. The coast-line of England and Wales, from Berwick round to Solway Firth, if followed along the principal estuaries and other inlets of sea-water, exceeds 1800 miles, which, if we take the joint area of England and Wales to be 58,320 English square miles, is in the proportion of one mile of coast-line for every 32½ miles of surface. Of the 133 Coastal Districts, 50 have a mortality registered from Heart Disease *above* the average, and 83 *below* it.

If we separate the three coasts of the triangular portion of Great Britain, comprising England and Wales, into I.—The East Coast, from Berwick to Easting; II.—The South Coast, from Dover to Helston; and III.—The West Coast, from Penzance to Wigton; we shall be enabled to see whether the low or the high mortality in any of these coast districts is coincident with similar physical features to those already observed along the coast of the Divisions and the Counties.

SECTION III.

There are 41 districts on the East Coast from Berwick to Eastry; of these, 29 have a mortality *below*, and 12 *above*, the average; they are separable into five groups: I.—The Northumbrian high mortality group extends from the Tweed to the Tyne; II.—The Durham and North-East Yorkshire low mortality group, comprehends the coast-line between the south bank of the Tyne to the river Esk, on which Whitby is built; III.—The small East Yorkshire high mortality group is confined by the high oolitic and chalk rocks, which stretch from Whitby to Bridlington Bay; IV.—The



extensive low mortality group, which extends along the low coast, which characterizes the sea-board between Bridlington and the Isle of Sheppey; and V.—The East Kent Districts of Thanet and Easting; this may be called the Lincolnshire and Eastern Counties' group.

The excess of mortality in this group is not great; it is however coincident with the following physical characters; the rivers Tweed, Coquet, Wensbeck, and Tyne, flow from west to east into the North Sea, at right angles to the incidence of the tidal wave, which, along this coast, rolls twice a day from the Orkneys southwards, until it enters the mouth of the Thames; the courses of these rivers being nearly all from west to east, and extremely tortuous, whilst tending to the sea through the carboniferous limestone hills of Northumberland, offer every obstruction to the prevailing winds, whether they come direct from the sea like the north-east, or remotely from the south-west. The valleys of Northumberland are well protected; the moorlands are too bleak, and the valleys too little ventilated: the aspect of the coast is nearly due east.

The next group is the Durham and North East Yorkshire. Its low mortality co-exists with the following geological and physical characters. The aspect of the Durham coast is north-east by east, and that of the Yorkshire almost due north-east, so that they are favourably circumstanced with regard to the sea wind from the German ocean. The rivers from the Tyne to the Tees have their courses especially towards their embouchures directed from the south-west to the north-east to a greater extent than those in Northumberland, although, except the latter river, they are not very favourably disposed for the reception of the tidal-wave. The Tees, however, and the rivers which flow from the north side of the Eastern Moorland, have their courses, and the valleys through which they run, offering every facility for the free access of the ocean winds from the North Sea, and form a remarkable contrast to those which are met with on the southern side of the moorland, where the Rye and the Derwent take their sources, and where the valleys of this locality are sheltered by the towering oolitic range which extends from Old Peak to Hambleton End. The new red marl cliffs offer no obstruction to free ventilation, as they are not high, and are divided by the considerable sea inlet of the 'Tees' mouth. The oolitic Cleveland range open their valleys, through which their drainage flows, so as to receive every breath of wind that comes from the north-east.

The East Yorkshire group of high mortality, is bounded by a precipitous coast of oolite and chalk cliffs; it has no sea inlets; in fact, the watershed is directed inland from the high hills bordering the coast. Its coastal boundary offers every obstruction to free ventilation from sea-winds, except in the case of places like Scarborough, which, in the most pre-eminent degree, enjoys every advantage that a free access to pure oceanic air can give.

The Lincolnshire and Eastern Counties group has a remarkably low death-rate from Heart Disease: with the two Yorkshire, it embraces 26 districts, interrupted only by two districts having a mortality above the average—Maldon and Wisbeach; the coincident watershed and other physical characters of this group may be shortly summed up: a



low coast, a flat country within the sea-board line, a comparative absence of deep and protected valleys, and their large sea inlets, which extend far into the country in the mouth of the Humber, the Wash, and the mouth of the Thames. This large group offers every facility for winds from all quarters sweeping well over its surface, whilst it admits the beneficial influence of the sea-winds to penetrate far inland up the courses of its rivers, which are favourably directed for free ventilation.

The next and last group, comprising the East Kent Districts of Thanet and Eastry, offers a strong contrast to the one we have just examined.

**East Kent Group.**

Thanet is certainly a rock bound district; and its chief towns, Margate and Ramsgate, are so situated as to enjoy every advantage of the most benign influences of sea-air; the construction however of these towns, their defective sanitary regulations, bad drainage and cesspools, have a marked influence on the mortality from any disease produced by the accumulation of air sewage.

When Margate and Ramsgate are made into separate Union Districts, their relative healthiness will be made patent to all: whereas, under

**Margate and  
Ramsgate.**

the present system, the general healthiness of the island masks the real state of things in these two watering places; and conversely, their fruitfulness in some diseases, arising from social causes, gives an unhealthy aspect to the whole district, when coloured according to undissected statistics. In watering places generally, the rule is to see how the local figures agree with those from the whole district; if, on taking the aggregate, the numbers are favourable, they are adopted; on the other hand, if the local statistics show a low death-rate, which is nearly always the case when the Union House is not situated within the parish or sub-district of the place of resort, then they are paraded in pamphlets and newspapers, to the utter confusion of those who depend upon such wilful misrepresentations.

#### SECTION IV.

There are 40 districts skirting the south coast from Dover to Penzance inclusive, 28 of which have a high, and 12 a low mortality; in fact,

**The South Coast.**

this group may be described as one of high mortality, interrupted at intervals by districts having one below the average. The general physical characters of this coast are high precipitous cliffs from Kent to Cornwall, with the exception of the coast of Hampshire to the east of the Southampton Water. Along this coast there are 20 rivers which empty themselves into the English Channel, not one of which has its course in the axis of the prevailing winds, and their mouths so open, as not to favour the upflow of the tidal wave, with the exception of those on the coasts of Penzance and Truro; and the inlet of the Tamar, which admits the south-west gales to Plymouth and the country in its rear, both of which are characterised by a low mortality. Two insignificant rivers, which have their inlets at Poole and Christchurch, have their courses from the west to the east; they admit the south-easterly gales, but the country through which they trend is protected by the Dorsetshire north and south Chalk Downs, from the south-west winds.



The low mortality districts are instructive: between Dover Cliffs and Beachy Head we see three—Elham, Romney Marsh, and Hastings; these occupy the littoral of the Wealden clays, the comparatively low coast of which offers little or no obstruction to free ventilation; this is especially seen in the district of Romney Marsh, the low mortality of which is coincident with a flat alluvial country, like that which characterises the eastern districts of Holbeach, Spalding, and Spilsby, in Lincolnshire. Rye can hardly be called a costal district, inasmuch as the great portion of it lies embedded in the valleys that are sheltered by the lofty ridges of the Wealden series, the southern series of which form the cliffs from Hastings to Hork Point. To the west of Brighton the coast becomes again low; at Westhampnett we find the promontory of Selsea intersected by a flat alluvial country, surrounding the peninsula of Bracklesham Beds of the middle eocene: the low mortality of this district is coincident with every facility for the free passage of the winds. The inlet of the Southampton Water carries us to South Stoneham, in which Southampton is situated, the town of which has a mortality of only 12·8, or 0·1 above the average. Christchurch, although sheltered from the south-west, has the valleys through which the Stour and Avon flow, opening towards the south-east winds. Weymouth is a peninsula, and admits winds from all quarters except from the north-east, from which the South Downs protect it; the high mortality of Dorchester we may note *en passant*, is also coincident with the high sheltering range of the same downs, which keep the south-west wind from it; it is also screened from the north-east by the Dorsetshire North Downs. From Portland to Plymouth the coast is rock bound, and the villages and towns protected in the midst of luxuriant red sandstone valleys. The inlet of the Catwater, leading out of the Plymouth Sound, has a direction favourable both to the access of the south-westerly winds and the tidal-wave. St Austell and Liskeard are also favourably circumstanced for free ventilation from the south-west, although rock bound, inasmuch as the embouchure of the river Fowey, the tributaries of which flow from the north-east to the south-west: we must not forget that passing along the north of these districts are parts of the Ocrinian chain. The inlet of the Fal, although considerable, is protected from the full influence of the south-west wind by the lofty Trappean and other igneous rocks, which characterise the district of Helston. Penzance and Helston are in reality peninsulas, and are breathed on and ventilated by winds from all points of the compass; they contain much elevated land, and coincident with these physical facts is the one that they enjoy nearly the lowest rate of mortality.

## SECTION V.

From Redruth to Wigton there are 52 districts, a portion of the boundaries of each of which is washed by the sea, and exposed to its winds; of these 42 have a mortality *below*, and 10 *above* the average. Along the south coast we have first seen that *low* mortality districts were the exceptions to the rule, when the sea-inlets were unimportant and limited, the coast bound by



precipitous rocks, and the courses of the rivers running at right angles to, instead of in the axis of the prevailing winds and the tidal wave.

We shall now see that *high* mortality districts are the exceptions along the coast where the sea-inlets are of high importance, open towards the eyes of the prevailing winds, and penetrate far inland; when the coast, although rocky to a great extent, is so formed as to give access to winds from the south-west, the west, or the north-west; sloping upwards inland where the rivers have their sources, through the valleys of which the gales are guided to every village on their banks:

Welsh Coast. this is especially seen in Wales. The Lancashire, Cheshire, and Westmoreland coast is low, and studded with sea inlets; the coast of Cumberland is also comparatively depressed, although it soon rises in the district of Whitehaven to the lofty ridge of the Cumbrian range, which protects the adjoining district of Cockermouth to the north; the valleys of Cockermouth. the Whitehaven District all look towards the prevailing south-west winds from the Irish Sea, and are easily flushed of their air sewage Whitehaven. by its strength. The north-west coast of Cornwall and Devon, and Coast of Cornwall, Devon, and Somerset. north coast of Somerset, are somewhat similar to some portions of the south coast. The inclination of the coast is from south west to north-east, therefore the winds from the former quarter do not impinge upon it, although whatever inlets there are receive the full afflatus from the north-west. From Redruth to Bedminster the sea inlets are as follows:—St Ives Bay, between the

Sea Inlets. low mortality districts of Redruth and Penzance; the mouth of the river Allan, on which Padstow lies, enters the low mortality district of Bodmin; the mouth of the Taw, which flows into Barnstaple Bay, penetrates Barnstaple, coloured red; the inlet of the river Parrett, on which Bridgewater is Parrett. built, and where the tidal-wave flows up in the form of what is Bridgewater. called a 'bore,' twice a day, as far as Langport, is a very considerable one, and traverses a flat country; Bridgewater and Langport are both low mortality districts; and lastly, Bedminster is separated from Clifton, both being characterized by their low mortality from Heart Avon. Disease, by the tidal and important sea-inlet of the Avon. Bedminster.

Low mortality being the rule in the western coast districts, I propose taking those exceptional districts which are marked blue, in order to see what they teach us. The high mortality districts on the coast of Cornwall, are High Mortality Districts. Truro, St Columb, Camelford, and Stratton. They all have a precipitous rock bound coast at right angles to the south-west winds; they are however exposed to the north-westerly; but the most densely populated portions lie in valleys protected from their influence by high ridges as the Pinhallon and Newton Downs in Truro, the Pyndar Downs in St Columb, and in Stratton the ridge to the west of the sources of the river Bude.

On the coast of Devon the district of Bideford has some remarkable physical features, which are especially interesting, coincident as they are Scarborough. with a high rate of mortality. We have seen in the district of Scarborough (the town itself is included in the district, although it is differently situated from any other inhabited place within the boundaries), that the greater portion of it is sheltered by the oolitic hills, which give rise to the sources of the rivers Derwent and Rye; in fact, we know that many of their streams have their



origin within a very short distance of the coast itself; we find that this character of the country is coincident with high mortality, not only in the coastal district, but in those which are contiguous; now, if we examine the country of the Bideford and Stratton Districts, we shall find towering rocks bounding the coast on each side of Hartland Point, and giving rise to the numerous sources of the Torridge and the Tamar, some of the former beginning to flow towards the south, within a mile or so of the cliff edge; the courses of these rivers indicate at once the aspect of the beautiful valley country through which they flow, and bespeak at once shelter and protection from the rude gales from the ocean; but whilst thus protected there is an amount of air sewage, having either an animal or a vegetable origin, always remaining behind, which, from the peculiar construction of the valley system, is never swept entirely away.

Barnstaple offers a remarkable contrast to the Bideford district; here we have the opening of the River Taw, penetrating the country, and receiving tributaries which flow from Kentisbury and Berry Downs, the valleys of which open so as to receive the south-westerly winds. The adjoining coast of Williton district is partly of red sandstone and partly of lias: it is precipitous. The streams run at right angles to the course of the winds in the Bristol Channel, and the country itself is protected by Oare Hill, Exmoor Forest, and Brendon Hills. Cardigan is favourably situated for a low mortality in many respects; but we see this large district is coloured blue, I suspect that some social cause, such as exists at Norwich, King's Lynn, Ipswich, and Colchester, in the Eastern Counties, exists here, and, like Chester, the whole district is obliged to be coloured in accordance with the excessive mortality of the town, instead of each place bearing its own burthen, as they do in the eastern counties, where separate districts are assigned to the principal towns. St Asaph is a district, although a great portion of it is in deep and protected valleys, yet an exceedingly populous portion of it lies in the Vale of Clwd, up which there is not the slightest obstruction to the north-westerly winds; the next district, Holywell, is healthy, but it must be remembered that it has the sea inlet of the Clwd on the west, and that of the Dee on the north-east.

The last is Cocker-mouth, a district to which I have already alluded, as offering a strong contrast to its neighbour, Whitehaven; the latter looks towards the sea, and is well disposed to receive the full afflatus from its surface, as well as the incidence of the tidal wave; it has an annual rate of mortality of 11·7 to every 10,000 living, whilst Cocker-mouth, which is cut off from it by the ridge of the Cumbrian Hills, and is protected on all sides from the sea-air, numbers annually 15·6. It is a fact worth noting here, that the oolitic Yorkshire group is the counterpart of what we see in Cumberland; there the tidal-wave comes from the north, and so do the prevailing winds; they both impinge upon the northern part of this group and distribute their full influence there, whilst the sheltered parts to the south are seen to be coloured blue, this high mortality we have seen to be coincident with lofty surroundings; on the west the tidal-wave and prevailing winds come from the south-west, Whitehaven district is exposed to them, and is healthy, Cocker-mouth is screened, from them and its mortality is high above the average.

*Recapitulation.*

- 1°. There are three coast-lines around England and Wales, the East, the South, and the West; they are composed of 133 Registration Districts, of these 83 have a mortality below, and 50 above the average annual rate. The Coastal Districts therefore agree with the Coastal Divisions, and the Coastal Counties as to the coincidence of proximity to the sea, and a low mortality from Heart Disease and Dropsy.
- 2°. When the three coasts are compared, we shall find that the Eastern and Western have the most extensive, as well as the greatest number of sea inlets, and that the south has but one inlet of any importance, all the others being limited as to their extension inland, and opposed to the general direction of the sea-winds and tidal-wave so far as regards their axes.
- 3°. The East coast is comparatively low, and throughout a large area offers no obstruction whatever to the free access of the sea-winds; and the West coast, although more rocky, has innumerable inlets and an inland surface sloping upwards, instead of downwards from the sea, so that it presents to the prevailing winds when they blow, especially on the Welsh, Cheshire, Lancashire, and Cumbrian coasts, every opportunity of fully flushing the valleys.
- 4°. Coincident with the great numbers of sea inlets and low coast-line on the Eastern side of England, we find a low mortality in 29 out of the 41 districts.

Coincident with the rocky and precipitous coast of the south, an absence of important sea inlets, and the courses of the rivers being at right angles with the prevailing winds, we find that of the 40 districts 28 have a high mortality.

And lastly, coincident with the physical facilities afforded on the western coast, for a full purging by the strong winds from the Atlantic, of the valleys from air sewage, it will be seen that out of the 52 districts, from Redruth to Wigton inclusive, 42 are below the average, and only 10 above it.

- 5°. The Coastal Registration Districts, as a rule, have a low mortality from Heart Disease and Dropsy, this is in conformity with what has already been observed in the Registration Divisions and the Registration Counties.



## CHAPTER V.

## SECTION I.

*The Relative Mortality of the Inland Registration Districts.*

THE Inland Districts are not so easily grouped as the Coastal, and as a question may arise as to my selection of them, I shall adopt at once a plan which shall do away with all doubt on this point. Let us first take the inland groups comprised within the lines of 0° and 1° W. Long.; and 51° to 52° N. Lat.; within this area it will be seen that although the high mortality districts predominate, there is not one of the sixth degree or highest; and that, on the other hand, to the north there are several districts of low mortality contiguous with those which border the coast of the Wash, and the banks of the rivers which flow into it; to the east there is a group of low mortality districts, which are continuous with the riparial districts of the great sea inlet of the Thames; to the south there is another group which is continuous with those from the south coast; and lastly, an isolated group to the south-west, the elevated districts of Farnham, and Farnborough, which, independent of their dry Bagshot soil, are freely exposed to the winds from all quarters. The low mortality of this area is coincident with proximity to sea inlets and elevated land. If we take the area above within the same lines of longitude, intersected by 52° and 53° N. Lat., we shall find an almost universal low mortality, and this is coincident with proximity to the flat lands in the neighbourhood of the Wash. Above this area again, between 53° and 54°, the same low mortality prevails, and here we have it coincident with the flat country around the sea inlet of the mouth of the Humber, and the flat Lancashire coast. On the west, if we trace the areas between the 2° and 3° of longitude, we shall find that low mortality is coincident with the great sea inlets from the north to the south of England.

## SECTION II.

The Midland District may be fairly represented by the area embraced by the lines of the 2° and 3° of W. Long.; and 51° and 52° N. Lat.; here we do not find one single low mortality district; there is no sea inlet, nor river even, in the axis of the prevailing winds; on the contrary, in the next area to the west, we see the oolitic and chalk hills ranging almost due south and north, giving rise to rivers which flow from the Atlantic Ocean, and offering a barrier to the full afflux of the most powerful winds from the south-west; from other winds also, this area is protected by the continuation of these hills to the north-east; and we see in the area to the west, where the hills go from the south to the north, that in their immediate neighbourhood to the east, where there is the most protection from the winds, there is the greatest mortality in the whole of England from Heart Disease.

Again, if we take the Derbyshire group, we find that the greatest mortality is coincident with the greatest seclusion from the sea-winds; and in the Western Counties of Herefordshire, Worcestershire, and Brecknock, a remarkable group of high mortality presents itself; here all the rivers are at right angles to the prevailing winds; and the mountains which give them origin, rear themselves to the west, and act as efficient barriers to the purging influence of the powerful winds which we have seen to have such full sweep over the Welsh coast.

The protected districts of Westmoreland and Yorkshire have a high mortality, and are thoroughly inland. It will be remarked, however, that the highlands between the two seas, where the winds from both the Irish Sea and the German Ocean can sweep over without hinderance, there is to be found an uninterrupted belt of low mortality districts,—the very centre of England. Warwickshire is characterised by the terminations of three of the most important sea inlets of our island,—the Wash, the red sandstone vale, commencing in Cheshire, and the valley of the Severn and Avon.

## SECTION III.

*The Relative Mortality of the Insular and Peninsular Districts.*

There are four Insular Districts, three of which have a low, and one a remarkably high mortality; the average annual rate of mortality in each is as follows:—Anglesea 6·5, Isle of Wight 12·5, Isle of Sheppey 10·4, and the Scilly Isles 15·3, to every 10,000 living. This last exception to the rule is remarkable, and requires further investigation into its cause; in all these districts the mortality is greater amongst the males than females, but in the isle of Scilly the proportion is as 136 females to 170 males. Even including the Scilly Isles, the rate of mortality in insular districts is below the average, being 11·1 to every 10,000 living. There are 12 Peninsular Districts, having a mean annual mortality to every 10,000 living of 11·1, the same as the insular: they are Pylde 11·1, Wirrall 8·7, Pwllheli 10·9, Haverfordwest 12·5, Pembroke 12·2, Penzance 8·9, Swansea 7·4, Weymouth (Portland) 11·4, Thanet 16·6, Hoo 9·3, Tendring 12, Patrington 12·2. Again we see in this last series of districts, the most exposed of any to the direct influence of the sea-winds on all sides, that a low rate of mortality is coincident with their favourable position for free ventilation.

*Recapitulation.*

- 1°. The Inland Districts have a higher mortality than the Coastal; the low mortality inland districts, however, on both the eastern and western sides of England, are to be found contiguous to those which border the great sea inlets, and the coast, as well as where there is elevated ground, admitting of ventilation on all sides.
- 2°. The Midland groups of Districts, which are not intersected by the great sea inlets, but are protected by high ranges of hills on all sides, have the highest mortality. And lastly,



3°. The Insular and Peninsular Districts, the most exposed to the sea-winds of all districts, have a low mortality from Heart Disease and Dropsy.

We have thus seen that the same general law obtains throughout the three divisions of England and Wales into Registration Divisions, Counties, and Districts, viz.:—*That wherever the sea air has uninterrupted access, as over a flat country, up broad vales or valleys, and elevated country, we find a low mortality from Heart Disease and Dropsy; and that on the contrary, in places where the tidal wave has no access, where the rivers run at right angles to its course, or to that of the prevailing winds, there we find the highest mortality from this cause of Death.*

## CHAPTER VI.

## SECTION I.

*The Geographical Distribution of the six degrees of Mortality from Heart Disease and Dropsy.*

**I**N the map which shows the distribution of Heart Disease in the eleven Registration Divisions, we see that only three degrees of mortality are represented: the division which has the greatest mortality is the South Western V., and the lowest mortality is found in the XI. Division North and South Wales. It will be well to take each division separately.

**I. London.**—The mortality of this important division was only 12·5 to every 10,000, notwithstanding its twenty-six hospitals which are open to applicants from so many surrounding counties, and even foreign countries. If a line be drawn from the north of the Islington District (near Highgate) to the south of the Lambeth near Lower Norwood, it will be found that the great mass of the area of this division to the east of this line is coloured red, indicating a low mortality: whilst to the west the prevailing colour is light blue, which represents a death-rate just above the average, the fourth degree of mortality. The exceptions on the Eastern side are first, Greenwich, which in-

clude the military town of Woolwich as well as its own Naval Hospital (1851-60); and secondly, the high mortality group, which the City of London, St Saviour, St Olave, West London, Strand, St Giles', Holborn, and Clerkenwell, compose. Both Greenwich and Woolwich are favourably situated for receiving every advantage which the tidal influence of the Thames and the sea-winds, which are favoured in their course up the river by the heights of Essex, Kent, and Surrey, can afford. In 1868, when reading my first paper on this subject, I drew attention to the remarkable fact, that wherever there is a garrison or military

town in a district, it matters not what the climatic or physical surroundings of the district may be, a high mortality from Heart Disease among males is sure to be found. In London the difference between the mortality from Heart Disease among males and females is not so great as it is throughout England, the proportion being as 12·7 males to 12·4 females. In

Greenwich, inclusive of Woolwich, the average annual rate of mortality from Heart Disease and Dropsy is as 17·2 males to 13·2 females; whilst in the adjoining district of Lewisham the proportion is 10·8 males to 12·2 females. We shall have occasion to revert to this subject when we examine other districts, like that of the Medway, containing military towns such as Chatham and Rochester. The group of high mortality next to be considered is the one which embraces the Thames immediately to the east of our imaginary line: it contains every grade of high mortality. The greatest mortality is to be found in St Saviour's and St Olave; these districts contained Guy's and St Thomas's Hospitals: the two districts are taken together, as it was found that a very large proportion of the deaths that took place occurred in those hospitals, and that it was impracticable to give the corrected mortality of these two districts separately, parts of both hospitals being situated in each of the districts: whilst much of the excess



of the mortality from Heart Disease may be attributed to the attraction to these great hospitals of bad cases from other districts scattered over the home counties; we must not forget that the ventilation of these districts is of the worst description possible. We must ever remember that the street system is to towns what the river system is to the country. We have found, throughout our examination, that low mortality from Heart Disease is almost invariably coincident with free access of the prevailing sea-winds, and that, were the converse obtained, it was coincident with high mortality. Streets, like rivers, should traverse a town so as to admit of the freest access to the prevailing winds, if they do not, there will ever be lurking about some air-sewage waiting to do mischief at a moment's notice. The three main thoroughfares of the united districts of St Saviour and St Olave are all at *right angles* to the winds which sweep up the Thames; to the east of London Bridge there is no wide street at all; the whole of the two districts being made up of an intricate interlacement of narrow streets, alleys, and *cul-de-sacs*, out of which it is almost impossible to drive the air-sewage. The mortality is 20·7, the highest average annual rate of mortality in that part of England to the east of the 1° W. Longitude, although not higher than that of Frome, and considerably less than that of Wilton, both of which are shut out from the direct influence of sea-air.

Street System  
in Towns.

West London ranks next as to its mortality; here the main thoroughfare, Farringdon Street, is at right angles to the prevalent winds; and those lying between it and Chancery Lane and Grey's Inn Lane, as well as the streets to its east, are so arranged as to give the idea of a design to exclude fresh air as much as possible: the opening of the Holborn Viaduct, and the demolition of hundreds of hot-beds of disease and crime, has, however, given such a breathing power to this district, that there is every reason to believe that during the next decad its rate of mortality 18·1 will be considerably modified. Fleet Street is feeble as a ventilating thoroughfare; in fact, its position and its narrowness render it an obstruction rather than otherwise. West London includes St Bartholomew's Hospital, for which a correction has been made. Clerkenwell, Holborn, and the City of London have the lowest of the high mortality group. Although the City of London has a less density of population than other districts, yet none of its streets are so built as to give a thorough ventilation to the inhabitants: the streets leading to the river are at right angles to it, and none of the principal thoroughfares are so built in relation to other streets, as to admit of free draught. Although above the average, we must not think the mortality of Clerkenwell high, 13·4, when we consider not only the density of the population, but the social condition of the people: a portion of it is on the high ground adjoining the elevated and extremely healthy district of Islington; where the high site, wide streets, and semi-detached houses offer free ventilation on all sides, especially to the north-east, where the sea-winds from the German Ocean have full play when they prevail. Holborn has a mortality similar to that of the last district 13·4: it includes the hospital for sick-children, for which a correction has been made by the Registrar-General. The mortality of Holborn partakes of the character of the generality of the districts which lie to the west of the line which bisects this division.

