Cancer mortality in the Chelmsford and Maldon districts (East Essex) / by G. Melmoth Scott ; with introduction by John C. Thresh.

CANCER MORTALITY

4.

IN THE

CHELMSFORD AND MALDON DISTRICTS

(EAST ESSEX)

BY

G. MELMOTH SCOTT, M.D. (Cantab.)

With INTRODUCTION by

JOHN C. THRESH, M.D., D.Sc.

MEDICAL OFFICER OF HEALTH, ESSEX COUNTY COUNCIL

Reprinted from The Journal of State Medicine, *March and April, 1900*

LONDON

BAILLIÈRE, TINDALL AND COX

20 & 21, KING WILLIAM STREET, STRAND

With thanks for kind assistance given, from
J. W. Scott.

INTRODUCTION

In several of my Annual Reports to the Chelmsford and Maldon Rural District Councils I have referred to the apparent increase in the mortality from cancer during recent years, and I had intended making a special report on this subject at an early date. While accumulating information, my friend Dr. Scott very kindly undertook to carry on the investigation, and I at once placed all my books at his disposal. Beyond this, and a general discussion as to the lines upon which the investigation should be conducted, the whole of the work is by Dr. Scott. The great amount of labour he has expended on the subject has resulted in a memoir which is too valuable to be allowed to perish, especially as it is of more than local interest. If we could have similar thorough researches conducted with reference to the distribution, etc., of cancer in other parts of the country, they could not help but throw some light on this very obscure subject.

JOHN C. THRESH.

CHELMSFORD,
April 4, 1900.

CANCER MORTALITY IN THE CHELMSFORD AND MALDON DISTRICTS (EAST ESSEX).

AMONG the general public, as well as in the ranks of the medical profession, an impression has of late been gaining ground that the mortality from cancer has been increasing during recent years.

The deaths from this disease of one or two prominent men in Eastern Essex having accentuated this feeling, I have in the following pages detailed the results of an inquiry carried out with a view to testing its correctness. Having arrived at a conclusion on this point by means of a careful examination of the death registers, I have next directed my inquiry to the local distribution of the disease under the somewhat peculiar geological conditions of the district in question.

The kindness of Dr. Thresh, Medical Officer of Health for the County of Essex, and acting for the two Rural Sanitary Districts of Chelmsford and Maldon, enabled me to collect particulars of all the cancer deaths occurring within these two Unions between the years 1888 and 1898; and to these were added particulars obtained from the registers of the Urban Districts of Chelmsford and Maldon. As this gave a total of only some 300 deaths—a number which I considered insufficient to generalize from—I then proceeded to abstract the particulars of all the cancer deaths throughout the whole area from the year 1871 onwards. I thus obtained a total of 1,000 deaths, spread over the years 1871-1898 inclusive. When tabulating the results I have given separate tables for the years 1871-1880, 1881-1890, and 1891-1898, but for purposes of comparison I have calculated the last period of ten years—*i.e.*, the number of deaths shown in the tables are ten-eighths of the numbers which are obtained from the death registers; at the same time the mean population is estimated for the ten years 1891-1900, and not for the eight years 1891-1898.

Before discussing any theory of the local distribution of cancer, it may, perhaps, be well to dispose, so far as may be, of the general results obtained, and of the question of the increase of the disease during recent years.

TABLE I.

Total Number of Deaths in each Decade.

	1871-1880.			1881-1890.			1891-1900.		
	Total Deaths.	Proportion of M. to F.	Deaths per 1,000.	Total Deaths.	Proportion of M. to F.	Deaths per 1,000.	Total Deaths.	Proportion of M. to F.	Deaths per 1,000.
Persons . .	274	—	4·78	355	—	6·23	447·5	—	7·73
Males . . .	93	51·38	3·22	135	61·36	4·74	203·75	83·59	7·05
Females . .	181	100	6·36	220	100	7·73	243·75	100	8·41

It will appear from a glance at Table I. that there has been a steady increase in the rate of deaths certified as due to cancer, the total numbers in the three decades being 247 (4·78 per mille), 355 (6·23 per mille), and 447 (7·73 per mille).

This may be due to an actual increase in the disease, but in the first decade there were many deaths certified as being due to "tumour of abdomen," "stricture of bowels," etc., deaths which were probably due to malignant disease, but not being returned as such, they could not be included. This indefiniteness in certifying strongly impressed me when abstracting the registers with the truth of the Registrar-General's remark that "the increase is not wholly real, but may be accounted for to some extent by the fact that the statement of death-causes by medical men has been made with greater precision than had formerly been the case."* That some looseness in certifying actually existed is proved by Table II., where we see that in the last decade there were only 11·2 per cent. of the cases in which the certificates did not specify the organ affected, as against 26·6 per cent. in the first decade.

Table I. also bears out the further statement made by the Registrar-General that "the increase of cancer mortality is greater among males than among females,† for to every 100 females dying of the disease 51 males died in the first decade, 61 in the second decade, and 83 in the third decade.

On closer analysis this increase in the male death-rate is found (Table II.) to be chiefly due to cancer affecting the more inaccessible parts of the body, for while cancer of the lip, tongue, throat, breast, penis, testicle, were only slightly increased proportionately during the three decades, cancer of the more inaccessible parts increased from 16 per cent. of the total number in the first decade to 28 per cent. in the second decade, and to 36 per cent. in the third decade. Or to put it in another way, while during the three decades external cancer increased in the ratio of 1, 1·6, 2·4, internal cancer increased in the ratio 1, 2·2, 3·5. This would suggest that a part at least of the apparent increase in the disease is due to increased knowledge and skill on the part of the medical men signing the certificates. In the same way the particulars of the deaths among females show us that in the more accessible parts (tongue, lip, throat, breast, uterus, and vulva) the ratio was 1, 1·25, 1·08, and in the less accessible, 1, 1·31, 2·01.

TABLE II.

Cancer in Accessible and in Inaccessible Parts of the Body.

