previously denied them on account of the constant irritation which such food produced.

REFERENCE.
1 BRITISH MEDICAL JOURNAL, 1898, vol. i, p. 547.

A Contribution

TO THE

STUDY OF CANCER MORTALITY.

An Address delivered to the Dundee and District Branch of the British Medical Association,

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President of the Branch.

I HAVE first of all to thank you for the honour you have done me in appointing me President of this important Branch of the British Medical Association. With such an energetic Secretary as we possess in Dr. Buist the duties of the Chairman are very light, and the only thing calculated to give rise to serious embarrassment is that it entails the delivery of an address on some subject likely to prove of interest to the members of the Branch.

I have been at a loss to hit upon a subject suitable for such an occasion and such an audience as this, but it occurred to me that in these days, when the subject of cancer was so much in the air, it might be profitable to investigate the incidence of this disease in a manufacturing city such as Dundee, more especially as we possess a record, extending over a quarter of a century, of all certificates of deaths registered in the several districts of the city. From these it has been possible to obtain details as to parts of the body affected, etc., which are not available in the returns of the Registrar-General.

One is constantly being asked why it is that cancer is so much more prevalent now than it was wont to be, and if one were to judge solely by statistics, more especially those of our hospitals, one could not but admit that the question is a very pertinent one.

I propose, therefore, from a study of the cancer mortality in Dundee during the past 25 years—that is, from 1877 to 1901 inclusive—to consider the following questions:

1. Has the mortality from cancer increased?
2. Is the increase real or apparent?
3. If real how is it to be accounted for?

In making such an inquiry one has to bear in mind that the value of a statistical investigation such as this has its limitations. The only data available are the death certificates; and, apart from the fact that the diagnosis of cancer is often very obscure, it must be admitted that only too frequently medical men perform this duty of death certification in a very perfunctory manner, without regard to the important part such returns play in the solution of public health problems. Another fact to be remembered is that these statistics only apply to our own city, and that therefore the conclusions cannot be accepted as of universal application.

It will be apparent to you all at the outset that the comparison of the crude cancer death-rate—that is, the proportion of deaths to the total population—is of little value. Cancer is a disease of adult and later life. As Sir James Paget says: "It is a disease of degeneracy, the frequency of which increases as age advances." It is therefore obvious that a city in which a large proportion of the population are of an age at which cancer does not prevail—that is, in childhood and youth—will give us a low crude death-rate for this disease, while another in which a large proportion of its population are of mature years will give a high cancer death-rate, although the actual incidence of the disease in both be the same. In the same way, as the death-rate from cancer in females is higher than in males at all ages, this death-rate in any locality will vary according to the proportion of the sexes living there.

The manner in which this investigation has been carried out is as follows:

All the deaths from cancer have been extracted from the registers in the Public Health Department. Persons who have died in the infirmary but who resided outside the city boundaries have been excluded, but we have not the information necessary to allow us to include persons belonging to the

city who have died from cancer elsewhere. The former class has of late years been considerable, but the latter class has never been so large as to materially affect our figures. The deaths included are those of persons over 20. The few deaths in earlier years are certified as due to "sarcoma."

For the purpose of comparison the period over which the inquiry extends has been divided into five quinquennia. The rates given are the mean annual death-rate per 10,000 of the population over 20, unless where otherwise stated. These deaths have been carefully classified according to: (1) Sex, (2) age, (3) part of the body affected (in each sex).

TABLE I.—Showing the Total Number of Deaths from Cancer in Persons over 20 Years of Age.

	Males.	Females.	Total.
1877-1881	72	202	274
1882-1886	84	250	334
1887-1891	162	337	499
1892-1896	106	390	586
1897-1901	258	510	768

TABLE IA.—Showing Death-rates per 10,000 of Persons of each Sex over the Age of 20.

	Males.	Females.	Total.
1877-1881	4.97	9.25	7.27
1882-1886	5.45	11.46	8.77
1887-1891	9.83	13.87	12.24
1892-1896	11.27	15.27	13.65
1897-1901	14.02	18.90	16.92

These tables show us three facts: (1) that the total mortality during this period has more than doubled; (2) that the cancer mortality in males has during the whole of this period been considerably less than that of females; and (3) that the increase during this time has been almost the same in both sexes—namely, 9.05 per 10,000 in the case of males, and 9.65 per 10,000 in the case of females, though proportionately the increase in males is much the greater, having nearly trebled, while that of females has little more than doubled. The following chart shows this graphically:

Dundee
Cancer Death rate per
10,000 of Population over
twenty years of age.

