AN INQUIRY INTO THE RELATION BETWEEN SOCIAL STATUS AND CANCER MORTALITY.

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Considerable difference of opinion has existed as to whether the incidence of cancer is at all affected by the habits of life of different classes of the community. There is of course no doubt that in certain occupations particular forms of malignant disease are exceptionally prevalent, the case of chimney sweeps being notorious; but the more general question as to the incidence on large groups of occupations has not been so definitely determined. The present research was suggested by the apparently contradictory results obtained by Heron from his study of London statistics, and by Maynard from an analysis of United States data.

We have, we think, obtained a satisfactory explanation of this contradiction, the conclusion in this case being sufficiently clear; on the other hand, the exact interpretation of the statistical constants derived from other material is by no means so definite as we could wish. Nevertheless our observations seem to us likely to prove of interest to other students of the problem. The paper is divided into the following sections:

(1) We consider the method employed and results obtained by Heron.

(2) We analyse the data given in the last decennial supplement issued by the Registrar General in so far as they bear upon this problem.

(3) We deal with some direct measurements based upon income and wages statistics.

In the paper published by Maynard in 1910, he remarked that in studying the association between cancer and occupations arranged

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in the presumed order of social status the coefficients calculated appeared to show that status and cancer death-rates were negatively correlated, the occupations of highest status having lowest death-rates. Age corrections were employed and the coefficients of correlation were calculated by the method of ranks, and by that of four-fold division.

Since the appreciation of social status is to some extent a matter of personal opinion more than one classification was used, but re-arrangement in this way did not very sensibly affect the correlations, which were of the order of $-\cdot4$ to $-\cdot6$. The source of the material was the Registration Area of the United States. Maynard specifically called attention to the contradiction between his results and those of Heron, to which we now turn.

The conclusions at which Heron arrived are contained in his famous memoir entitled, " On the Relation of Fertility in Man to Social Status and on the changes in this relation that have taken place during the last fifty years."

His remarks on the present topic were merely incidental and our criticisms do not have any bearing upon his main theme. In the first place Heron found the correlation between the birth-rate (based on the proportion of legitimate births per 100 married women, aged 15 to 54) and the general death-rate from cancer per 100,000 persons, to be $-\cdot563 \pm \cdot089$. This finding, he remarked, seemed to require further investigation.

The following series of coefficients was then obtained:

Variables	Correlation
Female cancer rate and birth-rate	$-\cdot535 \pm \cdot093$
Male ,, ,, ,, ...	$-\cdot156 \pm \cdot127$
Female ,, ,, proportion of domestic servants	$+\cdot404 \pm \cdot109$
Male ,, ,, ,, ,, ,, ,,	$+\cdot422 \pm \cdot107$
Female ,, ,, ,, ,, professional men	$+\cdot553 \pm \cdot088$
Male ,, ,, ,, ,, ,, ,,	$+\cdot447 \pm \cdot104$

He then remarks, " These results seem to indicate that the conditions of prosperity and culture which lead to a low birth-rate also conduce to a high cancer death-rate. In other words, cancer cannot, like phthisis, be taken as a measure of that unhealthy environment with which a high birth-rate seems to be associated."

Further on he also states that " Cancer alone of the undesirable physical conditions dealt with so far seems more prevalent in the prosperous and cultured districts, and to be associated with a lower birth-rate."

These results seemed at first sight very definite and some were tempted to explain them by the supposition that the diagnosis would be likely to be more accurate in the better class districts.

It appears to us, however, that no such explanation need be invoked, but that in fact Heron's coefficients do not measure what he seems to have supposed them to measure. In the data used by him the cancer rates are the ordinary crude values, viz. deaths per 100,000 persons, males and females respectively.