	1871-1880.				1881-1890.				1891-1898.‡			
	Males.		Females.		Males.		Females.		Males.		Females.	
	No.	Proportion, total =100.	No.	Proportion, total =100.	No.	Proportion, total =100.	No.	Proportion, total =100.	No.	Proportion, total =100.	No.	Proportion, total =100.
External organs§	10	3·6	80	29·2	16	4·4	100	27·7	24	5·3	87	19·4
All other organs	46	16·8	64	23·4	101	28·0	84	23·3	162	36·1	129	28·8
Not stated . .	34	12·4	39	14·2	22	6·1	37	10·2	16	3·5	30	6·7

* Supplement to the Registrar-General's 55th Annual Report, Part I., 1895, p. xxix.

† *Ibid.*

‡ Calculated as ten years for purposes of comparison.

§ Lip, tongue, throat, breast, uterus, vulva, penis, testis.

These figures partly bear out the results obtained by King and Newsholme* from a study of the statistics of the city of Frankfort. They say that "in those parts of the body in which cancer is easily accessible and detected there has been no increase in the mortality from it between 1860 and 1889," and that "it is only the cancer of organs common to both males and females which has apparently increased, while cancer of the special female organs, which is most easy of all to diagnose, has practically remained constant." In Eastern Essex, however, it would appear that while cancer in females has only slightly increased in the "accessible" parts, yet there is a small though decided increase in the male "accessible" parts, and a very marked increase in the number of cases affecting parts where it is difficult to diagnose. On the whole, then, we must conclude that there is a slight, but only a slight, actual increase in the death-rate from cancer.

If, then, this be so, and the increase is chiefly apparent, we need not greatly concern ourselves with theories put forward by various writers to account for a supposed large real increase. I would only point out that any real increase cannot be due (as suggested by W. R. Williams)† to a change from an agricultural to an industrial occupation, for there has been no such change in this part of Essex. Chelmsford is the largest town included within the area under discussion, and it has increased by 2,000 only during the last 28 years. Nor is it likely to be due to a greater consumption of animal food,‡ for although the condition of the agricultural labourer has probably improved since the year 1871, yet his wages do not allow of high living, and all other classes connected with the land have suffered in the depression which has overtaken the agricultural industry. On the other hand, this depression must have been a fruitful source of worry and anxiety to a large number, and according to Sir James Paget§ this is a frequent precursor of cancer. While this state of mind might reasonably be supposed to be one of the factors in rendering Essex one of the maddest counties in England, yet I find it difficult to understand how it can be a potent factor in causing new growths in parts other than the nervous system.

I have found it impossible to investigate the influence of heredity, but this factor would only account for an increase proportional with the increase of population, and surely we must, every one of us, have had one or more cancerous ancestors.

In Table III. will be found a classification of the cases according to the organs involved. These are arranged under the heads of Persons, Males and Females and in each case the average age at death is given.

Of the 841 cases in which the organ attacked is mentioned we find 161 (19 per cent.) instances of cancer of the stomach, 131 (15·5 per cent.) of the uterus, 119 (14·1 per cent.) of the liver, and 98 (11·6 per cent.) of the breast. Of the whole number, 28·4 per cent., or more than one in four, occurred in the special female organs.

---

* Proceedings of the Royal Society, 1893, vol. liv., p. 209.
† *Medical Chronicle*, 1896, vol. v., N. S., p. 322.
‡ *Ibid.*
§ "Clinical Lectures and Essays."

TABLE III.

Parts Affected.

Parts Affected.	Persons.		Males.				Females.			
	No.	Average Age.	No.	Youngest.	Oldest.	Average Age.	No.	Youngest.	Oldest.	Average Age.
Not stated	163	—	69	—	—	—	94	—	—	—
Mouth	3	60·6	2	53	82	67·5	1	—	—	47
Tongue	22	66·1	16	39	83	64·0	6	57	87	71·5
Tonsils	1	63	1	—	—	63	—	—	—	—
Throat	20	62·3	10	41	79	59·8	10	47	82	64·8
Œsophagus	17	56·6	12	35	83	56·1	5	37	80	57·6
Stomach	161	62·1	90	30	88	61·3	71	37	85	63·1
Bowels	53	63·3	32	42	83	62·1	21	50	78	65·1
Rectum	58	60·9	29	36	80	62·6	29	32	86	59·2
Abdomen	34	61·5	13	44	84	61·9	21	43	78	61·2
Larynx	10	63·6	9	36	75	67	1	—	—	33
Trachea	1	57	—	—	—	—	1	—	—	57
Lungs	1	50	—	—	—	—	1	—	—	50
Breast	98	59·9	2	76	76	76	96	34	87	58·6
Uterus	131	56·3	—	—	—	—	131	28	93	56·3
Ovary	4	47·2	—	—	—	—	4	28	59	47·2
Vulva	6	65·7	—	—	—	—	6	41	78	65·7
Penis	3	73	3	66	86	73	—	—	—	—
Testis	2	57	2	50	64	57	—	—	—	—
Prostate	2	68	2	65	71	68	—	—	—	—
Bladder	13	67·2	8	45	79	63·4	5	65	79	73·4
Kidney	1	60	—	—	—	—	1	—	—	60
Liver	119	59·5	44	42	83	65·1	75	43	86	56·2
Scalp	1	74	1	—	—	74	—	—	—	—
Face	23	70·7	14	34	88	70·6	9	54	89	71
Nose	2	74·5	—	—	—	—	2	55	94	74·5
Lip	10	75·5	9	64	85	75	1	—	—	80
Ear	3	71·7	3	—	—	71·6	—	—	—	—
Neck	18	58·4	15	42	79	58·4	3	40	75	58·7
Thyroid	1	67	1	—	—	67	—	—	—	—
Orbit	2	68·5	2	59	78	68·5	—	—	—	—
Jaw	6	72·3	5	68	88	75·8	1	—	—	55
Mediastinum	1	62	1	—	—	62	—	—	—	—
Spine	1	61	—	—	—	—	1	—	—	61
Pelvis	1	67	—	—	—	—	1	—	—	67
Upper extremity	3	61·7	—	—	—	—	3	26	82	61·7
Lower „	6	72·7	4	62	82	75·7	2	61	82	71·5
Spleen	2	52	2	48	56	52	—	—	—	—
Heart	1	66	—	—	—	—	1	—	—	66
Totals	1,004	61·1	401	—	—	63·1	603	—	—	59·8

