

## **On certain changes in the English rates of mortality / by Thomas A. Welton.**

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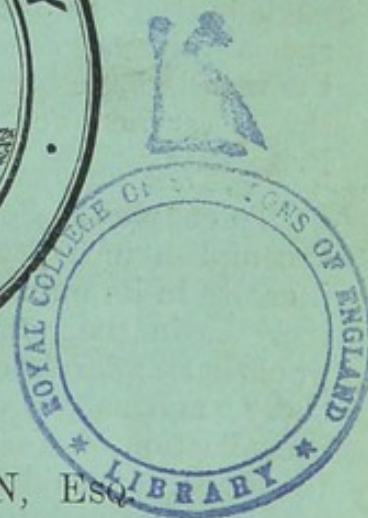
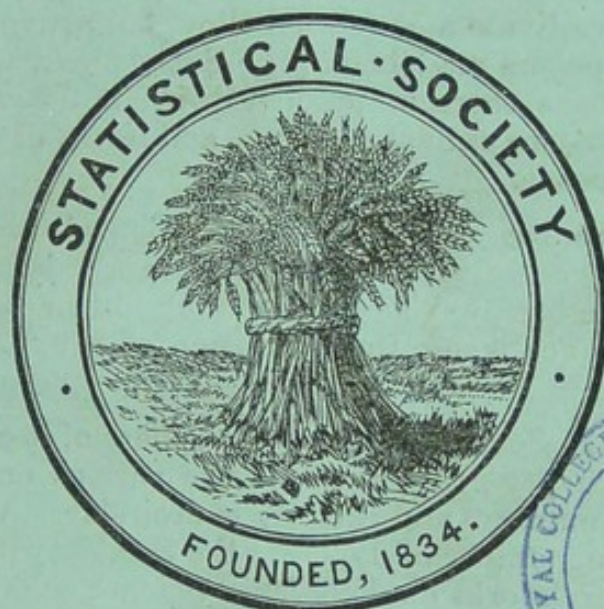
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CERTAIN CHANGES

IN THE

ENGLISH RATES OF MORTALITY.

*Tr. 105.*



BY THOMAS A. WELTON, ESQ.

READ BEFORE THE STATISTICAL SOCIETY, FEBRUARY 17, 1880.

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AN OUTLINE OF THE OBJECTS OF

# THE STATISTICAL SOCIETY.

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THE *Statistical Society* of London was founded, in pursuance of a recommendation of the British Association for the Advancement of Science, on the 15th of March, 1834; its object being, the careful collection, arrangement, discussion and publication, of facts bearing on and illustrating the complex relations of modern society in its social, economical, and political aspects,—especially facts which can be stated numerically and arranged in tables;—and also to form a Statistical Library as rapidly as its funds would permit.

The Society from its inception has steadily progressed. It now possesses a valuable Library and a Reading Room; ordinary meetings are held monthly from November to June, which are well attended, and cultivate among its Fellows an active spirit of investigation: the papers read before the Society are, with an abstract of the discussions thereon, published in its *Journal*, which now consists of forty-two annual volumes, and forms of itself a valuable library of reference.

The Society has originated and statistically conducted many special inquiries on subjects of economic or social interest, of which the results have been published in the *Journal*, or issued separately; the latest instance being the institution of the "Howard Medal" Prize Essay.

To enable the Society to extend its sphere of useful activity, and accomplish in a yet greater degree the various ends indicated, an increase in its numbers and revenue is desirable. With the desired increase in the number of Fellows, the Society will be enabled to publish standard works on Economic Science and Statistics, especially such as are out of print or scarce, and also greatly extend its collection of Foreign works. Such a well-arranged Library for reference, as would result, does not at present exist in England, and is obviously a great *desideratum*.

The Society is cosmopolitan, and consists of Fellows and Honorary Members, forming together a body, at the present time, of between *eight and nine hundred* Members.

The Annual Subscription to the Society is *Two Guineas*, and at present there is no entrance fee. Fellows may, on joining the Society, or afterwards, compound for all future annual subscriptions by a payment of *Twenty Guineas*.

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Nomination Forms and any further information will be furnished, on application to the Assistant Secretary.



On CERTAIN CHANGES in the ENGLISH RATES of MORTALITY.

By THOMAS A. WELTON, ESQ.

[Read before the Statistical Society, 17th February, 1880.]

6 Offerton Road  
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I.—Introductory.

THE leading fact in relation to the statistics of mortality is the *regularity* which underlies every variation of death-rate, whether such variation be found to exist on a comparison of statistics of several localities, or of the same locality at different periods and under dissimilar conditions; whether the reason of such variation be traceable to the influence of particular occupations upon mortality, to the results of migrations (in search of employment, of education, of amusement, or of renewed health), to the unequal stamina of different races of men, to the circumstances respectively affecting the two sexes, or to some alteration in the habits of the people.

The essential nature of this regularity consists in the graduation of the series of death-rates at the several periods of life, beginning with heavy losses in the earliest years, descending rapidly to a minimum, and thenceforward progressively increasing until the end of life. The exact place of the minimum may fluctuate, and the increase afterwards may not proceed by similar steps; the absolute rates at all periods of life may be strongly contrasted, but the general likeness of the series remains. We may say with truth that a resemblance exists between curves representing mortality at successive ages, even greater than that which unites in one category every right-angled triangle; for the sides of such a triangle may be of any length, but there are limits beyond which the variations of death-rates do not appear to go.

Whilst regularity of type is the leading feature of the curves resulting from different series of death-rates, variability of detail is the next. When once the mind has grasped the idea of regularity of general character, nothing more remains to be learned in that direction; but as variations in the amount of losses by death are material and frequent, they afford infinite matter for study, and observers are led to think rather too much of momentary changes



and contrasts, and too little of the substantial similarity and constancy which underlies them all.

I am far from regretting that this is so, for whilst the losses by death are so frequently excessive, it is well to instil the lesson that rates of mortality *are* changeable, and may consequently be modified by the endeavours of mankind. The more thoroughly people appreciate this fact, the greater the probability that they will exert themselves in order to reduce the ravages of preventable disease and death.

On the other hand, it is fit that from time to time the data for long periods should be examined, and the stability or changefulness of the phenomena considered. Tendencies may thus be discovered which, from the slowness of their operation, might produce, in any short period of time, effects so slight as to be overshadowed by those resulting from transient causes of disturbance, but which, being persistent, would in a series of years bring about changes of an unmistakeable character.

The English returns were comparatively imperfect until the system of registration had been some years in existence; and the population tables classifying the inhabitants of this country according to their ages were prior to 1851 very far from being reliable. I am therefore of opinion that it will be better to restrict our comparisons to the thirty years extending from 1846 to 1875, instead of commencing with 1838, the first year of registration.

According to the tables of annual death-rates given by the Registrar-General (Nos. 23 and 25, in his thirty-eighth report), the mortality of both sexes at ages 5—25\* has been continuously reduced with hardly an interruption, during twenty-five years, thus:—

	Mean Death-Rates per 1,000 Living.					
	Males.			Females.		
	Age 5—10.	Age 10—15.	Age 15—25.	Age 5—10.	Age 10—15.	Age 15—25.
Average 1846-50 .....	9·6	5·4	8·6	9·3	5·7	8·9
" '51-55 .....	8·8	5·2	8·1	8·5	5·3	8·5
" '56-60 .....	8·3	4·6	7·4	8·3	4·9	7·8
" '61-65 .....	8·5	4·7	7·5	8·2	4·8	7·6
" '66-70 .....	7·9	4·3	7·1	7·4	4·3	7·1
" '71-75 .....	7·2	4·0	6·9	6·6	4·0	6·7
Abatement equal to } (per cent.) .....	25	26	20	29	30	25

\* The mortality tabulated at ages 0—5 has diminished thus:—amongst males from 74·1 per 1,000 in 1846-50, to 70·0 per 1,000 in 1871-75:—amongst females,



At ages 35—75 the rates of mortality amongst males, after being somewhat diminished, have become higher than they were in 1846-50:—

	Mean Death-Rates per 1,000 Living, amongst Males.			
	Age 35—45.	Age 45—55.	Age 55—65.	Age 65—75.
Average 1846-50 .....	13·4	19·4	33·4	68·9
„ '51-55 .....	12·9	18·6	31·5	66·8
„ '56-60 .....	12·4	17·1	30·0	66·2
Abatement equal to } (per cent.) .....	7	12	10	4
Average 1861-65 .....	13·4	18·8	32·6	66·6
„ '66-70 .....	13·6	19·6	33·5	68·2
„ '71-75 .....	14·3	20·1	34·8	69·6
Later increase equal } to (per cent.) .....	15	18	16	5
Increase on the whole } period (per cent.) .....	7	4	4	1

The increase in male mortality would appear in a stronger light, were the years omitted in which epidemics occurred. Thus taking that year of each quinquennium in which the average mortality was lowest, we have the following death-rates at the ages mentioned, viz. :—

	Mean Death-Rates per 1,000 Living, amongst Males.			
	Age 35—45.	Age 45—55.	Age 55—65.	Age 65—75.
Year 1850 (lowest in 1846-50)....	11·6	17·2	29·8	62·8
„ '51 ( „ '51-55)....	12·4	17·9	30·3	64·0
„ '56 ( „ '56-60)....	11·9	16·4	28·8	61·6
Abatement equal to (per cent.)	3*	5	3	2
Year 1862 (lowest in 1860-65)....	12·7	18·1	31·3	62·5
„ '67 ( „ '66-70)....	13·5	19·1	33·5	68·5
„ '73 ( „ '71-75)....	13·6	19·5	34·0	70·4
Later increase equal to (per } cent.) .....	14	19	18	14
Increase on the whole period } (per cent.) .....	17	13	14	12

\* Increase.

from 63·9 per 1,000 in 1846-50, to 60·2 per 1,000 in 1871-75. The rates in 1841-45 were lower than any since shown, but the earlier records at this period of life were no doubt imperfect in comparison with more recent returns.