Since the age distribution varies considerably in the different boroughs, and since the incidence of cancer is greatly influenced by the age constitution of the population, the coefficients shown may merely mean that in the poor class districts the age constitution is unfavourable to the occurrence of cancer. We have tested this matter closely and the results will probably convince the reader of the justice of our criticism. To begin with, we determined the correlation between the crude cancer death-rate (*persons*) used by Heron, and the proportion of professional men as stated in his paper for the year 1901, and then the correlation after the cancer rates had been corrected for age and sex distribution, using the figures published by the Medical Officer for the County of London. We omitted the Boroughs of Deptford and Greenwich in both calculations, because they were taken together by Heron, but shown separately in the Medical Officer of Health's tabulation of corrected rates. The values are $+ \cdot 284 \pm \cdot 122$ in the case of corrected rates, and $+ \cdot 711 \pm \cdot 065$ employing crude rates, the former being only doubtfully significant.

We then calculated the correlation between both the crude and corrected cancer death-rates (*persons*) for 1906–10 and the proportion of domestic servants per 100 private families as shown in the recent census. The correlation when the corrected cancer death-rates are used is $- \cdot 032 \pm \cdot 127$, but when the crude cancer rates are employed the coefficient rises to $+ \cdot 562 \pm \cdot 087$.

If we use as a measure of poverty the proportion of persons over seventy years of age, in receipt of old age pensions on 31st March, 1911, and take once more the corrected cancer rate (*persons*) 1906–10 (Table I), the correlation is $+ \cdot 200 \pm \cdot 122$. In other words, we reach no significant association between measures of high or low social status in the London Boroughs and corrected cancer death-rates.

As further evidence of the difference between the results in accordance with whether crude or corrected rates be employed, we tabulate below some values yielded in the case of cancer and fertility (the latter

TABLE I.

Showing proportion of persons over 70 years of age in receipt of Old Age Pensions on the 31st of March, 1911, and the corrected cancer death-rate 1906–10 for 28 Metropolitan Boroughs.

	Number of pensioners per 1000 persons over 70 years of age (March 31st, 1911)	Corrected cancer death-rate (*persons*) 1906–10		Number of pensioners per 1000 persons over 70 years of age (March 31st, 1911)	Corrected cancer death-rate (*persons*) 1906–10
Chelsea	408	1·02	Hackney	502	·94
Fulham	475	1·08	Stoke Newington	445	1·07
Hammersmith	539	1·05	Poplar	595	·93
Kensington	310	·96	Stepney	480	·98
Westminster	397	1·01	Deptford	551	·99
Hampstead	272	·97	Greenwich	446	·91
Paddington	403	1·06	Woolwich	528	1·02
St Marylebone	399	1·12	Camberwell	547	·97
Finsbury	681	·96	Lewisham	392	·94
Holborn	448	·99	Bermondsey	729	1·11
St Pancras	492	1·09	Southwark	619	1·02
Islington	529	1·06	Lambeth	527	1·08
Bethnal Green	633	1·04	Battersea	569	1·06
Shoreditch	508	·93	Wandsworth	380	·95

factor again being based upon the proportion of legitimate births to married women, aged 15 to 54, in the case of the 1901 figures; for the later figures the birth-rate is based upon married women, 15–45, as shown in the census of 1911), and a series of other correlation coefficients designed to test the matter thoroughly, attention being paid to sex.

In view of these results we consider that Heron's inferences respecting cancer are mistaken and that, consequently, there is no necessary contradiction between Maynard's coefficients for the United States and the real condition of affairs in London.

We then attempted to investigate the relation between social class and cancer death-rate by means of the Registrar General's Decennial Analysis of occupational mortality. It will be remembered that the Decennial Supplement provides comparative mortality figures for a large number of different occupations—the data being available for "Occupied Males," 1890–2; for "Occupied Males," 1900–2, and for "Occupied and Retired Males," 1900–2. The plan we proposed to ourselves was the following:

The occupations, having upwards of 20,000 males engaged therein[1], were to be divided into a series of groups, supposed to correspond roughly

[1] This limit was adopted in order to give some steadiness to the rates.

TABLE II.