Perhaps the most noticeable feature of this table is the high average age at death of the whole number—namely 63·06 years for males, and 59·83 years for females. For one organ only, the ovary (4 cases, average age 47·25 years) is the average age at death below 50 years; for 9 organs it is between 50 and 60 years (389 cases—œsophagus, 17; trachea, 1; lungs, 1; breast, 98; uterus, 131; testis, 2; liver, 119; neck, 18; spleen, 2). Nineteen organs show an average

age at death of 60 to 70 years (394 cases—mouth, 3 ; tongue, 22 ; tonsils, 1 ; throat, 20 ; stomach, 161 ; bowels, 53 ; rectum, 58 ; abdomen, 34 ; larynx, 10 ; vulva, 6 ; prostate, 2 ; bladder, 13 ; kidney, 1 ; thyroid, 1 ; orbit, 2 ; upper extremity, 3 ; and mediastinum, spine, pelvis, and heart, 1 each), while 8 show an average of more than 70 years of life (54 cases—penis, 3 ; scalp, 1 ; face, 23 ; nose, 2 ; lip, 10 ; ear, 3 ; jaw, 6 ; and lower extremity, 6).

Excluding those organs which occur less than five times in the list, we find that cancer causes death at the earliest age when affecting the following organs, namely :

	Years.
Œsophagus (male)	56·16
Liver (female)...	56·24
Uterus	56·28
Neck (male)	58·40
Breast (female)	58·57
Neck (female)	58·66

If "the greater frequency of cancer of the pelvic organs and breasts of women explains the fact that the proportion of males to females that die with cancer of the liver is as 3 to 4 "* (in this table as 4 to 7), and also explains the further fact that the average age at death of such females is nine years below that of the males, we may fairly conclude that the number of deaths due to cancer of the female pelvic organs must be considerably understated in these returns. This surmise, if correct, would confirm the proposition that, with the possible exception of the œsophagus in males, cancer attacks the female reproductive organs with greater frequency and at an earlier date than any other organ.

So far we have confined our attention to what may be considered the incidental results of our inquiry. It now remains to test the applicability of Dr. Havilland's theory of the geographical distribution of cancer.

This theory postulates that :

(1) In the counties having a high mortality from cancer we find that the tributaries of the large rivers rise from soft marshes or other easily-disintegrated rocks, and these fall 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) The districts "characterized by the tertiary and more recent clays and other retentive soils have a very high mortality from cancer."§

In order to test the soundness of the theory we must first get a clear conception of the contour, geology, etc., of the district we are investigating.

This consists of the two Unions of Chelmsford and Maldon, the former of which lies to the west of the latter, the two together forming a tract of country extending inland some 25 miles, from east to west, while from north to south the distance is roughly from 10 to 15 miles. The district forms an irregular parallelogram, being bounded on the east by the North Sea, on the south by the River Crouch, and on the west by a line running north and south some 6 miles to the west of Chelmsford. The northern boundary is more irregular.

---

* Hale White, in Allbutt's "System of Medicine," vol. iv., p. 197.
† Havilland, "Geographical Distribution of Disease in Great Britain," p. 37.
‡ *Ibid.*
§ *Ibid.*, p. 15.

The area of the whole is 175,231 acres. (In future we shall refer to the two Unions together as the "area.")

In one respect the physical features of the two Unions differ markedly, for while the Chelmsford Union is entirely inland, and is watered by small rivers only, the Maldon Union is cut in two from east to west by the great salt-water estuary of the Blackwater, and is bounded on the south by the very similar estuary of the Crouch.

The country lying on each side of these estuaries, and the sea-shore lying between their mouths, is extremely flat, the water being kept out by sea-walls, and the fields intersected with small creeks and ditches, while, as the map shows, in many places there are "saltings," *i.e.*, land which grows a rough species of grass, although covered with salt-water at high tides. This part of the country used formerly to be the home of malaria. De Foe, writing in the year 1772, says that "those gentlemen who are such lovers of the sport (of wildfowling), and go so far for it, often return (to London) with an Essex ague on their backs, which they find a heavier load than the fowls they have shot." And an old practitioner in Maldon tells me that forty years ago he spent £70 in one year for quinine! Fortunately the complaint is now almost unknown, due, presumably, to better drainage.

The streams that run into these estuaries are the Crouch and the Chelmer (with its tributaries the Cann, the Widd, and the Blackwater), which have their origins in the clay lands for which the county is noted. They flow through an undulating country, though the hills are not of sufficient height to form very sheltered valleys. In times of heavy rain both these rivers and their tributaries are liable to floods, which are apt to take some time in subsiding in consequence of the level nature of the country through which they flow. But these floods are not of very frequent occurrence, as the rainfall is under 30 inches per annum.

Besides the floods caused by these larger streams, there are "washes" formed on each side of the blackwater estuary, *i.e.*, small brooks which when swollen by heavy rains and their mouths blocked by high tides cause freshwater floods in some of the low and thinly inhabited districts. Thus within the area under consideration we have some parts subject to fresh water floods and other parts to the overflowing of the sea.

For purposes of comparison the area may be divided into four districts according to their elevation above the sea. Of these four divisions the highest is the south-western, consisting of the southern part of the Chelmsford Union, together with the parishes of Woodham Walter, Woodham Mortimer, Haseleigh and Purleigh, all of which lies above the 100 feet contour line and rising to 311 feet at Stock, 314 feet at West Hanningfield, 320 feet at Ingatestone, and 353 feet at Danbury. In the northern part of the Chelmsford Union (north-western division) the land is flatter—it never rises above 240 feet, and for the most part lies between the 100 feet and 200 feet contours.