West London.

City of London.

Clerkenwell.

Holborn.



The large mass of districts lying to the east have a low mortality, and this is coincident with the fact that they first receive the full afflatus of the winds from the sea, which blow freely over the low lying ground between the rivers banks and the heights of Essex, at Epping and Hainault, on the north, and those of Kent on the south. The winds flow unrestrainedly over the flats in the district of Hackney to the northern heights of Islington (Highbury) and Hampstead. To the east many of the principal thoroughfares are in the axis of the prevalent winds, and admit a thorough air flushing from all quarters: this fact is coincident with a low mortality from Heart Disease.

The Western Districts, which receive the sea and river winds after they have passed over those on the east, we see, as a rule, have a mortality above the average, although not greatly so: those districts which are exceptional are Hampstead, the greater portion of which lies high, and has a site of London clay and Bagshot sand; St George's, Hanover Square, and Westminster, within which group are Hyde Park, Kensington Gardens, and St James' Park, all of which exercise a most beneficial influence on the health

**Western Districts.**

**The Parks.**

of the inhabitants: these open spaces for the most part lying on gravel, and not overcrowded with trees, are vast reservoirs of pure air, a great portion of which, at times, is derived from the tidal-breeze. St Pancras and Marylebone have a higher rate of mortality than we otherwise would be led to expect from their position; both have wide streets and open spaces, such as Regent Park and Primrose Hill; considering, however, that St Pancras contains University College Hospital, and the Royal Free Hospital, and St Marylebone, St Mary's Hospital, for which, however, corrections are made, the mortality is not excessive, especially that of St Pancras, which is only 12·8; that of Marylebone is 15·0. Regent's Park and Primrose Hill, although admirable play and exercise grounds for the people, are not such good reservoirs of air as Hyde Park, their clay soil, and the wooded character of the boundaries of the Park, fail to give that bracing character to the superincumbent air which we find so invigorating in Hyde Park or on the top of Hampstead Hill.

The Division of London is characterised by the great sea inlet of the Thames, which traverses it from east to west: coincident with this physical feature, which has such a remarkable influence on its climate, we have already said that the mortality from Heart Disease and Dropsy is only 12·5. The bidiurnal rise and fall of the tide at London Bridge is between 16 and 20 feet; if we consider the effect of a rise or a fall of such a vast surface as the Thames presents in its course through London, we shall be able to appreciate the influence it exerts in changing the air; when it rises it brings with it an inrush of pure air, which displaces that pervading the low localities in the neighbourhood of its banks; whilst on its return to the sea it again exerts its power of withdrawing the air from the lower grounds, and carrying it seaward; whilst that from the higher locality takes its place, so that there is a constant change at every tide, especially in the riparial districts. In addition to this, the tidal-wave is generally accompanied by its own peculiar breeze, which has a far wider influence than is generally suspected. If a contour map of London be taken, it will be easily seen what an extensive surface is capable of being flooded by the uplifting of the air 16 or 20 feet above low tide. Every precaution should be taken, therefore, to

**The River Thames.**



preserve our river pure, and not allow the air from the sea to be contaminated by the foul gases of sewage, which neutralise its power before it reaches this great city.

*Recapitulation.*

- 1°. A line drawn from Highgate to Lower Norwood will separate the Division of London into a Western and an Eastern Division.
- Recapitulation.* 2°. The Eastern Division is nearly entirely coloured *red*, indicating a low mortality.
- 3°. The Western Division is nearly entirely coloured *blue*, indicating a high mortality.
- 4°. The Eastern Division receives first the full influences of the sea-winds of the ocean, and its main approaches are favourable to their free access. The Western receives these winds after they have passed over the most densely populated districts of the Eastern Division.
- 5°. The Eastern Division contains the high mortality district of Greenwich, this is coincident with the existence of a military town within its area.
- 6°. In the Eastern Division the low mortality group, embracing the Thames, is characterised by having the streets in its several districts so arranged as to preclude free ventilation by the winds which sweep from the sea up the river.
- 7°. The exceptions on the western side of London to the high mortality are Hampstead, Westminster, and St George's, Hanover Square; coincident with this low death-rate from Heart Disease, we have in Hampstead elevated ground capped by Bagshot sand, and full exposure to prevailing winds on all sides. In the other two districts coincident with low mortality are the parks and gardens, which have a gravelly soil, and in Hyde Park sparse foliage.
- 8°. London as a division has a low mortality, 12·5, and coincident with this it is traversed by the great sea inlet, the Thames, which has an average rise and fall of the tide between 16 and 20 feet.

SECTION II.

II. *The South-Eastern Counties Division.* As all the divisions except London, have been previously more or less discussed, I shall not now devote so much space to them as I have just given to that of the metropolis; it will be only necessary after what has been said, to give a short account of some of the more salient features in the distribution of Heart Disease in each. The South-Eastern Counties' Division has the second highest mortality of the eleven; its annual average rate of mortality to every 10,000 living, is 14·0. It has three districts occupied by soldiers, all having military hospitals; for instance, the district of Medway includes Rochester and Chatham, and the Military Hospitals; Portsea Island, Portsmouth, and its Military Hospital;

*The South-Eastern  
Counties Division.*

*Military Towns.*



and Alverstoke includes Gosport and Haslar Hospital. All these districts are favourably situated so far as free access of sea-air is concerned, but coincident with their military occupation, all have a mortality above the average, and two out of the three have a greater mortality among the males than the females, which we know not to be the rule throughout England. Medway 15·8 males to 13·4 females; Portsea 12·5 males to 12·8 females, and Alverstoke

**Military Camps.**

15·9 males to 11·7 females. On the other hand, it has two military camps, Aldershot, in the districts of Farnborough and Farnham, and Shorncliffe in that of Elham, the former on the heathery downs of Bagshot sand, near Frimley, and the latter on the breezy chalk downs of Kent, near the source of the Little Stour. These three districts have a low mortality; in fact, the two first stand out conspicuously in the midst of districts having a death-rate above the average; and it must be further noted that in all these districts, the mortality amongst females is the greatest. For instance, Farnham 9·4 males, 13·5 females; Farnborough 9·7 males, 13·0 females; Elham 11·0 males, 12·0 females. This is an interesting fact, and worthy of strict investigation. This division contains districts having the three

**High Mortality Districts.**

degrees of high mortality; two, Andover and Alresford, have the southern greatest degree of mortality, and eighteen have one of the fifth degree, or next to the highest. With the exception of Thanet and Rye, all these are inland districts, and well sheltered from the prevailing winds. The most remarkable group is the circular one which surrounds Wantage: it is composed of the districts through the protected valleys of which the Thames, the Ock, and the Kennet trend, the sources of these rivers to the west of this group at once indicate the range of hills which intercepts the full influence of the south-west and westerly winds; the Marlborough Downs and the Cotswold Hills to the west, are the barriers which are coincident not only with the high mortality in this division, but with that of those adjoining.

**Low Mortality Districts.**

**Inlet of Thames.**

This division has on its north boundary the sea-inlet of the Thames, and coincident with this we find its riparial districts having a low mortality—from Thanet to Kingston there are 13 riparial districts, including the southern part of London, 10 of which have a low mortality; the exceptions are Thanet, before alluded to, p. 28, Medway having the military towns of Chatham, Rochester, and Dartford. The riparial districts of south London have already been discussed. The high mortality districts of Andover and

**Highest Mortality. Andover and Alresford.**

Alresford are protected on all sides by overshadowing hills, and I have often heard my friend Jabez Henry Elliott, Esq., who lives at Andover, and who has one of the most extensive practices in Hants, declare his opinion that the cause of the excess of Heart Disease in his district is the prevalence of rheumatism, which crops out on every occasion, and is the bugbear of the medical man; during convalescence from other diseases it often checks the steady course to health by its unwelcome appearance. Both districts are agricultural. The lowest mortality in this division is to be

**The Lowest Mortality.**

found in the flat district of Romney Marsh, where the sea-air has full sway; and in the exposed districts of Hoo and North Aylesford, at the



mouth of the Thames; here the low mortality is again coincident with the unchecked afflatus of the ocean winds and the tidal breezes.

**Southampton.** The mortality of Southampton is low, being only 12·8. It is situated in a district, South Stoneham, having a low death-rate from Heart Disease; and on the north-east bank of the only considerable sea-inlet on the south coast of this division, the Southampton Water.

#### Recapitulation.

- 1°. The districts in this division having the highest mortality are to be found inland; and its only inland county, Berkshire, which is free from the influence of the Thames or the coast, has the fifth degree of death-rate.
- 2°. The sea-inlet of the Thames flows along the greater portion of its northern boundary; the reparial districts have a low mortality.
- 3°. The districts in which military towns are situated have a high rate of mortality, and more males die from Heart Disease than females.
- 4°. The districts having the lowest mortality are those most exposed to the full influence of the east-winds.

#### SECTION III.

III. *The South Midland Counties Division.* This division, I have previously remarked, cannot properly be called midland, inasmuch as one of its counties stretches to the Wash (Cambridge). The average annual rate of mortality in this division is 13·0 to every 10,000 living. The five high mortality counties, 10, 9, 8, 7, dominate the three having a death-rate below the average, viz., 11, 12, 13. On looking at a map of the counties, it will be at once seen that there is a natural division between those coloured blue, and those coloured red. The former having a high rate of mortality, are the inland: of these Oxford and Middlesex, the most inland of all, have the highest rate; whereas the three coastal counties have a low rate, and those lying nearest the Wash have the least mortality.

The district map gives a more minute detail; and here it will be found that the low mortality districts are to be found in the level country from the Wash along the banks of the Ouse, the Welland, and the Nen; these wide flat vales seem to offer free access to the winds from the German Ocean nearly up to the sources of the rivers which traverse them; on the borders of Oxfordshire, Buckinghamshire, and Hertfordshire, a different watershed occurs, that of the Thames, the oolitic and chalk ridge of which protects the districts within the basin from the winds from the Wash; and coincident with this sheltering, we find a high mortality; the valley system, especially on the oolitic range, is very intricate. The rivers Cherwell and the Thames (until it arrives

at Reading) have their courses north and south at right angles to the prevailing winds from both oceans; and coincident with this, we find that there is a riparial group of high mortality districts, of the fifth degree, which is continuous with the one already alluded to, when examining the circular group of high death-rate in Berkshire; Berkhamstead and Woburn are both well enclosed by hills and protected on all sides; coincident with this is a high mortality. Wisbeach, although a coastal district, is coloured blue, its death-rate is only slightly above the average, viz., 12·7, or 0·3 in excess. There are four districts having a very low mortality (2nd degree), all are exposed to the sea-winds. It is to be remarked that within this division, our two great English Universities are included, Cambridge and Oxford. The latter we find has a low mortality from Heart Disease, in the midst of districts having a high death-rate from this cause, whilst the former has a rate above the average, although in the midst of a district having nearly the lowest degree of mortality, and surrounded by others of nearly the same character.

During the deced 1851-60, in Cambridge there died 12·7 males and 12·6 females, mean 12·6; and in Oxford 9·1 males and 12·3 females, mean 10·7.

Harrow School is also situated in the Hendon District, where the mortality is as follows, 14·5 males, 12·5 females, mean 13·0. The district of Hendon is encircled by hills from which the tributaries of the river Brent flow; the Harrow ridge, whereon the school is built, is lofty, about 200 feet above Trinity high-water mark, which gives it certain advantages over the valley lands that are enclosed.

Hendon is protected by the Hampstead Hill, which is 431 feet high; it has a capping of Bagshot sand, and on its summit receives every wind that blows, without interruption; coincident with this, we have already seen that it has a low mortality, 12·0.

#### *Recapitulation.*

- 1°. The counties which compose this division form themselves into two groups—5 midland having a high, and 3 coastal a low mortality.
- 2°. The high mortality counties have their districts well protected by their valley system; the low mortality counties have their districts exposed freely to uninterrupted air flushing over the flat lands bordering the Wash.
- 3°. Cambridge has a mortality above the average, and Oxford one below it; each form exceptions to their surrounding districts.
- 4°. Harrow is in the district of Hendon, but is considerably above the mean level of the district.



## SECTION IV.

IV. *The Eastern Counties Division.* The area of this division has the lowest level throughout its entire extent to be found in England, and, from its low sea-board, offers the least resistance to the full sway of the sea-winds from the German Ocean; in fact, owing to its general flatness, it is capable of being swept by winds from all quarters; coincident with this capability of being thoroughly purged, we find it having a low mortality, 11·4.

The Eastern Counties  
Division.

Flat Country.

All the counties are Coast Counties. The most exposed county, Norfolk, has the lowest death-rate from Heart Disease, 10·1. The most sheltered county, Essex, a portion of which is within the London clay ridge of the Thames basin, has the greatest mortality from this cause of death, 12·7. The low mortality counties are continuous with those of the last division, which border the Wash; and the disposition of the low mortality districts is coextensive with the contour line of less than two hundred feet; these districts are continuous, not only with those of the last division, but also with those of the coastal parts of the North Midland Districts, VII. Coincident with the high mortality in the districts of Thingoe, Thetford, and Stow, there is the valley system of the Little Ouse and the Lark rivers, the death-rate, however, is only slightly above the average. The London clay and chalk heights of Essex, whence arise the Chelmer, the Stort, and the Roding rivers, give shelter to the country to the south; and coincident with this, we find a group of districts having a death-rate above the average. This we see, is continuous with the group already noticed in the last section, as being within the basin of the Thames. This division has one district of the

Death Rate of  
Counties.

Low Mortality.

High Mortality.

lowest degree of mortality, Tunstead, it lies on the coast, and is exposed to the full blast of the sea-winds. There are also several districts having the second degree of mortality: these also are exposed to the prevailing winds. The principal towns are nearly all coloured blue, except Yarmouth, having a mortality above the average; for instance, King's Lynn 15·6; Norwich 13·3; Bury-St-Edmunds 16·5; Ipswich 13·2; and Colchester 16·7. In Colchester there is a military camp. In King's Lynn the number of male deaths is remarkable, viz., 18·1 to 13·1 females, or 6·3 above the male average. The low mortality of Yarmouth is also remarkable. This division forms the boundaries of two of the great eastern inlets, the Thames and the Wash, the riparial districts of which all have a low mortality.

Tunstead.

High Mortality in  
Principal Towns.

The high mortality in the large towns I cannot help ascribing to defective sanitary regulations therein, and place them in the same category with Margate and Ramsgate.

*Recapitulation.*

- 1°. The average annual rate of mortality is low, and this is coincident with flatness of country and unobstructive sea-board.
- 2°. The most protected county, Essex, has the highest mortality; the most exposed, Norfolk, the lowest.
- 3°. The high mortality group in the centre is coincident with the valley system of the Little Ouse and Lark rivers, and that in the south of Essex with the sheltering ridge of the watershed whence arise the Chelmer the Stort and the Roding.
- 4°. The high mortality in the principal towns arises, in all probability, from neglect of sanitary laws.
- 5°. Yarmouth has an exceptionally low mortality.

## SECTION V.

Instead of examining the divisions in the numerical order of the Registrar-General, I prefer taking them consecutively from south to north, and thence to the south again; this will be a more natural order, and assist the memory by reference to the facts indicated in contiguous divisions

VII. *The North Midland Counties Division* lies to the north of the Eastern Counties Division IV.: it certainly is not a purely Midland Division, in as much as it embraces the large coastal county of Lincoln, which extends from Norfolk to Yorkshire. Here the low mortality in Lincolnshire and Rutland dominate the high mortality in the remaining three Inland Counties, Nottinghamshire, Leicestershire, and Derbyshire, if we take the mean of the whole division, which is 12·5; on dividing it into counties we find that those having the lowest mortality are nearest the coast, for instance, the mortality of Lincolnshire is only 10·3, and that of Rutlandshire 11·8; whereas the most Midland County, Derbyshire, has a death-rate of 15·5, it contains no district having one below the average, and the intermediate counties of Leicestershire and Nottinghamshire, a death-rate of 12·8 and 12·6. The low level of all the counties except Derbyshire is coincident with this low mortality. The valley of the Trent is in the axis of the north-east sea-winds, in the first part of its course, and its riparial districts have a death-rate all below the average; when it gets inland, however, it still favours the winds from the north-east; and coincident with this course we find that the districts which skirt its banks have a mortality only just above the average. The group of high mortality districts, comprised of Chapel-en-le-Frith, Bakewell, Ashborne, and Belper, lies in the valleys of the rivers Dove and Derwent, both of which run at right angles to the prevailing winds, whether they be north-east, or south-west, or north-west. Barrow-on-Stour has a fifth degree of mortality, it is traversed from south-east

**The North Midland  
Counties Division.**

**Mean Mortality.**

**Coast Counties.**

**Midland and Inland  
Counties.**

**The Trent.**

**Highest Mortality.**



to north-west by the river Soar, and is therefore not in the axis of the winds from the German Ocean; Blaby, however, where the Soar takes its rise, is more or less elevated, and its aspect is generally towards the north-east. The

**Lowest Mortality.** three most exposed districts, Spilsby, Spalding, and Holbeach, have the lowest mortality. All the principal towns have comparatively a low death-rate from Heart Disease. This division forms one of the boundaries of the great eastern sea-inlets, namely, the Wash, and the mouth of the Humber; and the riparial districts along each have a low mortality. The districts having a low death-

**Inlets of Wash and Humber.** rate in this division are continuous with those in the last; and, coincident with this fact also, an extensive level area, which offers little or no obstruction to the full force of the sea-winds. We have found coexisting with the broad flat country of the coastal counties of the South Midland Division, a low rate of mortality; and that coextensive with this level character in Lincolnshire, a mortality considerably below the average obtains: we shall now follow this low tract, and coincident low mortality into the vale of York, of the next

**Buxton and Matlock.** division. Buxton is in the elevated part of the district of Chapel-en-le-Frith, and Matlock in the well sheltered district of Bakewell, which is protected from the sea-winds by the East Moor.

#### *Recapitulation.*

- 1°. The mean mortality of this division is low; the low mortality of Lincolnshire and the other adjoining counties dominates the excessive mortality of Derbyshire.
- 2°. Among the counties the one having the highest mortality is the most midland, Derbyshire 15·5, that having the lowest, the most coastal, Lincolnshire 10·3.
- 3°. The course of the river Trent through this district forms the access for the winds from the German Ocean.
- 4°. The Derwent and the Dove traverse a series of districts in the north-west of Derbyshire, at right angles to the prevailing winds; these districts form a group of high mortality, the most sheltered by the East Moor, Bakewell, has one of 17·7, and Chapel-en-le-Frith 17·1.
- 5°. This division forms one of the banks of the two great sea inlets, the Wash and the mouth of the Humber. The riparial districts have a low mortality.
- 6°. The districts having a low mortality, and lying on the level country of this division, are continuous with the low mortality districts of the last division, which also had a low alluvial site.
- 7°. Buxton and Matlock lie in the districts which have the highest mortality from Heart Disease.

## SECTION VI.

IX. *Yorkshire*.—Yorkshire is the best type that we have in England of what our counties and districts would be if determined by our watershed.

*Yorkshire.*

This division is rather more than a tenth part of the whole of England and Wales, and is divided into three Registration Counties, the North, East and West Ridings, or Trithings; about seven-ninths of its whole extent falls within the basin of the Humber (Hughes), and the waters of this vast area are conveyed to that river by its great tributary the Ouse.

The mortality in this division is below the average, 11·8. The North Riding

*Mortality,  
North Riding.  
High Mortality  
Districts.*

is protected from the sea-winds by the precipitous cliffs along the coast from Redcar to Flamborough of the oolitic and chalk formations; its mortality is 13·2. Moreover, the valley of the Derwent is sheltered by the high range of oolitic hills to the north (Eastern Moorlands), whence descend the Rye, the Pickering, and the Derwent. The only low mortality district is Easingwold, 12·0, a great portion of which lies on the elevated tract of the oolitic Howardian Hills.

*Low Mortality  
Districts.*

To the north of the Eastern Moorlands, exposed to the full sway of the sea-winds from the German Ocean, are the districts of Stokesley, Guisborough, and Whitby. All the rivers and becks, including the Esk, flow directly into the sea, and their valleys are swept by every breeze that comes from it. The districts most exposed are the two first, and their mortality is the lowest. We must remember that this rounded coast so projects that the tidal wave, in its course from north to south, impinges immediately upon it. The town of Scarborough has every advantage which position can afford. The district, however, is in a great measure protected by the high hills behind, such as Olivers Hill and Seamen Beacon, that form the eastern boundary, with others of the valley of the Derwent which courses from north to south, and then from east to west in this district.

*Scarborough.*

The East Riding has a comparatively low coast, with the exception of the northern part from Filey Point to Bridlington Bay, including the bold chalk promontory of Flamborough Head. The districts to

*East Riding.*

the west of these cliffs have a mortality above the average, although not considerably; one of the districts is York, which is remarkably well situated in its vale, up through which sweep the winds without hindrance.

*York.*

The remaining high mortality districts are those through which the river Hull passes from north to south in its passage to the Humber. The town of Hull itself, although on the tidal Humber, has its river

*Hull.*

as well as its principal streets at right angles to the healthful gales which blow up this sea inlet, like some of the districts surrounding the Thames. The districts having the lowest mortality are Skirlaugh, 12·2, and Patrington 10·2, the latter is a peninsula, and most exposed, it terminates at Spurn Point. In Skirlaugh the men die in greater proportion than the women, as 13·8 to 10·6.

*The West Riding*.—The mean mortality of this large Riding is only 11·8,

*West Riding.*

it will be seen that in the southern part of the Riding where the rivers are fully formed and have considerable valleys, which are, as it were, so many ramifications of the great sea inlet of the Humber, all the



districts, with two exceptions, Barnsley and Leeds, are coloured red; and that in the north-western portion, where are to be found the sources of these rivers in the deep valleys of the Pennine range, which defines the watershed of the western portion of the county, the districts are coloured blue. The majority of these districts have, however, a mortality only just above the average. Otley has a remarkable death-rate 17·6 males to 20·2 women, mean 18·9; Ripon 16·6, Barnsley 14·6, and Leeds 13·0, which must be considered low, for its two hospitals must attract severe cases from the neighbouring districts. The remarkable group

**Low Mortality  
Group.**

of low mortality districts which follow the courses of the Aire and the Calder, in the latter case to the very western confines of Yorkshire, is continuous with the one already described, which stretches from the Wash and the Humber to Yorkshire, and not only so, but with the low mortality group the North Western Counties Division VII., the base of which stretches from Whitehaven to the estuary of the Dee, and then follows the course of the Ribble to join the Yorkshire group. From the Wash to the mouth

**Stretches from  
the Wash to  
the Ribble.**

of the Ribble there is an unbroken line of low mortality districts. The sea breezes from the German Ocean pass up the valleys of the great Yorkshire rivers, and flood the eastern part of Yorkshire with fine sea air; whilst from the Irish Sea come the north-westerly gales, which perform a similar part on the west of the great Yorkshire ridge: and coincident with this air flushing from both seas, we get a belt of low mortality which stretches from sea to sea.

The division of Yorkshire has the sea inlet of the Tees to the north, and that of the Humber to the south, the riparial districts of both of which

**Sea Inlets.**

have a low mortality, except Hull and Sculcoates.

#### *Recapitulation.*

- 1°. The mortality in this division is low: it has only one district of the fifth degree, although it has six of the second or nearly the lowest.
- Recapitulation.**
- 2°. The northern part of the Division from the coast of Scarborough to the ridge of high hills between Yorkshire and Lancashire, contains nearly all the high mortality districts in one large group: in this part are the sources of the rivers.
  - 3°. The southern part of this Division, from the mouth of the Humber to the confines of Lancashire and Cheshire, contain nearly all the low mortality districts; here the courses of the fully formed rivers favour the free access of the winds from the German Ocean.
  - 4°. The other group of low mortality districts lies to the north of the North Riding, and are all freely exposed to the influence of the tidal wave and prevailing sea winds.
  - 5°. All the principal towns have a low mortality.
  - 6°. That part of England between the mouth of the Ribble and the mouth of the Humber is the narrowest and most deeply penetrated by sea inlets; it is characterised by an uninterrupted belt of low mortality districts.



## SECTION VII.

X. *The Northern Counties Division.*—The Mortality of this division is 12·7, or only slightly in excess of that of England and Wales.

This division embraces Northumberland, Cumberland, Durham, and Westmoreland; it is remarkable for the facts that it is washed on the east by the German Ocean, and on the west by the Irish Sea; and that within its boundaries it has almost every character of the distribution of Heart Disease to be found in England and Wales. For instance, from the Tweed to the Tyne we find a river system very similiar to what we have observed along the south coast, where the mortality is above the average; in both cases the rivers are numerous, and have their courses generally terminating in the sea at right angles to the prevailing winds and the incidence of the tidal wave; in the south coast the south-west and westerly are the prevailing winds, and the tidal wave flows from west to east along the English Channel; the direction of the rivers and the valleys which they traverse, are, as a rule, at right angles to both wind and tide; the former blow *over* them and not *up* them; consequently there was hindrance to thorough air flushing, and wherever this obtained we found coincident high mortality from Heart Disease and Dropsy.

On the east coast of Northumberland, from the Tweed to the Tyne inclusive, there are fourteen rivers and burns, all of which, without exception, run to the sea and open into it at right angles to the course of the tidal wave, and nearly so to that of the prevailing north-east winds from the North Sea. Here we must again recall the fact, that the tidal wave has a course from north to south, inasmuch as when it reaches the east coast from the Atlantic, it has taken more than half the circuit of the British Isles, from Penzance round to the Orkneys, and along the coast of Scotland. Presently, when we come to the Cumberland coast, we shall see how the courses both of the tide and the winds are reversed. Coincident with the facts just stated, we find that all the coastal districts included between the

Tweed and Tyne have a death-rate above the average, although only of the fourth degree, and in reference to this I must draw attention to the fact, that the coast of Northumberland between these rivers, is not so precipitous nor so obstructive as that which bounds many parts of the south coast

where the mortality reaches the fifth degree. Below the river Tyne the character of the country entirely changes; the red-sandstone takes the place of the carboniferous lime-stone and coal formation;

the coast looks towards the north-east, and forms a complete bay, which is open alike to the full afflatus of the sea winds and tidal wave; moreover, the rivers Wear and Tees pass to the sea

and open into it from the south-west, so that their courses and their valleys are so directed as to be free to admit every air purging that the German Ocean affords them; coincident with this we find that the county of Durham has an exceedingly low mortality, 10·4, and that only three of its districts—

Teesdale, Darlington, and South Shields, have a mortality above the average, and this only of the fourth degree. It is instructive to watch the course

The Northern Counties  
Division.

The Coast between the  
Tweed and Tyne.

High Mortality along  
the Coast.