The average mortality amongst females at the ages 35 to 75 appears to have been as under, viz. :—

	Mean Death-Rates per 1,000 Living, amongst Females.			
	Age 35—45.	Age 45—55.	Age 55—65.	Age 65—75.
Average 1846-50 .....	13·5	16·7	29·4	63·3
'51-55 .....	12·4	15·6	27·8	59·0
'56-60 .....	11·6	14·7	27·1	54·9
Abatement equal to } per cent.) .....	<b>14</b>	<b>12</b>	<b>8</b>	<b>13</b>
Average 1861-65 .....	12·1	15·4	28·0	57·9
" '66-70 .....	12·0	15·8	28·0	59·4
" '71-75 .....	12·0	15·8	28·9	61·2
Later increase equal } to (per cent.) .....	<b>3</b>	<b>8</b>	<b>7</b>	<b>11</b>

showing, upon the whole, a reduction, in spite of recent increase; but on comparing the most favourable years, as in the case of males, a tendency towards increased death-rates from age 45 upwards is observable :—

	Mean Death-Rates per 1,000 Living, amongst Females.			
	Age 35—45.	Age 45—55.	Age 55—65.	Age 65—75.
Year 1850 (lowest in 1846-50) ...	11·7	14·7	26·1	57·3
" '51 ( " '51-55) ....	11·9	15·2	26·8	58·5
" '56 ( " '56-60) ....	11·3	14·0	25·1	51·2
Abatement equal to (per cent.)	<b>3</b>	<b>5</b>	<b>4</b>	<b>11</b>
Year 1862 (lowest in 1861-65) ....	11·8	14·7	26·7	57·2
" '67 ( " '66-70) ....	11·9	15·6	27·6	59·6
" '73 ( " '71-75) ....	11·5	15·5	28·4	61·8
Later increase equal to (per cent.)	<b>2</b>	<b>11</b>	<b>13</b>	<b>21</b>

On the whole then the tables show that the striking abatement in mortality at ages 5—25 has been attended with an aggravation of the loss by death at higher ages, putting aside epidemic years, and that such aggravation has been far more considerable amongst males than amongst females. Every circumstance which will help us to measure the extent, and to understand the causes, of such a deterioration in the vitality of males, demands attention.

I shall proceed before the close of this paper, to point out *the apparent causes*, as shown in the Registrar General's tables, leaving to others to determine how these have been brought into operation.



## II.—*The Extent of the Changes in Mortality.*

The tables in the Registrar-General's thirty-eighth report, from which the above ratios were extracted, are useful enough for ordinary purposes; but when we have to grapple with questions of serious import, in order to appreciate which small and gradual but cumulative changes have to be measured, it is right that every correction which the figures need should be borne in mind.

I have arrived at the conclusions (1st) that the census returns as to ages require to be amended; (2nd) that the approximate proportions of births which annually escape registration are discoverable; and (3rd) that the net results of migrations into and from the country may also be measured.

By the help then of such transpositions of the numbers stated to exist at different ages as appear to me to be necessary, I proceed to show what I believe to be an approximately true national table of mortality for 1856-60, when the upward movement seems not to have commenced; and also a similar table representing the experience of the years 1871-75, when such movement had attained a considerable if not alarming development.\* These two tables, for males and females respectively, and showing the excess of either sex surviving at different periods of life in a stationary population solely recruited by births, are here contrasted with Dr. Farr's English Life Table No. 3.

\* Besides correcting the returns of population by ages in conformity with the suggestions contained in my paper "On the Inaccuracies which probably exist in the Census Returns of Ages," printed in the "Transactions of the Historic Society of Liverpool," for 1875-76, vol. iv, which will be found in the Library of the Statistical Society, I have allowed for unregistered births in conformity with the percentages mentioned in the same paper; and then having, by means of estimates, apportioned the recorded deaths under the quinquennial periods in which the persons dying were born, I have arrived by way of difference at the probable loss or gain resulting from migrations at each age in the intervals between the censuses, and have obtained sets of ratios showing the proportionate losses by death out of the population existing at each age, in 1841, 1846, 1851, 1856, 1861, 1866, and 1871, during the five years next succeeding each of those years. Each set of ratios so obtained is immediately convertible into a table of mortality (column  $P_x$  according to Dr. Farr's notation), capable of direct comparison with the English Life Table No. 3, because based on an equal number of supposed annual births.



Age.	England and Wales. Population resulting from a Thousand					
	Survivors (Experience of 1856-60).				Survivors (Experience	
	Male.	Female.	Males compared with Females.		Male.	Female.
			Excess.	Deficiency.		
0—5 ....	2026·254	1999·405	26·849	—	2030·349	2005·753
5—10 ....	1823·021	1803·464	19·557	—	1848·430	1835·665
10—15 ....	1769·607	1749·360	20·247	—	1801·110	1791·242
15—20 ....	1744·129	1701·429	22·700	—	1760·946	1750·043
20—25 ....	1659·129	1634·392	24·737	—	1699·490	1688·967
25—30 ....	1586·128	1559·864	26·264	—	1623·863	1617·187
30—35 ....	1515·387	1484·211	31·176	—	1543·807	1541·987
35—40 ...	1437·345	1407·626	29·719	—	1453·341	1462·112
40—45 ....	1353·260	1327·111	26·149	—	1350·299	1376·578
45—50 ....	1259·073	1245·495	13·578	—	1241·060	1284·761
50—55 ....	1152·430	1157·812	—	5·382	1119·189	1189·946
55—60 ....	1025·893	1057·893	—	32·000	984·550	1079·162
60—65 ...	884·115	933·590	—	49·475	827·712	945·671
65—70 ....	709·768	772·453	—	62·685	644·954	769·966
70—75 ....	513·306	577·409	—	64·103	448·566	566·926
75—80 ....	309·728	367·752	—	58·024	264·475	356·199

Using the figures in Dr. Farr's Life Table as a convenient standard of comparison, we find the excess or defect of survivors (per cent.), according to the other tables to be—

Amongst Survivors Aged	Experience 1856-60.		Experience 1871-75.	
	Males.	Females.	Males.	Females.
0-35.....	1·4 more	1·4 more	3·1 more	3·9 more
35-55.....	3·1 „	3·3 „	2·4 „	6·8 „
55-80.....	6·1 „	8·1 „	2·3 less	8·4 „
All ages up to 80.....	2·5 „	3·0 „	2·1 more	5·4 „

The period of years which elapses before the persons who are born are reduced to half their original number, is, according to the above tables, as under:—

	By Dr. Farr's Table.	By Experience of 1856-60.	By Experience of 1871-75.
Males .....	44·4	46·5	45·8
Females .....	46·4	48·9	50·9
Female expectation greater by .....	2·0	2·4	5·1

Thus the probable lifetime of female infants seems now to exceed



Annual Births: 511'745 Male and 488'255 Female.						
of 1871-75).		Survivors (by Dr. Farr's Life Table No. 3).				Age.
Males compared with Females.		Male.	Female.	Males compared with Females.		
Excess.	Deficiency.			Excess.	Deficiency.	
24'596	—	2015'886	1988'330	27'556	—	0— 5
12'765	—	1801'316	1783'240	18'076	—	5—10
9'868	—	1742'507	1723'706	18'801	—	10—15
10'903	—	1696'773	1675'461	21'312	—	15—20
10'523	—	1632'979	1609'814	23'165	—	20—25
6'676	—	1560'236	1534'785	25'451	—	25—30
1'820	—	1483'840	1456'076	27'764	—	30—35
—	8'771	1402'868	1374'392	28'476	—	35—40
—	26'279	1315'244	1289'612	25'632	—	40—45
—	43'701	1218'321	1201'075	17'246	—	45—50
—	70'757	1108'460	1107'735	0'725	—	50—55
—	94'612	981'337	999'667	—	18'330	55—60
—	117'959	834'862	866'700	—	31'838	60—65
—	125'012	664'601	706'898	—	42'297	65—70
—	118'360	475'223	523'015	—	47'792	70—75
—	91'724	288'993	333'526	—	44'533	75—80

the duration of that of males by perhaps five years, against a difference of little more than two years according to earlier data.

This great change might seem to arise rather from increased mortality amongst males than from diminished female death-rates. For example, those surviving to be counted at ages 60—65 were by table resulting from

Experience of 1856-60	Males 884'115	Females 933'590
„ '71-75	„ 827'712	„ 945'671
	Fewer 56'403	More 12'081

It should, however, be remarked, that 1856-60 was an exceptionally healthy quinquennium; and if we base our comparison upon Dr. Farr's Life Table, as representing the average of a greater number of years, we find that the figures for 1871-75 show but a small reduction in the number of males attaining the age 60—65, against a very considerable augmentation in the number of surviving females at that period of life. There has apparently been an increase of male mortality at the higher ages, sufficient to counterbalance the improvement in early life, and even after a time to turn it into a loss; whilst among females, a more than proportionate improvement in early life has been followed by a condition of things at the higher ages which leaves the gain practically undiminished.