The third, or south-eastern division, includes all the southern part of the Maldon Union exclusive of the parishes of Woodham Walter, Woodham Mortimer, Haseleigh and Purleigh (*i.e.*, roughly, all the country to the east of a line joining Maldon and North Fambridge), together with the parishes of Ulting Langford, Heybridge, Goldhanger, and Tollesbury, which lie on the north bank of the Blackwater. Within these limits will be found almost the whole of the country, which is less than 50 feet above the sea, while very little of it is above the 100 feet line.

To the north-east is a more elevated district, consisting of the parishes of Wickham Bishops, Great and Little Branted, Great and Little Totham, Tolleshunt Major, Knights and D'Arcy. These slope gradually from say the 50 feet line to an elevated ridge (200 feet to 230 feet) which trends north-east from the village of Wickham.

Thus the south-western and north-eastern divisions comprise some of the highest land within the eastern part of the county of Essex, while to the south-east is a tract of land low-lying, in some parts marshy, in some intersected with salt-water creeks, and in former times a very hotbed of malaria.

When we come to compare the cancer death-rates in these divisions we shall find it advisable to exclude from them the town of Chelmsford, and for two reasons, firstly because it is the only large town within our area, and, secondly, because the ground-water under the lower parts of the town lies very near the surface, in consequence of the damming back of the river Chalmer by Moulsham Mill.

The geology of the whole district might fairly be summed up in the one word "clay." Excepting along the course of the rivers and on the seacoast, where there is a deposit of alluvium, the geological map is coloured one uniform tint over the whole area. The London clay is exposed over the greater part of the area, but in the north-western division the London clay is overlaid by the boulder clay, which in parts reaches a thickness of some 70 feet, and the same formation also covers an area of several square miles in the south-west part of the south-eastern division. In the higher parts of the south-western division the clay is capped with beds of Bagshot gravel and sand, while small deposits of a similar character are scattered irregularly and sparsely over a large part of the rest of the area.

In times past the county of Essex, and more especially this eastern part of it, was renowned as being some of the best corn land in England, and no doubt it would still be in demand for growing cereals had not the fall in the price of wheat rendered such crops unprofitable. As corn-growing is no longer remunerative, and no other crop has been found so suitable to the heavy soil of our south-eastern divisions, a considerable portion of the land is now uncultivated and practically valueless.

The crops most generally cultivated throughout our area are wheat, barley, roots, and peas, the latter in considerable quantity for the London market. The trees are mostly elm, oak, and ash.

From this short description it may be gathered that we have to deal with a district in parts of which, at all events, one would presume a very high cancer mortality if Dr. Havilland's theory be correct. We shall now proceed to put this presumption to the test.

In the first place, then, we find in the Registrar-General's Reports* that for the decade 1881-1890 Essex stands thirty-first in the list of counties, *i.e.*, there are thirty-one counties with a higher cancer death-rate and thirteen only with a lower (one is bracketed). The list given below shows the mortality for persons per million living aged thirty-five years and upwards (corrected rate):

1. London ...	... 2,250	7. North Wales	... 1,914
2. Huntingdon	... 2,157	8. Northumberland	.. 1,897
3. Cambridge	... 2,012	9. Surrey ...	... 1,891
4. Sussex ...	... 1,999	10. North Riding	... 1,884
5. Warwick ...	... 1,976	11. Northampton	... 1,881
6. Cumberland	... 1,914	12. Middlesex	... 1,881

* Supplementary Report, Part I., 1895, p. lvi.

13. Devon ..	... 1,835	30. Leicester ...	... 1,736
14. East Riding	... 1,831	31. Essex ...	... 1,732
15. Gloucester...	... 1,825	31. Somerset	... 1,732
16. Berkshire ...	... 1,818	33. Hereford ...	... 1,726
17. Kent ...	... 1,815	34. Lancashire	... 1,706
18. Nottingham	... 1,808	35. Durham ...	... 1,696
19. Lincoln ...	... 1,795	36. Stafford ...	... 1,663
20. Shropshire...	... 1,792	37. Rutland ...	... 1,663
21. Hampshire	... 1,788	38. Worcester ...	... 1,653
22. Bedfordshire	... 1,785	39. South Wales	... 1,647
23. Oxford ...	... 1,779	40. Cornwall ...	... 1,630
24. Cheshire ...	... 1,779	41. Wiltshire ...	... 1,604
25. Norfolk ...	... 1,775	42. Derby ...	... 1,597
26. Hertford ...	... 1,772	43. Buckingham	... 1,578
27. West Riding	... 1,765	44. Dorset ...	... 1,578
28. Suffolk ...	... 1,749	45. Monmouth	... 1,574
29. Westmorland	... 1,746		

If females only are considered it will be found that twenty-five counties stand above Essex in the list and seventeen below, while three are equal.

Also in the large map of England, published in Havilland's book, in which the counties are coloured to represent the cancer death-rate from 1861-1870, we find Essex coloured second degree red, *i.e.*, that of the six degrees of cancer mortality this county was in the healthiest degree but one.

In Tables IV. and V. are shown the number of deaths at various age-periods for male and females per 1,000 living per ten years (1881-1890) in the two Unions of Chelmsford and Maldon, both separately and collectively, and also, for purposes of comparison, the corresponding figures for the county of Essex, and for the whole of England.

TABLE IV.

Deaths at various Age-Periods compared—1881-1890.

Males.

