Part First.

ORIGINAL COMMUNICATIONS.

ARTICLE I.—*Influence of Marriage on the Death-Rates of Men and Women in Scotland.* By JAMES STARK, M.D., F.R.S.E.

(Read before the Royal Society of Edinburgh, 17th Dec. 1866.)

A NINE years' average of the deaths in Scotland shows that at all ages, excepting from ten to fifteen years, males die in a higher ratio than females. Table I. shows this fact; and when the male and female death-rates at each quinquennial period of life are compared, it is seen that even the additional dangers to which females are liable during the child-bearing period do not cause their death-rate to rise so high as that of the males who are exempt from all such risks.

A more important inquiry, however, and one which does not seem to have been hitherto investigated, in consequence of the difficulty of procuring facts which could be depended on, is, What is the effect of marriage on male and female life? Is its influence, in so far as the death-rate is concerned, for good or for evil? Is its influence limited to the female; or has it also a marked influence on the duration of life in the male?

TABLE I.—*Mean Annual Percentage of Deaths to the Population at different Ages in Scotland during the Nine Years, 1855-63.*

AGES.	Percentage of Deaths to Population.		AGES.	Percentage of Deaths to Population.	
	Males.	Females.		Males.	Females.
0-5	6.238	5.686	50-60	2.099	1.771
5-10	0.924	0.892	60-70	3.933	3.308
10-15	0.501	0.513	70-80	9.410	8.266
15-20	0.731	0.662	80-90	20.011	18.075
20-30	1.006	0.817	90-100	37.700	36.325
30-40	1.077	1.021	100 and above,	39.652	41.979
40-50	1.388	1.186			
			Total, all Ages,	2.216	2.023

So far as known to me, no attempt has been made by any statist to trace the effect of marriage on the sexes. Even Quetelet, in his masterly treatise on Man, has not hinted that marriage exerts any influence on human mortality. In a paper which I published in 1847, "On the Sanitary State of Edinburgh," it was stated as one of the results of the inquiry into the mortality of the married and unmarried in that town, that the mean age at death of the married was ascertained to be 57·54 years, while that of the unmarried from the 22d year of age to the close of life was 42·18 years. The result seemed so extraordinary that I was led to doubt the accuracy of the returns of the ages; but to the present day I have had no opportunity of following out the inquiry, and it does not seem to have been taken up by any other. It is true that a few managers of insurance companies have in their reports alluded to the mortality of the married and unmarried who were insured in their offices; but these partial facts could give no information as to the influence of marriage on mortality in the general population.

In an inquiry like the present, everything depends on the correctness of the registers on which the statistical tables are founded. The tables for the males were prepared from the Registers of Death in Scotland for the year 1863; those for the females from the same Registers for the years 1861 and 1862; and as almost no death escapes registration in Scotland, and the Scottish people are very particular in entering on the death registers the age and condition of their deceased relatives, every confidence may be placed on the tables prepared from these registers. The numbers also are sufficiently large to yield truthful results, being for the whole of Scotland.

I. Death-Rates of Married and Unmarried Men.

Table II. shows the total male deaths above 20 years, in Scotland, for the year 1863, distinguishing the married from the unmarried; and grouping the ages into quinquennial periods for the sake of easy reference and accurate comparison.

This table is a very remarkable one, and the results brought out by it quite startling, so great is the difference between the mortality of the married and the unmarried. By that table it appears that at every age from 20 to 85 the death-rate of the married men is very much smaller than that of the unmarried. After the 85th year of life the numbers are too small to afford the means of accurate comparison, and the observations would require to be carried over a great number of years before any definite conclusions could be arrived at with regard to the influence of marriage at these extreme ages.

By that table it appears that, from 20 to 25 years of age, out of every 100,000 unmarried men 1174 died during the year; but out

of a like number of married men only 597 died, or just half the number. In other words, between the age of 20 and 25 years, the death-rate of the bachelors was exactly double that of the married men.

As the age increases, the difference between the death-rates of the married and unmarried decreases; but it decreases slowly and regularly, showing a marked difference in favour of the married men at every quinquennial period of life. Thus, at the age of 25 to 30 years, when the number of married and unmarried men in Scotland is pretty nearly equal, of every 100,000 bachelors 1369 died during the year; but, in an equal number of married men, only 865 died. At that period of life, also, the death-rate of the bachelors very greatly exceeded that of the married men.

