THE INFLUENCE OF THE AGE OF THE PARENT ON THE VITALITY OF THE CHILD—A FIRST STUDY.

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The subject I propose to discuss in the present and subsequent papers is of importance in two ways. Popular traditions have frequently implied that the age at which a parent begets offspring is not without influence upon the characters of the latter, the prevailing belief being humorously portrayed in the late W. S. Gilbert's ballad "The Precocious Baby." Again, recent thinkers, notably Professor Karl Pearson, have asserted that elder born children differ markedly in liability to certain diseases from their younger brethren. Were this view to be accepted it would be relevant to enquire whether the difference might not be a function of the age of the parents at the time of birth of the offspring or at least whether such difference might not play a part in bringing about this result. Assuming that any such effect could be demonstrated, it is plain that a valuable stimulus would be given to the study of physiological changes in the reproductive system within the fertile period. These are the immediately interesting aspects of the subject, but with them I am less directly concerned than with certain secondary consequences.

To state that an essential preliminary of a comparison is that the things to be compared must be in *pari materia*, may seem unnecessary, but this truism is in constant danger of being forgotten. We are all aware that the crude birth or death rates of different communities cannot be made the subjects of a valid comparison, but that corrections for age and sex distribution are necessary. The introduction of these

corrections has, however, tended to engender a feeling of undue confidence in the ease of interpreting such adjusted ratios. Quite recently warnings have emanated from various quarters with regard to this point. Thus Brownlee has pointed out in this *Journal* that the customary employment of a corrected death rate as a measure of salubrity is not free from doubt, while Hamer in his presidential address to the epidemiological section of the Royal Society of Medicine and again in his annual report to the London County Council has dwelt upon the possible importance of migration as a factor in death and birth rates which cannot be entirely allowed for by means of age and sex corrections. Evidently if the age at which a child is begotten or conceived, influences not merely the probable number of its brothers and sisters but also its own physical or mental characters, we have to reckon with another factor in the interpretation of a changing death or disease rate. It will not be sufficient to allow for the age constitution of a community, it will be necessary to consider that of the previous generation as well, since, whatever else may be obscure, it is certain that a small but significant increase in the average age at marriage has taken place in most sections of the community. For these reasons, it is plain that an attempt to measure the influence of the ages of parents at the time of procreation or conception upon the longevity of their offspring is worth making, and this paper contains an account of a preliminary effort. I shall not try to summarise the literature, at once voluminous and meagre, which has some more or less direct bearing upon my theme; much of it is merely traditional and theoretic, little of it is based upon exact statistical data handled in an appropriate fashion. Stanley Hall's well-known book on adolescence contains references to various earlier papers, and additional citations will be found in Gini's 1912 paper, while among writers who have treated of the influence of order of birth, mention should be made of Lucien March, Karl Pearson and his associates, Weinberg, Yule and Greenwood, Goring and Ploetz. I may also refer to some preliminary notes of my own, cited in the list of references appended. This paper is confined to a study of the influence of parental age upon the longevity of offspring and age at marriage, and the data used will in the first place need careful description. These data fall into four series, viz.:

The first was collected from Burke's *Peerage*, 1902, and related to the possible influence of the age of the father at birth, on the age at death of sons who had survived to the 15th year; the first male born of the first male in each generation only being considered.

The second was collected in Middlesbrough, through the agency of the Medical Inspection of School Children, and deals with the age of the grandmother at the birth of the mother and the number of children dying before adult life.

The third also collected in Middlesbrough, through the agency of the Notification of Births Act, permitted the consideration of the age of mother at birth of the offspring and its chance of living one year.

The fourth and last collected through the same agency as the third, had for its object the possible association between age and the chance of foetal death prior to term.

It will be observed, that, though there is some overlapping, all periods of life are covered and further that both parents have been dealt with. Unfortunately data were not obtainable in the *Peerage* with respect to the age of the mother. It is obvious that in an enquiry of this kind, both parents ought to be considered, for should an association be found to exist in the case of the male parent, it might arise from the ages of the uniting ovum and sperm or the environmental influence of the mother's age, subsequent to fertilization. We can now consider each series in detail, indicating the corrections that should be made and such fallacies as are dependent upon the method of collecting the data.

Age of Father at Son's Birth, and Age at Death of Adult Sons.

The peculiarities of this series of observations which should be borne in mind are as follows:

(*a*) The oldest males only were considered. That is, only instances where the father was the eldest born and the son whose age at death was recorded was also the first male born. Unfortunately the actual position in the family of the person under consideration is not given in the raw material.

(*b*) Only such sons as survived the 15th year are considered.

(*c*) All deaths through violence were excluded so far as recorded.

It has already been shown by Beeton, Pearson and Yule, that a correlation exists between the length of life of the father and that of the son which is equal to ·12. Now it is obvious that a child born of an elderly parent may be influenced in two ways: (1) He may tend to survive to a mature age because his father has already done so and (2) his life expectancy may be curtailed because his parents were

old when he was born. Hence partial correlations must be formed, with the age of the father at death constant. The following three correlation tables were drawn up:

(I) Age of father at birth of son and age of son at death.
(II) Age of father at death and age of son at death.
(III) Age of father at birth of son and age of father at death.

TABLE I.

Age of father at death and age of son at death. First male births and such as survive to adult life.

Age of Father \ Age of Son	13–16	17–20	21–24	25–28	29–32	33–36	37–40	41–44	45–48	49–52	53–56	57–60	61–64	65–68	69–72	73–76	77–80	81–84	85–88	89–92	93–96	97–100	101–104	105–108	Totals
29– 32							1		2		1	1	1				1	1							8
33– 36				1	1		1		1		1		1			1		1							8
37– 40		1					1	1	1	2			2	5	2	1	2	2	1				1		22
41– 44				1	1				1	1	2	1	1	2		1		1							12
45– 48		1		1	2	1	3		5	3	3	5	1	3	3	3	4	2	3						43
49– 52			1	2	1		1		4	6	1	2	3	4	6	6		1	1		1				40
53– 56				1	2		5	4	1	1	3	4	6	3	7	2	6	1	2	1					49
57– 60		1	1		1		6	3	2	6	2		3	7	6	6	2	7		2					55
61– 64			1		1	1	2	2	5	3	4	4	6	6	8	8	5	4	2	1					63
65– 68	1				3		2	5	9	3	9	8	10	6	7	5	6	6	3	1					84
69– 72						2	3	4	1	6	4	4	13	11	11	13	10	5	3						90
73– 76					1	1	5	4	5	9	5	6	12	8	10	14	11	9	4	3	1			1	109
77– 80				1			1	1	2	7	2	7	8	11	10	6	6	10	5	1					78
81– 84							2	1	3	2	3	5	10	5	7	15	4	4	4	1	1				67
85– 88								1	2	3	2		1	6	9	7	5	5	5						46
89– 92											1		2		2	2	2	1	2	1					13
93– 96														1	1		2								4
97–100														1											1
101–104																									
105–108															1	1									2
108–109													1												1
Totals	1	3	3	7	13	5	33	26	44	52	43	47	81	79	90	91	66	60	35	11	3		1	1	795