Variables	Correlations: Corrected cancer death-rate	Correlations: Crude cancer death-rate	
26 Metropolitan Boroughs (1901):			
Birth-rate (married women 15–54) and cancer death-rate (*Persons*)...	− ·002 ± ·132	− ·555 ± ·092	
28 Metropolitan Boroughs (1901):			
Birth-rate (married women 15–54) and cancer death-rate (*Females*)	− ·177 ± ·126	− ·535 ± ·093	(Heron)
Do. do. do. (*Males*)	·242 ± ·122	− ·156 ± ·127	,,
28 Metropolitan Boroughs (1906–10):			
Birth-rate (married women 15–45) and cancer death-rate (*Persons*)	− ·102 ± ·126	− ·608 ± ·080	
28 Metropolitan Boroughs (1911):			
Birth-rate (married women 15–45) and cancer death-rate (*Persons*)...	− ·122 ± ·126	− ·677 ± ·069	
Do. do. do. (*Females*)	− ·315 ± ·115	− ·701 ± ·065	
Do. do. do. (*Males*)	·118 ± ·126	− ·421 ± ·105	
26 Metropolitan Boroughs (1901):			
Proportion of professional men per 1000 occupied males and cancer death-rate (*Persons*)...	·284 ± ·122	·711 ± ·065	
28 Metropolitan Boroughs (1901):			
Proportion of professional men per 1000 occupied males and cancer death-rate (*Females*)	·283 ± ·119	·553 ± ·088	(Heron)
Do. do. do. (*Males*)	·049 ± ·130	·447 ± ·104	,,
28 Metropolitan Boroughs (1906–10):			
Proportion of persons per 1000 over 70 in receipt of Old Age Pensions on Mar. 31, 1911 and cancer death-rate (*Persons*)	·200 ± ·122	− ·409 ± ·106	
28 Metropolitan Boroughs (1911):			
Proportion of persons per 1000 over 70 in receipt of Old Age Pensions on Mar. 31, 1911 and cancer death-rate (*Persons*)	·213 ± ·122	− ·473 ± ·099	
Do. Females do. do. (*Females*)	− ·040 ± ·127	− ·398 ± ·107	
Do. Males do. do. (*Males*)	·243 ± ·120	− ·300 ± ·116	
28 Metropolitan Boroughs (1901):			
Proportion of domestic servants per 100 private families and cancer death-rate (*Females*) ...	·093 ± ·129	·382 ± ·111	
Do. do. do. (*Males*)	·020 ± ·130	·454 ± ·103	
Proportion of domestic servants per 100 females and cancer death-rate (*Females*) ...	·080 ± ·129	·400 ± ·109	
Do. do. do. (*Males*)	− ·003 ± ·130	·451 ± ·109	
28 Metropolitan Boroughs (1906–10):			
Proportion of domestic servants per 100 private families and cancer death-rate (*Persons*) ...	− ·032 ± ·127	·562 ± ·087	

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to social rank. The occupational rates were then to be distributed in these groups and from the arrays so formed the correlation ratio was to be determined. The difficulties to be faced were somewhat numerous. We shall set them out in order.

(1) Classification is necessarily somewhat a matter of opinion. Thus, our original classes were: (*a*) Professional, (*b*) Clerical and Commercial, (*c*) Shopkeepers and Shop Assistants, (*d*) Skilled workers, (*e*) Domestic Servants, (*f*) Unskilled workers. Although it would probably be admitted by most people that these groups do roughly correspond to the social strata of the nation, much difference of opinion might arise as to the absolute propriety of the divisions, *e.g.* domestic work would, by some, be placed, not in a class of its own, but with the skilled trades, or by others again with the unskilled trades, and, even if the classes were accepted, there must again be differences of opinion as to the one to which particular occupations ought to be assigned, *i.e.* whether certain trades are "skilled" or "unskilled." We have allowed for these objections in two ways. Firstly, the number of classes has been reduced and the correlation ratio re-calculated. Secondly, the whole list of occupations has been separately classified by four independent observers, the classifications, which differed in three cases, being used for the re-determination of the constants.