Between the ages of 30 and 35 years, while in every 100,000 bachelors 1475 died; only 907 died out of an equal number of married men. Between the ages of 40 and 45, while 1689 died out of every 100,000 bachelors, only 1248 died out of an equal number of married men. At the ages 60 to 65 years, while 4330 died during the year out of every 100,000 bachelors, only 3385 died out of a like number of married men. Even at the age of 70 to 75 years, while 10,143 died out of every 100,000 bachelors, only 8055 died out of a like number of married men. And at the

TABLE II.—MARRIED AND UNMARRIED MEN at each Quinquennial Age in SCOTLAND in 1863; the Deaths at the same Ages; and the Proportion of Deaths to the Living at each Age.

AGES.	HUSBANDS AND WIDOWERS.			BACHELORS.		
	Number Living.	Deaths.	Percentage of Deaths.	Number Living.	Deaths.	Percentage of Deaths.
20-25 .	22,946	137	0.597	106,587	1,251	1.174
25-30 .	54,221	469	0.865	48,618	666	1.369
30-35 .	66,153	600	0.907	25,962	383	1.475
35-40 .	63,858	690	1.080	15,857	253	1.595
40-45 .	62,645	782	1.248	12,311	208	1.689
45-50 .	54,505	869	1.594	8,824	179	2.028
50-55 .	49,591	880	1.774	7,636	205	2.684
55-60 .	38,006	929	2.444	5,550	142	2.558
60-65 .	35,920	1,216	3.385	5,242	227	4.330
65-70 .	22,021	1,134	5.149	2,848	156	5.477
70-75 .	16,029	1,291	8.055	2,021	205	10.143
75-80 .	9,716	1,135	11.681	1,081	157	14.542
80-85 .	5,477	953	17.400	513	101	19.688
85-90 .	1,708	488	28.571	151	32	21.192
90-95 .	449	137	30.512	50	21	42.000
95-100 .	103	40	38.835	6	3	50.000
100 and above	28	15	53.571	3	—	—
Not stated	—	4	—	—	5	—
All Ages	503,376	11,769	2.338	243,259	4,194	1.723

extreme age of 80 to 85, while 19,688 died during the year out of every 100,000 bachelors, only 17,400 died out of a like number of married men.

Here then, we have the remarkable fact for the first time proved by trustworthy statistics, applicable to the whole population, that the influence of marriage on the mortality of the male is of the most potent kind; that, in fact, the bachelor life is much more destructive to the male sex than the most unwholesome of trades, or than a residence in a crowded locality where there is not the most distant attempt at sanitary arrangements of any kind.

This conclusion is fully borne out by looking at the table from a different point of view, viz., by calculating the mean age at death of the married and of the unmarried men. If we take the whole married and the whole unmarried, whose deaths are noted in the above table, viz., from 20 years of age to the close of life, we find that the mean age at death of the married men was $59\frac{1}{2}$ years; whereas the mean age at death of the bachelors was only 40 years. Reckoning from the 20th year of life, therefore, married men have a chance of living $19\frac{1}{2}$ years longer than those who live unmarried.

In the general population, however, the number of bachelors and of married men is nearly equal at the 24th year of life. It will afford, then, a more unexceptional average, if we strike from the table all persons under 25 years of age, and only calculate the mean age at death from the 25th year to the close of life. When this is done, it is found that the mean age at death of the married men is $60\frac{2}{5}$ years, that of the unmarried only $47\frac{7}{10}$ years—thus showing $12\frac{1}{2}$ years of life in favour of married men.

This remarkable fact seems clearly to prove, that the married state is the condition of life best fitted for mankind; and that the prolongation of life which attends that state, is a special provision of nature to protect the father of a family in order that he may provide for his offspring, and superintend their rearing. It is quite true, however, that this special prolongation of life is based on fixed laws of nature. For the married man is in general not only more healthy, vigorous, and free from disease than the unmarried, but he is also more regular in his habits, is better housed, better fed, and better attended to. Indeed, the married men may be accounted, in one sense, as selected lives; for the weak, the delicate, those suffering from disease of any kind, the dissipated, the licentious, do not marry, so that all such are found among the unmarried. And as all such die at a much higher rate than the robust and temperate, we have what we may term a natural explanation of the great difference in the death-rates of the married and unmarried men.