TABLE II.—Showing the Rates per 10,000 Persons Living at each Corresponding Age Period:

Males					
Age.	1877-81.	1882-86.	1887-91.	1892-96.	1897-1901.
20-25 ...	—	—	0.34	0.64	0.63
25-35 ...	0.98	0.47	0.21	0.62	1.17
35-45 ...	0.91	2.61	6.19	5.94	3.02
45-55 ...	11.44	7.06	14.92	16.57	22.73
55-65 ...	18.33	20.32	24.35	33.22	40.92
65-75 ...	10.80	21.61	64.22	52.08	70.52
75 upwards ...	11.00	29.01	51.16	55.73	52.25

Females					
Age.	1877-81.	1882-86.	1887-91.	1892-96.	1897-1901.
20-25 ...	0.25	0.24	0.23	0.22	0.21
25-35 ...	2.37	1.06	1.59	1.84	2.16
35-45 ...	8.87	13.49	10.11	12.59	14.47
45-55 ...	20.45	14.87	24.10	23.42	31.49
55-65 ...	19.76	34.20	34.59	42.71	45.31
65-75 ...	21.55	26.67	52.91	51.00	66.55
75 upwards ...	19.49	34.95	61.68	49.71	68.69

These tables show:

1. That in males there has been an increase at all ages; in females only over the age of 35.
2. That this increase becomes greater as age advances.
3. That from 1877 to 1887 the mortality in females was greater than in males at each age period.
4. That since 1887 the mortality in males has exceeded that in females at the age of 65 to 75, but except from 1892-96 it has been lower at all ages over 75.

At first sight these figures would seem to justify the most pessimistic views on the subject, but before we consider to what extent we believe this increase to be more apparent than real, let us first examine the figures relating to the parts of the body affected, so as to determine in what regions this increase is most evident.

Here I must premise that the numbers we have to deal with in most cases are small, and the value of the statistical method of investigation under such circumstances must be somewhat discounted. I think, however, the general conclusions to which they lead us may be regarded as reliable, although the proportions may not be strictly comparable.

TABLE III.—Showing the Cancer-rates per 10,000 of the Population of both Sexes above the Age of 20, except in the Case of Cancer of the Uterus and Breast, where the Rates are per 10,000 Females over 20.

	First Quinquennial Period.	Second Quinquennial Period.	Third Quinquennial Period.	Fourth Quinquennial Period.	Fifth Quinquennial Period.
Uterus ...	3.89	3.22	4.36	5.20	5.22
Breast ...	1.23	1.85	2.05	1.64	2.07
Mouth, etc. ...	0.19	0.44	0.66	0.58	0.83
Jaw ...	0.08	0.13	0.19	0.30	0.44
Rectum ...	0.24	0.49	0.39	0.51	0.55
Face and neck ...	0.44	0.49	0.44	0.46	0.39
Prostate and bladder ...	0.08	0.08	0.20	0.21	0.32
Abdomen ...	0.22	0.09	0.26	0.28	0.61
Stomach and gullet ...	1.60	1.83	2.89	2.91	4.21
Liver ...	0.48	0.76	1.52	1.81	1.74
Bowel and omentum ...	0.30	0.29	0.69	1.04	1.76
Not specified ...	0.51	0.76	0.53	0.67	0.63
Other parts ...	0.24	0.39	0.59	0.76	1.16

In considering these it will be convenient to group them in two classes, namely:

1. *Accessible cancer*—that is, cancer of parts which can be seen or felt, and where, therefore, the diagnosis is comparatively simple; and
- (2) *Inaccessible or deep-seated cancer*, where the diagnosis is more obscure and difficult.

One would naturally expect that the great advance of recent years in clinical and pathological diagnosis would be more apparent in the latter class than in the former, and that in the case of "accessible" cancer any great increase in the mortality would less likely be attributable to improved diagnosis, though it might to a certain extent be explicable by more careful certification.

FEMALES.