Ages.	Males.			Females.		
	English Life Table No. 3.	Table for 1871-75.	Difference per Cent.	English Life Table No. 3.	Table for 1871-75.	Difference per Cent.
30—35	1483·840	1543·807	+ 4·0	1456·076	1541·987	+ 5·9
45—50	1218·321	1241·060	+ 1·9	1201·075	1284·761	+ 7·0
60—65	834·862	827·712	— 0·9	866·700	945·671	+ 9·1
75—80	288·993	264·475	— 8·5	333·526	356·199	+ 6·8

I have endeavoured to clear up still further the question as to how the average mortality of the English people has varied since 1841, by constructing a series of life tables on the principles which guided me in preparing the tables already given for 1856-60 and 1871-75. By that means the following results have been reached, viz. :—

Experience of	Survivors Aged 30—35.			Aged 45—50.			Aged 60—65.		
	Males.	Females.	Males in Excess.	Males.	Females.	Males More or Less.	Males.	Females.	Females in Excess.
1841-45 ....	1525·674	1491·276	34·398	1264·691	1243·227	+ 21·464	906·245	938·136	31·891
'46-50 ....	1455·492	1426·174	29·318	1179·817	1163·474	+ 16·343	809·585	847·168	37·583
'51-55 ....	1475·754	1451·982	23·772	1211·694	1201·721	+ 9·973	837·633	886·911	49·278
'56-60 ....	1515·387	1484·211	31·176	1259·073	1245·495	+ 13·578	884·115	933·590	49·475
1861-65 ....	1493·194	1474·474	18·720	1224·212	1229·989	— 5·777	835·077	910·842	75·765
'66-70 ...	1512·780	1501·741	11·039	1227·833	1251·530	— 23·697	832·590	923·688	91·098
'71-75 ....	1543·807	1541·987	1·820	1241·060	1284·761	— 43·701	827·712	945·671	117·959
<i>Averages—</i>									
1841-60 ....	1493·077	1463·411	29·666	1228·819	1213·479	+ 15·340	859·394	901·451	42·057
'61-75 ....	1516·593	1506·067	10·526	1231·035	1255·427	— 24·392	831·793	926·734	94·941

The average figures which result from grouping the ratios for 1841 to 1860, and for 1861 to 1875, show an improvement, both absolute and comparative, in the vitality of females; and the series of quinquennial figures shows that this alteration in the relative mortality of the sexes not only continued in progress from the earliest to the latest date, with hardly any interruption, but was accelerated during the last fifteen years. Although in 1841-45 the average rates of mortality were much lower, and in 1846-50 they were much higher than the ordinary level, the tables for these two periods were alike in one respect, viz., in showing a smaller excess of female survivors at age 60—65 than in any later quinquennium.

Regarding the matter from another point of view, we perceive



that in 1871-75 the male mortality after age 30 was so high as to reduce

1543·807 aged 30—35,

to 827·712 aged 60—65, only 53·6 per cent. surviving.

Even in 1846-50, when the cholera epidemic so materially affected the average result, such a loss was not experienced; for

1455·492 aged 30—35,

became 809·585 aged 60—65, fully 55·6 per cent. surviving.

Consequently the male mortality during the latest quinquennium at ages 30—60 was higher than in any of the other six similar periods.

The variations in the risk of death at several periods of life, which are summed up in the life tables already given, may be better seen in the following table, which shows the proportional loss by deaths occurring in the five years next succeeding the attainment of the age mentioned in the first column :—



Age at Commence- ment.	Deaths per 1,000 in the Next Five Years.							
	"English Life Table No. 3."		Experience, 1841-45.		Experience, 1846-50.		Experience, 1851-55.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
Birth* ....	212·2	185·5	196·1	169·3	208·2	180·6	213·4	185·5
0—5....	106·4	103·1	99·9	95·8	112·1	107·3	103·3	98·9
5—10....	32·6	33·4	31·7	31·4	33·5	33·2	32·1	31·7
10—15....	26·2	28·0	26·8	29·8	29·2	31·7	27·7	29·6
15—20....	37·6	39·2	40·3	42·8	43·5	46·1	41·9	43·2
20—25....	44·5	46·6	44·2	47·9	50·1	52·0	46·9	49·7
25—30....	49·0	51·3	46·7	50·4	50·9	56·6	48·5	51·5
30—35....	54·6	56·1	52·9	55·3	58·1	59·9	53·6	56·1
35—40....	62·5	61·7	60·6	58·1	66·9	66·3	63·1	59·9
40—45....	73·7	68·7	68·3	63·1	77·7	70·6	74·0	67·3
45—50....	90·2	77·7	82·5	69·3	91·8	78·2	91·0	73·4
50—55....	114·7	97·6	102·6	85·1	116·0	95·5	112·4	91·9
55—60....	149·3	133·0	129·7	113·8	145·3	126·7	143·2	122·9
60—65....	203·9	184·4	184·7	165·3	203·5	181·5	200·0	176·8
65—70....	285·0	260·1	264·9	241·2	286·0	262·2	285·1	259·5
70—75....	391·9	362·3	380·3	344·1	406·2	369·1	406·7	374·2

\* The ratios in this line show that out of 1,000 births occurring in five successive years prior year are exposed to five years' risk, those at the very end of the last year are exposed to no risk,

The regularity of the several sets of ratios shown in the above table cannot escape notice; it remains to be seen what are the changes which they indicate to be in progress, and are such changes subject to any uniform laws? Other tables must be employed to assist us in placing the matter in a sufficiently clear light. Thus:—



Deaths per 1,000 in the Next Five Years.								Age at Commence- ment.
Experience, 1856-60.		Experience, 1861-65.		Experience, 1866-70.		Experience, 1871-75.		
Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	
208.1	181.0	212.1	184.2	213.3	185.8	206.5	178.4	Birth*
100.3	98.0	105.7	101.6	97.8	93.2	89.6	84.8	0—5
29.3	30.0	29.2	28.9	27.0	26.0	25.6	24.2	5—10
25.7	27.4	25.5	27.1	23.7	24.6	22.3	23.0	10—15
37.7	39.4	38.5	39.5	36.0	37.0	34.9	34.9	15—20
44.0	45.6	43.8	44.8	44.0	43.4	44.5	42.5	20—25
44.6	48.5	47.8	49.3	48.5	48.0	49.3	46.5	25—30
51.5	51.6	54.6	54.1	57.6	53.2	58.6	51.8	30—35
58.5	57.2	64.8	57.7	66.5	59.2	70.9	58.5	35—40
69.6	61.5	72.7	64.1	77.4	64.4	80.9	66.7	40—45
84.7	70.4	91.1	71.0	91.5	73.5	98.2	73.8	45—50
109.8	86.3	115.7	91.7	119.3	89.5	120.3	93.1	50—55
138.2	117.5	151.3	122.4	152.5	125.1	159.3	123.7	55—60
197.2	172.6	201.3	176.2	211.5	175.6	220.8	185.8	60—65
276.8	252.5	287.0	256.8	288.0	257.1	304.5	263.7	65—70
396.6	363.1	399.2	362.5	412.8	369.7	410.4	371.7	70—75

a census taken at the end of the period so many die. Those born at the beginning of the first cause they are immediately counted as living at the age 0—5.



Age at Commencement of Five Years.	The Male Death-Rate in the last Table being Assumed Equal to 1,000, the Female Death-Rate was Less* by							In Thirty Years the Female Death-Rate had thus become relatively	
	Experience, 1841-45.	Experience, 1846-50.	Experience, 1851-55.	Experience, 1856-60.	Experience, 1861-65.	Experience, 1866-70.	Experience, 1871-75.	Less.	More.
Birth.....	137	133	131	130	132	129	136	—	1
0—5 ....	41	43	43	23	39	47	54	13	—
5—10 ....	9	9	12	+24	10	37	55	46	—
10—15 ....	+112	+86	+69	+66	+63	+38	+31	81	—
Aggregate ratios....	75	99	117	63	118	175	214	—	—
15—20 ....	+62	+60	+31	+45	+26	+28	—	62	—
20—25 ....	+84	+38	+60	+36	+23	14	45	129	—
25—30 ....	+79	+112	+62	+87	+31	10	57	136	—
30—35 ....	+45	+31	+47	+2	9	77	116	161	—
Aggregate ratios....	+270	+241	+200	+170	+71	73	218	—	—
35—40 ....	41	9	51	22	110	110	175	134	—
40—45 ....	76	91	91	116	118	168	176	100	—
45—50 ....	160	148	193	169	221	197	248	88	—
50—55 ....	171	177	182	214	207	241	226	55	—
Aggregate ratios....	448	425	517	521	656	716	825	—	—
55—60 ....	123	128	142	150	191	180	224	101	—
60—65 ....	105	108	116	125	125	170	159	54	—
65—70 ....	89	83	90	88	105	107	134	45	—
70—75 ....	95	91	80	85	92	104	94	—	1
Aggregate ratios....	412	410	428	448	513	561	611	—	—

\* Where the female death-rate was *greater* instead of *less*, an affirmative sign (+) is used.

These ratios possess a great deal of regularity, whether we regard them in one way or another, and they show once more, that *for some reason, operating over the whole period*, male mortality, at ages 5 to 70, has diminished by a less amount, or has increased to a greater extent, than that of females. In 1841-45 the mortality of females exceeded that of males at the five ages from 10 to 35; in 1871-75 there was no such excess save at the age 10 to 15.

At the ages 15—35 it is specially to be remarked that, notwithstanding the dangers of maternity, female mortality now compares favourably with that amongst males. At ages 25—35 the male death-rates were hardly lower in 1871-75 than in 1846-50; at the same ages, female death-rates were in 1871-75 about 16 per cent. lower than in 1846-50.