$\sigma_x = 3{\cdot}8431.$ $\sigma_y = 3{\cdot}8933.$ $r = {\cdot}2248 \pm {\cdot}0248.$

TABLE II.

Age of father at birth of eldest son and age at death of son (adult).

Age at death of Son

Age of Father at birth of Son	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	100	102	104	106	Totals
16																				1							1																2
18													1	1	1																												3
20														1				1											1														3
22									1	1		1	2	1			1		3					2	3		2	1	1	1		3	1			1							25
24									1	3	1	2	3		2	2	1	2	1	2	1	6	4	1	7	2	3	3	1	1	2		1	2									54
26				2	1			1	1	1		1	1	2	4	1	2	3	2	7	5	2	7	3	7	2	3	9	1	1	3	2	1	1									76
28	1				1		2	1		2	1	1	1	5	3	1	4	4	2		6	7	2	10	5	8	2	5	5	4	2	2	5	2	1	1		1					97
30									1	3		2	1	2	5	4	3	1	1	2	5	2	4	4	4	3	7	3	4	4	2	3	2		3	2							77
32			1		1			1	1	2	1	2	1	2	2	4	1	5	3	3	5	5	3	1	4	8	9	3	5	2	1	4	3					1					84
34			1						1		4	2		1	1	2		3	2	5	5	2	4	4	2	8	4	4	5	2	2	2	1	3									70
36								1	1	3	1	1	1	5	2	4			4	2	2	1	3	2	4	1	5	4	2	1	6	1	1	2	1								61
38						2	1		1	1	2	1	2		3	1	3	2			5	5			3	3	1	3		3	3	1	2	2	1	1							52
40				1					2	2	2		2	2	2		2	1	1	2	2			4	2	3	2	6	1	2	2	2	1	1	1			1					49
42						2		1		1	2		2	2	1	4	1	2		1	1	2	2	2	2	1	1	3		1	1	2											37
44									1	1	3		1		3		3	1	2		1			1	2	1	3	1	1	2		1		1									29
46					1		1					1	2	3		1					1			1	1			1	2	2	2	1			1							1	22
48										1			3							2		2		1				1	1				1	1									13
50						1								1		1	1	1		1	1	1				1				1			1										11
52		1				1						1									2	1		1		1		2															10
54			1																			1	1	1	1					1			1										7
56																											1				2												3
58																									1	2			1					1									5
60																					1							1				1											3
62																											1																1
64								1																					1														2
66															1																1												2
68																																											
70																																1											1
72																																1											1
74																																											
76																																											
78																											1																1
80																																											
Totals	1	1	3	3	4	6	4	6	11	21	17	15	23	28	30	25	22	26	21	28	43	37	30	38	48	44	46	50	32	28	29	27	21	16	8	5		3				1	801

$\sigma_x = 4{\cdot}31061$. $\sigma_y = 7{\cdot}43599$. $r = +{\cdot}0345 \pm {\cdot}023$.

TABLE III.

Age of father at birth of eldest son and death of father.

Age at birth \ Age at death	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	116	Totals
20								1	1	1	1										1																						5
22	1			1				1	2	5	1	1	1	2	3	3		2	4	2	1	1	3	1	3		1			3				1										43
24	2		2	1	1	6	2		2	1	3	4	2	5	4	1	2	1	4	3	5	5	3	6	4	2	2	1	1	1		1		1										78
26		1	1	2	1	3	1	1	5	3	5	5	2	3	4	3	8	4	6	1	6	5	7	8	6	5	2	3		1				1								1		104
28	2	2	1	2	2	1	1	2	6	4	4	2	4	6	5	4	5	14	7	6	7	5	9	6	8	5	6	1	3	4	1												135
30				2	2	6	1	1		9	5	2	5	6	5	5	5	6	3	10	2	11	5	9	6	5	2	4	5	4														126
32					2	6	1	1	5	5	6	1	4	3	7	7	11	6	9	11	8	7	5	6	8	3	3	8	2	2	1	2												140
34				2	3	5	2	6	1	3	2	2	3	7	3	1	2	6	5	5	2	5	4	8	5	4	1	7	1			1					1					1	1	98
36							1	1	5	5	2	5	1	4	1	1	7	1	5	4	8	4	7	7	4	4	3	6	3	2	1													92
38							1	1		4	1	7	1	2	1	5	2	3	4	5	8	2	5	7	1	2	4	6	9	2	1	3												87
40							1		3	1	5	6	2	1	2	1	4		3	5	4	5	6	3	6	3	5		3	1														70
42									2		2	1	1	2		3	4	2		6	8	5	6	2	2	4	3	2																55
44									1		2			1	3	3	2	1	1	1	2		1	3	1	1	3	3	1	1		1												32
46											2	1		1	2	2	1			5	5		1	6	2		2	1				2												33
48										2			1	1		1	3	1	1	1		2	1	3	1		1	1	1	1	1													23
50											1	1		3			2		2	1			1	2	3			2			1													19
52															1	1		1	1	1	1		2	1		3	1	1	1	1														16
54														1						1			1	1	2		2				1													9
56																				1		2				1		1																5
58																	1	1	1		1		1	1	1			1	1															9
60																						1		2					1															4
62																			1	1				1	1				1															5
64																			1				2	1																				4
66																						1		1	1			1																4
68																																		1									1
70																									1	1																		2
72																																											
74																																											
76																									1																		1
78																																											
80																																1											1
Totals	5	3	4	10	11	27	11	15	33	43	42	38	27	48	41	41	59	49	58	70	69	61	70	85	67	43	40	49	33	23	7	11		4			1				1	1	1201

$\sigma_x = 4{\cdot}1604$. $\sigma_y = 7{\cdot}3045$. $r = +\ {\cdot}2543 \pm {\cdot}0229$.