Genital cancer in the female shows an increase of from 85 in

the first quinquennium to 141 in the last—that is, an advance of the mean annual mortality from 3.89 per 10,000 females over 20 to 5.22, or about 34 per cent. Cancer of the breast also has increased from 27 to 56, or from 1.23 per 10,000 females to 2.07—an increase of 60 per cent. in the mean annual mortality.

Cancer of the mouth, throat, pharynx, etc. has increased by 0.64 per 10,000 of both sexes; of the jaw by 0.36.

Cancer of the rectum has more than doubled (10 cases in the first period against 25 in the last)—that is, 0.24 against 0.55.

Cancer of the face and neck, which remained fairly stationary during the first three quinquennia showed a slight decrease in the last.

Cancer of the bladder and prostate show an increase of 0.14 per 10,000. In all the other cases this increase is more substantial.

Cancer of the abdomen (the exact seat not being specified) shows an increase of mortality equal to 0.39 per 10,000.

The death-rates from cancer of the stomach and oesophagus have multiplied nearly three times, of the liver nearly four times, and of the bowel and omentum nearly six times, the numbers and rates being as follows:

TABLE IV.—Death-rates from Cancer of Stomach and Oesophagus.

	First Quinquennium.	Last Quinquennium.
Stomach and oesophagus ...	58 (1.60)	191 (4.21)
Liver ...	18 (0.48)	79 (1.74)
Bowel and omentum ...	11 (0.30)	80 (1.76)

Cancer of the bones and joints, spleen and kidney, lung, mediastinum, etc., have also increased from 0.24 to 1.16 per 10,000.

Regarding the part of the body most frequently affected in females, it is interesting to note that in the first ten years (that is from 1877 to 1887) the deaths from cancer of the uterus and of the breast together exceeded those of cancer in all other parts of the body.

Since then, however, the latter have outnumbered the former, the difference gradually becoming more marked. During the same time cancer of the abdominal viscera in the same sex (including stomach and oesophagus, liver, bowel, and omentum) show an enormous increase from 48 (2.29 per 10,000) to 201 (7.44 per 10,000). The figures are as follows:

TABLE V.—Deaths from Cancer of Abdominal Viscera.

	Uterus and Breast.	All other Parts.	Of these, there were from Cancer of the Abdominal Viscera.	
1877-81 ...	112	75	48	25 per cent. of the whole (excluding those not specified).
1882-86 ...	115	110	65	" " "
1887-91 ...	156	165	124	" " "
1892-96 ...	175	198	132	" " "
1897-1901 ...	197	293	201	" " "

MALES.

If we examine closely the parts of the body affected in males, we find that cancer of the abdominal viscera is the most prominent factor in this mortality.

TABLE VI.—Showing the Relation of Cancer of those Organs to the Total Mortality (exclusive of the Cases not specified). The Proportion has remained fairly constant.

	Total Deaths from Cancer in Males.	Deaths from Cancer of Abdominal Viscera.
1877-81 ...	67	39 = 58 per cent. of the whole.
1882-86 ...	80	44 = 55 " "
1887-91 ...	156	84 = 54 " "
1892-96 ...	184	116 = 63 " "
1897-1901 ...	246	149 = 60 " "

These figures represent in the mortality-rate an increase from 2.67 per 10,000 males (1877-81) to 8.09 (1897-1901). The great increase in abdominal cancer is thus common to both sexes, and is equivalent to 5.42 per 10,000 in the case of males and 5.25 in the case of females, and throughout the whole of the period under consideration this mortality has been higher in males than in females.

ORGANS AFFECTED.

The part of the body, however, showing the greatest increase in males is the mouth and the upper part of the digestive tract—including tongue, throat, and pharynx—in which the numbers were 2, 10, 22, 18, and 30 in the respective quinquennia, an increase of from 0.13 to 1.63 per 10,000 males. In females this part is not nearly so liable to attack, the highest recorded being 8 (1897-1901).

How is this to be accounted for? Some persons dismiss the subject by explaining that it is due to the fact that the expectation of life in the early years of life has increased so much by the diminished death-rate from infectious disease, etc., that therefore a large number are carried over to what might be called the "cancer" age, and that, as every one must die of something or other, the increase of cancer deaths is at once accounted for. In this investigation this explanation is entirely discounted by the fact that, in calculating the death-rates, regard has been paid to age and sex distribution, the rates being given for those of each sex living at the different age-periods.