Next, let us compare the absolute ratios contained in the preceding table for either sex, thus:—

Age at commence- ment of five Years.	Changes in Male Death-Rates.		Changes in Female Death-Rates.		Total Changes in Thirty Years from 1841-45 to 1871-75.		Latest Ratios (1871-75) compared with those derived from the English Life Table No. 3.	
	Between 1841-45 and 1856-60.	Between 1856-60 and 1871-75.	Between 1841-45 and 1856-60.	Between 1856-60 and 1871-75.	Males.	Females.	Males.	Females.
Birth.....	+ 12'0	- 1'6	+ 11'7	- 2'6	+ 10'4	+ 9'1	- 5'7	- 7'1
0—5....	+ 0'4	- 10'7	+ 2'2	- 13'2	- 10'3	- 11'0	- 16'8	- 18'3
5—10....	- 2'4	- 3'7	- 1'4	- 5'8	- 6'1	- 7'2	- 7'0	- 9'2
10—15....	- 1'1	- 3'4	- 2'4	- 4'4	- 4'5	- 6'8	- 3'9	- 5'0
15—20....	- 2'6	- 2'8	- 3'4	- 4'5	- 5'4	- 7'9	- 2'7	- 4'3
20—25....	- 0'2	+ 0'5	- 2'3	- 3'1	+ 0'3	- 5'4	—	- 4'1
25—30....	- 2'1	+ 4'7	- 1'9	- 2'0	+ 2'6	- 3'9	+ 0'3	- 4'8
30—35....	- 1'4	+ 7'1	- 3'7	+ 0'2	+ 5'7	- 3'5	+ 4'0	- 4'3
35—40....	- 2'1	+ 12'4	- 0'9	+ 1'3	+ 10'3	+ 0'4	+ 8'4	- 3'2
40—45....	+ 1'3	+ 11'3	- 1'6	+ 5'2	+ 12'6	+ 3'6	+ 7'2	- 2'0
45—50....	+ 2'2	+ 13'5	+ 1'1	+ 3'4	+ 15'7	+ 4'5	+ 8'0	- 3'9
50—55....	+ 7'2	+ 10'5	+ 1'2	+ 6'8	+ 17'7	+ 8'0	+ 5'6	- 4'5
55—60....	+ 8'5	+ 21'1	+ 3'7	+ 6'2	+ 29'6	+ 9'9	+ 10'0	- 9'3
60—65....	+ 12'5	+ 23'6	+ 7'3	+ 13'2	+ 36'1	+ 20'5	+ 16'9	+ 1'4
65—70....	+ 11'9	+ 27'7	+ 11'3	+ 11'2	+ 39'6	+ 22'5	+ 19'5	+ 3'6
70—75....	+ 16'3	+ 13'8	+ 19'0	+ 8'6	+ 30'1	+ 27'6	+ 18'5	+ 9'4

This table again shows that there has been more regularity than could have been expected in the changes of mortality ratios which have taken place. In the fifteen years between 1841-45 and 1856-60 both sexes experienced an unfavourable change\* in the earliest period of infancy, then an improvement extending to about 40 or 45 years of age, and at higher ages, a deterioration in vitality. In the second period of equal duration, there was a yet greater improvement in the period of youth, but after 25 the ratios for males showed very unfavourably, and after 35 there was a sensible increase in female mortality.

The sum of the changes within the two periods exhibits a striking improvement in the mortality of both sexes, after earliest infancy up to age 20; this continued fifteen years later in life for women; after which both sexes, especially males, showed enhanced death-rates.

On being compared with the English Life Table No. 3, the latest set of ratios would indicate that female vitality at every age up to 60 has improved, but that male inhabitants of this country aged 25

\* This unfavourable feature is probably illusory; if the record of infantile deaths had been as complete in 1841-45 as in 1856-60, very likely appearances would have pointed the other way.



and upwards are now subject to rates of mortality exceeding those shown in that table.

III.—*The Causes of the Increased Mortality amongst Males Aged 35—65.*

The deaths occurring amongst males aged 35—65 appear to have been due to the undermentioned causes in the proportions indicated at the periods mentioned :—

Causes.	Annual Male Death-Rates per 1,000 Living.								
	Age 35—45.			Age 45—55.			Age 55—65.		
	1851-60.	1861-70.	1875.	1851-60.	1861-70.	1875.	1851-60.	1861-70.	1875.
Zymotic diseases ....	1·60	1·38	1·41	2·07	1·69	1·52	3·12	2·54	2·33
Cancer .....	0·17	0·20	0·25	0·42	0·54	0·70	0·93	1·21	1·65
Scrofula,      tabes } mesenterica..... }	0·12	0·10	0·08	0·13	0·11	0·07	0·14	0·14	0·08
Phthisis .....	4·01	4·17	4·41	3·83	3·86	3·85	3·33	3·30	3·33
Disease of brain.....	1·18	1·34	1·55	1·99	2·24	2·45	4·10	4·66	5·57
Heart disease and } dropsy .....	1·00	1·23	1·59	1·90	2·19	2·61	4·13	4·58	5·40
Disease of lungs.....	1·52	1·72	2·52	3·09	3·50	4·78	6·62	7·59	10·32
Disease of stomach } and liver .....	0·89	0·91	1·01	1·66	1·71	1·82	3·03	3·06	3·20
Disease of kidneys....	0·29	0·41	0·52	0·47	0·66	0·87	0·94	1·28	1·77
Violent deaths .....	1·15	1·31	1·39	1·37	1·55	1·63	1·61	1·89	2·08
Other causes .....	0·55	0·69	0·37	1·03	1·11	0·70	2·90	2·75	2·00
All causes .....	12·48	13·46	15·10	17·96	19·16	21·00	30·85	33·00	37·68

At these ages, the zymotic diseases, or those specially consequent on bad sanitary conditions, such as fevers, small pox, cholera, and diarrhoea, seem collectively less fatal than they were, but local diseases, of the lungs, heart, brain, and kidneys, and also cancer, appear to be more destructive.

The causes of death at several ages are not shown in the Registrar-General's Reports except for the whole country and for London, save in the supplementary tables for 1851-60 and 1861-70. These supplementary tables enable us to present the following comparisons :—



	Annual Mortality per 1,000 Males Aged 35—45.									
	Disease of Lungs.		Heart Disease and Dropsy.		Disease of Brain.		Disease of Kidneys.		Cancer.	
	1851-60.	1861-70.	'51-60.	'61-70.	'51-60.	'61-70.	'51-60.	'61-70.	'51-60.	'61-70.
<i>Large Towns*—</i>										
London (division) .....	1·98	2·18	1·32	1·54	1·45	1·55	0·44	0·62	0·24	0·29
Liverpool .....	3·10	3·53	1·46	2·06	1·43	1·43	0·37	0·57	0·23	0·23
Manchester .....	3·14	3·56	1·23	1·47	1·55	1·96	0·42	0·50	0·21	0·24
Birmingham .....	1·91	2·11	1·21	1·35	1·41	1·44	0·42	0·40	0·25	0·22
Leeds .....	2·48	2·93	1·19	1·62	1·06	1·15	0·35	0·48	0·23	0·29
Sheffield .....	2·37	3·00	1·09	1·58	1·12	1·29	0·27	0·31	0·14	0·10
Nottingham .....	0·97	1·30	0·87	1·18	1·18	1·28	0·18	0·35	0·10	0·23
Bristol .....	1·73	1·89	1·14	1·30	1·71	1·73	0·44	0·64	0·38	0·34
Hull.....	1·73	1·62	1·55	1·61	1·36	1·42	0·30	0·37	0·20	0·18
The Potteries .....	2·78	3·68	1·12	1·36	1·07	1·08	0·21	0·33	0·15	0·06
Newcastle-on-Tyne .....	1·37	2·03	2·03	2·44	1·21	1·28	0·44	0·49	0·29	0·34
Leicester .....	1·41	1·65	1·09	1·93	1·61	1·74	0·43	0·53	0·17	0·14
Wolverhampton .....	2·35	1·92	1·11	1·15	1·03	0·73	0·34	0·49	0·12	0·23
<i>Rural Divisions—</i>										
Div. II. South Eastern .....	1·27	1·38	1·05	1·38	1·26	1·44	0·32	0·46	0·19	0·19
„ III. South Midland.....	1·13	1·18	0·85	0·96	1·43	1·67	0·26	0·36	0·19	0·23
„ IV. Eastern .....	1·02	1·03	0·72	0·86	0·94	1·09	0·26	0·36	0·13	0·17
„ V. South Western.....	1·35	1·39	0·86	1·08	1·14	1·31	0·26	0·43	0·16	0·21
Rest of Div. VI. W. Mdlnd.	1·28	1·32	0·92	1·05	1·18	1·34	0·22	0·34	0·14	0·18
„ VII. N. Mdlnd.	1·00	1·12	0·82	0·90	0·78	0·94	0·23	0·30	0·13	0·17
„ VIII. N. Wstrn.	1·70	2·09	1·02	1·19	1·14	1·38	0·25	0·29	0·13	0·16
„ IX. York .....	1·22	1·53	0·84	1·11	1·06	1·25	0·23	0·31	0·14	0·17
„ X. Northern	0·92	1·14	0·99	1·20	0·99	1·05	0·25	0·25	0·18	0·17
Div. XI. Wales, &c. ....	1·32	1·41	0·70	0·92	0·80	1·01	0·18	0·32	0·13	0·20
England and Wales .....	1·52	1·72	1·00	1·23	1·18	1·34	0·29	0·41	0·17	0·20

\* The several towns are represented in this table by groups of registration districts: for example, Manchester, by the districts of Manchester, Chorlton, and Salford; Bristol, by those of Bristol and Clifton.