This, however, would only account for the difference in the death-rates of the married and unmarried to a very small extent, and that, too, during the earlier years of life,—say from 20 to 40 years; but it quite fails to explain the difference in the death-rates at the higher ages. Thus, all the men between 20 and 30 years

who remain unmarried from natural infirmity, or from possessing sickly or diseased constitutions, or from being addicted to intemperate or licentious habits, die before they have attained their 40th year. Scarcely one such survives the critical climacteric age of seven times seven. All men, therefore, who have survived their 40th year, certainly all above 50 years, must be considered, for all practical purposes, as selected lives; and if a difference should be found in the death-rates of the married and unmarried after that age, it can alone be referred to causes connected with the married state. But Table II. proves that at every separate quinquennial age, from 40 years up to extreme old age, married men died in a much smaller ratio than the unmarried. This lower death-rate in the married men can, therefore, be alone attributed to the influence of marriage, and to the habits which attend marriage in this country; and it would be a most interesting subject for inquiry in countries where married habits are different, to ascertain to what extent these different habits caused the death-rates of the married and unmarried to differ from those of the Scottish people.

This new fact in vital statistics seems to throw light on other subjects. For instance, it has been found impossible to reduce the mortality of the soldier, even when in barracks, and not on active service, to the mortality of the male sex in civil life, except by invaliding and paying off all the men likely to die. The above facts account for this. Sanitarians, in their ignorance of the powerful influence of marriage on the male mortality, were comparing the death-rates of the unmarried soldier with that of both married and unmarried men in civil life. Whereas, the mortality of the soldier ought to have been compared with the death-rates of bachelors alone, and not with the bachelors of the whole population, but with those living in towns, who, we know, die at a much higher rate than those living in the country. If, on the other hand, we consider the soldiers to consist of selected lives, which in reality they are, then their mortality should be compared with that of married men, when it would prove their death-rate to be twice greater than at present we imagine it to be.

Let us return to our Table II. We have seen that at each quinquennial period of life the death-rates of the married men were greatly below those of the unmarried. One would, therefore, naturally expect that a comparison of the death-rates at all ages would show the same conclusion. The very reverse, however, is the case. The summary of that table contradicts, and is opposed to the results of every quinquennial period; and were we to trust to that summary, it would lead us to the manifestly false conclusion, that married men die in much higher proportions than bachelors. Thus the summary shows that bachelors at all ages only died at the rate of 1723 annually in every 100,000 bachelors; whereas married men died at the rate of 2338 annually in every 100,000 married men.

Every one can see that this is a paradoxical and false conclusion. Because, if, at every several year of life, bachelors died in higher proportions than the married men, it must be the same for the whole of life. How, then, it may be asked is this paradoxical result produced?

This is at once explained by looking at the respective numbers dying at each age. Very nearly a half of all the bachelors who died had not attained their thirtieth year of life. At that age the mortality, as compared with the population, is very small; so that when the deaths at all ages are compared with the total number of bachelors, the deaths at the earlier ages bulk so largely that they cause the general mortality of the bachelors to appear to be very little higher than it was at the age 25 to 30 years. All this is reversed for the married men. Instead of the greatest mortality among them being at ages under 30 years, by far the largest number of deaths occurs between 60 and 80 years, at which period of life the mortality, as compared with the number living, is very high. The consequence of this is, that when the total deaths are compared with the living, the death-rate seems to be much higher than it was with the bachelors.

Summarizing the columns, therefore, and comparing the total deaths of the bachelors with the total deaths of the married men, necessarily leads to a false conclusion. The comparison is only correct when limited to the mortality at each quinquennial age, or to that of the mean age at death—supposing that our object is to ascertain the comparative healthiness of an occupation, or the value of life in each.

All are aware that the Registrar-General of England has published, in the supplement to his Twenty-Fifth Annual Report, a series of tables giving the first fruits of his inquiry into the death-rates of persons following different occupations or trades. Hitherto these tables have not been turned to any account, indeed have been quite overlooked, from wanting the key to interpret them. Dr Farr, evidently expecting, as we all did, that they would of themselves settle the question as to the comparative healthiness of each occupation, selected fifteen known trades for comment, and calculated the proportion of deaths to the number of persons following each of these trades. The glaringly erroneous conclusions brought out by comparing the deaths at all ages with the total numbers following each trade, and which he could not explain, seem to have so staggered him that he wisely abstained from commenting on them at all; but, in lieu of comment, added a table, in which he arranged these fifteen selected trades, not in their order of least mortality at all ages, but in their order of least mortality between 45 and 55 years!