(2) The question also arises as to whether the rates should be weighted with the number of workers in each trade or profession, and opinions as to the propriety of such weighting might differ. We have calculated the constants twice in each case, *i.e.* with and without weighting. The small number of occupations in certain groups, *e.g.* domestic workers, is compensated for to some extent by the process of weighting.

(3) The exact interpretation of the correlation ratio in such a case as the present, in view of the difficulties of grouping, is certainly not so distinct as that of the ordinary coefficient of correlation (r). As, however, we could not calculate the product moment r, owing to the qualitative nature of our classification, the next best method seemed to be the use of the correlation ratio, notwithstanding the objection which we freely admit might be taken to this course.

(4) It has been impossible to get an accurate distribution of trades into the different classes, owing to the fact that the classification of occupations adopted by the Registrar General for the purpose of calculating the comparative mortalities includes, in the same industry, persons of widely different status; *e.g.* in the builder's group there are

comprised builders, bricklayers, builders' labourers and bricklayers' labourers. In classifying this group, most observers would say that the building industry is a skilled trade, but when the large proportion of unskilled men is taken into account, it is clear that some modification ought to be made and that any conclusions arrived at from such a grouping must be adopted with extreme caution. For this reason we are inclined to attach less importance to the method of weighting in this particular instance than we might otherwise have done.

In the following tables the results of this somewhat laborious analysis are set out:

TABLE III*.

Association between occupation and cancer mortality.
1*st Classification.*

(*a*) *Occupational mortality unweighted with the number of males engaged in each trade.*

	Mean cancer death-rate	S.D.	Coeff. of variation	6 Groups η	6 Groups Corrected η†	5 Groups η	5 Groups Corrected η†	4 Groups η	4 Groups Correct η†
1890–2 "Occupied Males"	55·00 ± ·74	9·72	17·66	·28 ± ·07	·12 ± ·08	·28 ± ·07	·17 ± ·07	·24 ± ·07	·15 ± ·(
1900–2 "Occupied Males"	64·91 ± 1·03	13·79	21·24	·43 ± ·06	·36 ± ·06	·42 ± ·06	·36 ± ·06	·42 ± ·06	·37 ± ·(
1900–2 "Occupied and Retired Males"	68·57 ± 1·12	15·07	21·98	·47 ± ·06	·41 ± ·06	·45 ± ·06	·40 ± ·06	·44 ± ·06	·40 ± ·(

(*b*) *Occupational mortality weighted with the number of males engaged in each trade.*

	Mean cancer death-rate	S.D.	Coeff. of variation	6 Groups η‡	5 Groups η‡	4 Groups η‡
1890–2 "Occupied Males"	52·63 ± ·68	8·88	16·88	·20 ± ·07	·19 ± ·07	·19 ± ·07
1900–2 "Occupied Males"	64·09 ± 1·20	16·07	25·07	·37 ± ·06	·36 ± ·06	·35 ± ·07
1900–2 "Occupied and Retired Males"	67·71 ± 1·30	17·41	25·71	·40 ± ·06	·38 ± ·06	·38 ± ·06

* The "probable errors" in this and subsequent tables have been computed from the formula $\cdot 67449 \times \frac{1-\eta^2}{\sqrt{n}}$ where n is the number of occupations used. This formula is not strictly appropriate, but perhaps sufficient as a rough and ready test of reliability.

† See Pearson, *Biom.* VIII. 254–6. We used the formula $\eta^2 = \frac{\bar{\eta}^2 - (\kappa-1)/N}{1-(\kappa-2)/N}$, where $\bar{\eta}$ is the observed value and κ the number of arrays.

‡ Corrected values of η are not given for the weighted groups, as if N be taken as the sum of the weights, no appreciable difference is made by correction.

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TABLE IV.

Association between occupation and cancer mortality.
2nd Classification.