	Annual Mortality per 1,000 Males Aged 45—55.									
	Disease of Lungs.		Heart Disease and Dropsy.		Disease of Brain.		Disease of Kidneys.		Cancer.	
	1851-60.	1861-70.	'51-60.	'61-70.	'51-60.	'61-70.	'51-60.	'61-70.	'51-60.	'61-70.
<i>Large Towns—</i>										
London (division) .....	4'55	4'84	2'45	2'73	2'68	2'90	0'81	1'07	0'61	0'82
Liverpool .....	6'37	8'22	2'62	3'07	2'50	2'50	0'61	0'91	0'44	0'70
Manchester.....	7'37	8'45	2'54	2'40	2'89	3'22	0'62	0'91	0'50	0'58
Birmingham .....	4'60	4'93	2'47	2'58	2'71	2'60	0'86	0'85	0'62	0'51
Leeds .....	5'24	6'22	2'22	3'08	2'17	2'80	0'55	0'92	0'46	0'65
Sheffield .....	5'58	5'72	2'35	2'82	2'09	2'56	0'45	0'64	0'47	0'40
Nottingham .....	2'59	2'44	1'81	2'07	2'03	2'32	0'40	0'63	0'27	0'53
Bristol.....	4'26	3'98	2'18	2'30	2'45	2'88	0'81	1'00	0'61	0'56
Hull.....	3'46	3'33	2'44	2'76	2'47	2'40	0'41	0'70	0'46	0'37
The Potteries .....	7'78	8'51	2'42	2'54	2'56	2'63	0'51	0'52	0'33	0'54
Newcastle-on-Tyne .....	4'05	4'08	3'44	3'92	2'77	2'92	0'53	0'66	0'66	0'89
Leicester .....	3'50	3'99	2'20	3'12	2'46	2'56	0'78	0'53	0'60	0'93
Wolverhampton .....	4'43	4'48	2'84	2'34	2'25	1'62	0'45	0'53	0'30	0'56
<i>Rural Divisions—</i>										
Div. II. South Eastern .....	2'09	2'30	1'85	2'09	2'08	2'21	0'52	0'73	0'38	0'53
„ III. South Midland.....	2'01	2'15	1'62	1'87	1'90	2'31	0'43	0'58	0'51	0'60
„ IV. Eastern .....	1'83	1'97	1'26	1'60	1'54	1'71	0'44	0'54	0'34	0'42
„ V. South Western.....	2'56	2'42	1'57	1'91	1'73	1'99	0'35	0'56	0'40	0'56
Rest of Div. VI. W. Mdlnd.	2'44	2'81	1'94	2'04	1'90	2'30	0'40	0'59	0'35	0'43
„ VII. N. „	1'87	2'13	1'65	1'85	1'50	1'64	0'38	0'50	0'32	0'44
„ VIII. N. Wstrn.	3'77	4'64	1'98	2'31	1'98	2'28	0'35	0'55	0'33	0'42
„ IX. York .....	2'62	3'28	1'70	2'14	1'82	2'18	0'39	0'50	0'40	0'42
„ X. Northern	2'10	2'27	2'10	2'24	1'80	2'02	0'30	0'42	0'39	0'46
Div. XI. Wales, &c. ....	2'43	2'77	1'26	1'63	1'28	1'48	0'28	0'47	0'38	0'48
England and Wales .....	3'09	3'50	1'90	2'19	1'99	2'24	0'47	0'66	0'42	0'54

These last tables are curious, as showing the *unequal fatality* of certain diseases in different places. Lung disease, which was least fatal in the eastern counties, was most so in Liverpool, Manchester, and the Staffordshire Potteries, where the mortality from this cause was almost fourfold.

The *wide diffusion* of the *increase* in mortality from each of the five causes mentioned in these tables is yet more noticeable. Out of 115 cases in the first table (age 35—45) only 11 showed any decrease in the rate of mortality, and 4 a stationary death-rate, the rest indicating increase more or less considerable. The other table, out of a like number, showed 15 instances of decreased mortality, and 1 of a stationary rate.

The cases where the increase in the rate of mortality exceeded 10 per cent. were naturally much fewer than those where there was merely some amount of increase, small or great. It is interesting



to consider what were the places where such marked increase of fatality from the undermentioned classes of disease was observed:—

Disease of lungs, at age 35—45, in London, Liverpool, Manchester, Birmingham, Leeds, Sheffield, Nottingham, the Potteries, Newcastle-on-Tyne, and Leicester; also Rural Divisions VII (North Midland), VIII (North Western), IX (York) and X (Northern).

At age 45—55, in Liverpool, Manchester, Leeds, and Leicester; also in Rural Divisions II (South Eastern), VI (West Midland), VII (North Midland), VIII (North Western), IX (York), and XI (Wales).

Heart disease and dropsy, at age 35—45, in London, Liverpool, Manchester, Birmingham, Leeds, Sheffield, Nottingham, Bristol, the Potteries, Newcastle-on-Tyne, and Leicester; also in every one of the rural divisions.

At age 45—55, in London, Liverpool, Leeds, Sheffield, Nottingham, Hull, Newcastle-on-Tyne, and Leicester; also in all the rural divisions except VI (West Midland), and X (Northern).

Disease of brain, at age 35—45, in Manchester and Sheffield, and in all the rural divisions except X (Northern Counties).

At age 45—55, in Manchester, Leeds, Sheffield, Nottingham, and Bristol, and in all the rural divisions except II (South Western), and VII (North Midland).

We are obliged to conclude, that of these three classes of disease the only one the fatality by which was peculiarly increased in the *manufacturing districts* as distinguished from the rest of the country, was that of diseases of the lungs; the other two classes were much more fatal in the later period, whether in the agricultural divisions or in the more densely peopled divisions to the north and west. Disease of the kidneys and cancer also show a seriously increased rate of fatality, extending to the non-manufacturing divisions.

We find then that the mortality amongst males at ages 35—65 has been increasing, not only in the large towns and manufacturing districts, but also elsewhere; and we observe that this increase has not been largely due to epidemic disease, to consumption, or to diseases of the stomach and liver, but to other causes which have been specified. It remains to be seen whether the increased mortality from the causes in question has been steadily augmenting, or has been subject to much fluctuation.

The following table of annual death-rates amongst males, for England and Wales, will supply an answer to that question:—



Year.	Disease of Lungs.		Heart Disease and Dropsy.		Disease of Brain.		Disease of Kidneys.		Cancer.	
	35—45.	45—55.	35—45.	45—55.	35—45.	45—55.	35—45.	45—55.	35—45.	45—55.
1851 ....	1'50	3'01	0'98	1'80	1'14	1'88	0'21	0'35	0'15	0'35
'52 ....	1'35	2'77	0'97	1'87	1'13	1'90	0'25	0'41	0'17	0'44
'53 ....	1'60	3'34	0'98	1'99	1'20	1'97	0'28	0'47	0'17	0'42
'54 ....	1'42	2'85	1'03	1'93	1'14	1'95	0'29	0'48	0'18	0'43
'55 ....	1'76	3'58	0'97	1'90	1'15	2'03	0'30	0'49	0'21	0'38
1856 ....	1'37	2'73	0'94	1'74	1'15	1'92	0'29	0'50	0'16	0'44
'57 ....	1'47	2'90	0'95	1'82	1'14	2'00	0'31	0'50	0'18	0'40
'58 ....	1'58	3'25	1'06	1'97	1'23	2'08	0'32	0'51	0'18	0'40
'59 ....	1'52	3'20	1'10	1'97	1'20	2'06	0'34	0'53	0'18	0'47
'60 ....	1'75	3'45	1'11	2'10	1'38	2'21	0'34	0'50	0'19	0'50
1861 ....	1'66	3'27	1'10	1'98	1'23	2'07	0'35	0'57	0'19	0'52
'62 ....	1'58	3'30	1'19	2'06	1'23	2'15	0'31	0'58	0'20	0'47
'63 ....	1'59	3'09	1'13	2'03	1'33	2'18	0'37	0'64	0'20	0'51
'64 ....	1'93	3'92	1'27	2'22	1'40	2'28	0'41	0'69	0'19	0'56
'65 ....	1'71	3'59	1'27	2'46	1'41	2'34	0'41	0'65	0'20	0'51
1866 ....	1'70	3'64	1'29	2'22	1'33	2'30	0'46	0'68	0'21	0'52
'67 ....	1'78	3'59	1'25	2'28	1'32	2'29	0'44	0'67	0'21	0'57
'68 ....	1'59	3'18	1'21	2'15	1'33	2'36	0'43	0'70	0'19	0'55
'69 ....	1'82	3'72	1'32	2'32	1'42	2'29	0'44	0'70	0'23	0'58
'70 ....	1'91	3'88	1'34	2'26	1'46	2'31	0'44	0'73	0'24	0'62
1871 ....	1'78	3'83	1'42	2'35	1'42	2'35	0'48	0'74	0'23	0'60
'72 ....	1'74	3'39	1'44	2'42	1'42	2'32	0'50	0'78	0'20	0'67
'73 ....	2'03	3'94	1'52	2'33	1'47	2'39	0'48	0'86	0'22	0'68
'74 ....	2'21	4'45	1'53	2'43	1'46	2'50	0'50	0'81	0'22	0'66
'75 ....	2'52	4'78	1'59	2'61	1'55	2'45	0'52	0'87	0'25	0'70