Age.		52—	53—	54—	55—	65—	75 and upwards.
England	Population	1,955,274	1,514,486	1,112,527	746,339	417,389	153,686
	Deaths . .	1,549	4,504	11,098	17,162	15,620	6,016
	Deaths per 1,000 .	·79	2·97	9·97	22·99	37·42	32·63
Essex	Population	54,714	36,882	26,304	17,909	10,700	4,205
	Deaths . .	30	74	233	376	377	168
	Deaths per 1,000 .	·65	2·03	8·47	20·99	35·23	39·95
The two Unions	Population	3,299	2,857	2,482	2,077	1,454	629
	Deaths . .	2	5	26	35	44	23
	Deaths per 1,000 .	·60	1·75	10·47	16·85	30·26	36·47
Chelmsford Union	Population	1,991	1,683	1,450	1,208	805	360
	Deaths . .	2	2	22	17	26	15
	Deaths per 1,000 .	1·00	1·18	15·17	14·07	32·20	41·66
Maldon Union	Population	1,308	1,174	1,032	869	649	269
	Deaths . .	0	3	4	18	18	8
	Deaths per 1,000 .	0·00	2·55	3·87	20·71	27·73	29·73

TABLE V.

Deaths at various Age-Periods compared—1881-1890.

Females.

Age.		25—	35—	45—	55—	65—	75 and upwards.
England	Population	2,130,321	1,620,293	1,222,633	849,206	503,754	205,794
	Deaths . .	3,672	13,811	24,971	28,599	22,698	9,422
	Deaths per 1,000 .	1·72	8·52	20·42	33·67	45·05	45·78
Essex	Population	47,158	37,213	27,072	18,972	11,671	5,117
	Deaths . .	75	259	486	620	558	271
	Deaths per 1,000 .	1·59	6·95	17·21	32·67	47·81	52·96
The two Unions	Population	3,671	3,101	2,652	2,153	1,461	682
	Deaths . .	5	27	32	54	62	40
	Deaths per 1,000 .	1·36	8·70	12·06	25·08	42·43	58·65
Chelmsford Union	Population	2,250	1,858	1,586	1,276	873	420
	Deaths . .	4	17	17	34	39	26
	Deaths per 1,000 .	1·77	9·14	10·71	26·64	44·67	61·90
Maldon Union	Population	1,421	1,243	1,066	877	588	262
	Deaths . .	1	10	15	20	23	14
	Deaths per 1,000 .	·70	8·04	14·07	22·80	39·11	53·43

These tables show that though from forty-five to fifty-five years of age, and from seventy-five and upwards, the male death-rate in our area exceeds that for Essex and for England, yet in the other four decades (twenty-five to thirty-five, thirty-five to forty-five, fifty-five to sixty-five, sixty-five to seventy-five) the rate is decidedly below the average. In the Maldon Union alone the death-rate at every age-period is still more markedly below that for the whole country.

Among females this difference is still further accentuated, and it is not until the age of seventy-five is passed that the rate exceeds that of the whole country or of the county, while the same remark applies to "persons."

These results appear even more clearly in Table VI., in which will be found the death-rate above twenty-five years of age per million living from 1881 to 1890, calculated to standard population. In England the rate is 5,746 per million ; in Essex 5,437, and in our area 4,832. For males the figures are 1,996, 1,825, and 1,680, respectively, and for females 3,750, 3,612, and 3,143. It is only when the age of seventy-five years is passed that the cancer death-rate in our area exceeds that of the whole country in any degree.

TABLE VI.

Death-rates per Million calculated to Standard Population—1881-1890.

Persons.

Age.	25—	35—	45—	55—	65—	75—	Totals.
England	189	665	1,311	1,644	1,393	524	5,746
Essex	169	521	1,140	1,578	1,410	619	5,437
The two Unions .	147	608	959	1,231	1,236	642	4,823
Chelmsford Union .	208	603	1,089	1,204	1,306	695	5,105
Maldon Union . .	54	613	781	1,266	1,137	566	4,417

Males.

England	56	163	403	624	568	182	1,996
Essex	46	111	342	569	534	223	1,825
The two Unions .	42	96	423	457	459	203	1,680
Chelmsford Union .	71	65	613	382	488	232	1,851
Maldon Union .	0	140	156	562	421	166	1,445

Females.

England	133	502	908	1,040	825	342	3,750
Essex	123	410	798	1,009	876	396	3,612
The two Unions .	105	512	536	774	777	439	3,143
Chelmsford Union .	137	538	476	822	818	463	3,254
Maldon Union . .	54	473	625	704	716	400	2,972

Thus far the facts adduced lend no support to Havilland's theory; for although the county of Essex consists almost exclusively of clay, and although it is bounded on the south by the muddy and marshy bank of the Thames, and on the north by the river Stour and its large estuary, in addition to containing the two estuaries described above, yet the cancer mortality is decidedly below that which obtains in England as a whole. And, further, although our area includes a larger proportion of muddy foreshore, creek and marsh than can be found probably in any area of similar size within the county, yet the mortality here is less than in the county as a whole.

Up to this point the death-rates referred to have been those for the decade 1881-1890, but now that we come to consider the four divisions of our area, and the smaller parishes and groups of parishes, we must use the figures for the period

1871-1898, in order to eliminate as far as possible the error that would probably be present if we only used the figures referring to the shorter period of time.

The rates of mortality in all the tables from Table IV. onwards are, unfortunately, crude rates only, it being impossible to obtain the numbers of males and females living in each decade of life in each parish, which would be necessary before we could arrive at the corrected rates.

In the four divisions of our area we find that the death-rates per 1,000 do not differ very largely among themselves, the lowest rate being that of the south-eastern division (5·36 for "persons"), while the north-western has the highest rate (6·62 for "persons").

TABLE VII.

Deaths per 1,000 *per* 10 *Years in the Four Divisions of the Area* (*Crude Death-rate*), 1871-1898.