The values of the correlation disclosed by the tables are as follows:

Age of father at birth (1) and son at death (2), $r = \cdot 0345 \pm \cdot 023$

Age of father at death (3) and son at death (2), $r = \cdot 2248 \pm \cdot 0248$

Age of father at birth of son (1) and death (3), $r = \cdot 2543 \pm \cdot 0229$

It is to be observed that the second coefficient is much larger than that previously given by Prof. Pearson and Miss Beeton, namely $\cdot 135 \pm \cdot 0209$, and the matter needs further discussion. In the first place the correlation surface is not a random sample of the type descriptive of the degree of association obtaining in the whole "population" of fathers and sons owing to the restriction as to age and birth order already mentioned. So far as the former is concerned the same selection was practised by Beeton and Pearson in their paper of 1899 (*Proceedings, Royal Society*) which also dealt with peerage data, and the correlations they obtained are decidedly smaller than mine; but they did not restrict the analysis to first male births. This may partly account for the discrepancy between our results. It will be noticed that there is far less difference in mean age and variability of father and sons in my data than in that of Beeton and Pearson. It will be remembered that the latter pointed out (*op. cit.* p. 292, etc.) that the filial generation was less stringently selected than the parental. The observed correlation was necessarily lowered, there being a mixture of material due to the operation of that fraction of the death rate which is really non-selective upon the sons. It appears probable that the further selection in confining oneself not only to adult firstborn males, but to those who actually survived their fathers, is a sufficient explanation of the difference. Whether my value is a really adequate measure of the force of inheritance in respect of longevity and what part is played in heredity by the influence of the age of the parents at birth of the son cannot be stated off-hand.

In the following table (p. 460) are the constants as given by Beeton and Pearson in their 1899 paper and found from the above data.

If we now make age of father at death constant then

$$r_{12} = -\cdot 0431 \pm \cdot 0239.$$

The conclusion or rather suggestion is that as the father increases in age at the birth of the son, the life expectancy of the son, who has already survived to the 16th year, tends to be curtailed. The correlation ratio for means of arrays of sons' ages at death for various ages of fathers at birth of sons $= \cdot 3394 \pm \cdot 0389$, and when corrected by Pearson's method (*Biometrika*, VIII) the value approximates to $\cdot 3042$.

	Beeton and Pearson's data (1899)	Present Paper
Mean age of Fathers at death* ..	65·835	67·14
Mean age of Sons at death ..	58·775	65·84
Standard Deviation (Fathers) ..	14·6382	14·24
Standard Deviation (Sons) ..	17·0872	14·20
Coefficient of correlation	0·1149 ± ·0210	·2214 ± ·0248
Correlation ratio (Fathers) † ..	—	·3394 ± ·0389
Corrected ‡	—	·3042

* The mean age of fathers who were Peers is one and a half years greater than the sons who succeeded them. This is due to the fact that a proportion did not inherit the title and hence would be of a mature age when it was conferred upon them.

† Any distribution has two correlation ratios; the word in brackets indicates which has been calculated, *e.g.* correlation ratio (fathers) denotes the coefficient obtained from the means of arrays of fathers.

‡ The correlation for η is calculated by the method described by Prof. Pearson, 1912.

If we replaced number of years lived by the death rate at ages and thus reversed the order of our categories, the association would become positive and we might say that the death rate at ages increases with the age of the father at birth. This change as will be seen subsequently would bring the present series of observations into line with the remainder.

The Age of the Grandmother at the Birth of the Mother and the Number of Children dying in the Family.

This enquiry as already stated was carried out in Middlesbrough through the agency of the Education Act (Administrative Provisions) 1907, or what is known as the Medical Inspection of School Children. The method was as follows: All children in their 8th year were selected and their parents invited to attend the examination; of the total number, 50 % complied. The sample thus obtained can be regarded as comprehensive and is such that it reaches each family once only. It is obvious, however, that the material is a selection and not a random sample because it ignores all sterile matings and those in which all the children born have died before the 8th year; further the representation of families of various sizes is directly proportional to the number that survive. Hence the larger the family the greater the chance of its possessing a member 8 years old.

According to the work of Weinberg, Macaulay, Yule and Greenwood it appears that considerable caution must be exercised in basing deductions on data collected in this way, as the possible statistical fallacies are numerous and in some respects cannot be corrected.

One error which tells against a positive conclusion arises from the fact that if age at birth is detrimental to the survival value of the family, it is obvious that those families which have been hit the hardest are only represented in our data in proportion to the chance of one of the survivors being 8 years old, which, even if the family was originally large, might be small, under the method of selection adopted.

It is to be regretted that no allowance has been made for the length of time the mother had been married, as the age at marriage was not obtained in the original data. To assume that the mean reproductive periods in the categories chosen will be approximately equal is an assumption that is hardly justifiable. Bearing these reservations in mind we may proceed to discuss the actual findings. The information obtained from each mother or responsible guardian was (1) present age of mother; (2) age of grandmother if living, or age she would have been had she lived; (3) the number of children born to mothers—still births are included, but not miscarriages; (4) the number dead.

It is to be noted that information relative to ages is fairly reliable, owing to the widespread use of insurance against burial expenses at death. As in the previous case, partial correlation was used and the problem was to find the value of the association, if any, between the age at which the mother was born and the number dying for total number born constant.

The correlations for the above tables are as follows:

Age of grandmother at birth of mother (1) and number dead (2):

$$r_{12} = \cdot 0238 \pm \cdot 0213.$$

Number of children dead (2) and size of family (3):

$$r_{23} = \cdot 7230 \pm \cdot 0109.$$

Size of family born (3) and age of grandmother at birth of mother (1):

$$r_{13} = \cdot 0641 \pm \cdot 0150.$$

Testing our crude correlations for linearity, we have for age of grandmother at birth of mother and number dying:

$$\eta_{12} \text{ (number dead)} = \cdot 076.$$

Corrected $\eta_{12} = \cdot 0314 \pm \cdot 0209,$

$$\eta_{13} \text{ (age)} = \cdot 139.$$

Corrected $\eta_{13} = \cdot 1015 \pm \cdot 0208.$

There may be some non-linearity with respect to the age categories, still a partial correlation should give a little information.