Another and more plausible explanation is found in the more exact diagnosis of recent years and the more careful and correct certification of deaths. Let us see to what extent this has influenced our cancer mortality. In the first place the great increase in visceral cancer cannot be accounted for by the more careful returns as to the site of the disease. Many deaths are certified as due to "cancer" without reference to the part of the body affected, but such in Dundee, instead of having diminished during the 25 years under consideration, have actually increased from 0.51 per 10,000 during the first quinquennium (20 cases) to 0.63 during the last (29 cases).

Throughout this period the number of such returns in females has considerably exceeded those in males. In females these varied from 15 to 17 in each year given (except 1882-87, when they numbered 25), and in males the highest number of such returns in any year was 12, and the lowest 5.

On the other hand, there is no doubt that a certain proportion of the increase in this cancer mortality is accounted for by improved diagnosis and certification—by the transference of ill-defined to more definite causes. The most important of these are the following: "Old age," "dropsy," "disease" of stomach, "disease" of liver, "disease" of uterus, and "causes not specified or ill-defined."

The deaths from "old age" calculated on the number of persons of both sexes living at the age of 60 and upwards, have decreased during the quinquennia under record, as follows:

TABLE VII.—Deaths from Old Age: Death-Rate per 10,000 Persons over 60.

—	Both Sexes.	Males.	Females.
1877-81	163	140	180
1882-86	144	136	154
1887-91	105	92	126
1892-96	94	81	102
1897-1901	94	81	100

This shows a steady decline in both sexes equivalent to 43 per cent.—42 in males and 44 in females; and I think it must be conceded that a certain proportion of these cases—probably a considerable proportion—should, especially in the earlier years, have gone to swell the cancer death-rate.

The returns of deaths from "dropsy" have also decreased from 1.71 per 10,000 (over 20) to 0.08 (from 63 in the first quinquennium to 4 in the last). Dropsy, however, is not a symptom which is prominently associated with malignant disease. One would expect that these cases should be referred rather to affections of the heart and kidney, and on examining the returns of deaths from affections of these organs we find that diseases of the circulatory system show an increased

mortality from 27.03 per 10,000 (over 20) in 1877-81 to 33.30 in 1896-1901, while disease of the urinary system has also increased from 5.67 to 8.70 during the same period. The fact that such diseases have increased, while deaths from "dropsy" have decreased, points rather to an improved diagnosis in diseases of these organs than in affections of a malignant character.

As regards those deaths classified by the Registrar-General as "not specified or ill-defined," they are not sufficiently numerous to make much practical difference. In 1877-81 they numbered 28, but during the subsequent quinquennia only 3, 4, 5, and 12 respectively.

As I have already mentioned, cancer of the female genitals shows an increase of 34 per cent. during the twenty-five years under consideration.

TABLE VIII.—Showing the Total Number of Deaths from Diseases of the Generative Organs during the Five Quinquennia, and also the Number and Rates per 10,000 Females of Deaths from "Disease" of Uterus and Vagina (without specifying its nature).

	Total Deaths from Diseases of Generative Organs, and Rate per 10,000 Females.	Deaths from "Disease" of Uterus and Vagina. —
1877-81	39 (1.78)	27 (1.23)
1882-86	35 (1.54)	13 (0.57)
1887-91	45 (1.85)	16 (0.66)
1892-96	35 (1.36)	16 (0.62)
1897-1901	29 (1.07)	14 (0.51)

This shows that the mortality from diseases of the generative organs (exclusive of cancer) has decreased, but with the exception of the first quinquennium, when 27 of the 39 cases were returned as due to "disease" of the uterus—the actual number and proportion of cases returned without proper specification has varied very little since 1882, showing no improvement due to better diagnosis or certification.

If we were to assume that the normal death-rate in females from such "disease" of the uterus (other than cancer) was that which prevailed during the last quinquennium, namely, 0.51 per 10,000, and if we presume that in the earlier years all above this proportion were really cases of cancer, then, making the correction for these we should have the death-rate from genital cancer during the five quinquennia as follows: 4.57, 3.31, 4.49, 5.3, and 5.22, still showing a slight increase.