	Persons.	Males.	Females.
South-eastern Division . .	5·36	3·69	5·61
North-western Division . .	6·62	6·20	7·02
North-eastern Division . .	5·93	5·08	6·85
South-western Division . .	5·69	4·49	6·92

Arranging the divisions in a descending scale of cancer-mortality, we find them in the following order, both for "persons," males and females:

1. North-western division.
2. North-eastern division.
3. South-western division.
4. South-eastern division.

Seeing that the south-western division includes the highest ground within our area, and that some of the larger villages are situated on hills capped with sand and gravel, we should expect to find here the lowest mortality. Indeed, these hills are comparable to those of Highgate and Hampstead, which have an exactly similar geological formation, and which should be "a fit site for a cancer hospital." The theory is so far applicable that we find the cancer mortality of this division to be the lowest but one of the four.

When, however, we turn to the low clayey and alluvial south-eastern division, we find that instead of having the highest, it has the lowest mortality of all. Still, we must not attach too much importance to these results by themselves, for there is only a difference of 1·41 per 1,000 per ten years in the cancer death-rate of the healthiest and unhealthiest divisions.

We shall now proceed to divide our area into still smaller districts, and endeavour by that means to discover other facts in proof or disproof of Havilland's theory.*

* "Geographical Distribution of Heart-disease, Cancer, and Phthisis" (Havilland).

When beginning this part of the inquiry I calculated the death-rates for "persons," males and females, in each parish for each of the three decades, but the results were obviously unreliable, in consequence of the small number of inhabitants in some of the parishes.

To take two extreme instances, Hazeleigh (population 117) shows a death-rate for the 30 years of 16·31 per 1,000 per decade, while Asheldham (population 176) is in the happy position of never having had a death from cancer within its boundaries since the year 1871. Only one cancer death per decade would have made the rate in the latter parish equal to that in the former.

I have, therefore, in many cases arranged small contiguous parishes into groups in such a way that in none of them shall the average population be less than one thousand, this number being the lowest on which it is at all probable that reliable data can be founded. The outlines of these groups, thirty-one in number, need not be described in detail.

The highest mortality (8·9 to 8·02 per 1,000 per decade) occurs in the Waltham and Purleigh groups. Of these, Great Waltham is situated in the extreme north-west part of our area. The soil consists entirely of clay, which rises in one part to a height of 230 feet above mean sea-level, and is nowhere less than 130 feet. It may be considered a fairly elevated parish. Through it runs the Chelmer, which is here little more than a brook, but such as it is the houses are mostly aggregated in its vicinity. The floods in this and other parts are seldom serious, as the rainfall rarely exceeds 25 inches per annum.

The Purleigh group also lies fairly high, a large part of the surface being above the 100 feet contour, while it rises in one part to 170 feet. The village of Purleigh comprises by far the largest collection of houses within the group, and is situated on a sharp slope. The low-lying part of the parish is liable to be flooded when Purleigh Wash is swollen by very heavy rains, but there are few houses in the vicinity.

Where, then, the mortality is highest in our area, it cannot be attributed to floods, nor yet to the clayey soil, which is common to the lowest as well as to the highest mortality districts.

The groups with the lowest mortality (3·43 to 4·74 per 1,000 per decade) are the following:

Tollesbury.	Springfield.	Woodham Ferris.
Wickham Bishops.	Ingatestone.	Stow Maries.
Woodham Walter.	Runwell.	Burnham.

A verbal description of these groups will enable us to gain a clearer conception of their physical features than can be gathered from maps alone.

Tollesbury (with the lowest death-rate of all) is extremely flat, the village being situated at an elevation of 85 feet only. The outline of the parish is roughly triangular, two sides of the triangle being formed by muddy foreshore, creeks, and saltings; more than half the parish is under water at high tide; there are no fresh-water streams.

In contrast with the above is the Wickham Bishops group. Here the largest collection of houses is the village of Wickham itself, situated on a patch of gravel at an elevation of 230 feet, the village church forming a conspicuous landmark. Although the (fresh water) river Blackwater, which is liable to floods, bounds the group on one side, yet there are very few houses in the vicinity of the water.

The Woodham Walter group is bounded on the north by the river Chelmer,

from the banks of which the ground rises rapidly, until it attains a height of 350 feet at the village of Little Baddow. The village of Woodham Walter is on the 100 feet contour line. Both the villages lie at some distance from the river, and there are no lands in their immediate vicinity that are ever liable to floods. The parish of Little Baddow is well wooded.

The inhabitants of Springfield are aggregated in that part of the parish nearest to Chelmsford, where the land rises from the bank of the river to a height of 140 feet. If floods ever occur here, they could only affect those living close to the river, as the land rises quickly from its banks.

Ingatestone forms the south-west corner of our area. The levels vary from 140 feet to 320 feet, the town standing upon the clay at an elevation of 230 feet, some 100 feet above the little river Widd. In the northern part of the parish is a large patch of gravel, high-lying and covered with timber.

Along the southern boundary of the Runwell group flows the river Crouch, up which the tide flows as far as the parish of Runwell. In the south-east corner of the group a few "saltings" are found, but from the banks of the river the land rises until it reaches an elevation of 200 feet. The soil is clay, with a little alluvium near the river.

The tidal Crouch, with its creeks and saltings, bounds the parish of Woodham Ferris on the south. From this low land the surface slopes upwards, until it reaches an elevation of 200 feet. There are extensive woods in the northern part of the parish.

The land in the Stow Maries group rises from the banks of the (tidal) Crouch to an elevation of 200 feet. Near the river are extensive "saltings" and a considerable deposit of alluvium.

The Burnham group consists largely of low-lying land. Along the southern boundary runs the (tidal) Crouch, with its "saltings," while there are also "saltings" and extensive marshes in the eastern part of the group. A large proportion of the inhabitants live in the town of Burnham, which is situated on the bank of the river.

From this short description of these eight groups it is apparent that a low cancer mortality may co-exist under most diverse physical conditions. Ingatestone, with its high position and clay soil, Wickham, with its high situation and gravel beds, Springfield and Woodham Walter, lying on the banks of the Chelmer, and the Tollesbury and Burnham groups, with their saltings and marshes, are all equally free from cancer.