To get rid of exceptional years, let us compare the *medium* and *minimum* ratios in each period of five years; thus:—

Period.	Disease of Lungs.		Heart Disease and Dropsy.		Disease of Brain.		Disease of Kidneys.		Cancer.	
	35—45.	45—55.	35—45.	45—55.	35—45.	45—55.	35—45.	45—55.	35—45.	45—55.
<i>Medium Ratios—</i>										
1851—55 .....	1'50	3'01	0'98	1'90	1'14	1'95	0'28	0'47	0'17	0'42
'56—60 .....	1'52	3'20	1'06	1'97	1'20	2'06	0'32	0'50	0'18	0'44
'61—65 .....	1'66	3'30	1'19	2'06	1'33	2'18	0'37	0'64	0'20	0'51
'66—70 .....	1'78	3'64	1'29	2'26	1'33	2'30	0'44	0'70	0'21	0'57
'71—75 .....	2'03	3'94	1'52	2'42	1'46	2'39	0'50	0'81	0'22	0'67
Increase per cent. ....	35	31	55	27	28	23	79	72	29	60
<i>Minimum Ratios—</i>										
1851—55 .....	1'35	2'77	0'97	1'80	1'13	1'88	0'21	0'35	0'15	0'35
'56—60 .....	1'37	2'73	0'94	1'74	1'14	1'92	0'29	0'50	0'16	0'40
'61—65 .....	1'58	3'09	1'10	1'98	1'23	2'07	0'31	0'57	0'19	0'47
'66—70 .....	1'59	3'18	1'21	2'15	1'32	2'29	0'43	0'67	0'19	0'52
'71—75 .....	1'74	3'39	1'42	2'33	1'42	2'32	0'48	0'74	0'20	0'60
Increase per cent. ....	29	22	46	29	26	23	129	111	33	71



This table demonstrates, I think, that the increased mortality by each of the five specified causes was no mere accident, but arose from some condition of things which if not altered may admit of further increase in the future, to an extent which we cannot measure.

*Summary.*

1. I find that whilst both sexes, especially females, have experienced a diminished mortality during many years past at ages under 25; there has been an increased death-rate amongst males at the ages from 35 upwards, if not commencing earlier, which has raised male mortality at those ages, not only far above the standard of 1856-60, but even higher than the unfavourable rates which prevailed in 1846-50. A similar tendency to increase is observable in female death-rates at ages 45 upwards, but it is much less powerful than that affecting male rates.

2. It appears that in consequence of these changes the probability of attaining a high age has diminished in the case of males, but has increased in the case of females, so that the tendency towards an excess of female population arising is stronger than it was. A National Life Table based on recent data, would consequently deviate considerably from Dr. Farr's English Life Table, No. 3.

3. The changes in question seem to have progressed step by step without much interruption, at all events since 1856-60.

4. The particular diseases to which the increased numbers of male deaths at ages 35—65 were attributed in the Registrar General's Tables, appear to have been mainly lung disease (bronchitis, pneumonia, &c.), heart disease, dropsy, brain disease, disease of the kidneys, and cancer. The ordinary fatality resulting from these diseases in medium or favourable years is shown to have risen considerably.



## DISCUSSION on MR. WELTON'S PAPER.

The CHAIRMAN (Sir Rawson W. Rawson), after alluding to the importance of the paper, said that there could be little or no doubt as to the facts contained in it. With regard to the calculations and deductions Mr. Welton had drawn from them, there were some gentlemen present who would be able to speak with greater knowledge than he (the Chairman) was able to do. Having had the paper in his hands the previous day, it appeared to him so important that he took the trouble to look into it for the purpose of bringing before the meeting a few features which Mr. Welton had not drawn out, and which he would suggest should be drawn out before the paper was published in the *Journal*. He would suggest that the author should give the proportions in several cases. In the first table he showed that the death-rates amongst males and females from the ages of 5 to 25 had been gradually increasing from the quinquennium of 1846-50 to that of 1871-75; but the mere figures did not show the proportions. The author stated casually they were about 25 per cent., and so it was; but it would be very important to draw these out exactly, and so with regard to many of the others. There was one point in the paper which was very tantalising to him. Mr. Welton said, "I have arrived at the conclusions (1st) that the census returns as to ages require to be amended; (2nd) that the approximate proportions of births which annually escape registration are discoverable, and (3rd) that the net results of migrations into and from the country may also be measured." It would have been a great boon if the author had given the information which enabled him to state positively those three conclusions. He would also suggest to Mr. Welton if he would, at the end of his paper, summarise the chief facts and deductions, which, being spread between the different tables, would have to be sought out, and require a care which many persons actively engaged would not be able to give. In the first table, the chief facts with regard to the mean death-rates per 1,000 living seemed to be these. Between the two dates which he took as his extremes, 1846-50 and 1871-75, there had been a uniform increased vitality amongst males and females, and he observed that it had only been checked in one quinquennium, and that only amongst the males, namely, in 1861-65. There was a moderate check in this period, curiously enough, occurring amongst the males, but not occurring amongst the females. That was the first fact—that the vitality of young people seemed, during the thirty years from 1846 to 1875, to have increased about one-fourth. Amongst males of the age of from 5 to 10 there were exactly 25 per cent.; between 10 and 15, 25·9; between 15 and 25, 19·7. Then amongst the females, in the first period it was 29 per cent., being 4 per cent. more than amongst the males; in the second period it was 29·8, and in the third period



24·7. No mention was made, however, of children under the age of 5. Although it might not accord with the facts which Mr. Welton had brought out in this table, it would be desirable to note in connection with them what the change was with regard to the younger ones. As far as he could make out, there had been an increased mortality; but as the information was not shown in the same form, he had not been able exactly to draw that out. Then came the really important fact in the paper, that the vitality of the men of middle age—the staple of our population—was on the decrease, the cause of which ought to be looked into. The second table showed this very interesting, but very sad statement, that between the ages of 35 and 75 for the first three quinquenniums, there was a gradual improvement. Then there came a change, and each succeeding quinquennium up to the present time showed a falling off to the prejudice of the population. Mr. Welton had brought forward four periods in regard to age: from 35 to 45, 45 to 55, 55 to 65, and 65 to 75. Between the first quinquennium and the third there was a diminution of mortality for those several ages respectively in favour of our population of 7 per cent., 12 per cent., 10 per cent., and 4 per cent. Then the tide turned, and there was a corresponding increase of mortality up to the quinquennium ending in 1875 of 15 per cent., 17 per cent., 16 per cent., and 5 per cent., all to the bad; and comparing the first with the last quinquennium, there was a disadvantage represented by nearly 7 per cent., nearly 4 per cent., 4 per cent., and 1 per cent. Those were the ratios of increased mortality between the years 1846-50 and the quinquennium 1871-75. In that way he should like the several tables to be examined, because the mind could then grasp the changes that had occurred. (Mr. Welton said it would be very easy to do so, but he was anxious not to overload the paper.) The Chairman said the next point of interest which occurred to him was the difference brought out between Dr. Farr's table and the experiences of 1856-60 and 1871-75. He was not competent to judge of Mr. Welton's method; but supposing that Dr. Farr's table was recognised as accurate, and that Mr. Welton had adopted the same method, there would be the following interesting results. It was clear, from the figures as they stood, that Dr. Farr's table corresponded very closely with the experiences of 1856-60, but that, as regards females, it differed materially from those of the later period. Taking the whole of the males and females at the different periods of life, which was the only way of obtaining an average, adding them up and comparing them, he found the following results:—that in 1856-60 the value of male life at all ages by the tables, as compared with Dr. Farr's tables, was  $2\frac{1}{2}$  (2·6) per cent. in excess of Dr. Farr; while among females it was just 3 per cent.; but in 1871-75 it had fallen among males to 2 per cent. below Dr. Farr's table, while among females the excess had increased to 5·4 per cent. These changes, however, varied very much at different times of life. Up to the age of 35 the variations amongst the males from Dr. Farr's tables were +1·45 and +3·1 per cent. at the two periods selected by Mr. Welton. Then from 35 to 55 the differences were +3·13 and +2·37; but