TABLE IV.

Age of grandmother at birth of mother and number of children dead.

Age at birth	0	1	2	3	4	5	6	7	8	9	10	11	12	No. dying.	Means
20 yrs. and under..	38	24	30	6	6	5	4	1	1		1			116	1·724
21st to 25th year..	95	68	45	23	19	5	3	2	1		1			262	1·528
26th to 30th year..	95	75	49	25	11	6	3	2	1	2	2	1	1	273	1·578
31st to 35th year..	78	46	42	15	16	6	5	4	2		1	1		216	1·741
36th to 40th year..	31	32	19	15	8	3	1	3	1					113	1·743
41st and over	22	13	11	7	1	3	1	1						59	1·491
Totals	359	258	196	91	61	28	17	13	6	2	5	2	1	1039	1·621
Means	3·09	3·12	3·04	3·34	3·06	3·21	3·52	3·69							

$\sigma_x = 1{\cdot}351$. $\sigma_y = 1{\cdot}8486$. $r = {\cdot}0238 \pm {\cdot}0213$.

TABLE V.

Age of grandmother at birth of mother and number of children born to mother.

Age at birth ..	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	No. of children born	
20 yrs. and under ..	6	16	19	14	22	15	11	9	4	3	5	1		3	1		129	5·34
21st to 25th year ..	14	28	65	57	43	28	17	21	26	9	4	1	3	3		1	320	5·12
26th to 30th year ..	17	49	50	43	53	34	17	16	14	10	5	3	2	5			318	4·92
31st to 35th year ..	17	42	46	45	48	24	13	14	8	7	4	3	1	1			273	4·59
36th to 40th year ..	15	25	40	18	16	11	10	10	6	3	4	1	1		2		162	4·55
41st and over	1	17	19	16	4	9	7	7	2	2	3	1	2	1			91	5·03
Totals	70	177	239	193	186	121	75	77	60	34	25	10	9	13	3	1	1293	5·77
Means	3·34	3·47	3·33	3·23	3·02	3·15	3·20	3·21	2·9	3·12	3·28	3·5	3·54	2·61	3·68	2·8		

$\sigma_x = 1{\cdot}473$. $\sigma_y = 2{\cdot}8561$. $r = -{\cdot}064 \pm {\cdot}015$.

TABLE VI.

Size of family and number dead.

No. dead	Size of family 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	Totals
0	31	73	71	82	49	27	16	7	4	4	1									365
1		12	44	51	62	36	15	21	14	4	0	1	1							261
2			14	20	27	38	30	40	11	11	3	1	1	1						197
3				1	10	17	13	18	17	10	7	2	0	2						97
4					1	6	6	10	10	13	8	1	1	3	2					61
5							5	2	1	1	4	6	5	2						26
6							1	3	2	3	1	4	1	1		1				17
7									2	1	2	2	2	1	1					11
8										1	0	1	1	1	1				1	6
9											1	0	0	1						2
10														3		1				4
11														1						1
12														1					1	2
Totals ..	31	85	129	154	149	124	86	101	61	48	27	18	12	17	4	2	0	0	2	1050

$\sigma_x = 3{\cdot}122$. $\sigma_y = 1{\cdot}84$. $r = {\cdot}723 \pm {\cdot}0109$. Mean size of family 5·77. Mean number dead 1·56

Age of grandmother at birth of mother and number dying in the family, total number constant:

$$_3r_{12} = {\cdot}0943 \pm {\cdot}0174.$$

This would suggest that as the age at which the mother was born increases, the chance of her rearing all her children decreases. It is of interest to note that the association having regard to its probable error is more significant than in our first series. Had the present data been as reliable we should have been justified in assuming that the effect of parental age at birth is more marked in early life than at the more mature ages.

The Age of the Mother at Birth of Child and its chance of living one year.

The third series of observations dealing with the possible association between age of mother at birth and chance of living one year is also subject to certain reservations:

(1) The data deal only with a poor class population.

(2) Only such as remain in the town for one year are considered.

(3) A fair number are lost owing to migration. These are usually the latter born, for it is the parents of such who are most affected by

trade fluctuations. The number lost in this way is a little over 5% of the whole number. The information collected was:

(1) Age of mother at birth.

(2) Order of birth. (Miscarriages and still births are included.)

(3) Whether living or dead at end of the year. This information is of course furnished by the Registrar to all Health Departments. The method adopted was as follows: A table was formed (Table VII) with age of mother at birth and order of birth as abscissae and ordinates respectively, and in each appropriate square the number born and the number dead at the end of the year were placed and the death rate for each age and order worked out. This table was then turned into two sub-tables:

(1) Infantile Mortality and age of mother at birth.

(2) Order of birth and Infantile Mortality.

The figures in the squares being the number of observations upon which the various mortality categories are based. The third table, Age of mother at birth and order of birth, was taken from the original table.

The constants obtained from these tables are:

Age of mother at birth of offspring (1) and order of birth (3):

$$r_{13} = \cdot 6128 \pm \cdot 0051.$$

Age of mother at birth of offspring (1) and infantile mortality (2):

$$r_{12} = \cdot 1157 \pm \cdot 0142.$$

Order of birth (3) and infantile mortality (2):

$$r_{23} = + \cdot 0367 \pm \cdot 0208.$$

Taking the age of mother at birth of offspring and infantile mortality, with order constant:

$${}_3r_{12} = \cdot 1179 \pm \cdot 0143,$$

and birth sequence and infantile mortality with age of mother at birth constant:

$${}_1r_{23} = - \cdot 0531 \pm \cdot 0205.$$

Testing these for linearity of regression, order of birth and infantile mortality

$$\eta \text{ (order)} = \cdot 2403, \ \eta \text{ (corrected)} = \cdot 2254 \pm \cdot 0145.$$

Age of mother and infantile mortality:

$$\eta \text{ (mortality)} = \cdot 2939, \ \eta \text{ (corrected)} = \cdot 2810.$$

TABLE VII. *Number of births and deaths in first year according to age of mother at birth and order.*