(*a*) *Occupational mortality unweighted with the number of males engaged in each trade.*

	Mean cancer death-rates	S.D.	Coeff. of variation	6 Groups η	6 Groups Corrected η^*	5 Groups η	5 Groups Corrected η^*	4 Groups η	4 Groups Corrected η^*
1890–2									
"Occupied Males"	55·00 ± ·74	9·72	17·66	·22 ± ·07	?†	·18 ± ·07	?†	·12 ± ·08	?†
1900–2									
"Occupied Males"	64·57 ± 1·01	13·52	20·95	·23 ± ·07	?†	·21 ± ·07	?†	·21 ± ·07	·08 ± ·07
1900–2									
"Occupied and Retired Males"	68·15 ± 1·10	14·68	21·54	·27 ± ·07	·10 ± ·07	·25 ± ·07	·11 ± ·07	·24 ± ·07	·14 ± ·07

(*b*) *Occupational mortality weighted with the number of males engaged in each trade.*

	Mean cancer death-rates	S.D.	Coeff. of variation	6 Groups η‡	5 Groups η‡	4 Groups η‡
1890–2						
"Occupied Males"	52·61 ± ·68	8·88	16·89	·28 ± ·07	·15 ± ·07	·15 ± ·07
1900–2						
"Occupied Males"	64·09 ± 1·15	15·36	23·96	·26 ± ·07	·26 ± ·07	·25 ± ·07
1900–2						
"Occupied and Retired Males"	67·49 ± 1·28	17·13	25·37	·30 ± ·07	·30 ± ·07	·29 ± ·07

* See Pearson, *Biom.* VIII. 254–6.

† Corrected η is not determinable in these instances η being $< \sqrt{\frac{\kappa - 1}{N}}$.

‡ See Footnote † to Table III.

TABLE V.

Association between occupation and cancer mortality.
3rd Classification.

(*a*) *Occupational mortality unweighted with the number of males engaged in each trade.*

	Mean cancer death-rates	S.D.	Coeff. of variation	6 Groups η	6 Groups Corrected η^*	5 Groups η	5 Groups Corrected η^*	4 Groups η	4 Groups Corrected η^*
1890–2									
"Occupied Males"	55·00 ± ·74	9·72	17·66	·24 ± ·07	?†	·24 ± ·07	·08 ± ·08	·24 ± ·07	·14 ± ·07
1900–2									
"Occupied Males"	64·57 ± 1·01	13 52	20·95	·30 ± ·07	·17 ± ·07	·30 ± ·07	·20 ± ·07	·29 ± ·07	·22 ± ·07
1900–2									
"Occupied and Retired Males"	68·22 ± 1·10	14·71	21·56	·33 ± ·07	·22 ± ·07	·32 ± ·07	·23 ± ·07	·31 ± ·07	·25 ± ·07

* See Pearson, *Biom.* VIII. 254–6.

† Corrected η is not determinable in these instances η being $< \sqrt{\frac{\kappa - 1}{N}}$.

(*b*) *Occupational mortality weighted with the number of males engaged in each trade.*

	Mean cancer death-rates	S.D.	Coeff. of variation	6 Groups η^*	5 Groups η^*	4 Groups η^*
1890–2						
"Occupied Males"	52·61 ± ·68	8·89	16·89	·17 ± ·07	·16 ± ·07	·11 ± ·08
1900–2						
"Occupied Males"	64·09 ± 1·15	15·36	23·96	·26 ± ·07	·26 ± ·07	·25 ± ·08
1900–2						
"Occupied and Retired Males"	67·49 ± 1·28	17·13	25·37	·30 ± ·07	·30 ± ·07	·29 ± ·07

* See Footnote † to Table III.

It will be seen that the values of η reached vary very considerably, according to which of the different classifications is taken. We have given the corrected value of η in the case of the unweighted observations wherever this was determinable but it will be noticed that in several instances this could not be done, η being less than $\sqrt{\frac{\kappa - 1}{N}}$ [1]. In the case of the weighted observations, however, corrected values have not been given, as no appreciable difference would be made if N were taken to be the sum of the weights.