And, further, although Ingatestone and Great Waltham are both located upon clay at a distance from the sea, are both intersected with small streams, and are at about a similar elevation above the sea, yet in the former the mortality is low, and in the latter high. It is true that in Ingatestone there are large gravel beds and extensive woods, but the distance of these from the centre of population must minimise any influence that they might otherwise exert.

Again, contrast the contiguous Burnham and Southminster groups. Both include saltings and a large extent of marsh land ; one has a long frontage to a tidal river, the other a (shorter) frontage to the low seashore. In both the majority of the inhabitants live in small towns. And yet, although Burnham town is on the banks of the river, and Southminster town is situated at a distance from the water, the former has a low mortality and the latter a high.

So, too, it is not evident why Springfield should be comparatively free from cancer and the adjoining parish of Boreham suffer much more severely. Both

parishes are bounded on the south by the (fresh water) river Chelmer; both are at a similar elevation above the sea; and the soil in both consists of clay. If it is argued that the greater amount of timber in Boreham is the cause of the higher death-rate, it is also open to argument that as the inhabitants of Springfield live nearer to the river than those of Boreham, the former should be more liable to the disease than the latter.

These facts are, on the whole, at variance with Havilland's theory; indeed, at first sight, one would think it impossible to find a locality that conforms more closely with his definition of a high cancer mortality district than does Tollesbury. In only one particular do the conditions of Tollesbury differ from those which are presumed to predispose to cancer, namely, that the water which covers so large a portion of the parish is not fresh but salt.

Supposing that salt water is inimical to the development of a hypothetical cancer germ, we should expect to find a low mortality from the disease in our south-eastern division. And this we find to be the case, this division enjoying a greater freedom from the disease than any of the other three.

Within this division are certain groups which include a larger area of saltings and creeks than others. These are: Tollesbury, Burnham, Goldhanger, Tillingham, Bradwell, and Southminster.

Of these six groups, *Burnham* is perhaps the driest, for although it includes extensive marshes, they are at some little distance from the town, and there are few saltings and little mud along the river side.

The *Goldhanger* group consists chiefly of three villages—Goldhanger, Heybridge, and "The Basin." Goldhanger stands a little way back from the water, on dry ground; Heybridge is situated on a tidal creek which floods the main street at extra high spring tides; through it runs a canal, and there are saltings along its southern side; "The Basin" lies below high-water mark and is surrounded by river, canal, and ditches.

The *Tillingham* group is bounded on the east by the sea, the shore being very low and about a mile of mud being exposed at low tide. In addition to this there are extensive marshes.

The Bradwell and Southminster groups are very similar to that last described.

Thus it is seen that the physical conditions in these groups show very little variation, but when we look at the following we find a considerable difference in their rates of mortality, for

Tollesbury has a death-rate of		3·41	per 1,000;
Burnham	,,	4·24	,,
Goldhanger	,,	4·99	,,
Tillingham	,,	5·66	,,
Bradwell	,,	6·64	,,
Southminster	,,	7·96	,,

the first four of which are below the average of the whole area, the fifth is almost equal to the average, and the last above it.

This last group is an example of those inexplicable (or unexplained) cases to which Butlin has called attention,* where a high mortality area is bounded by others in which a low mortality prevails. All the groups which are contiguous to

---

* *British Medical Journal*, 1887, i.

this Southminster group show a death-rate below the average, and the little parish of Asheldham (Steeple group) has been entirely free from cancer for twenty-eight years.

It may, I think, be assumed that the prevalence of cancer in Southminster depends on some unknown condition not common to the other five groups, and if this is so we should have some grounds for believing that where the land is liable to be flooded with salt water, cancer will be infrequent in neighbouring parts.

On the other hand, the strongest evidence to be derived from our inquiry in favour of Havilland's theory is obtained from a consideration of the conditions which exist within this same (high mortality) parish of Southminster ; for in the eastern part of it is a large tract of land which goes by the name of Southminster Marshes, although now well drained by ditches. These ditches serve to divide the fields one from another in the same way that hedges do in other parts of the country ; the water that fills them is mainly derived from the surface of the land, although there is probably some percolation from the sea in the parts nearest to the shore. Seeing that the subsoil water cannot stand much below the level of that in the ditches, we may conclude that it is always very near the surface, and thus it follows that we have a heavy clay and alluvial soil which is constantly wet, although no "fully-formed river" runs through it, and though it is not invariably flooded during the rainy season—a very near approach to Havilland's description of what should form a high mortality district.

Under the somewhat similar conditions which exist in Chelmsford, we also find a high death-rate (7·89 per 1,000). Here the river is dammed back at Moulsham Mill, in consequence of which the ground-water in the lower parts of the town comes very near to the surface.

These two instances would appear to lend weight to the theory that a wet soil is conducive to the spread of the disease, but it must not be overlooked that a high death-rate also occurs in the Great Waltham, Purleigh, Writtle, Boreham, and Tolleshunt d'Arcy groups, where no such conditions exist.

Let us now examine into the cancer mortality of those groups which lie on the banks of our two rivers.

The north bank only of the river Crouch from Runwell eastward is included in our area. We have already seen that in the Burnham group, situated at the mouth of the estuary, the mortality is low (4·24 per 1,000). The groups to the west of this latter are those of Latchingdon, Stow Maries, and Runwell, with death-rates of 4·96, 4·71, and 3·96 per 1,000 respectively, all of which are decidedly below the average of 6·70 per 1,000. The proximity of the river Crouch, therefore, cannot adversely affect the cancer mortality in its neighbourhood.

Turning to the Blackwater, the north bank is formed (from east to west) by the following groups : Tollesbury (a small slip of Tolleshunt d'Arcy), Goldhanger, Langford (Hatfield), Boreham, and Springfield. These have mortality rates of 3·41, 4·99, 5·56, 7·86, and 4·54 per 1,000, all of which are below the average, with the exception of that for Boreham.