High Mortality.

The Coast  
between the Tyne and  
the Tees.

Low Mortality.

Durham.

River Tees.



of the river Tees, where in the latter part it runs through Stockton, and has its axis in the direction of the prevalent sea wind it is accompanied by low mortality; but, on the other hand, in the former part, where it runs through Teesdale and Darlington from north-west to south-east, and therefore at right angles to the prevailing winds,

**Sunderland.** it runs through the midst of high mortality districts. As to Sunderland there is in all probability some local cause to account for its excess of deaths. Weardale is a broad carboniferous limestone vale and admits freely

**Teesdale and Weardale.** the sea winds. Teesdale, on the contrary, is sheltered by the lofty range which divides the sources of these two rivers, and which, on the north sides, gives rise to more than ten sources of the Wear, all running from the hill side through wide valleys in the direct axis of the prevailing winds from the sea. Weardale has a very low mortality 8·8, Teesdale 14·2.

The Northern Counties Division has really no inland counties, for Westmoreland, which is the most so of the four, has an important sea inlet penetrating its south-western boundary; the embouchure of the river Kent, which opens into the Bay of Morecambe, an inlet that exercises a powerful influence on the ventilation of the coastal area of Cumberland and Westmoreland. To show, however, how typical this division is of what obtains throughout England, we will now examine the Inland Districts; this can be done by drawing a semi-circular line from the north of the Glendale to the south of the westward district; this line will pass through the districts of Glendale 13·2, Rothbury 15·2, the

**Inland Districts.** extreme eastern end of Billingham 12·2, Hexham 15·1, Alston 15·4, and westward 14·1; these are essentially the midland districts of this division; the mean average annual mortality to every 10,000 living in which is 14·2. The only exception as to mortality among them being Bellingham, this is

**High Mortality.** bounded on the south-west by a lofty range of carboniferous limestone hills, which have an aspect facing the north-easterly sea winds; from this range the north Tyne receives nearly a dozen tributaries, all having the troughs of their valleys corresponding to the direction of the prevailing winds, and the town of Bellingham itself is situated within a short distance from the point where the river Reed becomes confluent with the North Tyne; after passing through a broad valley from north-east to south-west, through which a copious air flushing from the ocean has no obstruction. On the contrary, in the Hexham and Halt-

**Bellingham.** whistle Districts, the tributaries of the South Tyne run more from south to north, and the South Tyne itself, in the first part of its

**Hexham.** course, runs from south-east to north-west.

The western part of this division may be divided into two parts, the north and south; it is a natural division defined entirely by the watershed.

**Western part of the Division.** If a line be drawn from a point between Workington and Whitehaven, and made to take a south-easterly direction as far as the south-eastern boundary of Westward, it will represent sufficiently the elevated ridge of the Cumbrian Hills, which separates the two water-sheds of the Cumbrian Lake county. This ridge of towering fells, having an average height

**Two Watersheds, North and South.** of 2000 feet, acts as a barrier on the north side, to keep the direct influence of the sea winds from the valley of the Derwent

**North.** to the great valley of the Eden, which is also sheltered by a high ridge of carboniferous limestone rocks to the north-east; on the south side

of the river Tees, where in the latter part it runs through Stockton, and has its axis in the direction of the prevalent sea wind it is accompanied by low mortality; but, on the other hand, in the former part, where it runs through Teesdale and Darlington from north-west to south-east, and therefore at right angles to the prevailing winds,





however, we find all the streamlets, and rivers and the valleys, through which they course, running straight to the sea and exposed in every instance to the full flushing influences of its winds. From Morecambe Bay to St Bees Head there is scarcely a valley but what is air purged every time the wind blows toward it from the Irish Sea. What, therefore, are the coincident facts relative to the mortality from Heart Disease?

High Mortality.

South.

Low Mortality.

On the north and sheltered side there is a high, and on the south exposed side, a low mortality. The map shows at once the line of demarcation between the two watersheds. When examining the northern districts of the North Riding, we found that there was a similar, although not so lofty a ridge, stretching from the south of Whitby to the eastern boundary of the North Allerton district, and separating the watersheds of the eastern part of the North Ridings; we found, however, that the southern districts had a high,

Compared  
with Eastern part of  
North Riding.

and the northern a low mortality; and coincident with this we know that the sea winds came from the north-east, and that the tidal wave rolled from north to south; the very reverse of what obtains in Cumberland, where the sea winds are from the south-west, and the tidal wave from the south; and we have just seen that coincident with this reversal of the course of the wind and tide, a reversal also in the position of the low and high mortality districts. The sea inlet of the Solway Firth must now be noticed briefly: it will be seen at a glance that it is so placed as to receive, without interruption, the south-westerly winds; at its extreme point, where the rivers Liddle and Line become confluent in Solway Moss, to the south-west of the district of Longtown, the mortality of which is one of the lowest throughout the division, being only 9.0, the low flat alluvial district of Wigton projects seaward so as to receive a full sweep of the sea winds, and coincident with this is its low mortality, 10.8. Carlisle lies to a certain extent inland in the vale of the Eden, but its mortality of the fifth degree is higher than its position would lead us to expect; it may probably be placed in the same category with Chester, and some of the towns in the Eastern Counties Division IV. All the

Mortality of the  
Principal Towns.

districts lying within the sheltered vale of the Eden have a high mortality. The principal towns Newcastle, Carlisle, and Sunderland, have a death rate above the average; and Durham, Kendal, and South Shields, below it.

#### *Recapitulation.*

- 1°. The mortality from Heart Disease in this division is low, although above that of England and Wales.
- 2°. Its coasts are washed by the Irish Sea and the German Ocean, and the distribution of the mortality from Heart Disease is typical of what obtains throughout England.
- 3°. The coast districts of Northumberland, with their numerous rivers running at right angles to the sea wind and tidal wave have a high mortality resembling the coastal districts of the south of England.
- 4°. The coast districts of Durham, where the rivers have a direction favouring the access of sea winds, such as the sea inlet of the Tees, are characterized by a low mortality.
- 5°. The Inland districts have a mean average annual mortality of 14.2.



- 6°. The western part is divided naturally by the high ridge of the Cumbrian Hills; on the north and sheltered side there is a high mortality from Heart Disease, when, on the southern and exposed side a low mortality obtains.
- 7°. On comparing the mortality and the aspect of the western part of the division with those of the eastern part of the North Riding, we find the direction of the prevailing winds and the flow of the tidal wave the opposite to what takes place on the Cumbrian coast, we find also that the position of the high and low mortality districts is reversed.
- 8°. The sea inlet or the Solway Firth has a powerful influence on the ventilation of the county to the north-east, and Longtown which is situated so as to be well flushed by the winds which blow up this inlet, has the lowest mortality in the division.
- 7°. All the districts in the doubly sheltered valley of the Eden have a high mortality.
- 8°. The death rate in the principal towns is not excessive, and in three is below the average.

## SECTION VIII.

VIII. *The North-Western Counties Division.*—This, next to London, is the smallest and most important division in England and Wales. It is a purely coastal division, like the Eastern Counties, and, like it also, it has a low mortality, 11·4. Notwithstanding it includes such a number of large and densely populated towns, such as Liverpool, Stockport, Manchester, and Birkenhead. The mean density of the whole division is 74 acres to a person. Out of thirty-five districts, there are only seven having a death-rate from Heart Disease above the average, and in each instance the excess of mortality is on the female side, and the density of the population considerably above the mean of the division, well illustrating the remark that I made at p. 14, relative to density of population and the death-rate from Heart Disease. Macclesfield 15·7, belongs to the Derbyshire group already described. Great Boughton 15·6, includes Chester; and the high mortality from Heart Disease in that city being recorded with the whole division, an imperfect idea is given of the relative mortality between the city and the adjoining country: from its surroundings, Great Boughton is open to all the beneficial influences which proximity to the sea can give. This is one of the blots of the present map of the Registration Districts, which, along with others, I hope ere long to see effaced from it. In Clitheroe more than 30 per cent. of adults are employed in agriculture; and as an agricultural district, it ranks next to Ormskirk and Garstang: it is the least densely populated district in the two cotton counties of Lancashire and Cheshire.

From the mouth of the Dee to the mouth of the Duddon there are no less than eight sea inlets, all of which are the mouths of rivers which flow through this division in the axis of the three principal sea winds which on this coast prevail, namely, the south-west, the west, and the north-west. All the valleys are well flushed with pure air, and

North-Western Counties  
Division.

High Mortality  
Districts.

Low Mortality  
Districts.

coincident with this, the mortality is as low as that of the flat division in the Eastern Counties, where little or no impediment, as we have seen, is offered to the winds from the German Ocean. The exposed districts of the peninsula of Wirral, Ormskirk, and the red sandstone heights of Nantwich and Congleton, where arise the sources of the river Weaver, have the second degree of the lowest mortality. Moreover, the low mortality group of the division adjoins that of Yorkshire, and completes the belt of red districts which stretches from the mouth of the Humber to that of the Ribble.

Liverpool, Manchester, and most of the principal towns, except Chester and  
 Liverpool, etc. Ashton-under-Lyne, have a low mortality.

#### Recapitulation.

1°. Although a most densely populated division, the mortality from Heart  
 Recapitulation. Disease is considerably below the average.

2°. Of thirty-five districts, seven only have a death-rate above the average, and these are all inland.

3°. The twenty-eight low mortality districts are freely exposed to the winds from the Irish Sea, and have all their rivers and sea-inlets in a direction calculated to receive one or more of the prevalent sea-winds.

#### SECTION IX.

XI. *Monmouthshire and Wales Division.*—This division has the lowest mortality, 9·4, of all the eleven; it has but one county, Brecon, that has a death rate above the mean annual average. Like  
 Monmouthshire and Wales Mortality. England, Wales has a ridge of hills extending from north to south, and separating its water-sheds. We may divide them into the Coastal and Inland Watershed; or, the Western and Eastern.

The districts of the Coastal Watershed may be divided into three amphitheatres.

The northern extends from the extreme north-west point of the  
 Coastal Watershed. North Amphitheatre. Isle of Anglesey to the Point of Air, the extreme north-west of Flintshire; it comprises five districts, three of which have a degree of mortality the lowest but one; one, Holywell, of the third degree, and one, St Asaph, one degree above the average; coincident with the low death-rate of the four, is the fact that they all look towards the Irish Sea, and receive freely, without obstruction, the full influence of the sea winds from the north-west. The Isle of Anglesey receives also the south-west, it has the lowest mortality of the group. St Asaph is well situated, so are Denbigh and Ruthin in the red sandstone vale of the Clwd, so that they have every advantage which such an inlet can afford; perchance some social cause is here existing, which is the cause of the excess of mortality similar to what we have seen on the eastern coast. The inland valley system of this district is intricate and not well disposed for air-flushing; the population in it, however, is sparse, and could hardly dominate the death-rate of the district.



The western amphitheatre stretches from the Menai Straits to St David's Head, the extreme western promontory of Pembrokeshire; it has five considerable sea inlets, including the Menai Straits, the terminations of rivers flowing from the highlands, besides eighteen rivers of varying magnitude, all of which run in the axis of one of the three prevailing sea-winds which sweep over St George's Channel. All the twelve districts, with one exception, Cardigan, 13·5, are below the average. Cardigan is well situated, like St Asaph, and has a considerable inlet, that of the river Teifi; its high mortality cannot be explained by its position; some other cause is operating, which future investigation will explain.

**West Amphitheatre.** All the other eleven districts have a low death-rate. Two, Fistiniog and Tregaron, have the lowest degree of mortality. The first is situated on the sea inlet of the Glaslyn; the second is a highland district, receiving winds from all quarters: it is on the border of the two systems of watershed. All the other districts have a mortality of the second degree; it is the largest group of this low rate throughout England and Wales, and is continuous with the groups of the same degree to its north, south, and west.

The southern amphitheatre extends from Milford Haven to the district of Monmouth, through which the Wye passes to reach the sea; it looks towards the Atlantic Ocean and the Bristol Channel, and is more irregular than the other two in form: it has four considerable sea inlets, besides forming the *irregular northern* shore of the largest sea inlet throughout the country, the Bristol Channel. It has but two districts above the average, Monmouth 12·1, and Chepstow, 14·2; through these districts the Wye runs at right angles to the sea amidst some of the deepest and woodiest valleys that can be found. All the other districts are well exposed to the sea winds, and in all, except Pembroke, the mortality is of the second degree. Llanelly, which lies on the sea inlet which it shares with Cardiff and Gower, has the lowest death-rate, that of the first degree.

The inland watershed of Wales comprises the sources of the Dee, the Severn, the Wye, and the Usk; all the districts that lie in it are at a great elevation, and although screened from the winds that blow from the St George's Channel, the Bristol Channel, and the Atlantic Ocean, they are fully exposed, from their altitude, to the upper currents of the pure atmosphere, which, after its force has been broken, descends from above upon them, as well as to the direct upper currents from the German Ocean. There is only one high mortality district in this group, Brecon, which lies immediately under the hills which supply the sources of the Towy, as well as the other numerous rivers of South Wales.

#### Recapitulation.

- 1°. The mortality of this division is the lowest of the eleven 9·4; and coincident with this all the three coasts have their river systems so disposed as to admit of the free afflatus of all the three sea winds which blow over the Irish Sea—St George's Channel, the Atlantic, and Bristol Channel.
- 2°. The districts on the inland watershed are on elevated ground, and with one exception only, have a mortality below the average; coincident with this, their position enables them to receive the upper stratum of pure



air from the west without its force, whilst their altitude enables them to receive the sea winds from the German Ocean undiminished in power.

## SECTION X.

VI. *The West Midland Counties Division.*—This division has a mortality of 13·2; it is the most sheltered of all the eleven, lying as it does in the vale of the Severn, which runs through it from north to south at right angles to the sea-winds from both the western and eastern seas: the Severn valley has the old red sandstone hills of Herefordshire, and the new red sandstone hills of Shropshire on the west and north, and the new red sandstone hills of Staffordshire and oolitic range of Gloucestershire on the east and south. In Herefordshire there are some of the sources of the Wye and the fully formed river runs through this county at right angles to the course of the winds from the sea. The riparial districts of this beautiful valley country all have a high mortality, and form a remarkable triangular group, which has its apex at Brecon, one of the Welsh districts, and its base inland, extending from Church Stretton to Alcester. This group is separated from the high mortality group of Gloucester to the south of the Severn, by a series of districts of low mortality, which follow the course of the Severn and Avon into Warwickshire. This last remarkable series is in the direct axis of the prevailing south-westerly wind which comes immediately from the Bristol Channel, and is nearly continuous with a similar series that follows the courses of the rivers which arise at the intervening ridge of elevated land that gives rise to the rivers which flow into the Wash: so that even if we take the districts that are coloured blue in the line from the Severn to the Wash, we shall have a belt of low mortality districts stretching from sea to sea. The northern part of this division comprehends the heights of Staffordshire and Warwickshire, which give rise to the south-west sources of the Trent; within this elevated country we find a group of districts, including Birmingham, all having a low death-rate from Heart Disease. This group is continuous with those districts of low mortality which will be found in the south of Shropshire. A group of high mortality is seen to extend from Oswestry to Burton-on-Trent, nearly all of which lie immediately to the south of the hills which give origin to some of the sources of the Severn and the Trent: in fact, this group nearly defines the boundary line between the watershed of Shropshire, Staffordshire, and Warwickshire, and that of Cheshire. On a reference to the small map of the counties, it will be seen how strongly the counties of Hereford 17·5, and Worcester 15·6, stand out, with their intense blue, indicating high mortality; essentially midland, surrounded on all sides, they have no equal in mortality except in the counties of Wilts 16·0, and Berks 16·6, which are separated from them by Gloucester, through which the series of low mortality riparial districts of the Severn and Avon are found.

Within this division there are five districts of the greatest mortality, Leominster 18·8, Weobly 20·5, Upton-on-Severn 19·7, North Leach 20·1, and Dursley 20·1, all sheltered districts and out of reach of the direct influence of the sea-winds. In Herefordshire there is an extensive group of districts having a mortality of the fifth degree. All the

West Midland  
Division.

High Mortality.

Low Mortality.

Highest Mortality.



principal towns of this division have a high mortality except Birmingham. Rugby, which is situated near where the Avon takes its rise, has a low mortality like the neighbouring district of Foleshill; the heights of Dunsmore Heath, to the south-west of Rugby are so situated as to favour the afflatus of the south-west winds to this and the adjoining district.

*Recapitulation.*

- 1°. The division has a very high death-rate from Heart Disease, and contains two counties, Hereford and Worcester, which have the greatest mortality in England of any county except Wilts and Berks. This high mortality is coincident with a midland and most sheltered position.
- 2°. It contains a group of low mortality districts to the north-east, which are situated on the elevated country around Birmingham, and extend to the borders of Wales.
- 3°. The districts lying immediately to the south of the heights which separate the watershed of Shropshire and Warwickshire from that of Cheshire, have a high mortality.
- 4°. To the south there are five districts of the greatest mortality, all of which are sheltered and well protected.
- 5°. The riparial districts which follow the Severn and Avon in the axis of the south-west wind from the Bristol Channel, have a low mortality.
- 6°. All the principal towns, except Birmingham, have a high death-rate. Birmingham is the most elevated and exposed.

SECTION XI.

V. *The South-Western Counties Division.*—Having entered so fully into the characters of this division in a former chapter, I have little now to add except a few general remarks. Like the South-Eastern Division, the South-Western has a ridge running through it of a most irregular altitude, separating its southern from its northern watershed. The catchment basins of the rivers Parrett and Avon are worthy of notice as typical: both these rivers are tidal for many miles up their course; and as I have before stated, the first has the remarkable tidal phenomenon called the *bore*, like the *Severn*. The character I wish to note is that the immediately riparial districts are of low mortality, in each case, whilst the districts surrounding them have a mortality so little above the average, that they almost define the watershed of the hills whence they arise, to the east of which, however, we see an abrupt line of high mortality districts which swells the death-rate of Somersetshire, Wiltshire, and Dorsetshire. In Devonshire the midland group of districts, Southmolton and Crediton, are sheltered on every side, and their population lives in deep valleys. They have a mortality of the sixth or greatest degree. Again, Dorchester and Beaminster are surrounded on all sides, and so is Frome. In Wiltshire we have that remarkable group which follows the tributaries of the Avon; they are also sheltered on all sides, and in every instance we have a mortality of the highest degree; in fact, within Somersetshire and Dorsetshire, there are no low mortality districts except where there are sea-inlets; and in the inland county of Wilts, there is absolutely none,

The South-Western  
Counties Division.

it forms with Berks, a group which was alluded to in the last Section, when comparing it with the Hereford and Worcester group.

In Devonshire there are the Districts of Stoke Damerel and East Stonehouse; the former has a naval, and the latter a military hospital.

**Military and Naval Districts.** Both of these districts have a mortality above the average—Stoke Damerel 13·3; East Stonehouse 16·8; whilst Plymouth, which is well open to the south-west winds, and has no military hospital, has only a death-rate of 11·9.

The low mortality district of Tavistock embraces a great portion of the elevated granitic height of Dartmoor, in which arise so many rivers that flow both to the English and Bristol Channels.

All the principal towns, except Plymouth, have a death rate above the average.

#### *Recapitulation.*

1°. The death-rate of this division is high, 14·2.

**Recapitulation.** 2°. In the whole of this division there are no low mortality districts, except where there are sea-inlets which admit freely the prevailing winds and the tidal wave; or else, where there is elevated land, as that of Dartmoor.

3°. All the principal towns have a high mortality, except Plymouth and Bridgewater.

4°. All the highest mortality districts are sheltered and completely hemmed in by hills.

5°. The influence of the tidal rivers is seen beyond the immediate riparial districts.

6°. Like the South-Eastern Division, it has a north and south watershed, although the separating range is more diversified and irregular in its course.



## CHAPTER VII.

## SECTION I.

IT now only remains for me to add a few concluding remarks relative to the extremes of mortality, the probable causes of the excess of Heart Disease, and the use of the map which accompanies this memoir.

On looking at the large coloured map of the districts, the dark blue and the bright red localities strike the eye at once. All the dark blue, where the highest or first degree of mortality is to be found, is in the south-west and south of England, and contiguous to, or lying in, the midst of groups of the second degree. In the West Riding there is an exception to this rule, for we find Otley (now Otley and Wharfedale) lying almost entirely within a group of districts having a death-rate below the average.

The seventeen high mortality districts of the south-west of England are arranged in Table III., from which it will be seen that all of them have an agricultural population greatly in excess of the average for England and Wales, which is 14·6 to every person aged 20 years and upwards; the mean of the whole number is 30·8, or more than double the average; the inhabitants, however, are otherwise variously employed.

Otley has its population not only engaged in the manufacture of cloth and worsted, but it has an agricultural population above the average.

On comparing the districts having the lowest death rate, which are placed in the lower part of Table III., with those having the highest, we shall find that they have one thing at least in common, an agricultural population in excess of the average; they differ, however, in the fact, that minerals instead of animal vegetable products occupy those not engaged in the fields, with the exception of Tunstead, which has its adults employed in agriculture to the extent of 40·2 per cent., a larger population than in any other district, whether of the highest or the lowest mortality.

Between the two extremes of death rate there is little else worth alluding to that forms a common character. The highest mortality districts are always to be found in the most sheltered spots, and are generally those that are leewardly nearest to the sheltering range; without exception all the eighteen districts of the highest mortality are so situated.

All the four districts having the lowest mortality are, on the contrary, some of the most exposed in England and Wales; a glance at the map at once shows this, and without exception, all are surrounded by groups of the next degree of mortality.

If we trace the first and second degrees of mortality from Mid-Devon to Radnorshire, we shall find that they form a V shaped series, having its apex at Henley-on-Thames, its north-west extremity ending at Presteigne in Wales, and its south-west in South Moulton in Devon; all these districts are to the leeward of ranges of hills which protect them from the powerful influence of the south-west winds.

It will be observed, what has been before alluded to, that the valley of the

TABLE III.

<i>Districts having the Highest Mortality from Heart Disease and Dropsy.</i>									
COUNTIES.		DISTRICTS.		Persons Employed in any 100 living at 25 years of Age and upwards.	SPECIAL OCCUPATION.	Mean Population, 1851-61.	Mortality from Heart Disease and Dropsy, 1851-60.	Average Annual Rate of Mortality to every 10,000 Living.	Excess above the Average Annual Mortality 174.
No.	Name.	No.	Name.						
4	Hants, .	113	Alresford . . .	29.9	—	7,301	159	21.7	9.3
"	"	118	Andover, . . .	30.1	—	17,198	352	20.4	8.0
17	Wilts, .	260	Warminster, . .	28.7	Woollen Cloth, .	16,505	330	19.9	7.5
"	"	263	Alderbury, . . .	25.2	—	14,839	327	22.0	9.6
"	"	265	Wilton, . . . .	34.7	Carpets, . . . .	10,703	258	24.0	11.6
"	"	266	Tisbury, . . . .	35.6	Quarries, . . . .	10,022	224	22.3	9.9
18	Dorset, .	275	Dorchester, . . .	28.5	—	24,887	469	18.8	6.4
"	"	277	Beauminster, . .	33.6	Hemp, Flax, . . .	13,928	296	21.2	8.8
19	Devon, .	292	Crediton, . . . .	34.8	Woollen Stuffs, .	21,001	391	18.6	6.2
"	"	294	S. Moulton, . . .	39.2	—	19,588	382	19.2	6.8
21	Somerset,	320	Wincanton, . . .	29.9	Gloves, . . . . .	21,405	410	19.0	6.6
"	"	321	Frome, . . . . .	19.1	Woollen Cloth, Coal,	24,515	510	20.7	8.3
22	Glo'ster, .	333	Dursley, . . . . .	21.3	Woollen Cloth, . .	14,067	284	20.1	7.7
"	"	341	North Leach, . .	37.2	—	10,940	220	20.1	7.7
23	Hereford,	349	Wobly, . . . . .	39.3	—	8,867	182	20.5	8.1
"	"	351	Leominster, . . .	32.2	—	15,201	286	18.8	6.4
26	Worcester,	388	Upton-on-Severn,	25.1	Gloves, . . . . .	19,540	384	19.7	7.3
			Mean			Total	Total	Mean	Mean
				30.8		271,807	5464	20.4	8.0
35	W. Riding,	493	Otley, . . . . .	17.2	Cloth, . . . . .				
					Worsted, . . . . .	20,022	548	20.2	7.8
<i>Districts having the Lowest Mortality from Heart Disease and Dropsy.</i>									
16	Norfolk, .	230	Tunstead, . . . .	40.2	Coal, Copper, . . .	15,065	97	6.4	6.0
43	Carmarthen,	586	Llanelly, . . . .	15.9	Tin, Iron, . . . . .	25,742	140	5.4	7.0
"	Cardigan, .	598	Tregaron, . . . .	41.3	Lead, . . . . .	10,572	78	6.4	6.0
44	Merioneth,	618	Festiniog, . . . .	27.4	Slate, Copper, . . .	17,225	105	6.1	6.3
			Mean			Total	Total		
				31.2		68,604	420	6.0	6.4



Severn and Avon cuts through the north-western extremity of the series, and that there is to be found the only break in the series; coincident with this break in the range of the hills between Wales and Gloucester is a series of low mortality districts; this valley is well flushed with the sea air which rushes up it from the south-west, purging as it goes. At the apex of this remarkable series is an isolated district Wantage, having a lower mortality than its neighbours; it occupies the high ground between the vale of Kennet on the south, and that of the Thames on the north: both these vales are sheltered, and both have a high mortality of the second degree.

SECTION II.

I cannot conclude without expressing my opinion that the great majority of Heart Disease cases in our country have their origin in Rheumatism, and that this disease in many parts of England is endemic.

Heart Disease, if we use the term generally, has almost every variety of cause imaginable; but *the* Rheumatic Heart Disease which kills in such large proportions, is of insidious growth, often unsuspected in youth, and frequently allowed to remain unheeded until it has taken too firm a root to be removed. I believe that it does not require a regular attack of rheumatic fever in order to set up disease in the heart, my experience extending now over nearly a quarter of a century in hospital and private practice, leads me to believe that in certain localities rheumatic disease begins to show itself very early in life: and that from neglect of the first symptoms much mischief accrues. In the agricultural districts we see too frequently the crippling effects of chronic rheumatism.

I think that the coincident phenomena displayed in the foregoing pages point to some *materies morbi*, resident in certain localities, perhaps in all; the only difference being that one district is frequently purged by the beneficial influence of the sea-winds, whereas another is sheltered so as to admit of an accumulation; this accumulated air-sewage may have either an animal or a vegetable origin, or both; it is impossible to say—all that we know is, that it is coincident with excess of rheumatism and excess of mortality from Heart Disease. What we see obtain in the deep unventilated valley districts of Devon, Dorset, Hants, and Hereford, we find in towns where a free flushing of the air-sewage is precluded by the natural position of the town itself; or, if well situated for air flushing, by the bad arrangement of the streets, which are so built as to intercept what otherwise would thoroughly ventilate them, and either chemically or physically rid them of the disease poison.