Thus, by comparing the deaths at all ages with the number of persons following each occupation, the most unhealthy trades were made to indicate a death-rate only half as high as occupations noted

for the longevity of those following them. Thus, bakers, butchers, miners, workers in cotton, flax, tin, copper, lead, etc., were, by this mode of interpreting the Tables, made to have a much lower death-rate than agricultural labourers, shepherds, ploughmen, physicians, lawyers, officers of the national government, and clergymen. But the true comparative healthiness or expectation of life in each occupation cannot be ascertained in this way, but by deducing the mean age at death, or by comparing the relative mortality at the several quinquennial periods of life.

Our Table II., therefore, and the explanation attempted to be given as to the discrepancy between the proportional mortality of the married and unmarried at the several ages, as compared with that at all ages, furnish the key wherewith we shall be able to unlock the treasures at present hid from us in the Registrar-General's Tables. The same explanation applies to them as to our Table. The summary at all ages, though a statistical truth, necessarily leads to a false conclusion.

The above facts, then, prove how careful we must be in deducing conclusions from statistics. Tables of figures, provided they are accurately drawn up, and embrace all the necessary elements, are necessarily truths. But they do not necessarily lead us to true conclusions. On the other hand, as in the above instances, though the figures express a truth in themselves, they necessarily lead us to form erroneous conclusions. In fact, it is much more difficult to arrive at the truth of statistical facts than most people imagine, —perhaps more difficult than in most other sciences,—because we fancy we are dealing with facts and with truths which must infallibly lead us to a true conclusion.

II. *Death-Rates of Married and Unmarried Women.*

The deaths of the married and unmarried women of Scotland at each quinquennial period of life, from 15 years upwards, were abstracted for the two years 1861 and 1862, and the results are given in Tables III. and IV.

In Table III. are given the number of married and unmarried women living in Scotland at each quinquennial period of life, at the middle of the year 1862, the deaths during the same year, and the proportion of deaths to the living. For the year 1861, however, only two columns are given, showing the proportion of deaths in the married and unmarried women during that year, for the sake of affording the means of easy comparison with the results of 1862. By that Table it appears that, though the proportion of deaths at each age differed very slightly during each of these years, there was almost no difference in the results of the comparison between the death-rates of the married and the unmarried at each age; for, excepting at the extreme ages 80 to 85 years, and again from 90 to 95, when the numbers are too small to afford constant quantities, the

results brought out by the Table of both years are absolutely identical.

This almost unexpected result confirms the general correctness of the Tables prepared for each year, and shows that the facts brought out by these Tables may be depended on, and that they demonstrate what may be called the law of nature on the subject. Our remarks may, therefore, be limited to Table IV., which gives the mean result of the two years.

When the mean annual percentage of deaths in the married and unmarried women at each quinquennial period of life is compared, it is found that the married died in a higher proportion during the three quinquennial periods of life, 15 to 20, 20 to 25, and 25 to 30 years, but that during the next two quinquennial periods of life, viz., from 30 to 35, and from 35 to 40 years, during which nearly half of their children are born, the married died at a lower rate than the unmarried. Thus, in every 100,000 married, and in a like number of unmarried women, between the ages of 15 and 20 years, 860 married died for every 692 unmarried. Between 20 and 25 years, 911 married women died for every 783 unmarried; while between 25 and 30 years, 940 married women died for every 866 unmarried. From 15 to 30 years, therefore, the mortality of the married exceeded.