On the south bank of the river lie the groups of Bradwell, St. Lawrence, Latchingdon, Maldon, Woodham Walter, and Little Baddon, with death-rates of 6·64, 5·43, 4·96, 6·14, 4·70, and 6·26, all of which, again, are below the average of the whole area, although somewhat higher than the rates which obtain along the north bank of the river.

When we trace the course of the Chelmer from Chelmsford (where the river is first fully formed) to the mouth of the estuary and notice that, with the single exception of the parish of Boreham, all those groups that lie on its banks have either an average or less than average cancer mortality, we are inevitably led to entertain very grave doubts as to the truth of the theory that cancer is especially prevalent in localities in which a river rising from clayey soil runs through a clayey district.

To the west of Chelmsford the Chelmer (which is the chief river flowing into the Blackwater Estuary) can no longer be considered a "fully-formed river," since it breaks up into three branches, the Chelmer, the Cann, and the Widd, each of which is little more than a large brook.

It is so improbable that these small streams should influence the cancer death-rates of the places adjacent to them, that it would be unprofitable to further extend this part of our inquiry.

Our examination of the death-registers, therefore, leads us to believe that whatever truth may underlie Havilland's theory, it is insufficient to explain the distribution of cancer in eastern Essex; for (1) the disease is less common within the county of Essex with its clay soil and numerous estuaries than it is in England as a whole; (2) although the unions of Chelmsford and Maldon contain an excessive proportion of marshy land and estuary, yet their death-rate is below that of the county; (3) those parts of the two unions which include the greatest extent of muddy foreshore, creek and saltings have a mortality below that of the two unions taken together, and (4) the disease is not especially prevalent in those places which are situated on the banks of the fresh-water rivers.

GENERAL SUMMARY.

I. During the earlier part of the period under consideration the death certification was wanting in detail.

II. Cancer affects the female reproductive organs with greater frequency and at an earlier age than any other part of the body.

III. The increase in the number of deaths certified as being due to cancer is real in part, but is chiefly to be accounted for by greater accuracy in diagnosis.

IV. On the average there are fewer cancer deaths in Essex than in England as a whole; fewer in the area under consideration than in the county of Essex; and fewer in the Maldon than in the Chelmsford Union.

V. There are no fully-formed rivers in those parts of our area in which the death-rate is highest.

VI. A low mortality may co-exist under the most diverse physical conditions.

VII. A low cancer-death-rate exists near those parts which are characterized by muddy foreshore and salt-water creek.

VIII. In *some* parts having a high mortality the subsoil water lies near the surface.

IX. In those parts which lie on the banks of the fully-formed rivers there is no special prevalence of the disease.

THE INCREASE OF CANCER.

BIBLIOGRAPHY.

ALDERSON.—Cancer Prevalent near Rivers: Brit. Med. Journ., 1885, ii.

BUTLIN.—Cancer Infrequent near some Rivers flowing through Clayey Country: Collective Investigation of the British Medical Association: Brit. Med. Journ., 1887, i. Investigation of the Causes of Cancer: Brit. Med. Journ., 1897, i.

CHRISTIE.—The Geographical Distribution of Disease: Sanitary Journ. for Scotland, 1876, i.

CHURCHILL, J. F.—A Letter to the Registrar-General on the Increase of Cancer in England and its Causes, 1888.

DUNN, H. P.—The Increase Due to a Larger Number of Weakly Persons Attaining the Cancerous Age than Formerly: Brit. Med. Journ., 1883, i.

HAVILLAND, A.—Cancer Fields: Lancet, 1868, ii.; *Ibid.*, 1875, i., and 1888, i. Prevalent near Rivers: Lancet, 1889, ii.; Med. Press and Circ., 1880, ii. Increasing Fatality: Brit. Med. Journ., 1883, i.; Its Probable Cause: Lancet, 1890, ii. Geology in Relation to Sanitary Science: Report of Congress Sanitary Inst. of Great Britain, 1879. Geographical Distribution in British Isles: Lancet, 1888, i. Mortality Greatest where Population Densest: Lancet, 1888, i. Cancer most Prevalent where Fully-Formed Rivers running through Clayey Country frequently give rise to Floods. "Geographical Distribution of Heart Disease, Cancer and Phthisis," and "The Geographical Distribution of Disease in Great Britain," 1892. Increase due to Modern Drainage Works causing Extensive Floods: Lancet, 1890, ii.

JESSETT, F. B.—The Increase is Real and not Apparent; Proc. Royal Medico-Chirurgical Soc., vol. i., n.s., 1863.

KING AND NEWSHOLME.—Increase Apparent only, and due to Improved Diagnosis: Proc. Royal Soc., 1893, vol. liv.

JONES, E. LL.—Most Prevalent in Neighbourhood of Large Trees: Brit. Med. Journ., 1899, i.

LONGSTAFFE.—There is an Increase: "Studies in Statistics."

NASON, E. N.—Influence of Soil and Position: Brit. Med. Journ., 1898, i.; ditto, Brit. Med. Journ., 1899, i.

NEWSHOLME.—The Increase Apparent and not Real: Brit. Med. Journ., 1894, i.; Lancet, 1894, i.

PAGET, SIR J.—Cancer due to Various Causes, among which Soil and Surroundings are not Enumerated: "Lectures and Essays."

SNOW, H.—In the Cases of Six large Towns Local Opinion was in Opposition to Results arrived at by Havilland: Lancet, 1890, ii.

WALSH.—May arise from Various Causes: "Nature and Treatment of Cancer."

WEBB, J. L.—Endemic Cancer: Birmingham Med. Rev., 1892, xxxii.; "Etiology of Cancer," *ibid*, 1894.

WILLIAMS, W. R.—Increase not due to Increased Number reaching Cancerous Age: Liverpool Med.-Chir. Journ., 1895, xv. Due to Change from Agricultural to Industrial Occupation: Med. Chron., 1896, vol. v., n.s.; "Disease of the Breast, with Special Reference to Cancer."

Baillière, Tindall & Cox, 20 and 21, King William Street, Strand, London.