In the agricultural districts I have no doubt that low wages and low living conspire to render the body unfit to contend against the external influences which are to be found in certain districts; an ill-fed agricultural labourer turns out early in the morning to attend to his duties in the fields, often before the dew is off the ground, when the air is



most chill, and when the exhalations of the night are most noxious; it cannot therefore be wondered at that a large proportion of this class are to be found amongst those who succumb to rheumatism and its sequels—Heart Disease and Dropsy.

The dark blue places on the map are places to be avoided during convalescence, when a change of air is required for a rheumatic case; and again, the map shows us, if it be true that rheumatic

Practical  
Suggestions.

Heart Disease is the most prevalent form of that disease in England, that localities having the characters which have been set forth as coincident with a high death-rate, should not be selected for residence by those who wish to avoid the risk of evoking a disease to which their bodies are already too prone.

These are two practical points of immense importance to the medical practitioner and his patient; but the facts already detailed involve a great many more, which will suggest themselves to those who have enjoyed much experience in their profession.

A grand lesson is taught us by the map, of the beneficial effects of free ventilation, and one which we should ever remember when building our streets, our houses, and our hospitals.

I do not think that the influence of the sea-winds on the mortality from Heart Disease is altogether physical, I incline to the view that there is a chemical element as well in operation; I think that ozone may not play an unimportant part in destroying the material of rheumatism; if so, in the wards and chambers where cases of rheumatic fever lie, we should not only take care that the ventilation is perfect without draught, but that the atmosphere is impregnated with artificially formed ozone; this experiment, I feel, is worth a trial: I know its efficacy in fever.

Influence of Sea-  
Winds, both Physical  
and Chemical.

Ventilation and  
Ozone in bed-  
chambers.

On one thing I feel confident, that the removal, as soon as practicable, of a patient suffering either from the chronic or the acute form of rheumatism, to a locality unfavourable for the development of the disease, is quite essential in order to expedite recovery.

### SECTION III.

The colouring of the map is so arranged as to show six degrees of mortality; three above and three below the average, 12. The *highest* mortality is indicated by the *deepest* blue, and the lowest by the *deepest* red; the intermediate shades lessen in depth as they approach the average line. The *highest* or *first* degree of mortality indicates 19, 20, 21, and upwards to every 10,000 living, as the *annual* average rate of mortality.

Explanation of the  
Colouring of the Map.

Degrees of Mortality.

The *second* degree of mortality, 16, 17, 18, to every 10,000 living.

*Third* degree of mortality 13, 14, 15, to every 10,000 living. These three degrees of high mortality are coloured in different shades of blue.

The districts having a mortality below the average are coloured red in different shades, the lightest being next to the light blue.



The *fourth* degree of low mortality comprises 10, 11, 12, to every 10,000 living.

The *fifth*, 7, 8, 9; and the *sixth*, which is of the deepest red, 4, 5, 6.

The total number of deaths represented on the map of Heart Disease and Dropsy for the decad 1851-60, is 236,983.

Statistics to be  
added in Appendix.

The figures belonging to each district may be found in the Registrar-General's Supplement to his Twenty-Fifth Annual Report, published in 1864; these figures will be reproduced in an Appendix to this work, when complete, and be printed side by side with those belonging to other causes of death.





THE  
GEOGRAPHICAL DISTRIBUTION  
OF  
CANCER IN FEMALES  
IN  
ENGLAND AND WALES.

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CHAPTER I.

SECTION I.

*General Statistics of Cancer.*

**S**IXTY thousand one hundred and ninety-six persons died of Cancer in England and Wales during the ten years 1851-60, of whom 42,137 were females, and 18,059 males out of a mean population of 18,996,916.

Number of deaths.  
The difference between the two sexes, both as to the organs affected by this disease, and the mortality arising from it, being so great, we are compelled to make separate studies of its geographical distribution, commencing with that in females.

Difference in mortality in the two sexes.  
In Heart Disease it was found that the difference between the sexes in the mortality was not great, and that although more females died from this cause, it was improbable that the difference in sex was the origin of the difference in mortality; the organ affected, the heart, is the same in both sexes, and differs not either anatomically or physiologically. The principal seats of

Difference of seat.  
Cancer, however, in females are widely different both in their structure and functions, from any organ to be found in man; these organs—the mamma and uterus—are, moreover, especially liable to be affected: thus these two important seats are superadded to all the others which woman has in common with man, such as the stomach, liver, gullet, lips, &c. We should, therefore, naturally expect, knowing as we do practically, the susceptibility of the two great maternal organs to receive this disease, that the mortality would be higher among women than men. We see that it is more than doubly so.

Cancer is a disease that does not spare either sex or age; and although the mortality from it before puberty is insignificant in both sexes, it rapidly increases after that epoch of life, until the decennium between 55-65 years, when the greatest absolute number of deaths takes place, and the decennium between 65 and 75, when the greatest relative mortality obtains.

Cancer spares not sex or age.

In females the greatest absolute decennial mortality takes place between 45-55, and the greatest relative between 65-75. The great difference in the mortality between the sexes does not show itself until the decennium 25-35, when as it were, *per saltum*, the deaths among women nearly trebled those of the men; the greatest relative mortality occurs between 45-55.<sup>1</sup>

Absolute and relative mortality according to age.

Average annual rate of mortality.

The relative average annual rate of mortality from Cancer during the ten years 1851-60 was, among males, 2.0 to every 10,000 males living, and 4.3 to every 10,000 females living.

During the decenniad there died from all causes 2,072,179 females, so that Cancer caused more than a forty-eighth of the whole mortality among that sex; it was more fatal than the diseases of early life, viz., scrofula and hydrocephalus; it was also more fatal than small-pox, which killed 19,655; scarlet fever, however, destroyed nearly twice as many victims, viz., 82,122 females.

Mortality compared with that from small-pox and scarlet fever.

## SECTION II.

### *The Mode of Investigation.*

England and Wales are divided into eleven Registration Divisions, each of which represents a group of counties, which are again subdivided into Union Districts. During the period I have selected, the ten years 1851-60, each union district had its population carefully estimated according to the death and birth-rate, between the census of 1851 and that of 1861; this estimated mean population forms in the Registrar-General's Supplement to his Twenty-fifth Annual Report a standard which enables us to calculate what proportion the deaths of any district bear to the number of those living within its boundaries: for instance, if there have died in a district, during the decennium selected, having a mean population of 10,000, a hundred persons from any one cause of death, heart disease for instance, by dividing the 100 deaths by the number of years over which they were spread, we arrive at the average annual rate of mortality, which would be 10 to every 10,000 living; the numbers therefore that I use are *proportional*, not *absolute*; and being so, it is all the more necessary that the gross sum from which they are deduced should be as large as possible. Until the present time it was impossible to chartographise disease, inasmuch as the numbers were not sufficiently large, and what had been collected were not in a form suitable for the purpose: of this we can complain no more.

The mapping of England and Wales into 11 divisions, 53 counties, and 623 union districts, affords us the means of analysing the distribution of heart disease,

<sup>1</sup> See Table of Relative Mortality.



TABLE I.

The Absolute Number and Average Annual Number of Deaths by CANCER in both Sexes at certain ages to 10,000 Males and Females living at those ages in England and Wales in the Ten Years 1851-60.

	All Ages	TOTAL UNDER ONE YEAR.	1	2	3	4	TOTAL UNDER FIVE YEARS.	5-	10-	15-	20-	25-	35-	45-	55-	65-	75-	85 AND UPWARDS
Mean Population 1851-61.	Males.	9,278,742	—	—	—	—	1,265,880	1,111,954	1,011,594	915,583	827,833	1,356,605	1,074,115	792,246	523,384	285,163	101,371	13,121
	Females.	9,718,174	—	—	—	—	1,258,614	1,106,619	997,324	929,333	920,917	1,494,666	1,133,809	830,351	565,586	332,631	128,750	20,274
Deaths from Cancer.	Males.	18,059	86	45	56	46	35	107	83	148	224	849	1,874	3,344	4,872	4,288	1,758	244
	Females.	42,137	92	47	68	51	33	102	89	169	272	2,101	6,712	10,614	10,478	7,821	3,030	458
Average Annual Rate of Mortality from Cancer at different ages to 10,000 living during the ten years 1851-61.	Males.	2.0	—	—	—	—	0.2	0.1	0.08	0.1	0.2	0.6	1.7	4.2	9.3	15.0	17.3	18.6
	Females.	4.3	—	—	—	—	0.2	0.09	0.09	0.1	0.3	1.4	5.9	12.7	18.5	23.5	23.5	22.5
Mean of the Two Sexes		3.1	—	—	—	—	0.2	0.095	0.085	0.1	0.25	1.0	3.8	8.4	13.9	19.2	20.4	20.5

This Table is referred to at p. 64. It shows that as life advances the relative number of deaths increases, although the absolute number decreases. This is not the case with Phthisis, although it is so with Heart Disease. Cancer, as Dr. Farr observes, is fatal to few children; and the deaths are probably from soft Cancer (fungus hematodes). At the age of 35-45 this terrible disease, developing with years, now makes an impression in the catalogue of women's diseases. Dr. Farr further remarks that the diseases of the Urinary Organs are more fatal to men, those of the Generative Organs to women. At the age of 45-55 the mortality is 4.2 for men and 12.7 for women. Again, at the age of ripeness, 75-85, Cancer is more and Phthisis is less fatal to women in the proportion of 2.353 to 0.754.—We shall find, when we discuss the Geographical Distribution of Phthisis among Females, that there are still more remarkable differences between this disease and Cancer, which were not known until my investigations were made.

or any other cause of death. By this threefold division we are enabled to analyse our facts by three different processes. In the first place, we see what proportion the death-rate from a cause of death bears to the population in each of the eleven divisions; we colour blue or red those divisions which are above or below the average, and then study this gross distribution carefully; our next process is to colour the counties in the same way, and observe whether the distribution at all coincides with that of the divisions; and our third process is to discover how the proportional mortality of each county is influenced by the mortality in the districts. Having done this we again review our work, and calculate the effect of each of the many causes surrounding us in the production of the distribution, which our coloured map reveals: if during this scrutiny we discover a general law regulating the distribution in each of the three divisions, our last duty is to crucially test the effects of this law, separate the real from the apparent, study the exceptions, and examine their relation to the law discovered.

## SECTION III.

*The Registration Divisions of England and Wales.*

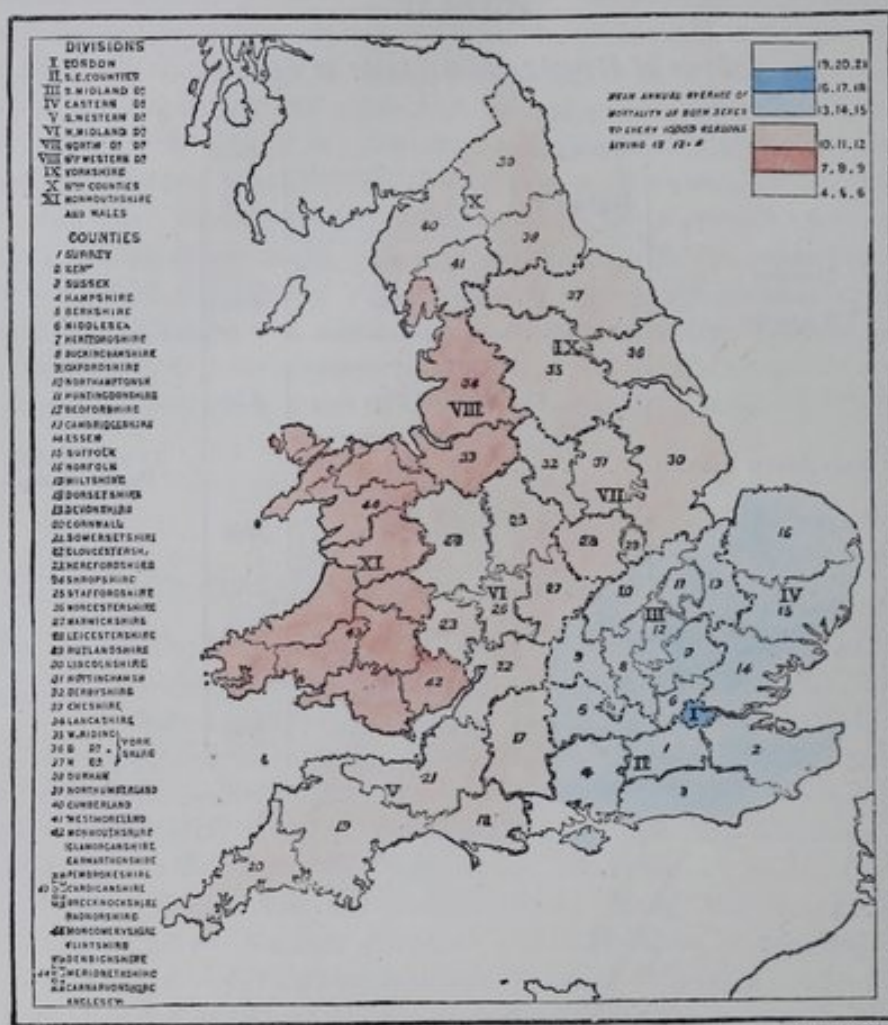
The eleven Registration Divisions into which the fifty-three counties are grouped, are named, with the exception of London, Yorkshire, and Monmouthshire, and Wales, according to their position on our island. For instance, we have the *South Eastern Counties Division*, embracing Surrey (*extra Metropolitan*), Kent (*extra Metropolitan*), Sussex, Hampshire, and Berkshire. The *South Midland Counties Division*, including Middlesex (*extra Metropolitan*), Hertfordshire, Buckinghamshire, Oxfordshire, Northamptonshire, Huntingdonshire, Bedfordshire, and Cambridgeshire. Essex, Suffolk, and Norfolk, constitute the *Eastern Counties Division*; whilst Wiltshire, Dorsetshire, Devonshire, Cornwall, and Somersetshire, compose the *South Western Counties Division*. The *West Midland Counties Division* is composed of Gloucestershire, Herefordshire, Shropshire, Staffordshire, Worcestershire, and Warwickshire. The *North Midland Division* includes within its boundaries Leicestershire, Rutlandshire, Lincolnshire, Nottinghamshire, and Derbyshire. Cheshire and Lancashire form the *North Western Counties Division*. The Three Ridings of Yorkshire are each considered a registration county, and united form the *Yorkshire Division*. The *Northern Counties Division* is made up of Durham, Northumberland, Cumberland, and Westmoreland. The eleventh and last division, that of *Monmouthshire and Wales*, includes all the Welsh Counties and Monmouthshire.



SECTION IV.

Scale of Mortality from Cancer in Females.

		Degrees of Mortality.	No. of Deaths.	
Mortality above The Average.	{	Highest 1° Dark Blue . . .	7·00	
		2° Lighter Blue . . .	6·00	
		3° Lightest Blue . . .	5·00	
THE MEAN ANNUAL AVERAGE . . . . .		4·3	To every 10,000 Females living.	
Mortality below The Average.	{	4° Lightest Red . . .		4·00
		5° Lighter Red . . .		3·00
		Lowest 6° Dark Red . . .	2·00	



## CHAPTER II.

## SECTION I.

*The Geographical Distribution of Cancer in England and Wales in the Eleven Registration Divisions.*

IF we colour a map of the eleven registration divisions of England and Wales according to the degrees of mortality from Cancer, indicated by the different tints of red and blue, always remembering that the most intense blue is the first degree or highest, and the most intense red the sixth degree or lowest mortality, from which the shades lessen as they approach the average line, we shall at once be struck with the definite character of the arrangement that the mortality assumes throughout the country, when divided only into eleven great divisions.

Colouring of the degrees of mortality.



From the west to the east we see four degrees of mortality. 1. The lighter red group of the fifth degree (low mortality) comprehends the North Western Counties Division (VIII) and Monmouthshire and Wales (XII). 2. The lightest red group of the fourth degree (low mortality) extends right through England from the Northern Counties Division (X) to that of the South Western Counties (V), between which we have Yorkshire (IX), the North Midland Counties (VII), and the West Midland (VI). 3. The lightest blue group of the third degree (high mortality) includes the South Eastern Counties (II), the South Midland (III), and the Eastern Counties (IV); and the last group, the London Division (I), coloured so as to indicate the second degree (high mortality).

When studying the distribution of heart disease, we found that the mortality in the divisions gave us a clue, which we were able to trace through the counties, and, lastly, through the districts, in such a manner as to establish the remarkable coincidence which obtains between low mortality from this cause and proximity to the sea-coast, and free access to the sea-winds; we had then to guide us the marked distinction between the mortality in the midland and the coastal divisions; in the case of cancer we have nothing of the kind, for midland and coastal divisions are coloured alike, and the exposed and sheltered coasts are seen to be of the same tints; we must therefore not expect that the same climatic influences which regulated the distribution of heart disease are the causes of that of Cancer.

If we take the extremes of mortality indicated in the divisional map, we shall be enabled to see what physical, geological, climatic, or social characters are coincident with the high and low mortality in eastern and western groups.

1. The lowest mortality group extends from Lancashire to Pembroke, and contains some of the most elevated country and the oldest geological formations; whereas the eastern group of high mortality is characterised by a comparatively flat country in the two divisions north of the Thames, the most recent geological formations, and an extensive double watershed, which, united, forms the Thames.

2. In the western group, on its coastal side, there are no great catchment basins, whilst the double watershed which forms the Severn is shared by both England and Wales. There is no great river system in western Wales; all the mountain streams seem to enjoy an independent course whilst wending their way to the sea, towards which they flow from the hard Silurian rocks that form the backbone of the Principality. They bring little alluvial matter with them as a rule; and when they flood their banks, the waters quickly subside. On the other hand, the Thames receives its waters from the soft oolitic, chalk and London clay hills, which flow often in turbid streams and swell the river so as to flood its riparial districts, which, almost every winter, are saturated with water for several weeks together. This river Thames runs through the centre of the high mortality group of divisions, in which, as we have seen, lies embedded the first division, London having the highest mortality of the four groups.

Four degrees of mortality.

Unlike distribution of heart disease.

Lowest and highest mortality groups.

In relation to the river system.

The Thames.

*Recapitulation.*

It will be well now to subjoin a recapitulation of the above leading facts coincident with a high and low mortality from Cancer, and add others which we know also to coexist with them.

With the *lowest* degree of mortality in the eleven divisions, we find coincident—(1) An elevated site, having a hard rocky foundation, like that of the upper and lower Silurian formation; (2) A single watershed, consisting of many distinct streams flowing directly to the sea, instead of combining to form an extensive river-basin; a comparatively scanty herbage, and a free exposure to the drying influence of strong winds.

With the *highest* degree of mortality we find coincident—(1) A large tract of country, having a low elevation, and a foundation of the more recent and softer formations from the oolitic to the eocene, and even alluvial; (2) A *double* watershed, the streams of which form a large catchment basin, and, united, produce a considerable river, which seasonally floods its riparial districts, from which the extravasated waters do not readily subside, and a luxuriant herbage in the river valley, which is protected on nearly all sides, as we have seen in describing the distribution of heart disease, from the drying and other influences of the winds.

## SECTION II.

*The Mortality from Cancer in Relation to the Density of Population and the Annual Mortality from all Causes.*

Of all the divisions, London (I) has the most dense population; but it will be well to compare its mortality with that of some other large towns when we are discussing the distribution of Cancer in the districts.

Next to London, the most densely populated division is the north-western (VIII), which in 1851-60 had 74 acres to a person as compared with the mean density of the eleven of 1.96 acres to a person. We have seen that this division belongs to the group of the *lowest* divisional mortality. The group of high mortality in the east, comprehending the divisions II, III, and IV, has a density of population much less than the mean of England and Wales; within this area there are 2.57 acres to every person living.

The division in which the mortality from *all causes* exceeds that of any other in England is the north-western (VIII), in which the annual mortality during the ten years 1851-60 amounted to 260 to every 10,000 living, the average for England and Wales being 220; this division has the lowest mortality from Cancer, if we except Wales, throughout England, its mortality, 3.5 to every 10,000 living, being below the average. The group of high mortality from Cancer to the east has an annual rate of mortality from all causes, even including London (I), of 210, or 10 to every 10,000 living *below* the average.

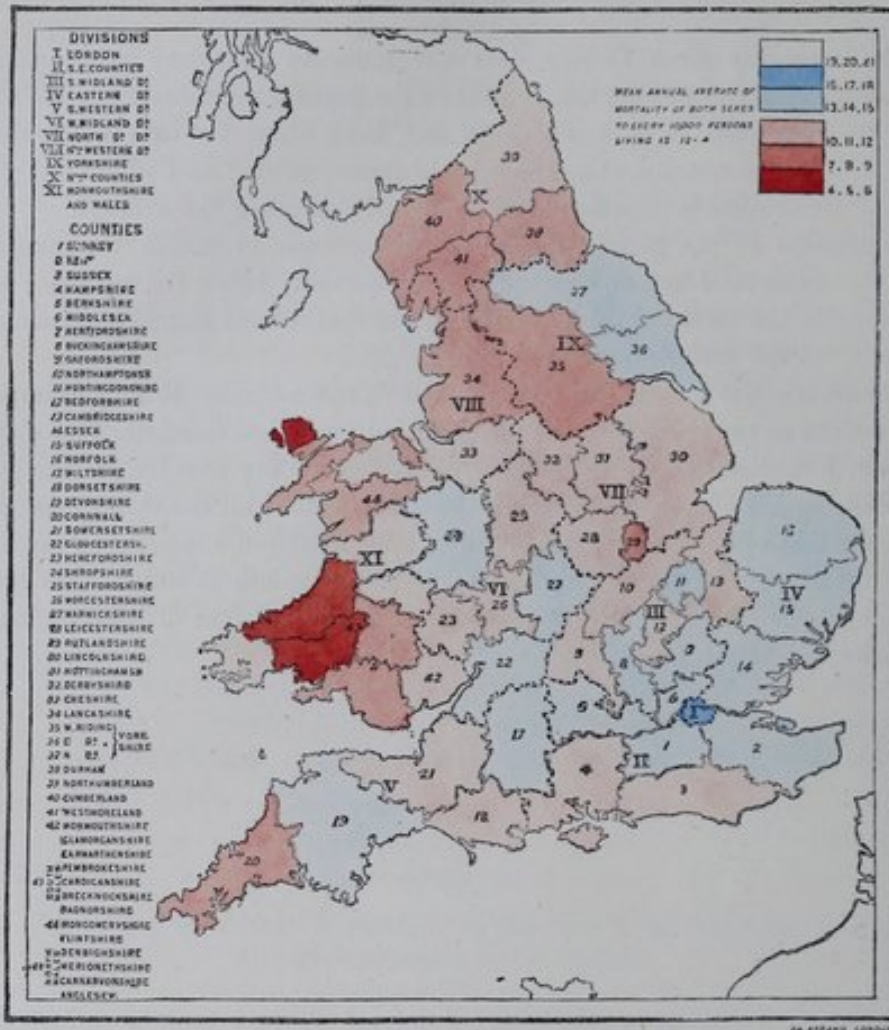


*Recapitulation.*

The mortality from Cancer does not seem to bear any relation to the density of population, nor yet to the general mortality from *all causes*; inasmuch as it has been shown that, where the *least* mortality from Cancer obtains, there the *greatest density* exists; and where the greatest mortality is returned, there the density is below the average.

In relation to the general mortality, the groups in which Cancer proved most fatal had an average annual mortality below the average; whilst, in the most unhealthy divisions, the deaths from Cancer only amounted to the fifth degree of mortality.

The facts above mentioned have now drawn our attention to several important considerations as to the effect of the physical and geological character, and elevation of certain localities, as well as of the river-system of our country, on the geographical distribution of a disease which hitherto has baffled all the skill of generation after generation of our professional brethren. To ascertain one point in the history of this disease will be important, and may lead on to others which have hitherto not been suspected. I shall now sift these facts through the division of England and Wales into fifty-three counties.



## CHAPTER III.

## SECTION I.

*The Geographical Distribution of Cancer in the Fifty-three Registration Counties.*

WE have just seen that the divisions indicated four degrees of mortality—the second, third, fourth, and fifth. The accompanying coloured map of the counties shows five degrees of intensity, the first, or that of the highest mortality, only being deficient. True to what was foreshadowed in the divisional map, we see all the counties on the western side of England, from Cumberland to Pembrokeshire, having the fifth or nearly the lowest degree of mortality. The characteristic features of these counties are—elevated site, with few exceptions; distinct and numerous river-systems, each



of which runs directly to the sea, without forming large basins; a free exposure to the drying influence of the winds, and, at the same time, to torrents, which subside as speedily as they rise, without flooding the adjacent land; the exceptions are the Eden, the Derwent, the Weaver, the Dee, the Conway, and the Dovey. To these exceptions I shall refer in the final analysis of the registration districts (p. 75).

The next group of counties is of the fourth degree (low mortality); it is circular—and partly Welsh and partly English. Denbighshire contains the protected basin of the river Dee, Montgomeryshire the western sources of the river Severn, and Herefordshire and Brecknockshire the well-sheltered streams which form the river Wye. In the centre of this group lies Shropshire (of the third degree), through which the Severn meanders from west to east along its red sandstone valleys, until at Coalbrook Dale it winds through the coal formation near Wenlock, the most northern extension of the old red sandstone in England, and travels to the south in the midst of the new red sandstone and lias valley which contains the towns of Worcester, Tewkesbury, and Gloucester. When describing the distribution of heart disease, I particularly drew attention to the fact that Shropshire was protected to the north and east by the hills which separate it from the watershed of the Dee, the Mersey, and the Trent; in fact, the valley of the Severn in this county is protected on all sides in the first part of its course, and on three when it turns southwards to join the Avon at Tewkesbury.