TABLE III.—*Number of MARRIED and UNMARRIED WOMEN at different Ages in SCOTLAND, in 1862; Deaths at the same Ages; and the Percentage of Deaths to the Population at each Age. Also, the Proportions for 1861.*

AGES. 15 Years and Upwards.	Married and Widowed Women in 1862.			Married and Widowed in 1861. Percentage of Deaths.	Unmarried Women in 1862.			Percentage of Deaths in Unmarried Women in 1861.
	Number Living.	Deaths.	Percent. of Deaths.		Number Living.	Deaths.	Percent. of Deaths.	
15-20	3,384	25	0·738	0·983	154,829	1,075	0·694	0·691
20-25	39,924	364	0·912	0·910	114,180	895	0·783	0·783
25-30	71,649	683	0·953	0·928	61,044	506	0·829	0·903
30-35	77,503	764	0·985	0·927	34,954	367	1·049	0·941
35-40	71,962	806	1·120	1·116	24,368	300	1·231	1·181
40-45	69,660	806	1·171	1·116	19,690	225	1·142	1·109
45-50	58,934	785	1·332	1·270	14,659	222	1·507	1·455
50-55	54,479	826	1·516	1·449	13,973	269	1·926	1·576
55-60	41,462	886	2·136	1·989	10,216	244	2·389	2·077
60-65	42,390	1,200	2·830	2·649	11,405	370	3·244	2·715
65-70	26,242	1,242	4·732	4·269	6,875	350	5·090	4·489
70-75	20,337	1,342	6·549	6·627	5,544	434	7·828	6·672
75-80	12,190	1,424	11·681	10·448	3,230	359	11·114	9·741
80-85	7,490	1,278	17·062	15·105	1,986	332	16·717	16·236
85-90	2,646	708	26·756	23·179	582	161	27·663	25·597
90-95	763	282	36·972	32·147	181	55	30·386	39·778
95-100	203	94	46·305	36·138	48	20	41·666	35·416
100 & ab.	34	17	50·000	50·000	23	3	13·042	26·087
Not known	—	11	—	—	—	3	—	—
All Ages	601,252	13,543	2·252	2·109	477,787	6,190	1·295	1·240

that of the unmarried. During the next ten years this is reversed, for in every 100,000 of each class, between the ages of 30 and 35, only 956 married women died, but 995 unmarried; and between 35 and 40 years, only 1118 married women died, but 1206 unmarried.

At the age when the usual "change of life" occurs, viz., between 40 and 45 years, the mortality of the married slightly exceeded that of the unmarried, seeing that in every 100,000 of each class 1143 married died for every 1125 unmarried. This result might have been expected, seeing that the fatigues of child-bearing and nursing, and the harder labour connected with the rearing of her family, somewhat weakens the system of the married woman, and renders that critical period of life more trying to her than to the unmarried woman.

From the 45th year of life to old age, or 75 years, married women die in smaller proportions than the unmarried; and though the numbers above that age are too small to afford steady results, the table shows that from 80 to 95 the chances are still in favour of the married woman.

It is thus seen, that at every quinquennial period of life, the difference between the death-rates of the married and unmarried women is very much less than that between the married and unmarried men. It is thus for the first time demonstrated, that marriage exerts a much more powerful influence on the male than it does on the female; for whereas the influence of marriage on the death-rate of the female is comparatively trifling, it is of the most marked and potent kind on that of the male. The common belief has always been the reverse of this. The common belief has always been that marriage, by adding to the female the additional dangers of child-bearing, would be found greatly to increase her mortality; but it was never even once suspected that it would

TABLE IV.—*Mean Annual Percentage of Deaths among the MARRIED and UNMARRIED WOMEN of SCOTLAND, at different Ages, during the two Years, 1861 and 1862.*

AGES.	Percentage of Deaths to the Number Living.		AGES.	Percentage of Deaths to the Number Living.	
	Married and Widowed.	Unmarried Women.		Married and Widowed.	Unmarried Women.
15-20	0·860	0·692	65-70 .	4·500	4·789
20-25	0·911	0·783	70-75 .	6·588	7·250
25-30	0·940	0·866	75-80 .	11·064	10·427
30-35	0·956	0·995	80-85 .	16·083	16·476
35-40	1·118	1·206	85-90 .	24·968	26·630
40-45	1·143	1·125	90-95 .	34·559	35·082
45-50	1·301	1·481	95-100 .	41·221	38·541
50-55	1·482	1·751	100 and above	50·000	19·064
55-60	2·062	2·233			
60-65	2·739	2·979	All Ages .	2·180	1·267

make any difference in the mortality of the male. These facts, however, whose correctness there is no denying, disprove all this; and prove that marriage exerts a much more powerful influence on the death-rate of the male, than all imagined sanitary improvements could ever hope to effect.