Years	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	No. born	Deaths	Rate per 1000
	1																	1	—	0
15	—																			
	2																	2	—	0
16	—																			
	7																	7	2	286
17	2																			
	17	2	1															20	2	100
18	2	—	—																	
	35	14																49	14	286
19	5	9																		
	61	11	2	1														75	10	133
20	7	2	1	—																
	49	20	6	1	2													78	14	179
21	10	3	—	—	1															
	45	29	14	6														94	15	160
22	7	4	4	—																
	39	41	28	8	5													121	17	140
23	6	7	4	—	—															
	29	31	22	11	9	3	1											106	9	83
24	1	4	3	—	1	—	—													
	45	27	36	26	7	4												145	17	117
25	6	4	5	1	1	—														
	29	37	29	23	11	4												133	18	135
26	7	4	2	4	1	—														
	17	18	19	15	15	10	1	1	1			1						98	15	153
27	2	3	—	2	4	2	—	—	1			1								
	16	23	27	20	18	4	6	3										117	13	111
28	2	5	1	3	1	—	—	1												
	15	10	23	19	16	16	9	2	1									111	15	104
29	4	—	5	2	—	—	2	2	—											
	4	13	12	20	23	18	10	6		1								107	14	131
30	2	2	1	3	1	1	1	2		1										
	2	8	10	8	10	13	18	5	1	1								76	13	171
31	1	—	2	1	2	—	4	2	—	1										
	3	8	8	14	16	24	11	13	5	5								107	15	140
32	—	—	—	2	1	2	5	1	1	3										
	6	3	4	7	8	21	20	9	4	2	3	1						88	16	182
33	2	—	—	2	1	5	3	1	1	—	1	—								
	3	4	6	8	11	18	17	17	5	8	4	3	1	1			1	107	11	103
34	—	—	2	—	1	1	2	2	—	2	1	—	—	—			—			
	4	3	5	10	12	11	17	6	9	5	2			1				85	12	141
35	—	2	—	1	1	—	2	3	1	1	—			1						
	1	3	6	3	8	12	5	12	10	4	4	2	1		1			72	9	125
36	—	2	—	—	1	2	—	—	1	1	—	1	1		—					
	1		2	4	3	5	9	13	10	7	3			1				58	10	172
37	—	—	—	—	1	1	—	4	—	4	—			—						
	1			2	4	10	11	8	8	10	6	4	1					65	11	169
38	1			1	—	—	—	3	2	2	1	1	—							
		1	1	1	6	2	2	5	12	9	4	2	2		2			49	6	122
39		—	—	—	2	—	—	—	1	1	—	—	—		2					
	1	6	3	1	4	4	4	3	6	6	8	5	3	1			2	57	13	232
40	—	3	1	1	—	2	—	—	1	1	1	2	1	—			—			
	2		1	1	5	4	2	4	2	6	1	3		2	1	1		35	8	229
41	—		1	—	2	—	—	1	—	1	—	1		1	1	—				
	1		1	1	1	2	2		1	1	9	3	1				1	24	3	125
42	—		—	—	—	—	—		—	—	1	1	—				—			
		1	3	2		1	1	1	3	1	5	2	4	2		1		27	6	222
43		—	—	—		—	1	—	3	—	1	—	2	—		—				
	1						1	3	2	2	2	3		2	2			18	3	167
44	—						—	1	—	—	—	1		—	1					
							1	3	1	2	4	1	1	2	1	1		17	5	294
45							—	1	—	—	2	—	—	1	—	1				
					1	1	1			2				1				6	0	0
46					—	—	—			—				—						
									1									1	0	0
47									—			—		—		—				
														1		1		2	0	0
48														—		—				
												1						1	0	0
49												—								
No. of births:	437	313	269	212	195	187	149	114	82	72	55	31	14	14	7	4	4	2159		
No. of deaths:	67	54	32	23	22	16	20	24	12	18	8	8	4	3	4	1	0		316	
																		Rate ..		146

The regression, therefore, is markedly non-planar. This is probably due to the fact that the data are heaped up in the two extreme categories, namely, mortality of ·0–5 %, the largest portion consisting of families in which none have died in the first year and mortalities of 90–100 %, mainly those families in which all have died (a fact which in the majority of cases was due to syphilis). In spite of these reservations, I think we can conclude that as the age of the mother advances, the chance of the child surviving decreases, and as the family gets larger, other things being constant, the probability of its living one year increases. Findings which are on the whole corroborated by one's general impressions. Since the third series is restricted to infantile mortality which is only a part in the second series, the suggestion is that the influence of parental age hardly affects the adolescent period of life. It must, however, be remembered that the methods of tabulation were not the same in the two cases.

Present Age of Mother and Number of Accidents in previous Family.

The fourth and last series was obtained with the object of ascertaining the possible association between the age of the mother and the death of the foetus prior to full gestation; the data were collected in Middlesbrough on the occasion of a birth. The mother being asked (1) the number of live births she had had; (2) the number of deaths in the first year; (3) the number of miscarriages and still births. It is to be noted first, that the enquiry was limited to certain working class districts of the town, though all births were reached that occurred in that area, and secondly, that each category is assumed to include the experience of the previous ones. This is not quite true, as the smaller families tend to be restricted to ages centring round the 29th year and are more rarely found in the early and late periods. The data are on these accounts obviously not homogeneous. The findings, however, in the previous series that size of family does not seriously affect infantile mortality when age is made constant, should remove this objection.

The data are as follows:

TABLE VIII.

Histories of mothers with respect to accidents, deaths in first year, and number of births in first year.

Age of mother	No. of enquiries	No. of births	Accidents	Rate	No. of deaths	Rate
16	4	4	0	0	0	0
17	10	10	0	0	0	0
18	26	32	6	188	2	63
19	51	63	1	16	6	95
20	82	111	3	27	9	81
21	89	154	12	78	14	26
22	102	218	19	87	16	73
23	129	313	19	61	31	99
24	118	321	24	75	39	121
25	110	321	18	56	37	115
26	110	384	31	81	48	125
27	100	399	36	90	66	165
28	103	421	26	62	66	157
29	98	463	27	58	59	127
30	101	426	41	96	75	176
31	68	307	16	52	31	101
32	88	522	36	69	61	117
33	75	479	32	67	66	138
34	77	559	68	122	69	123
35	61	437	26	60	44	111
36	63	413	25	61	59	143
37	54	425	33	78	68	160
38	44	396	47	119	45	114
39	40	381	61	158	62	163
40	41	393	34	87	60	153
41	9	110	8	73	17	155
42	23	289	44	152	44	152
43	12	138	13	94	12	86
44	12	128	12	94	30	234
45	3	42	4	95	1	24
46	3	30	4	133	1	33
47	1	9	0	0	2	222
48	1	13	0	0	1	77
49	1	12	0	0	2	106
Totals	1909	8728	726	86	1143	119

Correlating these directly and using the column "Number of Enquiries" as weights, we have:

Present age of mother and infantile mortality in previous family:

$$r = \cdot 0425 \pm \cdot 0210\,;$$

present age of mother and accident rate in previous family:

$$r = \cdot 2886 \pm \cdot 018\,;$$

infantile mortality rate and accident rate:

$$r = \cdot 4006 \pm \cdot 0064.$$

Considering the problem from the point of view of individual families we see that as the age of the mother increases so does the chance of the child dying either before or after birth increase, the correlation in the former case being about seven times that in the latter. It is of interest also to note the high correlation between death before and after birth.