Sir R. I. Murchison was led to suppose, from the geological character of the valley of the Severn, that it was once a channel of the sea, and that the Bristol Channel at that remote period commenced at the Breidden hills, near the border of Wales; in fact, it is more than probable that the great Y-shaped new red sandstone valley of England was a part of the same channel system, the tail of which is formed by the Severn valley, from which can be traced its two prolongations, one which ends on the Cheshire coast, after passing uninterruptedly through the counties of Gloucester, Worcester, Stafford, Salop, and Cheshire; the other, the longer of the two, follows the course of the Avon, the Soar, the Trent, the Yorkshire Ouse, the Swale, and the Tees, through the continuous counties of Worcester, Warwick, Leicester, York, and Durham. We shall find that this remarkable geological tract bears a most important relation, not only to the distribution of general health, but of some most important diseases. It will be referred to at a future time. Sir R. Murchison believed that as the Channel advanced southward it was bordered at its sides by the Malvern and Cotswold ranges; and Mr. Charles Frederick Cliffe, in his interesting 'Book of South Wales and the Bristol Channel,' adds that 'the bluffs of the Cotswold, which often resemble marine headlands, serve to give a popular character to this view.' We all know that the Severn floods its banks at certain seasons, and that the valley then resembles a channel more than a river. Mr. Cliffe tells us that, in consequence of the nature of the country through which the Severn and its tributaries flow—soft sandstone and marl—its waters are said to be charged with a larger amount of turbid deposits than any other river in Europe; in fact, Richard of Cirencester speaks of the 'turbidum Sabrinae fretum.' The strait must have been reduced to the limits of the present Bristol Channel by some considerable elevation of land. Even now, however, the fall of the river between Worcester and

The Severn counties.

R. I. Murchison on  
the River Severn.

Mr. Cliffe.



Gloucester, a distance of nearly 30 miles, is only 10 ft.; the descent from Buildwas, in the district of Madeley (358), to Gloucester (72 miles) is only 104 ft. 3 in.; and on the authority of Mr. T. Fuljames, C.E., Mr. Cliffe states that from Stourport to Gloucester (42 miles) the character of the stream is so continuously similar as to be without a parallel, the course being almost due north and south, and the width (150 ft.) the same at either end. The Severn is subject, from its mountain origin and the number of its tributaries, to sudden and sometimes *very destructive floods*, which are not much to be wondered at, when it is borne in mind that the superficial extent of the country which it drains down to Gloucester is 4,437 square miles. The flood of 1770 inundated the adjacent country to the depth of 6 ft. 9 in.

Coincident with the above facts, we find a death-rate from Cancer in females *above* the average. This high mortality is coincident with the same physical, geological, and hydrographical facts which were indicated in the high mortality group composed of the I., II., III., and VI. divisions, viz., a sheltered catchment basin, surrounded by heights which are composed of soft rocks affording abundant alluvium, seasonal floods, which, from the low elevation of the valley, do not readily subside, and ancient alluvial deposits which form the sites of the riparial districts.

The next high mortality counties are Gloucester and Warwick: in the former the Severn and Avon join; and in the latter is the high mortality vale of the Gloucester Avon, which has many of the characters of the Severn. These two counties join Wilts, with its sheltered Avon and tributaries; and next in order is the group of counties, the rivers of which unite to form the catchment basin of the Thames. Thus we have Berkshire and the river Kennet, Buckinghamshire and the river Tame, Middlesex with the river Brent, and Hertfordshire and Middlesex with the river Coln and river Lea; Essex with the river Roding; Kent with the rivers Medway and Darent and Wandle; and, lastly, Surrey with the Wey and the Mole rivers. Thus we find this group of six high mortality counties surrounding and joining the sheltered and fruitful valley of the Thames. Continuous with these last counties are those of Suffolk and Norfolk, which will be again treated when the districts are analysed (p. 85).

The next great high mortality group is that comprising the North and East Ridings of Yorkshire. Within these two counties are to be found the courses of the fully formed rivers which arise in the West Riding and the west part of the North Riding, and the sheltered river system of the Derwent and the Rye, which, like the Severn, run from north to south, and there joins the grand trunk of the Ouse; the river Hull falls into the Humber at right angles to its course.

All the Yorkshire rivers are liable to floods; the red sandstone and alluvial vale of York has a low level, and the waters which flow along it after heavy rains have much alluvial matter. The rivers of the vale of Pickering and Rye, where there is a stiff clayey and ironstone soil, frequently flood their adjacent districts during the wet winter months, and the country remains saturated for weeks together. The last high mortality county is Devon, with its Old Devonian soil, so rich and fertile, from which so many streams flow to form the rivers Exe, Torridge, Taw, and Tamar. All these



rivers run through well-sheltered valleys, as we have seen when discussing the distribution of heart disease; frequent floods take place after heavy rains, or sudden thaws after a deep snowfall. The mortality from Cancer in this county is higher than in any other; its river-system carries abundant alluvium when it swells, and the adjacent districts are often covered with water for a considerable time during the rainy season.

Thus have we seen that, in every county where there is a high mortality, the characters of their river-basins bear a strong resemblance to each other, which in recapitulation I may thus sum up:—

*Recapitulation.*

1. In the counties having a high mortality from Cancer, we find that the tributaries of the large rivers flow from soft marly or other easily disintegrated rocks into sheltered valleys, through which the main rivers flow.

2. These rivers invariably flood their adjacent districts during the rainy season, and have generally their waters coloured by the suspension of alluvial matter.

3. Those counties which are characterised by hard and not easily disintegrated rocks, such as the Welsh Silurian and the great carboniferous range, which forms the backbone of the northern counties to the north of the Mersey, and which are freely exposed to the drying influences of the wind, have, coincident with these opposite characters, a low mortality.

4. It was seen that the Thames counties, characterised by their tertiary soil, and frequently flooded river, form, as it were, a typical cancer-field.

## CHAPTER IV.

## SECTION I.

*The Geographical Distribution of Cancer in the Six hundred and twenty-three Registration Districts.*

**I**F the facts which we have noticed in the divisions and counties relative to the coincidence of low mortality from Cancer and an unelevated site, and high mortality and catchment basins of rivers which seasonally flood their banks, are real and not apparent, we have it within our power, in the third process of analysis, either to establish their reality or to dispel the illusion altogether.

A line drawn from the source of the Tyne in Northumberland to that of the Kennet in Wiltshire, will cut through all the districts which lie on the backbone of England, separating the eastern from the western watershed. Again, if we colour, according to their mortality, the districts along this elevated ridge, we shall find, with few exceptions, that they all indicate a very low mortality, especially along the northern portion, where the districts lie on the hard carboniferous limestone, and are fully exposed to the wind from both seas. The lowest mortality is to be found between Bellingham and the north of Staffordshire, the most exposed part of England.

From the north of Staffordshire another line may be drawn around Wales, which separates the coastal from the inland watershed; the latter includes the catchment basins of the Severn and the Wye. From one end to the other of this semicircular line is a continuous series of low mortality districts, all of which are the most elevated and most exposed localities in Wales, and their geological formation is the hard and unyielding Silurian rocks.

From Penzance to the South Foreland, another elevated ridge of an irregular course is seen; in the west of England it separates the northern from the southern coastal watershed, and in the east of England the south watershed of the Thames from the coastal river system. Along both these ridges we find again a continuous line of low mortality districts; and it is noteworthy that the most exposed, like those in Wales, have the lowest death-rate from Cancer.

The ridge north of the basin of the Thames, which stretches from Warwickshire through Northamptonshire, Buckinghamshire, Bedfordshire, and Hertfordshire, to the north bank of the Thames opposite Gravesend, where chalk appears, is again another instance of elevated site and a continuous line of low mortality districts. This ridge, with the southern one just described, and that portion of the central ridge of England in Wiltshire, entirely encompass the basin catchment of the river Thames and its oft-flooded valley. We have seen, therefore, that almost without exception the great ridges of England and Wales which determine the watershed of our country are the sites where the low mortality from Cancer is almost invariably found. The most exposed, the most elevated districts, and those having a hard rocky foundation, or an absorbent oolitic or chalky soil, are those where the lowest mortality is to be found.



## SECTION II.

We must now turn our attention to the watersheds and river-basins, and see what they indicate. In the first place, let us take the Severn and  
Watersheds. Avon, and the Wye included, within the main ridge of England and the circular ridge of Wales. Instead of districts coloured red, we find in all these rivers their courses are followed by high mortality districts; and that the most intense blue, or highest mortality, is to be found in those districts which, from the confluence of rivers within them, are most liable to be flooded. When a river cuts its way through a narrow defile in a hard obstructing rock, there we find the mortality lessened; the banks do not then admit of flooding.

Again, if we attentively look at the catchment basin of the Thames, we shall  
Thames. see how remarkably the high mortality districts group themselves along the course of the river and along those of its tributaries forming the largest Cancer field in England and Wales.

Going northward, if we trace the Trent and the great Yorkshire rivers, we  
Yorkshire and northern rivers. shall find their courses characterised by high mortality districts, especially where they pass through a low and sheltered country, which offers facilities for flooding. Again, in Cumberland we have a remarkable group of high mortality following the rivers Eden and Derwent, and sheltered by the high ridges of the Northumbrian and Cumbrian hills.

Descending to the south, we see the Wiltshire Avon followed by high mortality  
Southern rivers. districts; and the same is seen to be the case along the rivers of Devon and Cornwall, especially in the former county. Along Sussex and Hampshire, south of the ridge which forms the boundary of the Thames basin, the rivers there again are followed by high mortality districts, especially where the rivers are of any importance, and, from the nature of their courses, are liable to overflow their riparial districts.

*Recapitulation.*

We have seen that the analysis of the geographical distribution of Cancer by the registration districts corroborates what was foreshadowed by the divisions, and more clearly defined in the counties:—

1. That, geologically, the hardest and most elevated rocks, or the most absorbent, like the oolite and chalk, are the sites where the least mortality from Cancer is found.
2. That, along the river-courses which flood their banks seasonally, such as the Thames, the Severn, the Mid-Devon, and Yorkshire rivers, are to be found the districts in which the highest mortality takes place.

And 3. That wherever, from the nature of the rocks forming the watershed, the floods are much discoloured by alluvium, and where from the flatness of the country the floods are retained and not easily drained off, there we find the greatest mortality from Cancer among females.

## SECTION III.

*The Divisional Mortality in Relation to Density and the General Annual Mortality.*

TABLE II.—CANCER.

*The Average Annual Rate of Mortality in each of the Eleven Registration Divisions of England and Wales to 10,000 living, during the ten years 1851-60.*

DIVISIONS.	MALES.	FEMALES.	MEAN.	Density of Population. Acres to a person. 1851-60.	Annual Mortality to 10,000 living from all causes.
I. LONDON . . . . .	2.4	5.8	4.1	.03	240
II. SOUTH EASTERN COUNTIES . . . . .	2.1	4.9	3.5	2.34	200
III. SOUTH MIDLAND " . . . . .	2.3	4.6	3.4	2.53	200
IV. EASTERN " . . . . .	1.9	5.0	3.4	2.85	210
V. SOUTH WESTERN " . . . . .	2.1	4.4	3.2	2.74	200
VI. WEST MIDLAND " . . . . .	1.8	4.3	3.0	1.69	220
VII. NORTH MIDLAND " . . . . .	1.9	4.1	3.0	2.83	210
VIII. NORTH WESTERN " . . . . .	1.5	3.4	2.4	.74	260
IX. YORKSHIRE . . . . .	1.8	3.8	2.8	1.92	230
X. NORTHERN COUNTIES . . . . .	1.9	3.8	2.8	3.29	220
XI. MONMOUTHSHIRE AND WALES . . . . .	1.8	3.0	2.4	4.18	210
ENGLAND AND WALES . . . . .	2.0	4.3	3.1	1.96	220

From the above table we see at a glance the relative mortality in the Eleven Registration Divisions, but the bare figures fail to convey to our eyes the real significance of the geographical distribution of the death-rate from Cancer in females involved in them; the coloured map, however, does so at once, and indelibly. The student who is well acquainted with the physical and geological character of the face of our country, by an attentive examination of the grades of mortality from east to west portrayed on this map, will almost immediately be enabled to predict what the further analyses of the counties and districts will reveal.

That the mortality from Cancer is not in the direct ratio of the density of population is sufficiently apparent from the above table: for instance, the North Western Division (VIII.), which has the most dense population except London (I.), has also the lowest mortality after Monmouthshire and Wales (XI.). Again, of the divisions which surround London (I.) the Eastern counties (IV.) have, coincident with the least density of population, the highest mortality from Cancer.

It is, however, equally true that two divisions, the Welsh (XI.) and the Northern counties (X.), have a low death-rate amidst the most sparse population.

We see, therefore, as in the instance of division VIII., that almost the lowest mortality is compatible with a most dense manufacturing and trading population,



and that almost the highest mortality, as in the Eastern counties (IV.), is associated with a comparatively sparse and agricultural community.

We have already alluded to the relation between a high general death-rate and the average annual mortality from Cancer, p. 70. The table before us abundantly shows that we have associated with a general mortality below the average (IV.) a Cancer death-rate nearly the highest in the scale of the divisions; whilst, on the other hand, we see almost the lowest Cancer mortality obtaining in the midst of an area where the general mortality returns are exceptionally high.

Before leaving this subject the reader's attention may be drawn to the rather remarkable fact that, whilst the male population in three of the

Cancer Death-rate and  
General Mortality.

four counties around London participate with the females in suffering an annual mortality above the average, that in the Eastern counties does not do so. The equability, however, among males of the Cancer death-rate throughout England is a noteworthy feature in the distribution of this disease, and is in strong contrast with that among women: this, however, is quite in harmony with what we know to obtain in all diseases in the causation of which local conditions are prominent factors, whether they be social, telluric, or atmospheric: the

London Division (I.).

women stay at home, the men go forth to work. London (I.), unlike the other divisions, embraces only a part of each of the three counties which surround it; instead, therefore, of calculating its Cancer death-rate from these portions, we proceed at once to its registration districts, which bear the same relation to it as a whole as the counties do to the other ten divisions. On looking at the high mortality of this division, and considering the immense population living upon the banks of the Thames which washes the riparian boundaries of Middlesex, Surrey, and Kent, we might be easily led to think that the death-rate

District around

from this cause in the metropolis would naturally dominate that in the counties; but even a cursory glance at the large map of the districts will dispel any idea of the kind; for out of the twelve districts which immediately surround London, Bromley, Dartford, and Hendon are the only three having a mortality below the average, and including these the mean mortality of this extra metropolitan circle amounts to within seven decimals of that of London; for instance, Dartford 4.0, Bromley 3.6, Croydon 5.6, Kingston 5.8, Richmond 7.3, Staines 5.6, Brentford 5.5, Hendon 3.7, Barnet 6.2, Edmonton 5.2, West Ham 4.8, and Romford 4.9=5.1. Surrounding these will be found another circle of high mortality districts, and even a third more or less complete.

London, however, is only in the same category with Liverpool; it participates

compared with  
Liverpool

in the surrounding conditions which characterise the soil, the river, and the atmosphere of the area in which it is centred, and it shares their effects with its neighbours. In Liverpool exactly the same thing obtains, only fortunately, so far as this disease is concerned, this great hive of industry enjoys a neighbourhood having all the elements of climate herein shown to be coincident with a low Cancer death-rate. As London is hemmed in by a plus average cordon, so is Liverpool backed by districts having almost the lowest mortality in England. No one, however, on comparing the mortality of Liverpool and West Derby with the districts adjacent, will fail to see the evident struggle that has taken place within this area between social and climatic factors for the mastery. The latter,



however, were as successful in the north-west for good, as they were for evil in the south-east.

Like London, Berwick, Bury St. Edmunds, Canterbury, Chatham, Chichester, Brighton, Reading, Hull, Plymouth, E. Stonehouse, Exeter, Gloucester, Worcester, Shrewsbury, Carlisle, Newcastle, York, and Lincoln are situated within high mortality groups, and share it with the districts composing them; and like Liverpool the following towns enjoy a low death-rate in common with their immediate neighbours, viz., Leeds, Bradford, Blackburn, Manchester, Walsall, Merthyr, Cardiff, Bridgewater, Andover, Winchester.

There are, however, several exceptions to this rule, amongst the most notable of which are Cambridge, Hastings, Southampton, Falmouth, Bath, Bristol, Birmingham, Taunton, and Sheffield; in many of these instances the mortality is only just above the average, and may be accounted for by the immigration of diseased subjects from the neighbourhood, for the purposes of hospital treatment. Many of the towns, however, like Bath and Bristol, are situated upon the banks of rivers, as the Avon, which habitually flood their banks, and thus supply a condition which is absent in the neighbouring towns and villages built more inland and frequently on more elevated, and therefore on more advantageous sites.

It is worthy of remark that whilst we find high mortality exceptions within limited mostly to High Mortality Districts. low mortality areas, we do not find instances of the converse, as was noticed in Heart Disease, which seems to indicate that this disease is not so preventible by sanitary regulations as the disease just named, and that where Cancer is suspected to be latent in an inhabitant of a place possessing the natural conditions favourable to its development, the only safe precaution is emigration to any of those well-defined localities, where we have found it does not thrive.

I must now draw the reader's attention to London, which, although the most important division, has hitherto received only a general and a passing notice.

With regard to the geological character of the extensive site of our present huge metropolis, it is probable that the original founders of the city were actuated in its selection by more rational motives than the present generation is in its extension. There is every probability that the gravel and brick earth knoll, upon which the Tower and St. Paul's now stand, having an altitude, according to the geological maps of Mylne and Wyld,\* of between forty and sixty feet, was the chief inducement to the earliest settlers for making this classical spot the seat of their habitations and their stronghold; to this fortified knoll they gave a name, according to the best authority, which had reference, as all names of the kind should have, to its natural characters—the water *Llyn*, and fortified hill *dun*; even now, on looking at a contour geological map, we cannot help admiring the sagacious instinct that prompted the simple colonist to select this spot for his future dwelling and protection; now-a-days we act by the light of our reason guided by expediency and fashion, which, like two Will-o'-the-Wisps, lead us into

\* Lately published. This map shows not only the geological features and the altitudes, but it contains an area of about 450 square miles, on a scale of a mile to an inch.



bogs and morasses, enriching the land owners, who wisely do not live there themselves, and impoverishing the deluded community by the effects of disease and an excessive death-rate. This subject will be again noticed in a future work on the Geographical Distribution of General Health.

Now London, in the most comprehensive sense of the term, may be considered to be built upon three *natural* geological formations, alluvium with bog, drift gravel and London clay, on which, and more especially on the second, is superimposed artificially a stratum of a primary rock—granite. Another artificial formation is what is technically called *made ground*; the worst and most delusive of all.

The artificial granite formation is of high sanitary value, and the extent to which it has been laid on in the older parts of London, where the traffic is greatest, has undoubtedly had a wonderful influence on the local climate, and therefore on the public health; it is evident that the hygrometric and electrical condition of the atmosphere above a granite area, which favours the ready disappearance of the rainfall through the drains into the river, must be widely different from that floating over a macadamised clay area, or the air wafted from extensive enclosures of unmitigated and badly drained London clay, such as Regent's Park and Primrose Hill; spaces that might be made sources of health to the neighbourhood instead of the birthplaces of mists and fogs, with their attendant evils.

The great geological characteristic of London proper is the drift gravel, which lies on the clay, and skirts to a more or less considerable extent the left and right banks of the Thames; it is of variable thickness, and is here and there capped with brick-earth; it is to be traced up several of the tributaries of the great river, and is flanked in Middlesex, Surrey, and Kent by the heights composed of London clay, which are capped in several districts by various siliceous deposits—for instance, on Hampstead and Highgate heights are to be found the Bagshot sands, which, according to Wyld's map, also appears on the Combe and Wimbledon heights. Hyde Park is almost entirely composed of gravel, except where the original streams which once naturally trended through what is now called Bayswater have cut their way through the loose deposit and exposed the clay beneath. If anyone doubt the effect of soil on our nervous and muscular system, let him walk through Primrose Hill, Regent's Park, and Hyde Park after a little rain, and he will soon be satisfied that it is one thing to walk over undrained clay and another upon the turf resting on a naturally drained gravel area. Children, who are more susceptible than adults in their liability to be affected by local climatic causes, suffer sooner from fatigue on ill-drained clay and made earth than they do on a natural drained, gravelly soil.

London comprehends thirty-six districts, thirty of which have a mortality from Cancer above, and six only below, the average annual rate. The minus average is semi-circular, and extends from St. Luke's through East London, Bethnal Green, Poplar, Rotherhithe, and Bermondsey. It may be remarked in passing that nearly all the London districts follow the general law of geographical distribution, to which I was the first to draw attention before the Medical Society of London in 1868, and in my lectures at St. Thomas's Hospital at a subsequent date; this remarkable law, which is proved to exist by a large number of instances spread throughout England and Wales, may be summed up in the following

Children and difference  
of soil.

London.

East End.

Cancer and Phthisis.



proposition: That the geographical distribution of Cancer is the converse of that of Phthisis. This will be dealt with in a more detailed manner when I treat on Phthisis in females. Poplar, one of these low mortality districts, forms an exception to the general distribution throughout London, and also to that which obtains throughout the country, for on reference to either of the geological maps named it will be found that its site is flanked to the east by the alluvium which has been deposited on the western bank of the river Lea; all the others lie on gravel of moderate elevation, and are exposed to the drying influences of the easterly and north-easterly winds; the former of which sweeps uninterruptedly up the flat country bordering the Thames. As we recede from the gravelly eastern

Marylebone.

boundary towards the north-west and west we find the mortality increasing until it culminates in Marylebone, where the death-rate amounts to 9.2 to every 10,000 females living; this will be alluded to again. This high mortality is coincident with the neighbourhood of a large exposed and badly drained clay area comprised within the limits of Regent's Park and Primrose Hill. St. George's, Hanover Square, is another district having a high mortality, and it

West End.

seems evident that the death-rate in the low lying river extremity, situated as it is on alluvium brick-earth and made-ground, on which are densely crowded in the neighbourhood of Vauxhall Road a poor population, dominates that in the Hyde Park extremity, where the elevation is considerable, the houses larger, the streets more capable of ventilation, the inhabitants wealthier, and the drains not subject to flooding during high tides. On the other hand, we see Westminster having a comparatively low mortality; the neighbourhood of Kensington Gardens is included in this district. The gravelly soil and drier air probably conduce to a higher state of health; and as the larger portion of this district is thus favourably circumstanced, we find it in its turn influencing the death-rate in an opposite direction to that of the river and of St. George's, Hanover Square. A glance at the map will at once reveal the absurdity of the

Anomalies in the District Boundaries.

system by which the boundary lines of the several districts have been defined; it is well exemplified in the case of the two last districts named, both of which actually cross each other, each having a portion lying close to the banks of the river; and another at a great distance from it in a part of London differing in every essential point, such as soil, altitude, and population. Unfortunately, there are many such anomalies to be found throughout England, and they afford almost insuperable difficulties to the medical geographer.

London affords a good illustration of what I have often urged, that throughout

Localities near London adapted for a Cancer Hospital or Cancer patients.

North.

England, even in the neighbourhood of the worst localities, where diseases of a particular kind thrive, there are to be found spots rising, as it were, out of their midst, to which resort may be made as a preventive measure by those who are liable to succumb to predominant malady. On the north side we have the heights of Hampstead and Highgate capped by the Bagshot sand, in both instances more than four hundred feet above the Ordnance sea level datum, affording magnificent views, and an atmosphere frequently supplied with fresh and invigorating sea winds from the German Ocean, and ozoniferous breezes from the south west, besides which the air contains positive electricity frequently of high tension; a fit site for a Cancer hospital.



Hendon, with its gravel capped Hill of Harrow, seems to benefit from these genial influences, for we find it standing out as a low mortality district in the midst of the Thames Cancer field. On the South of the Thames there is Combe, Wimbledon, Blackheath, and Shooter's Hill, all more or less surmounted by gravel and a siliceous soil, which, combined with a moderate elevation, give them a distinctive character; Clapham Common is also composed of gravel, and has an altitude of nearly a hundred feet; all these places have local climates totally different from what is to be found where clay prevails unmitigated by drainage, and unsealed either by granite or concrete.

## CHAPTER V.

## SECTION I.

*The Mortality from Cancer in Relation to the Physical and Geological Character of Site.*

ON looking attentively at the large coloured map of the districts, the first great fact that draws attention is, that nearly the whole of Wales and the north-west portion of England is coloured *red*, which indicates a low amount of mortality from Cancer over this large area; coincident with this is the fact that these parts of England and Wales belong, geologically, to the oldest formations, namely, the Silurian and carboniferous, and, physically, include the highest and best drained mountainous districts in the country.

Low mortality group:  
Wales and north-  
west of England.

The aspects of the northern portion of England are directed both to the west and the east, and it is from these elevated regions that the great watersheds are formed which give rise to the Northumbrian and Yorkshire rivers that flow into the German Ocean on the east side of the Pennine Range, and those that find their way on the west into the Irish Sea. The coast part of Wales has a westerly and south-westerly aspect, and its mountain streams flow into the St. George's and Bristol Channels. Inland Wales looks towards the east, and gives rise to the Dee, the Severn, the Wye, and the Usk; the three last finding their way into the Bristol Channel, the Severn in conjunction with the Avon of Gloucestershire and the midland counties.

Aspect and watershed.

The next great low mortality or red group is to be traced in the south and south-east of England; it extends northwards from the Isle of Wight through the greater portion of Hampshire, crosses that part of Wiltshire where the Kennet rises, and passes still in a northerly direction to the Cotswold Hills in Gloucestershire, where the Thames has its source, and then turns eastward to pass through Oxfordshire, the south-west of Northamptonshire, Bedfordshire, Hertfordshire, Cambridgeshire, and Norfolk. The area includes the chalk hills of Hampshire, Wiltshire, Oxfordshire, Buckinghamshire, Hertfordshire, Bedfordshire, Cambridgeshire, Suffolk, and Norfolk, and is flanked by the range of the Oolitic series of Gloucestershire, Oxfordshire, and Northamptonshire.

These two large groups intercommunicate through the groups which lie on the red sandstone of Warwickshire, the red sandstone and lias heights of Leicestershire, and the red sandstone and carboniferous rocks of the mountain range of Derbyshire. Like the Cheshire portion of the great north-west group, the Gloucestershire or Cotswold portion branches northward, through the red sandstone heights of Worcestershire and Staffordshire, in fact through that portion of this elevated tract whence arise the rivers Cole, the Tame, the Trent, and the Dove. These two great groups, and their intermediate links, are the elevated districts of England, and they contain the *sources* of the great rivers which drain the country.

The two groups inter-  
communicate.



On the other hand, if we trace the boundaries of the high mortality or *blue* districts—which when formed into groups, as they are on the map, may be called the Cancer fields of England—we shall find that, instead of their occupying the elevated portions of the country, these groups are, almost in every instance, seen to surround the great rivers after their full formation, and when they have reached the low-lying valley land, where the districts through which they pass, in their passage to the sea, are liable, after heavy rains or sudden thaws, to serious floods.

Again, we shall find that the sites of these Cancer fields are mostly composed of the tertiary formations. Take, for instance, the Cancer field of the Thames, which is almost co-extensive with that large tract of the lower eocene called the London clay; the East Yorkshire field, which is traversed by the large rivers forming the Humber—a district we know to abound in alluvium and the recent deposits of the overflowings of its great rivers.