Let us, however, return to our tables, and see what additional light they throw on the death-rate of the married women. It was seen that from 15 to 30 years married women died in a higher ratio than the unmarried, but that from 30 to 40 years they died at a lower rate. As nearly half of the children who are born are produced by mothers 30 years of age and upwards, it is worth while to inquire what is the cause of this proportional difference in the death-rates. The fact that the death-rate of the married women from 30 to 40 years of age is lower than that of the unmarried at the same ages, of itself proves that it is not mere child-bearing which increases the mortality of the married woman who is under 30 years of age. Yet it must be some cause connected with child-bearing, else the mortality of the married women from 15 to 30 years of age would have remained as low as it is in the unmarried at these ages. For this cause we have not far to seek.

Every medical man knows that the risk to the mother is far greater at the birth of her first child than at any subsequent delivery; and it is extremely probable that the whole extra mortality of the married female under 30 years of age, may be caused by the greater dangers which attend the birth of her first child. Indeed, this may be considered to be demonstrated by the following facts and considerations.

In the Second Annual Detailed Report of the Registrar-General for Scotland,—viz., for the year 1856,—a table was given showing the ages of all the women in Edinburgh and Glasgow who gave birth to children in 1855, and also the number of children to which each woman had given birth. Table V. is prepared from that table, and shows the proportion of mothers at each quinquennial period of life who gave birth to their *first* child at these respective ages. That table at once demonstrates that the high mortality of the married woman, as compared with that of the unmarried, at ages between 15 and 30, is solely due to the super-

TABLE V.—*Number of Mothers in Edinburgh and Glasgow in 1855,—the Number and Proportion at each Age who bare their first child.*

Ages of Mothers.	Total Number of Mothers.	Number bearing their First Child.	Percentage bearing their First Child.
15-20 .	403	354	87·8
20-25 .	3814	1921	50·3
25-30 .	5057	1019	20·1
30-35 .	3943	331	8·3
35-40 .	2395	124	5·1
40 and above	961	32	3·3

added dangers which attend the birth of the first child. Thus, between 15 and 20 years of age, 87 per cent. of the mothers gave birth to their *first* child. From 20 to 25 years of age, 50 per cent. of the mothers gave birth to their *first* child. While from 25 to 30 years, 20 per cent. of the mothers bore their *first* child. Above that age, the proportion of women giving birth to their first child was quite trifling, gradually diminishing from 8 to 3 per cent.

It was, therefore, only at the ages when a very large proportion of the married women were giving birth to their first child that the death-rate of the married women rose higher than that of the unmarried. But the moment that age was attained, when the great majority of the married women had got over the birth of their first child,—viz., above 30 years,—the mortality of the married women fell below that of the unmarried. This fact seems clearly to demonstrate that the higher death-rate of married women between the ages of 15 and 30 is induced by causes connected with the birth of their first child. In fact, the Table seems to prove that after the birth of her first child the married woman, even from 15 to 30, has an equal chance of life with her unmarried sister; and that, after she has passed her 30th year, and during the whole of the remainder of the child-bearing period (30-40), she has a better chance of life than the unmarried woman.

Seeing things are so, there seems to be nothing to prevent the higher death-rate of the married woman under 30 years of age to be quite arrested. Once we know the cause, the remedy lies in our own hands. Medical men all know whence the dangers attending the birth of the first child chiefly arise. Most of them are removable if taken in time. They are causes almost entirely due to our civilisation, and to our faulty habits, which produce an over-excitable, over-stimulated, nervous, worn-out frame, where health and vigour ought alone to exist.

ARTICLE II.—*On the Pathology of Tubercular Meningitis.* By H. CHARLTON BASTIAN, M.A., M.D. Lond., F.L.S.; Lecturer on Pathological Anatomy and Assistant-Physician to St Mary's Hospital.

MOST pathologists are now pretty well agreed as to the relative importance, and precedence in point of time, of the two principal morbid changes characterizing the disease which, in the present day, is usually styled Tubercular Meningitis. Some few, however, still retain the old name "Acute Hydrocephalus," which seems to imply that they regard the effusion into the ventricles of the brain, and the softening of their walls, as the main and primary elements of the disease, instead of looking upon these as secondary, and even not invariable, results of certain more fundamental changes having their seat in the meninges of the organ.