Putting the foregoing results together we have,

(1) Present age of mother and miscarriage rate in previous family:

$$r = \cdot 2886 \pm \cdot 018\,;$$

(2) Age of mother at birth of offspring and infant mortality:

$$r = \cdot 1179 \pm \cdot 0143\,;$$

(3) Age of grandmother at birth of mother and number of family dying before adult life:

$$r = \cdot 0943 \pm \cdot 0174\,;$$

(4) Age of father at birth of son and longevity of sons:

$$r = -\cdot 0431 \pm \cdot 0239.$$

If, however, we could exclude from (3) the association due to infantile mortality, it might approximate to zero or actually become negative. It is possible that we are dealing with two different things, namely, sthenic and asthenic deaths. In the former the reactions of the organism are so excessive as to cause death, whilst in the latter the death is due to their relative absence. In infancy and late life death is mainly asthenic, whilst in the adolescent period it is sthenic. If this is so, then a negative correlation for the adolescent period would be expected. The above consideration, though it goes beyond the data, is a useful suggestion as it indicates that the next step in the enquiry must be the consideration of age of parent at birth of offspring and cause of death, age at death being kept constant.

Age of Father at birth of Son and Age of Son at Marriage.

As evidence has already been given which lends considerable force to the belief that the number of years that a person will live partly depends upon the age of the parents, when he or she was born, it

is not unreasonable to consider whether fertility is also influenced by the same factor. Before such an enquiry can be undertaken, the factors limiting the reproductive period must be clearly defined. The termination, that is death, has already been dealt with in the present paper, and the beginning, namely age at marriage, will now be examined.

The data on which this investigation is based have been taken from Burke's *Peerage*, and to produce as much homogeneity as possible only eldest born sons of eldest born fathers are considered. The characters chosen were:

(1) Age of father at birth of his son.
(2) Age of son at marriage.
(3) Age of father at death.
(4) Age of father at marriage.

Beyond the two fundamental factors it is necessary to allow for any hereditary tendency, first in respect to marriage, for if the father mates early the son is likely to do so, and secondly in respect to death, for if the father dies early it is likely to hasten the marriage of the son, as he will assume his full authority at an earlier date, and should he be a minor at the time there will be every social reason for his marriage at the earliest moment that convention allows, hence it is necessary to examine any association that may exist between the factors: Age of the father at marriage and age of son at marriage, Age of father at death and age of son at marriage, and should such prove to exist, suitable allowance must be made. The values are as follows:

Age of father at birth of son (1) and age of son at marriage (2):

$$r_{12} = -\cdot 0175 \pm \cdot 0247.$$

Age of father at birth of son (1) and age of father at marriage (4):

$$r_{14} = \cdot 7338 \pm \cdot 0114.$$

Age of father at birth of son (1) and age of father at death (3):

$$r_{13} = \cdot 2534 \pm \cdot 0232.$$

Age of father at marriage (4) and age of father at death (3):

$$r_{34} = \cdot 1620 \pm \cdot 0239.$$

Age of son at marriage (2) and age of father at death (3):

$$r_{23} = \cdot 2219 \pm \cdot 0236.$$

Age of son at marriage (2) and age of father at marriage (4):

$$r_{24} = \cdot 0463 \pm \cdot 0243.$$

TABLE IX.

Age of father at birth of son and age of son at marriage.

Age of father at birth	Age of son at marriage: 15—16	17—18	19—20	21—22	23—24	25—26	27—28	29—30	31—32	33—34	35—36	37—38	39—40	41—42	43—44	45—46	47—48	49—50	51—52	53—54	55—56	57—58	59—60	61—62	63—64	65—66	69—70	71—72	77—78	Totals
15—16					1					1							1													3
17—18			1	1	1		1																							4
19—20				2	2	3	1	2	2	2	2	2	2	1	2		2				1									26
21—22		1		5	7	10	15	14	7	11	12	5	6	5	3	3	1	1	5	1	2		1		2	1				118
23—24		1			12	19	17	11	18	11	7	4	10	7	3	1	2	2	2		2	1								130
25—26				8	5	11	14	13	21	19	6	11	8	9	3	3	1	1	1	1			1		1					137
27—28				5	11	13	11	14	9	7	6	11	4	2	1	2	5	2	3	1		2		1						110
29—30				3	7	5	8	9	12	6	13	7	4	6		2		2	1	1			1						1	88
31—32		1		1	5	7	9	7	6	5	6	7	7	1					1			1								64
33—34	1		1	1	2	4	6	3	10	5	10	3	4	3	3	3	1	1	1							1				63
35—36					4	3	5	6	4	2	5	5	2	3				2	1	1										43
37—38				1	3	3	5	4	4	5	2	2	2	1	1		2													35
39—40				1	2	2	2	1	2	1	2	3		1	1					1							1	1		21
41—42					3	2	4	3		1		4		1	1	1														20
43—44					1	1	5	2	2				1	1	1	2														16
45—46				2			1					1																		4
47—48					2			2	1				1		1															7
49—50					1							1		1	2															5
51—52					1		1	1			1																			4
53—54							1				1				1															3
55—56							1		1																					2
57—58																						1								1
59—60	1																													1
61—62															1															1
63—64					1	1																								2
65—66																														—
67—68								1																						1
73—74										1																				1
Totals	2	3	2	30	71	84	107	93	99	77	73	66	51	42	24	17	15	11	15	6	5	5	3	1	3	2	1	1	1	910

$\sigma_{\text{birth}} = 3{\cdot}7673$. $\sigma_{\text{marriage}} = 4{\cdot}3389$. $r = -\ {\cdot}0175 \pm {\cdot}0247$.