In Suffolk, the riparial districts of the Stour, except Stamford (221), and in Norfolk, those which the Yare, the Wensum, and the Bure traverse, are characterised by a high mortality, and form lesser cancer-fields on the tertiary soil.

Again, along the Nen and Ouse, we see a semicircular group (high mortality), continuous with the Witham and Trent group of Lincolnshire and Nottinghamshire.

Again, if we trace the field which commences between the south of Derbyshire and the north of Leicestershire, where there is the confluence of the Derwent and the Soar with the Trent, along the last-named river into the Lincolnshire field, which is traversed by the Don, the Trent, and the Witham, we shall find that alluvium follows the route of all these watercourses, and that the more recent formations characterise these lowlands.

The Cumberland field follows the course of the vale of Eden and the valley of the Derwent; the Eden runs through the new red sandstone, and in the neighbourhood of Carlisle the character of the soil is alluvial.

The mid-Northumbrian group embraces the comparatively low area where the north and south Tyne join to form the river, on the banks of which the Newcastle field lies, and forming a strong contrast to the coal districts generally, which have, as a rule, a low mortality from this cause.

The Berwick group lies on the banks of the Tweed, and that of Rothbury is traversed by the Coquet.

Through Gloucestershire, Worcestershire, and Shropshire, the plus-average groups follow the course of the river Severn on its western side, and this group is continuous with the Herefordshire field, which is traversed by the Wye and its tributaries.

The Stour of Dorsetshire and the Avon of Wiltshire traverse, on the west, the high mortality districts of Blandford, Sturminster, and Shaftesbury; and on the east, those of Ringwood, Fordingbridge, Alderbury, and Wilton.

The low-lying Tone runs through the centre of the Taunton district, and the great mid-Devon field comprehends the Taw, the Exe, the Tamar, and the Dart.

It will be thus seen that the Cancer fields of England are to be found in the sheltered and low-lying vales traversed by *fully-formed* rivers, and having sites composed of the more recent geological formations, such as the crag and alluvium of the Norfolk and Suffolk field, the clay of the Thames field, and the alluvium of the Lincolnshire and East Yorkshire groups.

## SECTION II.

*The Mortality from Cancer in Relation to Seasonally Flooded Sites.*

THE rainy seasons cause many floods in different parts of England, and every account that I have hitherto gathered has corroborated the views  
General conclusion. I hold with regard to the peculiarities of the sites of the Cancer fields, more especially in reference to the effects of inundation. In Yorkshire, the Midland Counties, and along the course of the Thames, floods constantly occur, and these areas are all coincident with the districts of high Cancer mortality. I wish, however, to extend the inquiry, and obtain information of all the inundations which have resulted from the heavy rainfalls. I, therefore, desire to call the attention of my readers to the subject, with the view of asking their assistance in the collection of further facts, which are of so much importance to the public health.

The Thames at Eton and Richmond floods the country near its banks, and,  
The Thames and tributaries. higher up, in Oxfordshire, in the neighbourhood of Little Moor and Wet Sandford. The high mortality districts of Hedington and Oxford are often inundated by the Cherwell and the Isis. These rivers unite in this district. There is a Dry Sandford in the low mortality district of Abingdon, in Berkshire, having a comparatively high site upon the coralline crag.

The plus average districts skirting the course of the Thames are: Wallingford, Henley, Reading, Bradfield, Eton, Windsor, Chertsey, Staines, Kingston, Richmond, Brentford, Croydon, and London. These districts are all more or less flooded by the Thames during continuous rain from the south-west, or after a sudden thaw, when the wind has veered to that quarter. It will be, therefore, extremely interesting to observe the extent of floods over these districts which form the centre of the Thames Cancer Field.

In the Midland Counties the site of the Cancer field through which the Derwent, the Trent, and the Soar pass before their confluence, is  
Derwent, Trent, Soar. frequently flooded, and at Nottingham, which is included in this field, the Trent occasionally overflows its banks, and completely submerges the vicinity.

Throughout the East Yorkshire Cancer field the floods ramify in every direction. At Stamford Bridge, to the south of York, some hundreds of  
Yorkshire rivers. acres are often under water, owing to the Ouse breaking bounds. To the north of York the country is equally subject to be submerged. The river at Ripon frequently overflows its banks. Marishes Road, near Pickering, in a district



where the mortality from Cancer is excessive—being nearly double the average, 8.1 to 4.3 to every 10,000 persons living—is usually inundated very largely. In a mean female population of only 5,092, 41 women died of Cancer during the decennium. Had Liverpool such a percentage of deaths, instead of numbering only 552 women among its female population of 134,014, its deaths from this cause would have been doubled—1,104.

In the midst of these high mortality groups of East Yorkshire are three minus average districts, forming two distinct groups. The one to the south-west is composed of Pocklington and Driffield, having near their sites the elevated chalk wolds of Yorkshire. The Easingwold low mortality district is to the north-west, and although a portion of it lies on the Kimmeridge clay, near the banks of the Swale and the Ouse, the largest and most important part has an elevated site on the oolitic range of the Howardian Hills, which lie between the towns just named and the Rye. In Easingwold the mortality from Cancer in a female population of similar amount to that of Pickering, is barely half what it is in the latter plus average district, and in those of Driffield and Pocklington the proportion of deaths from this cause is even less than half. Here, as in Hampshire, we find the chalk hills and towns forming the sites of minus average Cancer districts. In the next county, Lincolnshire, where the chalk range is continued as the Wolds of Lincolnshire, we find the districts situated on them the healthy or low mortality districts, skirting those which form the Lincolnshire and Nottingham Cancer field, whose alluvial site is watered by the Trent and the Witham.

The essentially chalk county of Hampshire is remarkably free from Cancer; its rivers, the Test and the Itchen, have their origin in the chalk hills; they are genuine rivers of the chalk, and possess these remarkable characteristics:—From the absorbent nature of the formation which gives them rise they do not swell suddenly after heavy rain, nor do they flood their banks. They retain a very equable height during summer and winter, neither drying up in a drought nor flooding their vicinity after a deluge of rain or sudden thaws; their waters are seldom coloured, in fact, they are the least alluvial of our rivers. We must remember not to confound these rivers *from* the chalk with those which only pass *through* the chalk after arising from the heights of other formations, such as those which spring from the Wealden heights, and then cut their way to the sea through the North and South Downs, like the Medway, Stour, Rother (Kent), Cuckmere, Ouse (Sussex), Adur, Arun, Wey, and Mole.

The high mortality Cancer districts of sheltered valleys, like those of the Severn, the Wye, and the Mid-Devon rivers, are often subject to sudden risings of the water after heavy rain, thunder-storms, and sudden thaws. It would, therefore, be especially interesting to know how these valleys are circumstanced during heavy rains.

The Avon has a Cancer field of its own, to the north of which is the one watered by the Tame, the Trent, and the Dove.

The Cumbrian field, through which the Derwent and the Eden flow, are well-sheltered valleys, and subject to sudden invasion of water from the lofty ranges which overshadow them.

In the otherwise healthy district of Hexham the mortality from Cancer is slightly above the average. In the centre of this district the confluence of the North and South Tyne takes place. Its site is carboniferous limestone and millstone grit.

I have especially insisted upon the fact that, as a rule, the site of the Cancer field is found to be composed of the most recent formation—alluvium in every variety, drift, gravel, &c. In any notes, therefore, made with reference to floods it will be necessary to bear in mind not only the quality of the soils flooded—for instance, whether it be clayey, sandy, absorbent—but also the character of the matter suspended in the waters. Sometimes much dead animal matter, as the bodies of vermin (rats, &c.), and even those of the higher mammalia, such as pigs, sheep, drift over the face of the country and pollute it. At other times the *flotsam* is of a purely vegetable character. It is a matter of much importance to know whether the waters, when once out, are liable to remain for a lengthened period, or whether they are quickly absorbed or drain easily away.

The chief points I should like noted are :—

1. The amount of rain at any of Mr. G. J. Symons' \* stations causing floods.
2. The extent in acres of the flood, and the name of the parish flooded.
3. The names of the affluents of the rivers overflowing their banks.
4. The length of time taken by the water to subside.
5. The colour of the waters, and to what attributable.
6. The quality of suspended matter, whether animal or vegetable.
7. The points whence the floods can best be witnessed, the highest points in the neighbourhood.
8. Whether summer floods or winter floods are the more prevalent.
9. Whether diseases, and of what kind, have been observed to follow the floods, both among men and beasts.
10. Whether floods leave any effluvium behind.
11. The amount and character of the deposit.
12. The effect of the floods upon the neighbouring wells and the water supply generally.

And lastly—What is the *electrical condition* of the land and of the atmosphere immediately superincumbent after the subsidence of the floods, as indicated by a trustworthy condensing electroscope like Volta's?

One very important fact is shown in the geography of Cancer, which may be put aphoristically. *Cancer does not thrive on a high dry soil.* This is a good fact, and may lead to important results in the preventive treatment of this formidable and too prevalent disease.

\* The author of *British Rainfall*, and a work of great scientific value entitled *Rain: how, when, where, and why it is measured.* 8vo. Stanford, London.



CHAPTER VI.

SECTION I.

*The Opinions of some Authors Relative to the Prevalence of Cancer in this and other Countries.*

**T**HERE can be no doubt that as a rule Cancer is very fatal in towns, but not more so than in the country, and certainly not in proportion to density of population. The principal cities, especially the old towns, are as a rule situated on rivers, and, therefore, are generally to be found in the centre of a Cancer district. As to density of population, we have only to compare Liverpool or Manchester, with their dense population and low Cancer mortality, with London, Bristol, Southampton, Oxford, or Cambridge.

Not more fatal in towns from density of population.

From the late M. Boudin, of Paris, we find that Europe among the continents is the most favourite haunt of Cancer, and that it is rare in Asia, and as evidence of the last fact he adduces the statistics of the Calcutta Hospital, where among 4,080 *men* admitted during three years, *three* individuals only were affected with Cancer; and among 701 admitted during two years, *two* women only presented themselves with this disease, which in both instances had its seat in the womb. Among the Hindoos the disease appeared to be very rare.

Europe favourite haunt of Cancer.  
M. Boudin.  
Asia.

On the other hand, in China Cancer is by no means uncommon. In Africa it is rare. M. Clot-Bey says that it is not met with except rarely in Egypt, and M. Bax asserts that it is seldom met with in Senegal. M. Lebert asserts in his *Traité pratique des maladies cancéreuses*\* that Cancer is much more rare in North America than in Europe.

China.

From Hirsch we find, according to the statistics published in the *American Journal of Medical Science*, by Drs. Shattuck, Darrel, Emerson, and Joynes, that Cancer is much more prevalent in Philadelphia and Baltimore than it is in either Boston or New York—for instance:

Hirsch.

Name of State.	Years.	Population.	Deaths from Cancer.	Proportion to 1,000.
IN BOSTON . . . . .	1811-39	2,000,000	176	0.09
„ NEW YORK . . . . .	1805-36	5,036,000	358	0.07
„ PHILADELPHIA . . . . .	1807-40	4,873,000	744	0.15
„ BALTIMORE . . . . .	1836-54	2,250,000	258	0.11

It has been stated that, ‘Whenever the disease is particularly rare it may be remarked that a low state of civilisation prevails; whenever organisation is of a highly perfect kind, then Cancer flourishes.’ This was expressed in 1845; since then statistics have accumulated, and the fallacy of

Low civilisation and high organisation.

\* Paris, 1851, p. 132.

the opinion has been abundantly shown. In Yarmouth and Norwich, where the annual mortality from Cancer is respectively  $\cdot 076$  and  $\cdot 065$  to 100 living, we cannot suppose that the inhabitants have a more highly perfect organisation, or any more civilised than those of Liverpool or Manchester, where the mortality in these densely populated hives of industry and civilisation is actually below the average,

American cities. the Liverpool  $\cdot 041$ , Manchester  $\cdot 043$ , or as 84 to 141. Again, the

American cities are not behind us in civilisation, yet the mortality in them from Cancer is insignificant when compared with our own. They differ even among themselves, for we see that the mortality in Philadelphia is twice as great as that in New York, or as 7 to 15; again, it is not reasonable to suppose that either the civilisation or organisation of the inhabitants of Marylebone, where the deaths from Cancer among females alone during the ten years 1851-60 amounted to 833, on a mean female population of 89,981, or 0.92 to 1,000, was higher or more delicate than those of the 744 males and females who died from this cause in thirty-three years out of the 4,800,000 of the population of Philadelphia.

The tropical parts of South America seem also to share a similar immunity from this disease to that enjoyed by Africa. In Iceland, during the eleven years from 1827 to 1837 inclusive, there were only 37 deaths from Cancer. In Ireland, during the night of the 30th March, 1851, when the census was taken, there were 161 males and 206 females living and under treatment for cancerous affections. In St. Helena, during the ten years between 1826 and 1835 inclusive, among the civil and military population of that island there were 552 deaths, only *two* of which were attributed to Cancer. At Algiers, from the *Gazette Médicale d'Alger*,\* among the 5,561 deaths which took place during the three years 1852, 1853, 1854, 37 deaths are recorded (1852-8, 1853-12, 1854-17). At Malta, the total number of deaths from 1822 to 1834 among the civil population amounted to 33,501.† Cancer, however, does not find a place among the 28 specified causes; but we must remember that 13,404 deaths are attributed to various causes.

M. d'Espine, speaking generally of the distribution of Cancer, remarks that it would be found to be more prevalent in towns than in the country.

M. d'Espine.

## SECTION II.

### Conclusion.

I feel convinced that by studying the geographical laws of disease we shall know where to find its exciting as well as its predisposing cause, and how to avoid it. It would be folly to build a consumption hospital so as to be exposed to the over-stimulating westerly winds of the Welsh hills, or on dry chalk ranges which are exposed to easterly winds; wiser would it be to select those sites where its indigenous victims number the least, as on sheltered and well drained slopes which form our valleys, where pure air comes to them from above, without harshness, and where the least number die from this cause in proportion to the mean population.

Consumption hospital.

\* du 25 janvier, 1856.

† *Statistical Reports on Sickness, &c. among the Troops.* London, 1839, p. 72a.



By acting upon such a principle we shall only be guided by the voice of common sense, aided by the pictorial illustrations of disease statistics.

If the facts before us now are sufficient to prove, or our own experience teaches us to believe, that rheumatism is the forerunner of the great mass of heart disease mapped out, certainly the groupings thus portrayed\* would prompt us where to advise our patient to go, or where not to go. We would not send a typhus case for change of

air from a typhoid field to another typhoid field, if we were aware of it. Neither should we send a rheumatic patient from a secluded valley, shut out from sea air, to another secluded valley for change of air. So in Cancer, the maps

teach us that the high, dry sites on the older rocks are the places where Cancer does not thrive, and that it does thrive in the vales by the sides of large rivers which overflow their banks, and in the neighbourhood of which are to be found the drifts of ages of washings from the inhabited country above. When there is a tendency to Cancer let the patient be removed to the high, dry sites; and perchance if whole families were thus to emigrate, we should not hear so much of

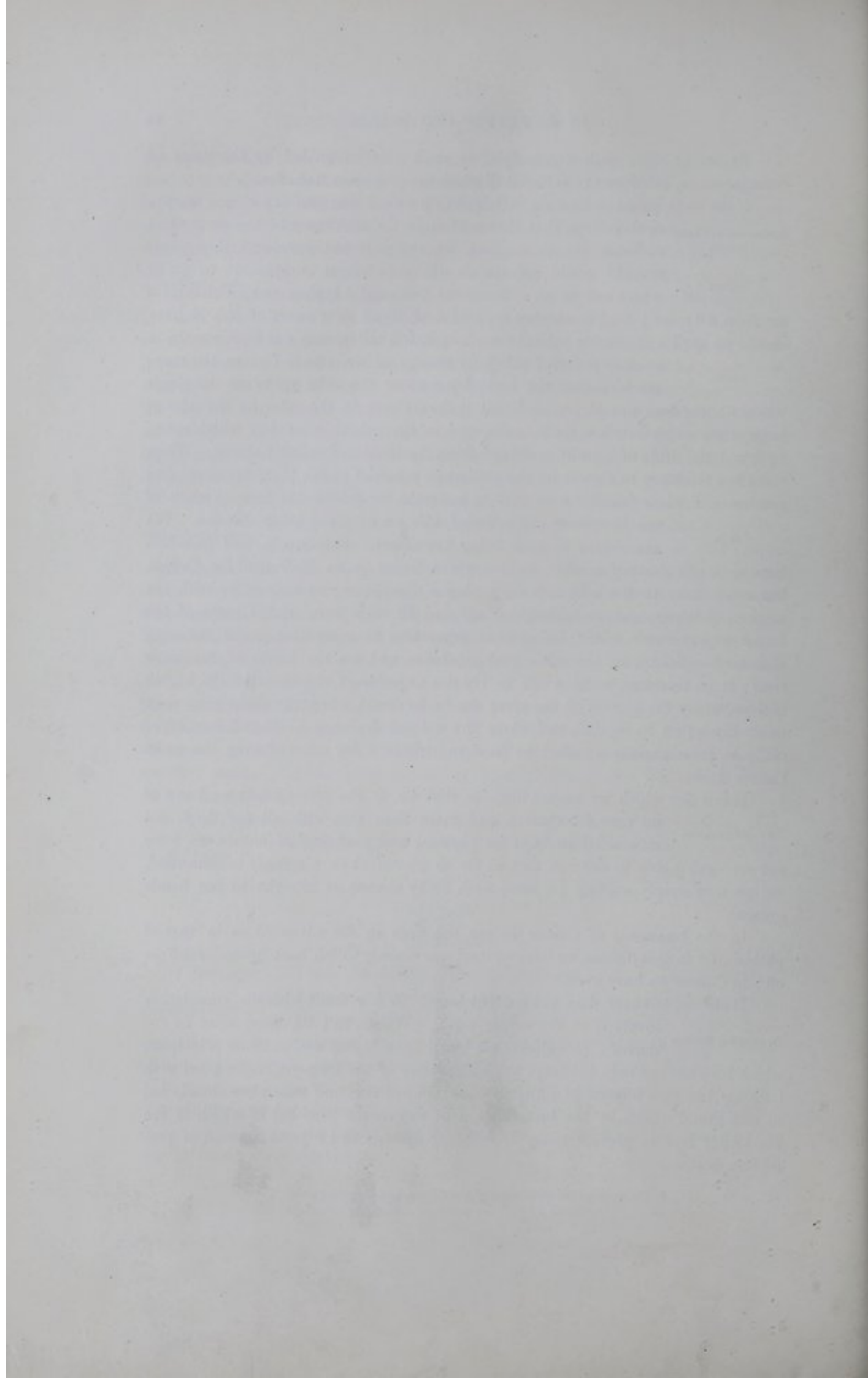
the hereditary character of this or of many other diseases. We never hear of ague being hereditary. Father, son, and grandson have ague one generation after another whilst living in an ill-drained fen district, but send them to the hills and their plague disappears; so may it be with the mother, daughter, and granddaughter afflicted in their turn with Cancer of the breast or the womb, whilst living from generation to generation under the same climatic conditions, on the same geological site, and on the banks of the same river; it is, therefore, worth while to try the experiment of emigration to higher regions, where the sources of the river are to be found, where the underlying rock easily throws off its rainfall, and where the natural drainage is all-sufficient, especially as these regions are often to be found within a few miles of even the worst Cancer fields.

It is a fact which we cannot disguise, that up to the present date we know of no cure for Cancer, and more than this, with all our deep and unwearied study of its physical and pathological nature, we have not even got a clue to one; in fact, so far as treatment or a remedy is concerned, we are now simply waiting for some such lucky chance as brought to our hands quinine.

In the treatment of Cancer we are not even so far advanced as in that of phthisis, for in this disease we have at least one remedy to fall back upon—cod-liver oil; in Cancer we have none.

Medicine, however, does not content herself in her strait with the consolation involved in the vulgar adage, 'What can't be cured must be endured.' Her objects are based upon higher and worthier principles, which lead her not only to accept the withholding of the long-sought-for boon with humility, but with hopeful humility to persevere in the course which has already led to such grand results in her investigation of causes, the grandest of which is the knowledge how to prevent many unnecessary diseases and a great amount of premature death.

\* *The Geographical Distribution of Heart Disease and Dropsy, passim.*





THE  
GEOGRAPHICAL DISTRIBUTION  
OF  
PHTHISIS IN FEMALES  
IN  
ENGLAND AND WALES.

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CHAPTER I.

SECTION I.

*Geographical Distribution of Phthisis (in Females) in England and Wales.*

IN the last two parts, I have endeavoured to show how unexpected the results are when we depict the mortuary returns of our country according to certain degrees of mortality regulated by the proportional number of deaths from any one cause to a given number living in each of the 623 districts, the 53 counties, or the 11 divisions. The reader will remember that, in describing the geographical distribution of each of the causes of death, which formed the subjects of the foregoing parts, I used three different tints of the two colours, *red* and *blue*. The most intense *red* represented the *sixth* or lowest degree of mortality, and the most intense *blue* the *first* or highest degree of mortality. The tints of the degrees between these extremes decreased in intensity as they approached the average, below which the degrees were coloured *red*, and above it *blue*. We may fix in our memory the object of these colours by remembering that the *red* represents *healthy* districts, so far as regards the cause of death discussed, and is the typical colour of healthy florid *arterial* blood, whereas the *blue* indicates the high mortality or unhealthy localities, and is the symbol of *blue*, effete, and unhealthy *venous* blood.

Having laid down a law that each of the divisions, counties, and districts, shall be coloured according to its proportional mortality from any one cause of death, we carry this into effect and study the result. This we have done in the case of heart disease and dropsy, and cancer in females. It will be now my duty to lay before the reader the statistics of phthisis in females, grouped according to the proportional mortality in each of the divisions, counties, and districts; but, before doing so, it will be first necessary to refer to the previous two parts, for the reader will find in the sequel, as I have already done, that these maps of disease have to be studied side by side as we progress in the series. The distribution of each cause of death

forms a distinct problem to be solved only by the light of our knowledge of the physical, climatic, social, and other factors, which either singly or collectively regulate it in the first instance, and then by the light of the fresh information conveyed to us through the unexpected results of our investigations.

Heart disease and dropsy I made my starting point and my first problem; and in the part devoted to it I have endeavoured to show what were the climatic facts coincident with the high and low mortality from this cause of death. We shall now see that they bear a remarkable relation to the facts which the distribution of phthisis discloses; and, moreover, the distribution of cancer in females we found had a remarkable and distinct character of its own, which it will be impossible, in discussing that of phthisis, to overlook.

The result of our investigation of the distribution of heart disease and dropsy was the following proposition: 'That, wherever the prevailing sea-winds have uninterrupted access, as over a flat or elevated country, or up broad vales or valleys, there we found a low mortality; and that, on the contrary, in localities where the tidal wave has no access, where the rivers run at right angles to its course or to that of the prevailing winds, and where the districts are sheltered by lofty hills from the full sweep of the sea-winds, there we find the highest mortality.'

This proposition arose out of the following leading facts: 1. That the most exposed divisions form a red arch of *low* mortality around the blue midland divisions of high mortality; 2. That the division of the northern and southern counties which are protected by a precipitous coast line, and where the rivers run at right angles to the prevailing winds and tidal wave, had a mortality *above* the average. Again, when we analysed the counties, we found that in the high mortality divisions the death-rate of the most midland counties differed, those which skirted the coastal counties having a low mortality, and that four of the counties, the most sheltered from the prevailing winds, had the highest mortality; and that in the low mortality divisions, such as the South Midland (vii) Yorkshire (ix), and Eastern Counties, the most sheltered counties had the highest mortality; and lastly, when we came to the last division, that of the districts, it was readily seen that low mortality obtained wherever there were great sea-inlets, such as the Thames, the Wash, and the Bristol Channel, besides along the banks of tidal rivers which gave free access to the prevailing winds, such as the Parret, Avon, Severn, and Gloucestershire Avon.

The movement of our atmosphere is called wind; and, immediately a calm ceases, a new quality is added—force. I shall call it the dynamical element of wind in contradistinction to its chemical, which involves its purity as well as impurity.

The facts that I have just shortly given point at once, I think, to the probability that the dynamical element is the great factor which regulates the distribution of heart disease and dropsy. When looking at the map of this cause of death, we seem to be told that the prevailing sea-winds sweep a something before them by their sheer power, which is the cause of that kind of heart disease which dominates the geographical distribution of heart disease generally. Whether whilst thus purging by *force* these winds destroy chemically the *materies morbi*, is a problem which may eventually be solved, but of which I can say nothing at present, although the opinion that they do has much to support it.





TABLE I.

The Absolute Number and Average Annual Number of Deaths by Phthisis in both Sexes at certain ages to 10,000 Males and Females living at those ages in England and Wales in the Ten Years 1851-60.

	ALL AGES	TOTAL UNDER ONE YEAR.	1	2	3	4	TOTAL UNDER FIVE YEARS.	5-	10-	15-	20-	25-	35-	45-	55-	65-	75-	85 AND UPWARDS
Mean Population 1851-60.	Males.	—	—	—	—	—	1,265,830	1,111,954	1,011,954	915,583	827,883	1,356,605	1,074,115	792,246	523,334	285,163	101,371	13,121
	Females.	—	—	—	—	—	1,258,614	1,106,619	997,324	929,333	920,217	1,494,666	1,133,809	830,351	565,586	332,631	128,750	20,274
Deaths from Phthisis	Males.	7,012	4,812	2,440	1,407	1,149	16,820	5,838	7,725	21,550	33,565	54,729	43,017	30,344	17,442	6,813	990	72
	Females.	6,141	4,624	2,529	1,504	1,327	16,125	6,856	12,885	32,670	39,465	68,388	47,342	25,903	13,490	5,437	971	96
Average Annual Rate of Mortality from Phthisis at different ages to 10,000 living in 1851-60.	Males.	—	—	—	—	—	13.2	5.2	7.6	23.0	40.5	40.4	40.0	38.3	33.3	23.8	9.8	5.4
	Females.	—	—	—	—	—	12.8	6.1	12.9	35.1	42.8	45.7	41.7	31.1	23.7	16.3	7.5	4.7
Mean of the Two Sexes	26.7	—	—	—	—	—	13.0	5.6	10.2	29.0	41.6	43.0	40.8	34.7	28.5	20.0	8.6	5.0

It will be well for the reader to compare this Table with those at pp. 8 and 65. According to the above statistics, Phthisis culminates in Women between the 25th and 35th years; after this period the rate of Mortality gradually declines, which is the reverse of what obtains in Cancer (Table I., p. 65).