from 55 to 80 there was an increase of 6.1 in the first quinquennium, and a decrease of 2.3 in the second, showing that the advantage which the males had in that period from 55 to 80 over Dr. Farr's tables of 6 per cent., had utterly disappeared, and had become a decrease of 2.3 per cent. With regard to the females, it stood thus: up to 35 they had the advantage in the first period (1856-60) of 1.34; in 1871-75, 3.95, being an increase of threefold in the latter. In the second period of life, 35 to 55, it was 3.31 in 1856-60; and 6.83 in 1871-75, being an increase of double in the latter. Beyond the age of 55 in the first period it was 8.1; and in the second period 8.31; which changes, he thought, afforded sufficient evidence that it became very necessary from time to time to examine life tables, and adapt them to circumstances. Always providing that the methods adopted by Mr. Welton in his paper were reliable, there was nothing to find fault with in his deductions from the facts on which his calculations are founded. One other point he desired to refer to, was the very remarkable change in the prospect in the life of women during the period of child-bearing. It would be seen that between the ages of 15 and 35 during the first quinquennium of 1841-45, there was an excess in the death-rate of females above that of males amounting to 270 in 4,000. In the next quinquennium it had decreased to 241; in the next to 200; in the next to 170; in the next to 71. In the sixth quinquennium the mortality was 73 less amongst the females than amongst the males; and in the last, viz., between 1871-75, the mortality was 218 less; so that whereas forty years ago the mortality amongst females at the age of child-bearing was 270 more in 4,000, or nearly 7 per cent., in 1871-75 it was 218, or nearly  $5\frac{1}{2}$  per cent. less, a change amounting to 12 per cent. Such a fact, if on examination it should prove to be accurate, led to the inference that there had been some very great change for the better in the treatment of women during that critical period. True (as Mr. Welton here interposed) the difference may have been caused in a considerable measure by an increase in the mortality of males. The males were dying in so much greater proportion than formerly that it affected the ratio of male and female; but he had little doubt that improved methods of treatment had beneficially affected the value of female life at this stage of it. He had made a calculation in reference to the last table. Mr. Welton considered that diseases of the lungs, brain, kidneys, heart, and cancer were the five that had most increased among males at the ages from 35 to 55 during the period named. He (the Chairman) made out that such increased mortality, as shown by Mr. Welton, caused by disease of the lungs during that period was 10 per cent.; by heart disease and dropsy  $7\frac{1}{2}$  per cent.; by disease of the brain nearly 7 per cent.; by disease of the kidneys  $6\frac{1}{2}$ , and by cancer  $16\frac{1}{2}$  per cent. He hoped some of those present would be able to give reasons for the peculiar increase of these diseases, and also for the increase of mortality amongst males at this period of life. Coming from abroad, he might be ignorant of the real state of things; but it appeared to him that it might be accounted for in some measure in



this way. There had been an improvement in the earlier stages of life, from 5 to 25, but there had been a marvellous increase of mortality amongst males between the ages of 35 and 75. It occurred to him that the improved vitality which seemed to occur at earlier stages might be accounted for, first, by the introduction of improved sanitary measures, of schooling, and of legislation regulating the employment of young people, all tending to the improvement of their condition; and, secondly, by the improvement in the rates of wages, which had benefited the families, the wives, and the children, more than the adult males themselves. There had also, in later years, been an increase in the wages earned by the children themselves, which enabled them to live better than formerly. But with the increase of wages beginning at the period of 1861-65, there had been an increased activity—perhaps excessive exertion—on the part of the labouring population, also excessive living, which had led to dissipation and weakened physical powers, which was now telling upon them at an advanced period of life. It struck him that this might be a partial explanation of one cause of this very remarkable change. Whether or not that was a possible cause, Mr. Welton's facts could not be put forward in too powerful a light.

Mr. A. H. BAILEY (President of the Institute of Actuaries) said that while appreciating highly the pains and research Mr. Welton had bestowed on the subject, he was quite unable to accept the conclusions at which he had arrived, as he did not think the data employed were available for the solution of the questions the author had been investigating. In order to determine rates of mortality, two things were necessary: first, accurate information of the number of deaths in any country or district in a year or any definite period of time; and secondly, the number of living population at the periods in which those deaths had arisen. He did not think it could be doubted that in this country the deaths were accurately registered, and that the censuses taken at intervals of ten years gave as accurate enumerations of the living as could be attained in any similar large operation. By observing the increase in the rates of population, there could be determined within a reasonable margin of error the numbers living in intervening years. By these data the annual mortality of the country as a whole could be obtained with considerable accuracy. Some time ago, in making some investigations for another purpose, he wished to know, amongst other things, what had been the changes in the English rate of mortality. Discarding the first two or three years of registration, he thought it advisable to divide the subsequent period into intervals of ten years: 1840-50, 1850-60, 1860-70, and the result was that there had been no change whatever in each of those ten years in the general mortality of England. Since 1870 he was aware there had been some improvement, but they had not got to the end of another ten years. This result was in accordance with a multitude of other observations that had been made, and went to show that it was a mistake to suppose that there had been any material change in the rate of mortality in this country, a notion



which arose from some inaccurate observations made last century in the number of deaths alone. For Mr. Welton's purpose it was not only necessary to know the whole number of deaths, but also the number of deaths at particular ages. Whilst he (Mr. Bailey) willingly admitted that the number of deaths was accurately registered, he could state, from the certificates passing through his hands, that the ages at death were very far from being accurate. It was even more difficult to ascertain the ages of the living population in the intervals between the censuses. Emigration was a disturbing element; there were far more male than female emigrants, and far more amongst the younger than the elder portion of the population. Emigration did not follow any law, and therefore taking any such estimates as these to ascertain the rate of mortality at particular ages would produce results which would, he believed, be altogether at variance with the facts. He should say, therefore, that those rates of mortality Mr. Welton had brought out were not to be depended upon at all. It would stagger those who had experience of insurance societies to be told that in 1846-50 the death-rate among females between the ages of 15 and 25 was 8.9 per 1,000, and that in 1871-75 it was 6.7. This was at variance with other observations, and this sort of result ran through the whole of Mr. Welton's calculations. Therefore, although he had listened to the deductions of the chairman, he doubted the premises. Of course there were variations in the rate of mortality in particular years, but he thought the changes were small when a long period of time was taken into account. As to the very interesting part of the paper referring to diseases, there were others who could more competently deal with it than himself. There were, no doubt, particular diseases that had altogether disappeared. They never heard of the plague now, and the ravages of small pox were less than they were two generations ago; but other diseases seem to have taken their place. (The Chairman having pointed out that according to Mr. Welton the zymotic diseases had decreased 23 per cent.) Mr. Bailey said it would be interesting to know whether other diseases, such as diseases of particular organs, had increased.

The Rev. I. DOXSEY said he was sorry that he had not known the subject of the paper, because he would have brought with him some calculations he had made from the registrar-general's reports on this very question; but the general conclusions at which he arrived were to some extent in harmony with those at which Mr. Welton had arrived. There had been an obvious improvement in the death-rate from 5 years of age to 45 among females, but only to 25 among males, above which it had increased in every decennium. He thought there were certain facts in regard to our manufacturing life that were perhaps unfavourable to the prolonged life of children. It was well known that when women worked in factories, infant children did not get the attention they required, and it was a remarkable fact, that while an increase of about 5 per 1,000 had taken place in children under 5 years of age, there was no perceptible difference between the male and female children in regard to increase. These facts might tend to show that the weaker



children were cut off in the earlier periods of life; and in harmony with the law that had been called "the survival of the fittest," the children that had escaped the discipline of early life might be those born stronger, and therefore that might in some measure account for the improvement of the death-rate at the ages to which the Chairman and Mr. Welton had referred. From a valuable paper by a medical gentleman, to whom the Howard Medal had been awarded, he (Mr. Doxsey) had come to the conclusion that there had been a similar increase in the death-rates in hospitals in the later periods, as compared with the earlier ones, and the death-rate had increased more among the males than among the females. This was in perfect harmony with the law laid down in the paper. He thought there could be no doubt that as there had been only a slight increase in the death-rate among females between 45 and 65, but in the male death-rate at all ages above 25, that therefore there must be some cause or causes operating among males which did not affect females. The search for these causes seemed to be the object of all statistical inquiry on the subject; but what those causes were he did not pretend to say. He did not think it arose only from the increase of drinking, which in later years had taken place more among females than males, and yet the death-rate among males had increased faster than the death-rate among females. He did not believe that the working classes worked harder now than they did forty years ago. Perhaps they drank harder, and that might partly account for the increased death-rate. Another cause might be the vast increase in the use of tobacco among boys. He should be thankful to know the relative proportions of male and female deaths from those diseases that had so much increased, and which would account for the greater ratio of increase of the death-rate among males than females. He believed that in the registrar-general's report, to which he had referred, they were all put together. If the registrar-general's report were compared with the essay on the increase of the death-rate in hospitals, there could be no doubt of the general principle laid down in the paper, that the death-rate was increasing to some extent, and that the increase was principally among the male population from 25 years of age to the later periods of life. The only other increase was amongst children under 5 years of age, and that was equal in both sexes.

Mr. CORNELIUS WALFORD said he had hoped that the scope of the discussion would have taken the turn of seeing how far the results given in the paper harmonised with any facts which could be brought to bear by way of solution of them. It seemed to him the broad fact stated in the paper was that the death-rate up to the age of 25 had lessened on the whole, and that beyond those ages it had much increased, more particularly amongst males. If so, there must be some reasons for it, but he had heard none stated in the course of the discussion. He thought that the increased mortality under 5 years of age was generally believed to result from more complete registration at those young ages. His own belief, however, was that the actual deaths under 5 years of age had been less rather than more of late years, and that this resulted from



improved medical science, which kept children alive until they arrived at the age of puberty, when they died. While, therefore, it changed the figures, it did not do any permanent good to mankind. Another circumstance which very much affected the ages in the direction indicated by Mr. Welton, was the emigration of young, active, strong men at the ages of from 15 to 25. This would seem to him to leave a weakened population at ages beyond, and that weakened population would show a larger mortality than if the more vital portion of the population had remained, but this was no new feature. The present generation had not been distinct from the preceding generation in that respect, and therefore although it had some weight, it by no means accounted for the peculiarity mentioned in the paper. One had also to look how far the habits of the people or the customs of trade had affected the vitality. He thought that the drinking customs of the country had a great deal to do with it. These customs had resulted from the increase of wages that had taken place in the present generation, and the death results from drinking habits were coincident with the period Mr. Welton had alluded to. Assuming the drinking theory to be true, he thought it applied much more to the males than the females. Another circumstance to be taken into account was the adulteration of food which had been carried on to a much larger extent before the Adulteration Acts were passed. That, however, would apply as much to the females as the males, because although females did not drink so much as the males, they probably ate a little more. That case of adulteration would not meet Mr. Welton's theory at all. He confessed that, after a consideration of all the points, there was nothing in itself, singly or in combination, which could account for this state of things, and he had come to the conclusion that there was something or other Mr. Welton had failed to discover which would go to show that his facts were reliable, unless indeed the drinking theory was held sufficient to account for it all.