The highest values are given for "Occupied and Retired" (1900–2), these ranging from ·41 to ·10 in the unweighted, and from ·40 to ·29 in the weighted observations, using the corrected ratio in the former case. For the "Occupied only" group in the same period, the ratios range from ·36 to zero and from ·37 to ·26 respectively. By re-grouping into five or four groups the values are reduced somewhat in the case of weighted observations, but are of substantially the same order.

The results for the earlier period under investigation (1890–2) are considerably smaller than those for 1900–2, but in view of the fact that the returns for 1890–2 are rather less reliable and not strictly comparable with those of the later period, owing to alterations in the Registrar General's classification, we do not consider too much importance should be attached to the earlier figures.

A general review makes it appear, however, that the association as measured by η can hardly be zero and a study of the following tables (VI, VII, and VIII), which show mean cancer rates, weighted and unweighted, within the different groups, indicates that the sign of the association is negative, that is to say, the cancer death-rate tends to diminish with increasing social status.

[1] See Pearson, *Biom.* VIII. 256.

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TABLE VI.

Constants calculated for the arrays of occupation (6 *Groups*).

1st Classification.

(*a*) *Unweighted with number of males engaged in each occupation.*

	1890—2 "Occupied Males"				1900—2 "Occupied Males"				1900—2 "Occupied & Retired Males"			
	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array
Professional men ...	51·25	7·94	15·49	6	61·67	10·17	16·50	6	64·17	11·79	18·37	6
Clerks & Commercial Men	58·75	13·86	23·60	4	65·50	6·78	10·35	5	69·50	4·00	5·76	5
Shopkeepers & Assistants	53·46	9·41	17·60	13	58·65	8·47	14·44	13	62·12	10·46	16·84	13
Skilled Workers ...	53·88	8·14	15·11	40	62·80	10·49	16·70	41	65·85	10·99	16·69	41
Domestic Servants ...	58·75	10·83	18·48	2	81·67	12·05	14·75	3	90·83	10·27	11·31	3
Unskilled Workers ...	59·81	10·31	17·23	13	74·46	20·67	27·76	14	79·29	22·29	28·11	14

(*b*) *Weighted with number of males engaged in each occupation.*

	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged
Professional Men ...	49·56	7·19	14·50	182	57·37	10·68	18·61	187	60·09	11·58	19·27	187
Clerks & Commercial Men	51·42	10·11	19·66	514	65·87	5·31	8·06	523	70·89	3·38	4·77	571
Shopkeepers & Assistants	53·63	11·20	20·89	704	59·12	7·55	12·78	721	62·33	9·43	15·13	721
Skilled Workers ...	51·44	7·19	13·97	4605·5	60·49	9·09	15·03	4788	63·29	9·21	14·55	4797·5
Domestic Servants ...	58·43	15·13	25·89	105	82·24	12·24	14·88	181	91·75	10·69	11·65	181
Unskilled Workers ...	54·95	9·36	17·04	2289·5	72·44	25·62	35·37	2142	76·98	27·62	35·88	2193·5

TABLE VII.

2nd Classification.

(*a*) *Unweighted with number of males engaged in each occupation.*

	1890—2 "Occupied Males"				1900—2 "Occupied Males"				1900—2 "Occupied & Retired Males"			
	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array
Professional Men ...	51·25	7·94	15·49	6	61·67	10·17	16·50	6	64·17	11·79	18·37	6
Clerks & Commercial Men	58·75	13·86	23·60	4	65·50	6·78	10·35	5	69·50	4·00	5·76	5
Shopkeepers & Assistants	53·33	8·76	16·43	15	60·33	9·01	11·61	15	63·67	10·54	16·56	15
Skilled Workers ...	55·18	9·63	17·46	41	70·24	13·96	19·88	42	67·98	14·45	21·25	42
Domestic Servants ...	62·50	12·91	20·66	3	75·00	8·04	10·72	3	82·50	7·07	8·57	3
Unskilled Workers ...	55·28	6·71	12·14	9	68·25	18·73	27·44	10	73·00	21·67	29·69	10