TABLE X.

Age of father at marriage and age at birth of eldest son.

Birth of eldest son	Age at marriage 13—14	15—16	17—18	19—20	21—22	23—24	25—26	27—28	29—30	31—32	33—34	35—36	37—38	39—40	41—42	43—44	45—46	47—48	49—50	53—54	55—56	57—58	59—60	Totals
15—16	1																							1
17—18			2																					2
19—20		2	2																					4
21—22			1	18	12																			31
23—24			2	1	37	17																		57
25—26		1		3	30	24	13																	71
27—28					8	22	40	22																92
29—30			1	2	5	11	11	22	19															71
31—32				2	8	6	11	19	34	11														91
33—34				1	5	6	11	10	8	13	9													63
35—36				1	2	2	3	9	7	8	18	9												59
37—38					2	6	2	3	2	6	6	8	9											44
39—40					1	1	3	2		3	4	5	14	2										35
41—42					3	5		1		1		5	5	8	3									31
43—44					1	2		2	1	2	3	2	2	3	3	2								23
45—46							2	1	4	1	1	2	1		5	2								19
47—48				1			2				1	1		1		1	3	1						11
49—50							1				1	1		2	1	4			1					11
51—52									1						1			1	3					6
53—54						1				1		1					2							5
55—56					1											1								2
57—58											1			1						1	1	1		5
59—60						1														1		2		4
61—62																						1		1
63—64												1												1
65—66								1																1
69—70				1															1					2
71—72										1												1	1	3
Totals	1	3	8	30	115	104	99	92	76	47	44	35	31	17	13	10	5	2	5	2	1	5	1	746

$\sigma_{\text{age at birth}} = 4{\cdot}3112$. $\sigma_{\text{marriage}} = 3{\cdot}5564$. $r = {\cdot}7338 \pm {\cdot}0114$.

TABLE XI.

Age of father at marriage and age of father at death.

Age at death	Age at marriage 13—14	15—16	17—18	19—20	21—22	23—24	25—26	27—28	29—30	31—32	33—34	35—36	37—38	39—40	41—42	43—44	45—46	47—48	49—50	53—54	55—56	57—58	59—60	Totals
23—28				1																				1
29—32			2	1			1																	4
33—36				1	3	1	2	1																8
37—40			1	1	5	1	3	4	2	1	3													21
41—44			2			2	4		2	1														11
45—48		2		3	6	4	4	6	3	3	2	1	3				2							39
49—52				1	10	8	6	2	3	1	3	1	2	1										38
53—56		1	2		8	8	6	7	3	4	2	2		1						1				45
57—60			1	2	8	11	5	6	8	2			2		5	1			1					52
61—64				2	12	9	11	5	5	3	3	2	3	1	1	1		1			1			60
65—68				2	9	6	9	17	6	10	4	6	4	1	1	2			2			1		80
69—72	1			3	13	17	13	5	10	3	7	3	5	3	2	1						1		87
73—76				5	13	12	12	15	14	7	5	5	2	4	1	1						1	1	98
77—80				4	12	11	13	5	7	3	5	3	2	2	1	2	3	1						74
81—84				2	9	6	8	8	6	2	6	5	5	4	2	1			2					66
85—88				1	5	6	2	9	4	5	3	5	3			1				1		1		46
89—92					2	1		1	2	2		2	1	1								1		13
93—96				1	2	1													1					5
101—104								1																1
105—116											1													1
Totals	1	3	8	30	117	104	99	92	75	47	44	35	32	18	13	10	5	2	6	2	1	5	1	750

$\sigma_{\text{death}} = 3{\cdot}5118$. $\sigma_{\text{marriage}} = 3{\cdot}4230$. $r = {\cdot}16198 \pm {\cdot}0239$.

TABLE XII.

Age of son at marriage and age of father at death.

Age at death	Age at marriage 13—14	15—16	17—18	19—20	21—22	23—24	25—26	27—28	29—30	31—32	33—34	35—36	37—38	39—40	41—42	43—44	45—46	47—48	49—50	51—52	53—54	55—56	57—58	63—64	71—72	Totals
25—28					1																					1
29—32				1	1	2				1																5
33—36				1	2	1		1						1					1							7
37—40				1	4	6		1	1	1	1	3								1						19
41—44					1	1	2		1	1								1						1		8
45—48	1		1	3	4	6	9	3	5	1				1					1							35
49—52				2	12	3	5	4	4	1	1			1	1	2	1									37
53—56				1	11	10	7	4	4	3	2	4	1		1											48
57—60				1	8	7	7	10	2	3	3	1	2	2	1									1		48
61—64			2	1	4	8	9	7	10	3		3	4	1		3										55
65—68		1			7	12	14	8	11	8	7		4			1	1	1		1					1	77
69—72				1	8	18	13	12	3	11	6	2	3	3		2		1		1						84
73—76		1		2	14	15	12	10	10	10	5	2	8	2	1	1		1	2				1			97
77—80					6	10	10	7	10	9	5	2	5	1	1	1		1	1		2					71
81—84				1	6	11	7	8	9	6	6	5	3	2		1	1									66
85—88				3	2	3	5	7	3	2	7	5	1	1	2		2					1				44
89—92				1	2	1	1	1	2		3		1						1							13
93—96					1	1	1							1												4
101—104							1																			1
109—112								1	1																	2
113—116							1																			1
Totals	1	2	3	19	94	115	104	84	76	60	46	27	32	16	7	11	5	5	6	3	2	1	1	2	1	723

$\sigma_{\text{death}} = 3{\cdot}4322$. $\sigma_{\text{marriage}} = 3{\cdot}5867$ $r = {\cdot}2219 \pm {\cdot}0236$.

TABLE XIII.

Age at marriage of father and age at marriage of son.