Mr. N. A. HUMPHRIES, after alluding to the value of the paper, said that during the past thirty-eight years there had been a continual increase in the mortality of males at all ages. In equal numbers living, the relative mortality of males from 1841-50 was 107 to each 100 deaths of females; in the next ten years it was 108; in the next ten years it was 111; and in the last seven years of the current decade it had increased to 113 to 100. With regard to the particular ages at which the increase had occurred, he thought Mr. Welton had brought a great many facts together which might probably be made very great use of. The second speaker had expressed a decided opinion that there was no change in the general death-rate; it was a fact that the mortality remained nearly stationary during the three decades 1841 to 1850, 1851 to 1860, and from 1861 to 1870; but taking into account the vast increase of aggregation in towns, the fact that mortality was stationary was in itself evidence of good sanitary work. There must have been some counteracting influence at work which kept it stationary. Looking at the present decade, of which only nine years had



passed, a vast improvement was observable. In 1872-75 the Public Health Acts were passed, and a new era of sanitation was thereby introduced into England. The registrar-general in his last quarterly report, pointed out that 150,000 persons had survived during the last nine years who would have died if the mortality had been the same as it was during the preceding thirty years. The excessive increase of mortality amongst males was very striking. The diseases which caused this increase appear to be the very diseases which are often induced by intemperate habits. He personally thanked Mr. Welton for the trouble he had taken with his paper, which was one of the most useful of its kind that the Society had ever had before it. (The Chairman having asked Mr. Humphries whether, from his experience in the registrar-general's office, he saw any ground of fallacy in the principal point brought out in the paper, that there was increased mortality amongst males and not amongst females between the ages of 35 and 65), Mr. Humphries said that the fact was beyond all dispute.

Mr. PHILIP VANDERBYL expressed his regret that the author did not conclude his paper with a summary statement of the results proved by the numerous tables. In the table enumerating the causes of increased mortality amongst males from 35—65 the author did not show how the diseases named had affected females, or the different percentages of increased mortality from certain diseases. He believed that the increased use of machinery and the more dangerous occupations of men would partly account for the increased mortality amongst males. With regard to the improved death-rate among females, he thought that was to be accounted for, not only by the improved medical skill, but more especially by the use of chloroform. As to the causes of death amongst females, it was an extraordinary fact, that on account of the male infant's head being on an average only half an inch larger in circumference than that of a female, if all the births in Great Britain during one year were females, 5,000 lives of mothers would be saved in that time. This was calculated by the late Sir James Simpson, of Edinburgh, who first used chloroform as an anæsthetic. It had been often said that we could prove anything by statistics, but he did not consider that the Society was established for such a purpose, and certainly the author of the paper did not exhibit any tendency to prove any pre-conceived ideas.

Mr. H. MONCREIFF PAUL said that the author, in his paper, had stated that "On the whole, then, the tables show that the striking abatement in mortality at ages from 5 to 25 has been attended with an aggravation of the loss by death at higher ages, putting aside epidemic years, and that such aggravation has been far more considerable amongst males than amongst females. Every circumstance which will help us to measure the extent and to understand the causes of this deterioration in the vitality of males demands our attention." Although the author had said "every circumstance," he (Mr. Paul) did not see in the paper any single instance given except the reference in the tables to certain diseases. On looking



to these tables, it would be seen at once that these were brain and heart diseases, from which deaths at the "higher ages" of males had, in the later periods under comparison sensibly increased. He referred more particularly to the last table. It would be seen also that these diseases were due to certain causes. Allusion had been made by a previous speaker to the shortening of working hours, but attention had not been drawn to the compression of work. There was too much of that in the present day, and the consequent strain really affected the vital powers, as did also the excitement arising out of constant railway travelling and the using the telegraph system, with all their concomitant evils. If these questions were looked at more carefully, results would be found quite in keeping with the deductions drawn by the author.

Mr. BOURNE thought that more importance ought to be attached to Mr. Welton's statistics with regard to specific ages, than probably Mr. Bailey would seem to accord them. There was no doubt whatever that sanitary measures and medical skill had done much to preserve younger as well as older life; but as far as middle age was concerned, it was quite true that the mode of life in the present day had very much to do with increased mortality at the period when life ought to be the strongest and most vigorous, and that it operated much more unfavourably upon males than upon females. No doubt drinking was a very important element in the matter. As a temperance reformer, however, it was a source of great gratification to him that there was a very great diminution in the consumption of alcohol among the mass of the population, as evidenced by the failure of the revenue. He would ask Mr. Welton if it had ever occurred to him to compare the deaths which took place with the marriage rates. The age at which men married had been very much extended, whereas females were now married rather earlier than formerly. This, he thought, arose very much out of habits and practices which tended most materially to affect the health of the males. In support of this proposition, he cited the opinions expressed by Mr. Ansell, the well-known actuary, in a book published by him some years ago on the statistics of families in the higher and professional classes. He (Mr. Bourne) had taken three periods of three years each. In the first of those periods the number of marriages among the population was 1 in 123; in the second, 1 in 121; and in the third 1 in 117; showing that the number of marriages in proportion to the population was increasing. Mr. Bourne then adduced some figures to show that while the age of matrimony was deferred in the males, it was not in the females, and that seemed to point to habits of life which would deteriorate the vital power of young men, and to account for the increased number of deaths amongst them more than amongst females. The increase of wages was also another cause; but he took it that it was more favourable to females than to males. It was true that the males were subjected to a strain of increased hurry and increased strain upon their health, arising partly from labour, but he believed in a far greater degree to the pursuit of pleasure and a deterioration in their habits and practices. With regard to females, the



effect of easier circumstances had been to lessen the amount of labour they had to perform, and to put them in more comfortable homes, surrounded by more comfortable circumstances; therefore it might be expected that female life would be prolonged, and the death-rate improved with regard to them to a greater extent than males. So far the inference to be drawn from that would bear out the conclusions demonstrated by Mr. Welton's figures. He (Mr. Bourne) believed in the fitness of our organisation and the exercise of our powers in obedience to natural laws; therefore that the true happiness and welfare of any community very much depended upon the fulfilling of the divine command: "Increase and multiply and replenish the earth."

Dr. C. E. SAUNDERS said he concurred entirely with the remarks of Mr. Bourne. He pointed out that it was acknowledged in our lunatic asylums that many cases of general paralysis of the insane, and of degenerative diseases of the nervous centres, were due to sexual excesses.

The CHAIRMAN then laid before the meeting, in connection with the remarks of the last speaker, a statement as to the rate of increase in the different kinds of diseases, for the purpose of guiding any further discussion that might take place on the paper. He stated that, according to the table at the commencement of the third section of Mr. Welton's paper, the increase in the annual death-rates among males between the ages of 35 and 65 in the year 1875, as compared with the average of 1851-60 (the value of the comparison being diminished by the contrast of a single year with an average of five years) was as follows: from diseases of the kidneys, 86 per cent.; cancer, 69 per cent.; lung diseases, 37; heart disease and dropsy, 36.5; brain diseases, 31; diseases of the stomach and liver, 8; phthisis, only 3.5 per cent.; while from scrofulous diseases there was a decrease of 41 per cent., and from zymotic diseases a decrease of 23 per cent. The average increase from all causes was 22 per cent.

Mr. LAWSON thought that the remarks as to the increase of diseases ought to be received with a certain amount of caution, because in the periods to which the paper referred there had been a considerable alteration in the nomenclature of diseases, and also a great improvement in the means of distinguishing them. Several speakers had remarked that the diseases amongst men had increased as compared with women, but the reports of the registrar-general show that among male children under 1 year of age, there was a decidedly greater mortality from all the ordinary children's diseases, except whooping cough, than amongst females. In the service to which he belongs there was a benefit society. In connection with it an inquiry was made some years ago, and it was found that the mortality amongst the single men was about twice as great as it was amongst those who were married. This fact was borne out by an examination made by the registrar-general for Scotland about twelve years ago. As to the causes of the higher mortality among



unmarried men, no doubt they lived more freely in every way, and that told upon their health. Greater indulgence, consequent on the increased wages of late years, produced a gouty disposition, to which much of the increased mortality from bronchitis seems attributable.

Mr. ROWLAND HAMILTON pointed out that a large proportion of the males of marrying age who were in feeble health, remained unmarried, while the whole death-rate, so to speak, of these was added to the class of bachelors, which would very materially alter the conclusion come to by a previous speaker.

Mr. WELTON, in reply, thanked the Chairman for the analysis he had made of the paper. In regard to Mr. Bailey's observations, he said that no one could impeach the accuracy of his (Mr. Welton's) figures without impeaching the registrar-general's reports, from which they had been taken. Speaking of the causes of disease, he thought that drink was one of the most potent in bringing about a state of things conducive to bronchitis. Hard work and excitement at the present time no doubt told upon many men, more particularly the middle class. The table showed that the increase in the number of deaths by accident was a mere fraction to that occasioned by disease. He believed that in substance the registrar-general's tables were correct. In answer to the supposition of the Chairman, that the methods adopted by him (Mr. Welton) were similar to those of Dr. Farr, he might say that he had followed a process which was perhaps more simple than that adopted by Dr. Farr, in framing his life table, but whatever method was employed, he believed the results arrived at could not vary much from those shown in the paper.