(*b*) *Weighted with number of males engaged in each occupation.*

	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged
Professional Men ...	49·57	7·17	14·46	183	57·35	10·68	18·62	183	60·09	11·58	19·27	187
Clerks & Commercial Men	51·43	10·11	19·66	513·5	65·99	5·07	7·68	562	70·89	3·38	4·77	571
Shopkeepers & Assistants	51·53	10·35	19·36	825·5	60·78	8·29	13·65	818·5	63·90	9·50	14·87	846
Skilled Workers ...	51·83	7·93	15·31	4823	62·89	10·87	17·28	4849·5	64·39	11·50	17·85	4936
Domestic Servants ...	64·52	9·65	14·96	320	73·34	6·61	9·01	320	79·70	5·30	6·65	321
Unskilled Workers ...	52·82	8·58	16·24	1711	70·08	26·02	37·14	1763	75·24	29·31	38·95	1790

TABLE VIII.

3rd Classification.

(a) Unweighted with number of males engaged in each occupation.

	1890—2 "Occupied Males"				1900—2 "Occupied Males"				1900—2 "Occupied & Retired Males"			
	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array	Mean cancer death-rate	S.D.	Coeff. of variation	No. of occupations in array
ofessional Men ...	54·29	10·46	19·26	7	62·50	9·64	15·42	7	65·36	10·88	16·65	7
erks & Commercial Men	54·17	13·12	24·23	3	65·00	7·50	11·54	4	68·75	4·15	6·03	4
opkeepers & Assistants	53·39	9·07	16·98	14	59·46	8·70	14·62	14	62·86	10·43	16·59	14
illed Workers ...	54·09	8·37	15·47	41	63·93	11·94	18·68	42	67·26	12·37	18·38	42
omestic Servants ...	60·00	15·21	25·34	2	76·25	11·39	14·94	2	85·00	7·50	8·82	2
askilled Workers ...	60·23	10·31	17·11	11	71·88	21·62	30·08	12	76·46	23·50	30·73	12

(b) Weighted with number of males engaged in each occupation.

	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged	Mean cancer death-rate	S.D.	Coeff. of variation	1000's of males engaged
ofessional Men ...	55·51	11·79	21·24	247	59·98	10·21	17·02	247	63·29	11·35	17·94	252
erks & Commercial Men	48·43	6·67	13·78	449·5	65·80	5·35	8·14	498	70·68	3·54	5·00	506
opkeepers & Assistants	53·49	10·49	19·62	803	60·46	7·98	13·19	795·5	63·59	9·44	14·85	823
illed Workers ...	52·10	7·89	15·14	5005	62·01	10·27	16·56	5039·5	64·59	10·92	16·90	5124·5
omestic Servants ...	58·43	15·13	25·89	105	75·07	11·34	15·11	105	84·15	7·45	8·86	106
askilled Workers ...	53·94	9·66	17·92	1760·5	70·91	26·10	36·81	1810	76·05	29·53	38·83	1839·5

In view of (1) the irregular distribution of means from class to class, (2) the alterations effected by re-grouping and differences in weighting, it is plain that conclusions must be drawn with caution. We do not feel justified in asserting more than that there appears to be some slight association between a high cancer death-rate and low occupational status. This result is in qualitative agreement with that of Maynard.

We next attempted to obtain a direct quantitative measure of status in the following way. The average earnings in a large number of occupations were recorded in the wages census of the Board of Trade 1906.

We used (1) Wages, (2) Comparative Cancer Mortality figures, 1900–2, (3) number of persons employed, and found the partial correlation between (1) and (2) for (3) constant. The value of $+ \cdot 138 \pm \cdot 092$ resulted. Since this value is derived from a selection, the census taking no account of professional earnings, we should *prima facie* anticipate a higher value were we able to extend the process to the whole population. This result is apparently in conflict with those described above and as the method is more direct, we should assign some importance to it, but, apart from the fact that the probable error is so large, that, for that reason alone, we can hardly base any arguments upon the value of the correlation actually obtained, another difficulty arises.