It is, however, in the internal forms of cancer that the increased mortality is most apparent, so we must now look at these a little more closely.

The death-rate from "cancer" of the stomach and oesophagus during the five quinquennia was as follows:

In males	1.58	1.94	3.40	3.50	4.51
In females...	1.60	1.72	2.53	2.50	4.00

showing practically all through a higher rate in males than in females, and an increase of 2.93 in the former and 2.40 in the latter.

Cancer of the liver shows the following:

In males	0.68	0.51	1.09	2.12	1.74
In females...	0.36	0.92	1.81	1.60	1.74

an increase of 1.06 in males, and 1.38 in females.

Cancer of the bowel and omentum gives the following rates:

In males	0.41	0.39	0.60	1.03	1.84
In females...	0.23	0.22	0.74	1.05	1.70

an increase of 1.43 per 10,000 males, and 1.47 per 10,000 females.

To what extent can this great increase in cancer of the abdominal viscera be accounted for by more accurate diagnosis and certification?

The Registrar-General's returns show that the total number of deaths from diseases of the digestive system has declined from 12.92 per 10,000 in 1877-81 to 9.91 in 1897-1901, but during the same period the number returned as due to "disease" of the stomach (including haematemesis and melaena) has increased from 1.95 per 10,000 to 2.77. No evidence here of better diagnosis or certification!

The following table shows the relation of such cases of "disease" of the stomach and liver to the total deaths from affections of the digestive system (exclusive of cancer).

TABLE IX.—*Diseases of the Digestive System.*

	Total Deaths and Death-rates.	Deaths from "Disease" of Stomach and Death-rates.	Deaths from "Disease" of Liver and Death-rates.
1877-81	469 (12.92)	71 (1.95)	123 (3.39)
1882-86	461 (12.11)	63 (1.63)	122 (3.20)
1887-91	580 (14.22)	93 (2.28)	107 (2.62)
1892-96	425 (9.90)	93 (2.16)	75 (1.74)
1897-1901	450 (9.90)	126 (2.77)	50 (1.10)

In connexion with the belief that many of these cases in which an exact diagnosis has not been made should be referred to the "cancer" group, it is interesting to observe that while the death-rate from cancer of the stomach in males has all along been higher than that in females, the deaths from "disease" of the stomach have been correspondingly lower. These have increased in males from 27 (1.86) in 1877 to 33 (1.89) in 1896 (detailed statistics for the whole of the last quinquennium not being as yet available), and in females from 44 (2.01) to 60 (2.35) during the same period.

The returns, however, from liver disease show a very different result. These, apart from malignant disease, are returned as (in the earlier returns) jaundice, hepatitis, "disease" of the liver, or as cirrhosis or "other diseases of the liver."

Thus, while the returns from cancer of the liver show an increase of 1.26 per 10,000, those from other diseases of the liver show a decrease of 2.29 per 10,000.

This cancer mortality in males has increased 1.06 per 10,000 during the twenty-five years under review, while the deaths returned as due to "disease" of the liver have decreased from 4.07 to 1.66 between 1877 and 1896. In females during the same period, while the cancer death-rate has increased 1.38 per 10,000, the return of deaths from "disease" of the liver has decreased by 1.13 (from 2.93 to 1.80).

Here I think we may fairly claim that the apparently large increase in the cancer mortality, especially in the male sex, is to a considerable extent accounted for by more correct diagnosis.

CONCLUSIONS.

A summary of these results seems to me to lead to the following conclusions as regards cancer in the city of Dundee:

1. That the death-rate from cancer as a whole during the twenty-five years under review has more than doubled, having increased from 7.27 to 16.92 per 10,000 of the population over the age of 20.
2. That this increase is greatest at ages over 45, is common to both sexes, but more marked in the male sex, though the actual mortality is higher among females.
3. That in females this is chiefly due to an increase in malignant affections of the abdominal viscera.
4. That uterine cancer and cancer of the breast in females have increased, though not in any marked degree.
5. That cancer of the rectum also shows a slight increase in both sexes.
6. That in males the highest mortality is from cancer of the abdominal viscera.
7. That in males cancer of the mouth and upper digestive tract has also greatly increased.
8. That therefore cancer of regions which may be described as "accessible" has increased, as well as that of parts which are not so accessible, and where the diagnosis is more difficult, but the increase in the latter is out of all proportion to that in the former class.
9. That during the same period there has been a great improvement both in clinical and pathological diagnosis, as well as in death certification, and consequently a considerable diminution in returns from such indefinite conditions as "old age" and "disease" of the various organs (without any specification of its nature).
10. That this must to a considerable extent have helped to swell the returns of death from "cancer."