On looking attentively at the two divisional maps—one of heart disease and the other of phthisis—the reader will at once be struck with the remarkable fact, that they are the reverse of each other: for instance, the series of *low* mortality divisions in the heart disease map, which extends from the north of the Bristol Channel around to the eastern coast and ends on the north bank of the river Thames, is coloured *red*, indicating a mortality *below* the average. In the map of phthisis, it will be seen that these very divisions are coloured *blue*, in order to indicate that their death-rate is above the average.

This series of divisions includes Wales, the North-Western Counties, Yorkshire, the North Midland and the Eastern Counties. All are well exposed to the direct and immediate influence of the sea-winds, coincident with which I have shown that low mortality from heart disease almost invariably obtains. These are the divisions that receive the brunt of our powerful winds, which sweep over them as it were unobstructed. They derive all the benefit which the dynamical element of our atmosphere in motion can accord; they are the least protected and least sheltered of all the eleven divisions.

In the map of phthisis, all these exposed divisions have a mortality *above* the average; we, therefore, are led to conclude that this free exposure to the force-element of wind is coincident with a high mortality from phthisis.

Again, the midland, the northern, and the southern divisions, which are the least exposed to the winds, have a high mortality in heart disease and a low mortality in phthisis. The high mortality in heart disease we found coincident with the sheltering influence of the elevated ridges which form deep valleys, where a thorough air-flushing cannot take place. We have something therefore foreshadowed in this divisional map of the geography of phthisis. The average annual rate of mortality from phthisis to every 10,000 females living is 27·7; and the scale I have adopted is in conformity with those used in describing the maps which formed the subjects of the two last parts.

The first or highest degree of mortality is coloured with the darkest blue, and the proportional mortality is from 37 to 40 and upwards to every 10,000 living; the second degree, having a shade lighter, is from 33 to 36; and the third degree, or lightish blue, from 29 to 32. The fourth degree, the one at and below the average, ranges from 25 to 28; it is the lightest pink tint. The fifth degree has a deeper red, and ranges from 21 to 24; and lastly, the sixth degree, that of the least mortality, is coloured with the deepest red, and ranges from below 17 to 20 deaths to every 10,000 females living during the decade 1851–60. With the aid of these gradations of colour, we shall be enabled to compare the maps showing the proportional rate of mortality from heart disease with that of phthisis in the fifty-three counties.

#### Recapitulation.

Before, however, entering upon the second process of analysis, I will recapitulate some of the facts already mentioned, and add a few others which will be necessary in the sequel.

1. More than a quarter of a million females died from phthisis during the decade 1851–60.

2. The divisional distribution of heart disease and phthisis was shown to be the reverse of each other.
3. The most exposed divisions have the highest mortality in phthisis and the lowest in heart disease.
4. The most sheltered divisions have the lowest mortality in phthisis and the highest in heart disease.
5. London (I) and the West Midland Division (VI) have the lowest female mortality, being each only 24.9 to every 10,000 living.
6. The division having the highest mortality is the North-Western Counties (VIII). This fact is coincident socially with the engagement of the population in cotton and other factories, and climatically with exposure to the direct and powerful influence of the north-westerly winds. The maps of heart disease and cancer show an exceedingly low mortality from these causes in this division.
7. In heart disease and cancer, we see that Wales (XI) has a remarkably low mortality, whereas in that of phthisis a high mortality is depicted. It ranks next to that of the North-Western Division; its female death-rate from phthisis being 32.0, or 4.3 to every 10,000 living *above* the average.

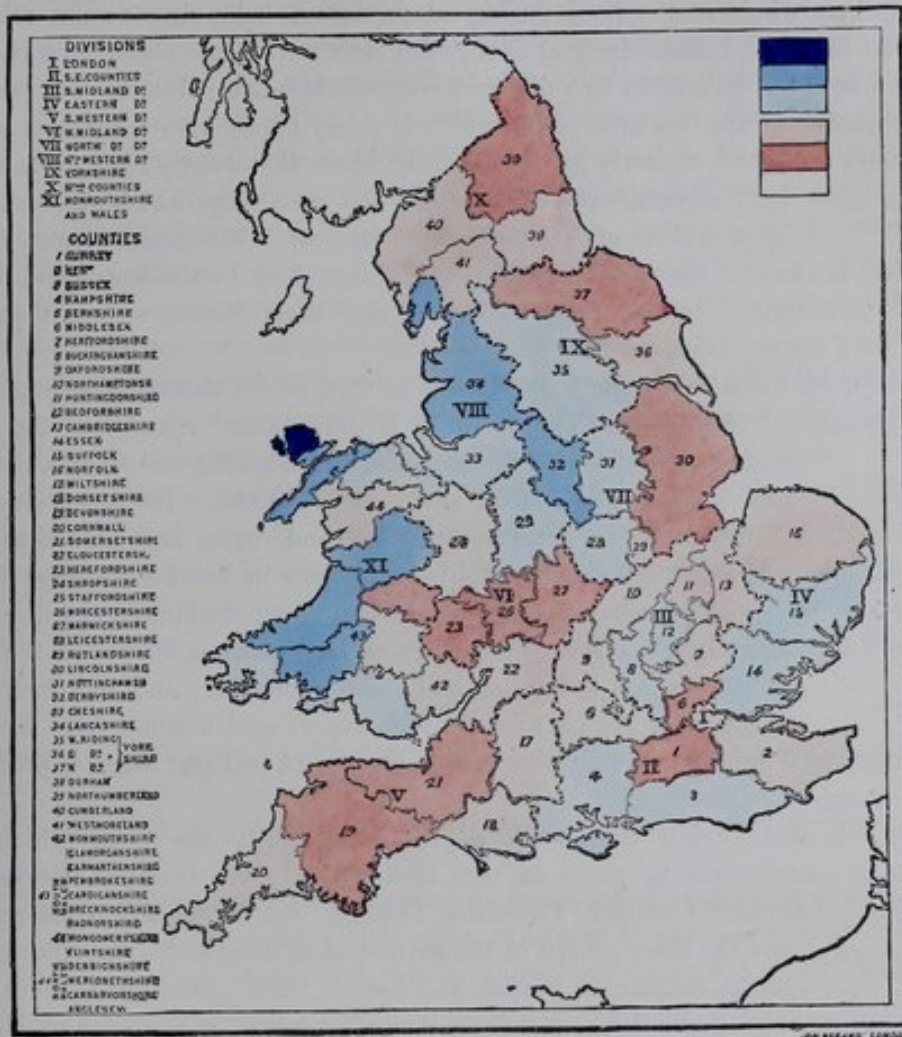
*The Divisional Mortality in Relation to Density and the General Annual Mortality.*

TABLE II. PHTHISIS.

*The Average Annual Rate of Mortality in each of the Eleven Registration Divisions of England and Wales to 10,000 living, during the ten years 1851-60.*

DIVISIONS.	MALES.	FEMALES.	MEAN.	Density of Population. Acres to a person. 1851-60.	Annual Mortality to 10,000 living.
I. LONDON . . . . .	32.9	24.9		.03	240
II. SOUTH EASTERN COUNTIES . . . . .	24.7	26.1		2.34	200
III. SOUTH MIDLAND " . . . . .	22.0	26.8		2.53	200
IV. EASTERN " . . . . .	23.6	29.7		2.85	210
V. SOUTH WESTERN " . . . . .	23.2	25.0		2.74	200
VI. WEST MIDLAND " . . . . .	22.3	24.9		1.69	220
VII. NORTH MIDLAND " . . . . .	21.4	28.7		2.83	210
VIII. NORTH WESTERN " . . . . .	29.9	33.4		.74	260
IX. YORKSHIRE . . . . .	24.7	28.7		1.92	230
X. NORTHERN COUNTIES . . . . .	22.1	25.3		3.29	220
XI. MONMOUTHSHIRE AND WALES . . . . .	29.8	32.0		4.18	210
ENGLAND AND WALES . . . . .	25.8	27.7		1.96	220





CHAPTER II.

SECTION I.

*The Geographical Distribution of Phthisis (in Females) in the Fifty-three Counties of England and Wales.*

AMONG the counties having a high mortality, we see on the phthisis map that the insular county of Anglesey has the highest death-rate—36·7 or 9·0 above the average. This is coincident with free exposure to the sea-winds, especially the north-west. Proceeding southwards, we see the county of Carnarvon having a death-rate of the fifth degree; and, again, the group extending from the middle of Wales to the south, and comprehending the counties of Montgomery, Cardigan, and Carmarthen, has also a mortality of the fifth degree. On referring to the cancer and heart disease maps, we find that all these counties

have a very low death-rate from these causes—the fifth, or the lowest but one. We found this fact coincident with elevated site, free exposure to the full force of the prevailing winds, and a hard geological formation belonging to the Silurian rocks. In England, Lancashire and Derbyshire rank next in the scale of mortality; these two counties belong to two different watersheds—Lancashire to the western, and Derbyshire to the eastern. Lancashire is freely exposed to the full sweep of the westerly and north-westerly gales, especially where the country rises towards the

Lancashire and  
Derbyshire.

lofty carboniferous limestone of the great ridge which separates the river-system of Yorkshire from its own. We must remember that Lancashire is skirted towards its western or sea boundary by the warm and fertile new red sandstone. In the maps of cancer and heart disease, we see that this well-exposed county has a very low mortality.

Derbyshire has a death-rate from phthisis of 33·2 or 4·5 above the average. It has two geological characters. To the north is the elevated country of the Peak

Geology.

and its neighbourhood, composed of carboniferous limestone shale and coal formations on their eastern flank. Its most elevated valleys, however, are sheltered; but they are cold and damp, and the climate is rainy. In cancer, we found a low mortality; although in heart disease we found that the axis of the valleys was not favourable to free air-flushing, and coincident with this a high mortality. The southern part of Derbyshire is formed of the new

Cancer.

sandstone. It is warmer and more protected; and, moreover, the Trent here begins to collect its waters and become fully formed. The districts will point to any difference that change of soil and altitude produces in the death-rate.

The counties having the fourth degree of mortality are those which are immediately contiguous to those of the fifth degree: for instance, Yorkshire, Nottingham, Leicester, Cheshire, Flintshire, Denbigh, Pembroke, and Glamorgan;

Fourth Degree of Mor-  
tality. Counties.

and the three groups in the south-east of England—viz., the eastern group, containing Suffolk and Essex; the south-midland, composed of Buckingham and Bedfordshire; and the southern group of Sussex and Hants. These last counties are all more or less exposed to the direct influence of the east wind. The south of Bucks contains a portion of the elevated chalk ridge—the Chiltern Hills—which forms the northern boundary of the Thames basin; and its northern half is characterised by the clays, Oxford and others, of the oolitic series.

Geology.

Chalk, marl, and gault form the soil of the Vale of Aylesbury. Bedfordshire is also characterised by the chalk ridge of the Chiltern Hills, which are called the Luton and Dunstable Downs. It crosses the county in a north-easterly direction, and separates the basin of the Thames from that of the Humber. The geological relations will be better seen when we discuss the districts.

The southern high mortality group, again, we see characterised by lofty chalk ranges and clay valleys. Hampshire, especially to the east of the

Hampshire.

county, where the chalk downs form the southern boundary of the Thames basin, is exposed to easterly winds; and, again, the south downs are swept by the east and south-east winds. To the north of these downs we find gault and the wealden clays characterising the valleys of Sussex.



*Recapitulation.*

1. The north-western counties, the Welsh, and the midland counties, which have the most elevated ridges of hard unproductive carboniferous limestone, or Silurian or other older formations, have the highest mortality. Anglesey, the most exposed of all the counties, has the highest death-rate. This is the reverse of what obtains in the geographical distribution of cancer and heart disease.
2. The south-eastern counties, which have a high mortality, are characterised by elevated chalk-ranges, and valleys in which the oolitic, the cretaceous, and wealden clays predominate.
3. The eastern counties, having a high mortality, are exposed in aspect to the easterly winds; and the lower lands are characterised by clays of the Eocene period, especially the London clay.
4. We therefore see that high, dry, chalky sites, exposed to the free access of the east winds, are accompanied by a high death-rate from phthisis; and that the same death-rate obtains in the cold, damp, clayey valleys, which these chalk-ranges shelter.

## SECTION II.

*Counties having a Low Mortality from Phthisis.*

I shall now proceed to the next series of county groups—those of low mortality.

In the distribution of heart disease, we found a high mortality coincident with sheltered site; and, again, in cancer, it was shown that the riparial districts of rivers, which ran through protected valleys, and seasonally flooded the adjoining counties, had a high mortality. These localities were well defined in both maps; and the counties that contained them were coloured with the blue characteristic of the proportional high mortality. For instance, the well-sheltered counties of Hereford and Worcester, the one characterised by its fertile warm old Devonian formation, and the other by its not less fertile new red marl, had a high mortality, which was coincident with these counties being surrounded on all sides by lofty ranges, excluding the direct influence of the sea-winds. In the phthisis map, we see these counties coloured so as to represent almost the lowest degree of mortality, and, with Warwickshire and Radnor, forming an oblong group, bisected by the Severn vale. Coincident with this low mortality is a sheltered site, lying on the warm and highly ferruginous red sandstone. Wiltshire, again, and Berkshire, are seen in the heart disease map as high mortality counties; and we found within them that the districts most protected had the highest death-rate. These counties are coloured red in the phthisis map. Devonshire, with its deep and fertile valleys and frequently flooded rivers, had a high mortality from both cancer and heart disease. In phthisis, we find this county standing out conspicuously from its low mortality; and it is accompanied by Somersetshire, which, as I have before remarked, has no low mortality districts

Counties having Low  
Mortality from Phthisis.

Sheltered and High  
Sites.

in the heart disease, except where there is free access to the prevailing winds up the rivers Parret and Avon.

Lincolnshire has a low mortality from phthisis, and forms an exception to the general rule, which at present seems hidden in obscurity. We must, however, remember that ague is prevalent in this part of England; and it has been said that this disease is seldom associated with consumption. A more significant coincident fact is the one that the greater portion of this land has been reclaimed from the sea. It is well known that many sites, although damp with sea-water, enjoy a remarkably low mortality from phthisis. That part of the North Riding of Yorkshire which we have seen to be protected by the oolitic range which forms its sea-boundary, and is traversed by the valleys of the Rye and Derwent, has an exceedingly low mortality; and so has the group to the north of Northumberland, both of which areas are coloured blue in the heart disease map.

The remarkably low mortality of the two counties Middlesex and Surrey, which lie in the basin of the Thames, is another contrast to what obtains both in heart disease and cancer. Middlesex we know to be chiefly composed of London clay; and a greater portion of Surrey belongs to the same formation. One county is protected by the northern boundary, and the other by the southern, of the Thames valley.

#### *Recapitulation.*

1. All the counties having the fifth or nearly the lowest death-rate from phthisis have been previously shown, in the two last parts, to possess well sheltered areas, which in cancer and heart disease were characterised by a high mortality.
2. Coincident with low mortality from phthisis in the counties to the west of  $1^{\circ}$  W. longitude, were sites having a formation consisting of either old or new red sandstone.
3. Lincolnshire forms an exception to the rule of exposed sites being coincident with high mortality from phthisis. The prevalence of ague has been said to account for some decrease in the mortality, but the fact that the sites have been reclaimed from the sea is more worthy of attention.
4. The protected counties of the North Riding and Northumberland have a low mortality from consumption, and the reverse from heart disease.

I shall now proceed to examine the districts, and endeavour to show how they carry out the facts that have been noticed in the divisions and counties.



## CHAPTER III.

## SECTION I.

*The Geographical Distribution of Phthisis in the 623 Registration Districts.*

AS it will be unnecessary to enter minutely into the groups of districts, I shall now merely draw the reader's attention to certain social, physical, climatic, and geographical facts, which are coincident with either the high or low mortality from phthisis in the 623 registration districts of England and Wales.

*The Distribution of Phthisis, compared with that of other Diseases.*

I have already alluded so frequently to the differences in distribution of heart disease and that of phthisis, that I will only now revert to cancer, and shortly compare some of the more important features displayed in the two maps.

The great cancer-field of the Thames will be seen to be almost co-extensive with its catchment basin, forming an irregular quadrilateral area of high mortality, and therefore coloured blue, in the map of cancer. We see how the darkest districts are grouped around the course of the Thames. If we now examine the map of phthisis, we shall find this very four-sided blue area coloured red, indicating a very low mortality from consumption; in fact, it is the converse of what obtained in cancer. In this area will be found a remarkable group around London, all of the lowest mortality; London itself having a mortality of the fourth degree, giving us the idea that the immediate districts around London had poured their phthisical patients into the twenty-six London hospitals, thereby reducing their own death-rate, whilst they raised that of the metropolis. But, if the metropolitan figures were merged into those of its neighbours, the group would even then have a mortality of the lowest degree. This was not the case with cancer, as London had a lower death-rate from this cause than some of the immediate districts—Richmond, for instance.

The Yorkshire cancer-field follows, as we have seen, the courses of the off-flooded rivers of this county. In the phthisis-map, we find the blue area coloured red, indicating the lowest mortality. In the West of England, if you trace the courses of the Severn and the Wye, you will find that their riparial districts are so coloured as to show a high death-rate from cancer. Compare this oblong area with the courses of these rivers in the phthisis map, and you will find that the districts show a very low death-rate. Again, compare the cancer-field of mid-Devon with the same area in phthisis, and there will be seen as remarkable a contrast as any of those alluded to. I have dwelt upon this point because it is a remarkable and unexpected fact, and worthy of further study. When I was exhibiting my maps before the Royal Society, Mr. Erasmus Wilson was much struck with what I have now pointed out; and he mentioned what he had observed in practice—that, in scrofulous families, one member will die of consumption; another will escape it,

and die of cancer; whilst a third shall not succumb to either, but be plagued with lepra. With regard to scrofula, I shall, on another occasion, discuss this matter fully; but I may here mention that there are certain differences in the distribution of these causes of death which require much careful attention. I may, however, state here that the groups of high and low mortality in the scrofula map have very similar sites to those in that of phthisis. In fact, a general resemblance obtains—accompanied, however, by some marked exceptions.

Scrofula and Phthisis.

#### SECTION II.

##### *The Distribution of Phthisis in Relation to the Winds.*

We have seen that the elevated districts of Wales, Lancashire, and Yorkshire, exposed to the direct influence of the north-west wind, have a very high mortality; whilst these very districts are the most free from cancer. Again, in the south-east of England, we find that the elevated ridge which surrounds the Thames valley, and is exposed to the easterly winds, has an almost uninterrupted series of high mortality districts.

The south-westerly wind has, coincident with its range over the western counties, and up through the two great red sandstone valleys of England, an extensive and continuous group from the mouth of the Severn to that of the Tees. Deprived of its dynamical element, this wind exercises a most genial influence, from its purity, on some localities, although its tonic powers are not so great as those winds which blow over the German Ocean and the Irish Sea. Whenever the prevailing wind rushes over the country in strong currents, as it does in Wales, persons having delicate lungs seem unable to withstand its effects. The wind may be pure, but it is too strong; and thus it is that, in valleys protected from its force, but which are supplied with abundance of its purity from above, we find a low mortality from phthisis. It is a significant fact that, where the wind rushes up the Severn valley with such force as to diminish the amount of rainfall\* in this part of Gloucestershire, its course is marked out by a line of three high mortality districts.

South-west Winds.

Force.

Severn Valley.

#### SECTION III.

##### *The Distribution in Relation to Geological Site.*

I have already alluded to the high mortality of the heights around the London basin; the dryness of the cretaceous soil is not likely to be a cause. I believe here that *aspect* has more to do with this high death-rate than soil. I believe that, were these heights surrounded by a higher ridge of hills and thus sheltered, their mortality would have been the reverse of what it is, inasmuch as the porous character of the chalk-soil admits of ready drainage.

Aspect.

Dr. Buchanan, of the Medical Department of the Privy Council, has elaborately worked out the effects of dampness of soil on phthisical subjects; and his conclusions are, that the drainage, either natural or artificial, and the natural covering, in some districts, by gravel, of the clay, produce

Dr. Buchanan.

\* This remarkable fact has been noticed by G. J. Symons, Esq., F.M.S., so well known for his many and able works on the British rainfall.



marked results in the mortality from this cause. I perfectly endorse what both Dr. Buchanan and Dr. Bowditch of Boston, U.S. have emphatically urged in their respective papers: that dampness of soil is a grand exciting cause of phthisis. The sequence will be as follows: a damp clay soil, such as we find in the wealden and galt districts of Sussex and Kent; a damp house, especially the kitchen; damp cupboards; damp sheets; damp clean linen; which ends generally in what is described as *catching a chill*. Now, there are some houses that for generation after generation have killed off members of the families occupying them, and yet they are allowed to stand undrained and unheeded, ready to kill the present and the next generations.

I will now draw attention to the Y-shaped tract of new red sandstone which extends from the mouth of the Severn up the valley of this river and over the heights which separate it from the watershed of the Weaver, and the Dee; and from Gloucester through Warwick, Leicester, Nottingham, and Yorkshire, to end in the valley of the Tees. This extensive tract of red sandstone forms the site of a continuous group of low mortality districts. Let us compare this formation with the irregularly square-shaped mass of carboniferous limestone and coal-formations which form the most elevated part of Yorkshire, Lancashire, and Derbyshire. Note its form, and then compare it with the high mortality group which is co-extensive with it. This mass is skirted with low red sandstone, Permian, and new red marl valleys and flats; and coincident with this change in the geological character of the soil is a lower mortality.\*

Dr. Moffat of Hawarden has kindly furnished me with his views on this subject. In a recent paper read before the British Association, he made some very forcible remarks on the difference in the amount of iron grown on carboniferous limestone and that produced from a red sandstone soil; and he computed that a person eating bread made from the latter took into his system *four grains* more iron than he would had it been made from the former. This is a most important practical hint, which is valuable to the practical student of medical geography.

The remarkable series of low mortality districts along the coast of Yorkshire and Northumberland has already been alluded to. The districts, although apparently close to the full influence of the sea-winds, are yet protected by the precipitous coast; they receive the *pure air* without its dynamical element. It is noteworthy that Pickering, well known for its damp clay and iron soil, has a higher mortality from phthisis than the surrounding districts.

#### Recapitulation.

1. The districts show that, coincident with sheltered positions, is a low rate of mortality from phthisis: they therefore confirm what was found among the counties and divisions.
2. The distribution of phthisis is almost the converse of that of cancer, and differs remarkably from that of heart disease.

\* The reader will here require the aid of a good geological map of England and Wales, and he cannot do better than procure the one constructed by Professor Andrew C. Ramsay, F.R.S., Director-General of the Geological Survey of the United Kingdom (Stanford). This beautiful map is exceedingly accurate, and on the same scale (twelve miles to the inch) as those which illustrate this work.

3. The easterly ridges of the south-east of England are characterised by high mortality; and this high death-rate is coincident with a general aspect favourable to the malign influence of the east wind.
4. Damp clayey soil, whether belonging to the wealden, the oolitic, or the cretaceous formations, is coincident with a high mortality, especially in the south-west of England, as shown by Dr. Buchanan.
5. The warm, fertile, ferruginous red sandstone tracts of country are remarkable for forming the sites of the most extensive series of low mortality groups throughout England.
6. The high elevated ridges of non-ferruginous and infertile carboniferous limestone and coal formation, and the elevated, hard, unfertile, and non-ferruginous Silurian formations, form the sites of the most extensive series of high mortality districts.
7. The elevated parts most exposed to the westerly and north-westerly wind, and to the easterly and south-easterly, are characterised by high mortality.
8. A sheltered position, a warm, fertile, and ferruginous soil, well drained, are coincident, as a rule, throughout England and Wales, with low mortality from phthisis.



## CHAPTER IV.

## SECTION I.

*The Distribution of Phthisis in London.*

I SHALL now proceed to say a few words on the distribution of phthisis in London. In heart disease, chapter VI., section I., p. 36, *et seq.*, and in Cancer, chapter IV., section II., p. 77, *et seq.*, the reader will find a description of London, as regards its site, its natural and artificial geology,\* the direction of the streets, &c.

On looking at the map of England, the group of low mortality districts around the metropolis, which is only of the fourth degree, at first gives one the idea that the surrounding districts, as I have said before (chapter III., sect. I.), had poured their phthisical patients into the twenty-six London Hospitals, thereby reducing their own death-rate whilst they raised that of the metropolis. But if the metropolitan figures were massed into those of its neighbours, the group would then have a mortality of the lowest degree. This was not the case with cancer, for London had a lower death-rate from this cause than some of its immediate districts—Richmond, for instance.

As a division, London differs from the other ten, inasmuch as it does not consist of counties, but of parishes; the relative mortality from phthisis in each of which will be seen in the subjoined Table III.

The table shows that out of the thirty-five separate and combined parishes which constitute the metropolitan division, *eight* only are characterised by mortality from phthisis in females above the average, viz. Chelsea, St. Giles's, where overcrowding exists to a lamentable extent; Holborn, in which a similar social cause is in great force; East London, Whitechapel, St. George's in the East, St. Saviour's and St. Olave's (combined), and St. George's, Southwark; the names of all of which are associated with social evils which are ever-fruitful sources of trouble to the Medical Officers of Health, and of misery and disease to the inhabitants.

If we contrast the mortality in these parishes with those which enjoy the natural climate of London, like Hampstead, Hackney, &c., we shall have little difficulty in accounting for the blue spots on the map, and no occasion to be surprised at them as exceptions. They are quite in accordance with the general law which obtains throughout the country, viz. that however excellent site, soil, elevation, and climate may be, all can be neutralised by crowding human beings into an inadequate space and giving them full scope to indulge in their hereditary, or acquired fondness for filth.

London is almost the centre of a large group of low mortality districts, and it is interesting to observe on the map how the well-cultivated districts in its immediate neighbourhood radiate around it as districts having the lowest degree of mortality. Hendon, Richmond, Kingston, Croydon,

\* I would recommend the reader to secure *The Guide to the Geology of London and the Neighbourhood*, by Mr. William Whittaker, B.A., F.G.S. (Longmans and Stanford, 1875.) This admirable work is an explanation of the Geological Survey Map of London and its Environs, and of the Geological Model of London in the Museum of Practical Geology, which is well worth a long visit and an attentive study.

Dartford, West Ham, and Edmonton, all belong to this degree; whilst the two remaining districts, Brentford and Bromley, belong to the fifth, or the degree just above the lowest.

TABLE III.