As we have pointed out elsewhere, the cancer rates for each industry are not calculated upon a basis that would lend themselves to a division into groups comparable as to wages, owing to the wide range of status within the trades. It may be therefore that in any one class of workmen, although an average wage with a corresponding cancer rate near the mean is shown, in reality the rates are weighted at one end with a large number of persons in receipt of high wages and having a low cancer rate, and at the other end with a large number of persons having a high cancer death-rate and low wages. As we are unable correctly to estimate the truth of this contention we cannot say to how far the correlation would be modified, or even in what direction, had our occupations been less selected and at the same time our cancer rates more representative of the position of affairs within each actual wage group.

Lastly, we made another direct measurement in the case of the City of Hamburg. In that city, deaths from cancer are separately tabulated for each subdivision, and the average income of the inhabitants is also recorded.

TABLE IX.

Showing deaths from cancer 1906–1912, *corrected cancer death-rate and average income* 1904–10 *for* 26 *divisions of the city of Hamburg.*

	Population 1910	Cancer deaths 1906—1912	Corrected cancer death-rate per 1000 per 7 years	Average income, Marks
Altstadt-Nord	20,440	228	9·7	612
Altstadt-Süd	9,141	78	7·6	840
Neustadt-Nord	40,603	349	7·6	663
Neustadt-Süd	30,877	274	8·1	475
St Georg-Nord	41,140	328	6·6	888
St Georg-Süd	61,291	426	7·7	475
St Pauli-Nord	39,954	316	7·8	560
St Pauli-Süd	35,026	255	6·9	485
Eimsbüttel	117,941	652	6·0	614
Rotherbaum	31,478	217	5·9	2,696
Harvestehude	25,233	151	5·8	3,679
Eppendorf	72,100	416	5·8	622
Winterhude	32,422	172	6·5	1,210
Barmbeck	93,241	461	5·0	417
Uhlenhorst	41,556	254	6·6	1,085
Hohenfelde	31,091	260	6·7	1,523
Eilbeck	54,907	337	5·9	830
Borgefelde	34,230	198	5·4	676
Hamm	44,624	226	5·8	756
Horn	7,826	53	7·2	503
Billwärder Ausschlag	46,945	255	6·6	364
Veddel	5,847	41	7·7	374
Means		270·3	6·77	924·9

Excluding a few very small districts, the populations of which were too small to give reasonably reliable rates, 26 were available and we had cancer for 1906–12 and income statistics for the years 1904–10. Corrected cancer death-rates were calculated (the statistics of the populations at ages in the districts, which are not published, were kindly sent us by the authorities of the Hamburg Public Health Department), and the correlation between cancer rate and average income was deduced. The value proved to be $-\cdot306 \pm \cdot130$. As this coefficient is 2·4 times its probable error some significance may attach to it, but we must not forget that (1) average income in the case of a great commercial city may be but a poor measure of status, *e.g.* it is possible that the incomes assessed in any one district do not refer exclusively to residents in that district, and (2) some of the districts are not very large, so that

rates deduced even from the returns of as many as seven years may not be altogether reliable.

However, this result is probably less open to criticism than any others we have obtained and serves to strengthen the general conclusion that cancer is not more, but less fatal among the well-to-do classes.

The results of the present enquiry may be summarized as follows :

(1) Heron's conclusion that cancer in London is associated with conditions of higher social status is dependent, we think, upon an erroneous method of calculation and is not borne out when cancer rates corrected for age are employed.

(2) An analysis of occupational mortality leads to the suggestion that cancer is less fatal among the higher social or economic classes, but the results are somewhat irregular.

(3) In Hamburg, average income is negatively correlated with the rate of cancer mortality.

We cannot bring this paper to a conclusion without expressing our hearty thanks to Dr M. Greenwood, Jr., of the Lister Institute of Preventive Medicine, for assistance and advice given in the course of this investigation.

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