I am of opinion, however, that this is by no means sufficient to account for the great increase in cancer mortality, and that this increase is a real and substantial one, though by no means so great or so alarming as the general public believe or as a superficial glance at statistics would seem to indicate. These conclusions do not altogether coincide with those

expressed by some other investigators dealing with the cancer mortality of whole countries (including both urban and rural districts) where the statistics are obtainable only from the Registrar-General's reports.

Dr. Newsholme, for example, whose investigations into this subject are well known, and who is justly regarded as an authority on all matters pertaining to vital statistics, inclines to the belief that "statistics, as far as they go, do not justify the conclusion that an increase in cancer mortality has occurred within recent years. They rather tend to the conclusion that the increase in cancer is only apparent, and is due to improved diagnosis, and more careful certification of the causes of death, especially the latter."¹

Professor De Bovis, of the Reims School of Medicine, has published a report of an exhaustive inquiry into the same subject.² From a study of the cancer statistics of different countries he came to certain conclusions which coincide in some respects with those to which our statistics have led, namely:

That cancer of the uterus and of the female breast have declined.

That cancer of the rectum appears to be stationary.

That cancer of the mouth and upper digestive tract has greatly increased.

That the most important element in the rise of cancer death-rate is that from visceral cancer.

I consider that my statistics, in which the necessary details in each individual case have been obtained, and proper allowance made for age and sex distribution, so as to allow of comparison between the different periods under consideration, justify us in believing that the conclusions arrived at apply at all events to the city of Dundee.

In the present state of our knowledge it is difficult to assign any specific cause for this increase. It is idle to speculate as to how much of it is due to the increased tension under which life is now carried on, or how much it is affected by our mode of living—by smoking, alcoholism, or by the increased consumption of flesh food. The former theory gets no countenance from an examination of the occupations of the cases under review. It is impossible to tabulate the female cases with reference to their occupations, as the returns in the case of married women and widows give only the occupation of the husband, but an examination of the returns in the case of males does not indicate that "cancer" is more prevalent amongst that class of the community whose occupations are likely to entail anxiety or worry.

It has not been possible to obtain statistics of the number of persons in the city following the occupations concerned, so that the "occupation"-rates cannot be ascertained, but, as might have been expected considering the large proportion of the population engaged in the mills and factories, by far the largest proportion of the cases are referable to this class.

The death returns from the class certified as "labourers" numbered 6, 15, 21, 25, and 32 in the different quinquennia; but a survey of the list does not indicate any special prevalence in any particular class of occupations, though this may probably be due to the fact that the numbers are too small to enable one to generalize.

Before we can solve this problem of the increase of cancer we must have a more accurate knowledge of its etiology, and if parasitic in its nature we must know something of the life-history of the organism which gives rise to it. We are not without hope that the present earnest and combined effort which is being put forth to solve these problems will result in a fuller and clearer knowledge of the causes and of the methods of preventing or curing cancer. If such hopes be realized it will prove one of the greatest boons which has ever been conferred on suffering humanity.

REFERENCES.

- ¹ *Practitioner*, April, 1899. ² *Semaine Médicale*: an excellent and full summary appeared in the *BRITISH MEDICAL JOURNAL* of October 4th, 1902.

NEW HOSPITALS IN RUSSIA.—On the initiative of the Empress Alexandra, an orthopaedic institute has recently been erected in St. Petersburg. Dr. Horn has been appointed Director. The Municipal Council, for some reason, was at first strongly opposed to the scheme and refused to grant a site. Finally, however, it gave a space of 400 metres square in the Alexandrinski Park, and the new hospital will shortly be opened. A Russian millionaire, M. Soldatenkoff, who has been most liberal in gifts of money for the promotion of the arts and sciences, has recently given more than £120,000 for the erection of a general hospital in Moscow, for the treatment of sufferers without regard to their religion.