	Cause of Death	
	Phthisis	Cancer
Kensington, H., H., H., H.	22.6 =	6.1 ++
Chelsea, H., W.	30.4 +	6.1 ++
St. George's, Hanover Square, H.	19.3 ≡	7.2 +++
Westminster, H.	28.4 -	5.1 +
St. Martin in the Fields, H.	25.4 -	6.2 ++
St. James's, Westminster.	26.4 -	5.5 +
Marylebone, H.	23.7 =	9.2 +++
Hampstead	14.1 ≡	5.8 ++
Pancras, H., H., W.	24.5 =	6.1 ++
Islington, H., H.	21.3 =	5.6 ++
Hackney, H., L., W.	18.1 ≡	6.1 ++
St. Giles's	32.6 ++	5.6 ++
Strand, H.	25.8 -	6.6 +++
Holborn, H.	29.1 +	5.8 ++
Clerkenwell	23.8 =	5.2 +
St. Luke, H., L.	28.3 -	3.8 -
East London	29.0 +	4.4 -
West London, H.	25.0 -	8.1 +++
London City	23.0 =	5.0 +
Shoreditch, L., W.	25.3 -	4.6 +
Bethnal Green, H., L.	21.4 =	3.5 =
Whitechapel, H.	30.3 +	5.0 +
St. George's in the East	34.8 ++	4.8 +
Stepney		
Mile End Old Town } H., H.	25.4 -	4.8 +
Poplar *	22.8 =	4.1 -
St. Saviour's, Southwark } H., H.	35.8 ++	9.0 +++
St. Olave's, Southwark }		
Bermondsey	23.7 =	4.5 -
St. George's, Southwark, L.	29.6 +	4.7 +
Newington	25.4 -	5.8 ++
Lambeth	23.5 =	5.8 ++
Wandsworth, L.	22.3 =	6.2 ++
Camberwell, L., L.	23.5 =	6.1 ++
Rotherhithe	23.3 =	3.7 -
Greenwich, H., H., H., H.	27.8 -	4.8 +
Lewisham	17.8 ≡	4.6 +

Explanation of Plus + and Minus - signs:—

+++ equals 1st degree (highest mortality).

++ " 2nd "

+ " 3rd "

= " 4th "

≡ " 5th "

≡ " 6th " (lowest mortality).

Phthisis, therefore, as far as regards females, does not thrive in the Valley of the Thames, and this is especially the case near London. In fact, the Thames does not pass through one high mortality district, from Wallingford to Hoo.

Let us now compare the mortality from cancer in females with that of phthisis. We have seen by Table III. that among the metropolitan parishes there were only *eight*, single and combined, that had a mortality *above* the average; now we shall find, on looking at the *plus* and *minus* column of

\* In the Map this district should be coloured the fifth instead of the second degree.



cancer, that there are only *six* parishes which have a mortality *below* the average, viz. St. Luke's, East London, Bethnal Green, Poplar, Bermondsey, and Rotherhithe.

Cancer Hospital. In one of the high mortality districts a Cancer Hospital has been established! Whilst there can be no objection to a Consumption Hospital in Brompton, there is every possible objection to a hospital devoted to the treatment of cancer being located in London, and especially in its low parts, in the vicinity of the river. If a hospital, however, must be had in London, then let it be built on the top of Hampstead Hill, Blackheath, or Clapham Common.

Again, we have seen that London as a whole in phthisis had a mortality of the Phthisis and Cancer. *fourth* degree, or *one below* the average. In cancer we find the reverse obtaining, the metropolis having a mortality from this cause equal to the *second* degree above the average.

We have just seen that in phthisis London is surrounded by *low* mortality districts, of which it is to a certain extent the centre. Let us now look at the map of cancer, and we shall find that out of the *ten* districts which encircle the metropolis *seven* are high mortality districts, the exceptions being Bromley, Dartford, and Hendon.

I have just said that phthisis does not thrive in the Thames Basin. We see, Cancer does thrive in the Thames Basin. however, that cancer does.

From Wallingford to the Hoo the Thames passes by or through twenty-one riparial districts, all of which belong to the high mortality group of the Thames Basin, with the exception of two on the north and five on the south side of its banks. A reference, however, to a geological map will readily show why these few exceptions are found.

With this I conclude my sketch of the distribution of phthisis within the London division, and shall now proceed to show that, whilst climate Social evils at work. is in many instances an exciting cause in developing latent disease, there are glaring social evils existing, connected with the housing of our labouring classes, which in hundreds of thousands of cases are at this present moment sowing the seeds which the harsh climate I have described will ripen and the grave-digger garner.

## SECTION II.

*Overcrowding and other Social Causes of Phthisis.*

Phthisis, when hereditary, has not an honourable pedigree, resultant as it is Pedigree of Phthisis. of ancestral habits which, either in the last generation or in those preceding it, have been substituted for those that are healthful and dictated by nature.

When not hereditary, poverty is a condition much concerned in the genesis of phthisis. Poverty drives the poor labourer and artizan into dwellings where overcrowding Overcrowding. is inevitable, and lung-disease the sequel. Poverty drives artizans to overcrowd their workshops for the sake of heating them with the fuel of their own bodies.

It has been well observed by Mr. Simon, F.R.S., Medical Officer to the Privy Council and the Local Government Board, that when many persons Sixth Report, published 1864. are employed together in any indoor industry, the ventilation of the workplace is likely to be so bad as to convert the employment, which perhaps in its own nature is not of a hurtful tendency, into an employment seriously dangerous to

health. Here, as he anticipated in his Report for 1858, lies the explanation of a fact most deplorable for the working classes of our own country: that, in *proportion as the people of a district are attracted to any collective indoor industries, indoor occupation, in such proportion, other things being equal, the district death-rate by lung disease will be increased.* For the bad ventilation which as a rule belongs to the place of employment tends to develop among the workpeople a large excess of phthisis, and probably also some excess or other of fatal lung disease; and probably in all England there is no exception to the rule, that in every district which has a large indoor industry the increased mortality of the workpeople is such as to colour the death-return of the whole district with a marked effect of lung disease.

The mortuary statistics recently laid before Parliament place this matter in a singularly striking light.

In those returns, for instance, it may be seen that while about 100 deaths by phthisis and other lung diseases are occurring in various agricultural districts of England among men aged from 15 to 55, these occur in similar masses of population—in Coventry, 163 such deaths; in Blackburn and Skipton, 167; in Congleton and Bradford, 168; in Leicester, 171; in Leith, 182; in Macclesfield, 184; in Bolton, 190; in Nottingham, 192; in Rochdale, 193; in Derby, 198; in Salford and Ashton-under-Lyne, 203; in Leeds, 218; in Preston, 220; and in Manchester, 263.

The same sort of evidence comes out even more strongly when (as in the annexed table) the statistics are limited to the decenniad of adolescence, and are so given that with regard to districts where only one sex pursues indoor industries the death-rates of the sexes may be compared. There, for instance, it is seen—and not anyone who knows the circumstances under which girls are employed in lace-making and straw-plaiting can wonder at the fact—that among the adolescent populations of Berkhamstead, Newport Pagnell, Towcester, and Leighton Buzzard the female victims of lung disease are more than twice as numerous as those of the male. And then, again, in the death-rates of Leek, Congleton, and Macclesfield the same sort of sad testimony is borne (but not exclusively by the female population) as to the atrocious sanitary circumstances under which much of our silk industry is conducted.

TABLE IV.

District	Nature of principal Industry in the District	Death-rate by Phthisis and other lung diseases at between 15 and 25 years of age per 1,000 of each class referred to	
		Males	Females
Berkhamstead . . . . .	} Extensive female employment in straw-plaiting {	219	578
Leighton Buzzard . . . . .		319	554
Newport Pagnell . . . . .	} Extensive female employment in lace-making {	301	617
Towcester . . . . .		239	577
Yeovil . . . . .	} Extensive female, with some male, employment in glove-making {	280	409
Leek . . . . .		437	856
Congleton . . . . .	} Extensive employment, more female than male, in silk-work {	566	790
Macclesfield . . . . .		593	890
Standard Northern Districts	Agriculture . . . . .	531	333



## SECTION III.

*Mode of Investigation by Medical Officers of Health.*

Medical Officers of Health have it within their power greatly to extend our knowledge of disease-distribution by pursuing a plan similar to the one I have adopted within my own area.

I have had a map of my area drawn on stone to the same scale as the large ones which illustrate this work; the districts on which are divided into sub-districts, thus giving a still minuter division—viz. as 12 is to 26—and then coloured in accordance with the scale of colours described elsewhere; in fact, if this were carried out by Medical Officers throughout England and Wales, the vital statistics of the country could be so depicted periodically as to be rendered not only immediately intelligible to the public, but of the highest practical value to sanitary authorities.

Again, when once a districtal area has been subdivided, the towns and villages within it can be grouped by the aid of a geological survey map according to their geological site, aspect, and relation to the watershed, and river system, a grand desideratum for the effective portrayal of vital statistics.

I will give an instance of the usefulness of this mode of investigation in ascertaining whether such a disease as phthisis depends upon social or climatic causes or both combined.

Hardingstone, during the two decennial periods 1851-60, and 1861-70, had a death-rate from phthisis among females equalling for each decennial period respectively 51·4 and 51·2 to every 10,000 females living at ages between 15 and 55; whilst in England and Wales that of the standard group of rural districts only amounted, in the first period, to 33·9, and in the last to 27·1.

When I first studied this cause of death in connection with the county of Northampton I felt inclined to attribute the high mortality among females from consumption to the cold climate of the valley of the Nene, exposed as it is to the chilling influence of its *preventible* floods and the unrestrained blast of the north-east wind, which blows, during some of the early months of the year, without hindrance through the Nene's riparial districts.

However, on constructing a map showing the watercourses and the trend of the valley system of this district, I found only seven out of the twenty-two villages really exposed to the north-easterly winds, all the others being situated and well protected in the valley of the brook which takes its rise in Yardley Chase and falls into the Nene to the *west* of the high protecting hill of Hunsbury. In other words, we have, out of a population of 10,908, only 3,954 persons exposed to the peculiar climate of the Nene valley, whilst 6,954 enjoy the shelter of a hill of considerable elevation which runs from the north-west to the south-east, bisecting the district into two unequal parts. The climate, therefore,

*per se* cannot be considered an exciting cause, however greatly predisposed to phthisis the people may be.

I then studied the sites of the villages from a geological point of view.

Geological character of the sites of villages. Proceeding from the high ground in the south-east to the north-western river boundary of Hardingstone, there are found six different strata—

1. The highest drift clay, with chalk flints.
2. The great oolite—a porous limestone.
3. The Northampton sand, with its ironstone—a porous formation.
4. The upper lias clay—impervious and tenacious, holding up the water which descends to it from the two last strata.
5. The middle lias, or marlstone—porous to a great extent.
6. The alluvium of the Nene.

None of the villages lie on the drift clay; ten out of the twenty-two are built high and dry on the porous great oolite, four on the porous and dry Northampton sand, one partly on the great oolite, the Northampton sands and upper lias clay, and one on the great oolite and the Northampton sands—sixteen in all. On the upper lias clay three villages are situated—on the marlstone one, and on the alluvium two—six in all.

From these facts it is evident that we cannot attribute the excess of phthisis to Causes neither climatic nor geological. soil-dampness,\* to which I have before alluded in connection with the valuable researches of Dr. Buchanan, of the Local Government Board, and Dr. Bowditch, of Boston, U.S.

Having eliminated climate and geological site as causes of the excessive death-rate from phthisis in Hardingstone district, we must look for some other source of this mischief, and unfortunately we shall not be long in finding one in almost every village we visit, for we shall have presented to us abundant evidence of overcrowding by night, in wretched one-roomed dilapidated houses, and by day in close schools and work-rooms, where women huddle together in the winter for warmth and company, and after work-hours go into the cold air whilst still the pores of their skin are open and abundantly sweating under the late influence of unwholesomely warm and fetid air in a fireless room, where the chimney has been boarded up and every crevice that otherwise might admit air closed with paste and paper.

Overcrowding and dilapidated houses are the two evils which destroy the

\* In 1869 a most interesting paper was read before the Geological Society of London by Mr. William Whitaker, B.A., F.G.S., entitled 'On the Connection of the Geological Structure and Physical Features of the South-east of England with the Consumption Death-rate,' in which the author drew the following conclusions:—1. That on pervious soils there is less consumption than on impervious. 2. That on high-lying pervious soils there is less consumption than on low-lying pervious soils. 3. That on sloping impervious soils there is less consumption than on flat impervious soils. 4. These influences must be put along with the other fact, that artificial removal of subsoil water alone, of various sanitary works, has largely decreased consumption.

Medical officers and sanitary authorities in the South-east of England have an advantage not enjoyed in any other part of the country, for they have within their reach the magnificent geological model of the South-east of England, including the Weald, by William Topley, F.G.S., Geological Survey of England and Wales (Stanford, London), and James B. Jordan, Mining Record Office. This model is on a scale of 4 miles to 1 inch horizontal, and 2,000 feet to 1 inch vertical. It is a splendid map for the scientific and practical medical man, as at a glance it reveals to him in a moment not only the soil, but the aspect of any locality within the included area.

Were these talented and painstaking authors sufficiently encouraged, we should soon have a model of the whole of England on the same plan, which would be of incalculable service to the cause of sanitary science and a most acceptable boon to the medical geographer.



mothers and render their offspring weakly, causing premature mortality, and swelling unnaturally the general death-rate.

Lately, speaking of the prevalence of rheumatism among the poor in the protected valley of some of the districts within my area, I remarked that undoubtedly not only was this disease, but phthisis also, caused or greatly aggravated by the wretched overcrowded hovels in which the agricultural labourer is forced to live. If as much care were taken of him, who does work, as there is of the prize ox, which does not, we should find the mortality from phthisis, diseases of the respiratory organs, rheumatism and heart disease decline in spite of the somewhat inclement climate of the Valley of the Nene during the winter and spring months.

It must ever be remembered that there are few diseases in the Registrar-General's list of causes of death which do not owe their birth to some social cause, and that The origin of most diseases is from social causes. however much their distribution may appear to be regulated by the climate, or by the physical and geological characters of the country, they do so only according to well-known laws in many cases. For instance, if the disease lie in the lungs, these organs are weakened, rendered irritable and susceptible of the influence of harsh winds—winds, in fact, that are characterised by their dynamical element, and which prematurely ripen the latent disease-seeds.

If, again, there is a tendency to develop disease in the womb or mamma, it is Disease of womb and mamma. quickened by any conditions which shall relax the tone of these organs; and thus we find cancerous diseases attacking those who reside in localities where the land is occasionally flooded and the air above it laden with moisture, and defective in the electrical element, which over a dry, elevated site has such invigorating tonic powers, endowing man with the best armour he can put on against disease.

It is to be deplored that we know so little about atmospheric or telluric electricity in its relation to health and disease; and it is still Our ignorance of atmospheric and telluric electricity. more to be deplored that no systematic investigation of this deeply interesting subject is likely to be attempted throughout England and Wales. Whenever I approach this subject I always feel that there is, although hidden, a vast unexplored mine of knowledge within our reach, capable of unravelling many an etiological mystery, if we only had the courage to band together and search until we have found it.\*

#### SECTION IV.

##### *Conclusion—Heart Disease in Scotland.*

Whilst these pages were passing through the press my attention was drawn to Heart disease in Scotland. some remarks made by the Registrar-General of Scotland on my opinions with regard to the distribution of heart disease and

\* For further statistics on consumption I must refer the reader to an exhaustive article on consumption, extending over thirty pages of closely-printed matter, in *The Insurance Cyclopædia* of Mr. Cornelius Walford, F.I.A., F.S.S., Barrister-at-Law (C. & E. Layton, Fleet Street, London). This work, of which two volumes are now complete, is a mine of statistical and bibliographical information—invaluable to medical men, Medical Officers of Health, and all interested in the bibliography and statistics of the long list of causes of death which the Registrar-General publishes. Mr. Walford deserves the best thanks of the medical profession for the material assistance he is affording it by the publication of his unrivalled work.

dropsy in England and Wales, in his supplement to his annual Reports for the ten years 1861-70.

Before, however, I read the Report, which the Registrar-General courteously forwarded to me, I obtained a large school-map of Scotland (published by Smith & Son, Charing Cross) and coloured it in accordance with what I thought would most probably be the distribution of heart disease in Scotland, provided the same laws held good in that country as I had showed regulated the distribution in England.

On receiving the Registrar-General's Report I anxiously compared his figures with my colours, and was gratified to find that in colouring speculatively the thirty-three counties of Scotland I had only erred in estimating the probable death-rate in two instances. In fact, had I known what I now do of the geography of heart disease in this part of the United Kingdom, I should have felt inclined to use it as a typical illustration of the mode in which the physical character of a country regulates the distribution of heart disease.

With regard to the connection between rheumatism and heart disease in Scotland, the statistics of the former disease are so scanty as to preclude our deriving any conclusions from them, and I cannot learn that the Registrar-General made any investigations, to supplement this deficiency, by visiting those counties where heart disease was shown to prevail, as I did in England, when I found that I could not arrive at the amount of rheumatism and rheumatic fever prevalent in high mortality districts from the death-returns of the Registrar-General of England and Wales.

One fact, however, is shown by the small numbers given by the Registrar-General: that in the exposed parts of Scotland rheumatism and rheumatic fever when they do occur are proved to assume an acute form and kill during that stage, and are therefore registered as such. This is what one would naturally expect in such a climate.

In the English villages, however sheltered and protected from the harsh sea winds, the more chronic form of rheumatism obtains, and to this form is attributable the heart disease which so insidiously slays and swells the death-rate from this cause.

#### SECTION V.

##### *Cancer and Consumption in the United States and Scotland.*

The Registrar-General for Scotland, in reviewing the opinions of Dr. Andrews, of the Chicago Medical College, U. S., who has generalised the laws of the distribution of consumption and cancer in the United States from the census returns under two heads—viz. (1) that cancer and consumption are most abundant near the sea, and diminish as you recede from it; (2) at equal distances from the sea they prevail most at the north, and diminish as you go south—has afforded a strong corroboration of what I have laid down as regards the distribution of these diseases in England and Wales, by giving tables of their death-rate in the different counties of Scotland, his conclusions from which he sums up in the following manner:—

Cancer and Consumption  
in America. By Dr.  
Andrews.



‘By these tables it is seen that of the counties of Scotland, Shetland was free from cancer; but it was one of the counties, on the other hand, in which the deaths from consumption were far above the average. The county of Berwick had the very highest death-rate from cancer of all the counties of Scotland, but it had a compensation in that it was the county which had the second lowest mortality from consumption. Forfar had a high death-rate from cancer, but a very low death-rate from consumption. Ayr had a very small death-rate from cancer, but a very high rate from consumption.

‘Then take the towns, and the same want of connection between the two diseases will be seen. Leith was the town with the smallest mortality from consumption, but it had a high mortality from cancer. Greenock had a very low mortality from cancer—the second lowest of the towns—but a very high mortality from consumption. Edinburgh had the third highest mortality from cancer, but a very low death-rate from consumption. Aberdeen, which had a very high mortality from cancer, had only a mean mortality from consumption; and Perth, which had a high death-rate from cancer, had a death-rate much below the mean for consumption.

‘Seeing that these diseases are thus proved to have no natural connection, inasmuch as the localities where the one is most prevalent do not coincide with those of the other, it is useless to show that the other fancies as to vicinity to the sea have influence on them.’\*

This remarkable correspondence in the distribution of cancer and consumption in the two countries is sufficient evidence, in my opinion, to warrant us in accepting the laws which I have laid down in the preceding pages, and which, although enunciated in 1868, were, I believe, unknown to the Registrar-General of Scotland when he penned what I have quoted from his supplement.

Remarkable correspondence of distribution in England and Scotland.

#### SECTION VI.

##### *Importance of the Study in selecting Sites for Residence, and to Insurance Companies.*

From the facts I have endeavoured to lay before the reader as succinctly as possible I think it will be conceded that the study of the geographical distribution of disease is one of paramount importance not only to the medical profession, but to the public at large.

This study will teach us to ponder before we select a place wherein to dwell, either for our own sake or for that of our families.

Parents selecting a school for their children certainly ought to consult their professional adviser, whose personal knowledge of his patients and of the diseases to which they are either heirs or otherwise prone will enable him to recommend localities the most suitable, provided he has studied the general principles on which the distribution of certain diseases and causes of death depends. Without doing so all would be guesswork and haphazard, whatever advice he might give.

To persons having hereditary disease like cancer or consumption it is of vital importance that they should make no mistake in the selection of a site for their

\* Supplement to the Registrar-General's Reports of Births, Marriages, and Deaths in Scotland during the ten years 1861-70, p. 82. Edinburgh, 1874.

residence; on this, however, I have already dwelt, and therefore shall not enlarge further on this subject.

By Insurance Companies the study of disease-distribution ought not to be disregarded; on the contrary, from the opinions expressed by many eminent actuaries, I am inclined to think that it will prove of essential service to these institutions.

*Disease-distribution  
useful to Insurance  
Companies.*

Let us take a simple case. A proposal is made to effect an insurance. The medical examiner ascertains the locality in which the proposer resides or intends to reside, where he was born, and where his parents resided and were married; in fact, he informs himself of the local surroundings not only of the proposer, but of his parents. After doing this he would consult maps of disease-distribution and ascertain whether the person before him had been or was likely to be favourably circumstanced with regard to locality, so that he should have every chance of living his full time. Supposing he finds that a female whose mother has died of cancer is living in a locality favourable to the development of this disease, he certainly would not look upon such a life without suspicion. On the other hand, if she had resided and was likely still to reside in a high, dry locality where cancer is known not to thrive, he might regard the case in a different light, especially if the proposer had been living for some years under such favourable circumstances.

*Example.*

What is applicable to cancer is equally so to many other diseases, and I need add little more on this subject. In the case, however, of heart disease it would be evident that a person subject to rheumatism, if he desire to make a good life, should cease to dwell in sleepy hollows, however grand the mansion, and however lovely the surrounding wooded scenery may be, that shuts out the prevailing winds and stores up the chilling emanations of night.

*Heart disease.*

When once the colouring of the maps is learnt, their teachings will prove to be simple and easily remembered; and I sincerely hope that what they teach will be of service to those who consult them.

*Segnius irritant animos demissa per aurem,  
Quam quæ sunt oculis subjecta fidelibus, et quæ  
Ipse sibi tradit spectator.—HORACE.*



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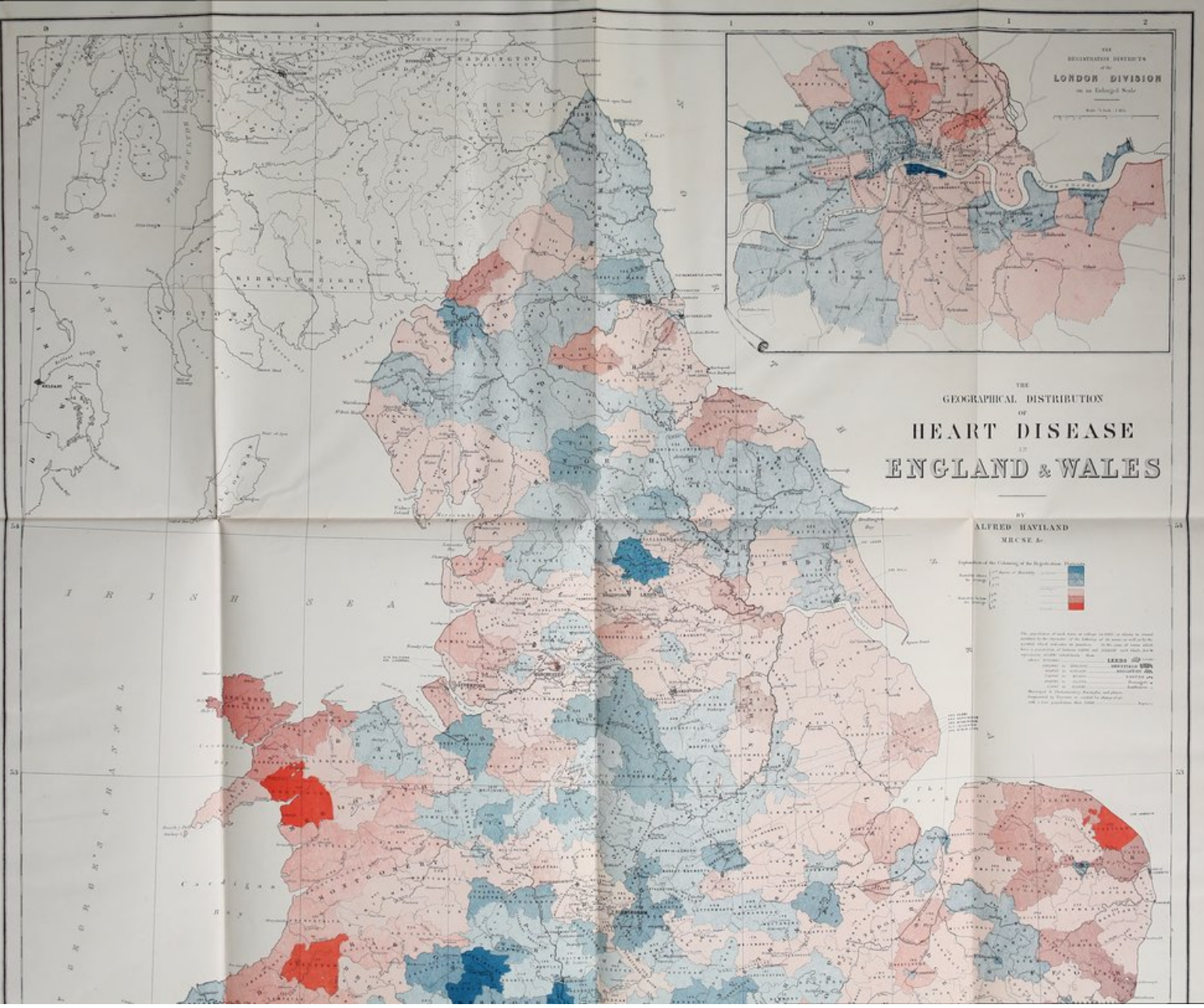


THE UNIVERSITY OF CHICAGO

PHYSICS DEPARTMENT

PHYSICS 311

LECTURE 1



THE  
GEOGRAPHICAL DISTRIBUTION  
OF  
**HEART DISEASE**  
IN  
**ENGLAND & WALES**

BY  
**ALFRED HAVILAND**  
M.C.S.E. &c.

Explanation of the Colouring of the Distribution:—  
Red: High Prevalence  
Blue: Low Prevalence

The distribution of heart disease in England and Wales is based on the results of a special inquiry conducted in 1900-1901. The results are given in the accompanying tables. The distribution is shown on the map by means of red and blue. The red indicates a high prevalence of heart disease, and the blue indicates a low prevalence. The distribution is shown on the map by means of red and blue. The red indicates a high prevalence of heart disease, and the blue indicates a low prevalence.