Father \ Son	13—14	15—16	17—18	19—20	21—22	23—24	25—26	27—28	29—30	31—32	33—34	35—36	37—38	39—40	41—42	43—44	45—46	47—48	49—50	51—52	53—54	55—56	57—58	63—64	73—74	Totals
13—14											1															1
15—16			1	1		1																				3
17—18					2	2	1			2																7
19—20		1		2	3	3	5	4		2	2		2	2			2									28
21—22	1	1	2	6	13	24	11	10	11	8	5	5	1	3		2	1		2		1		1			108
23—24				2	15	15	15	16	8	9	4	6	2	2	2	3		1	1	1						102
25—26					17	16	13	8	13	6	3	2	5	2	3	2		3		1				1	1	96
27—28				1	11	11	16	14	8	10	10	4	2	2								1				90
29—30				1	6	10	13	1	9	8	11	6	7			1		1		1						75
31—32				1	5	11	7	2	6	4	1		2	1					2							42
33—34					2	5	8	8	7	3	4	2	1	2												42
35—36				1	6	4	4	5	3	4	1			1	1	1	1				1					33
37—38				1		4	8	4	2	1	3		4				1		1							29
39—40					2		1	3	4	2		2	3			1										18
41—42					3	1	1	2			1	1												1		10
43—44					2	2		2			1		1			1										9
45—46				2		1				2																5
47—48								2																		2
49—50					1		1	2					1	1												6
53—54						1																				1
55—56						1																				1
57—58							1	1	1						1											4
59—60					1																					1
Totals	1	2	3	18	89	112	105	84	74	59	47	28	31	16	7	11	5	5	6	3	2	1	1	2	1	713

$\sigma_{\text{father}} = 3{\cdot}4747$. $\sigma_{\text{son}} = 3{\cdot}4683$. $r = {\cdot}04627 \pm {\cdot}0243$.

TABLE XIV.

Age of father at marriage and age at death of eldest son.

Death of son	Marriage of father 13—14	15—16	17—18	19—20	21—22	23—24	25—26	27—28	29—30	31—32	33—34	35—36	37—38	39—40	41—42	43—44	45—46	47—48	49—50	53—54	55—56	57—58	59—60	Totals
Under 20						2		1							1									4
21—24					1				1				1											3
25—28					1		1	1		1		1				1								6
29—32					1	2	2		2	1	1	1				1								11
33—36						1		1		1	1	1												5
37—40			1	1	6	4		6	4	2	3		2	2	1	1								33
41—44				1	3	4	2	3	2	1	1	2			2					1				22
45—48		1	1	4	4	3	5	6	5	2	2	3	2	2		1	1		1					43
49—52			2	1	7	7	3	7	7	4	3	2	1	1	1	1								47
53—56			1	1	7	8	2	2	4	5	3	2	2	1	1	1				1				41
57—60		1	1	3	9	2	5	6	6	3	4	1	4	1	1									47
61—64			1		9	7	13	11	8	5	6	4	4	2		1	1	2						74
65—68				2	10	20	12	8	3	3	2	1	1	2	2	1	2		1					70
69—72				3	17	14	17	13	8	7	2	3	2	2							1			89
73—76	1			5	18	8	11	6	11	6	6	5	4	1		2						3		87
77—80				2	8	8	16	5	7	2	2	4	2	1	1		1		1			1	1	62
81—84			1	3	9	5	5	7	5	3	5	1	4		3				3			1		55
85—88		1		1	3	6	4	7	2	1	2	3	2	2										34
89—92				3	1	1	1	2			1		1	1										11
93—96					1	1																		2
Totals	1	3	8	30	115	103	99	92	75	47	44	34	32	18	13	10	5	2	6	2	1	5	1	746

$\sigma_{\text{marriage}} = 3{\cdot}5429$. $\sigma_{\text{death}} = 3{\cdot}7561$. $r = -\ {\cdot}0298 \pm {\cdot}0242$.

Only two of these coefficients require note as the other four must necessarily be large owing to the nature of the data. r_{12} is negative, though small; as all the others are positive, it will be larger and still negative when the other variables are made constant. r_{24} is small but positive, this is due not to a transmitted tendency, but to the fact that the data cover a large period of time during which the marriage conventions have altered, and hence a slight positive association is produced. The restriction of the data as already narrated was not sufficiently stringent to remove it. Making the age of the father at death and marriage constant, we have:

$$_{34}r_{12} = -\cdot 1107 \pm \cdot 0211.$$

It would thus appear that a negative association exists between the age of the father when the son is born and the age at which the latter marries. It must be admitted that the value obtained is open to doubt; it is questionable as to whether it is really necessary to make the age of the father at death constant in all cases, for it may be, that only in the instances in which the son is a minor at the father's death is correction needful. Still, if we suppose that the true value lies between $-\cdot 1107$ and $-\cdot 0175$, the total and partial values, it would still suggest that a negative association exists.

A seventh table has been added to the above series, namely, Age of father at marriage and age at death of eldest son; in this case $r = -\cdot 0298 \pm \cdot 0246$, this lends support to the value of the partial r found for Age of father at birth of son and age of son at death, namely $r = -\cdot 0434 \pm \cdot 0239$.

The following series of observations are of some interest if the data can be said to be free from fallacy.

The information was obtained from such parents as attended the examination of their children under the provisions of the Education Act of 1907. As the particulars under consideration were limited to one age period, each pair was recorded once only. It is to be noted, however, that when information is obtained through the medium of offspring respecting characters pertaining to the parents, it is subject to certain fallacies that have already been mentioned and it may be that the following results are dependent on the number of surviving children possessed by certain of the categories into which the data were divided, rather than a consequence of the existence of a relationship between the age of the parents at birth of mates. This association is to be expected if age at birth influences age at marriage, for if a man

mates early because his father was old when he was born, that man must possess qualities which differentiate him from others, and in so far as assortative mating is an accepted fact a positive correlation should exist between the ages of parents at birth of mates.

The point is one of interest and it would be advisable that this portion of the enquiry should be re-examined through the material directly obtained by the Registrars on the occasion of the registration of a marriage. The constants for these observations are :

Age of mother at birth of husband, and age of mother at birth of wife :

$$r = \cdot 01798 \pm \cdot 0194.$$

It may be doubted whether it is justifiable to regard age as a simple variable or to consider definite periods of time as representative of changes that occur in an organism, dependent upon duration ; that is to say, it is doubtful whether the period designated by the 50th year measures something similar to that of the 20th. If this is the case then a contingency table would give a better reflection of the bias if such exists, than the fitting of a straight line to a series of means.

The coefficient of contingency $C_2 = \cdot 1654$. If corrected

$$C_2 = \cdot 0964 \pm \cdot 0214$$

(approximate only, computed by $\frac{1 - C_2}{\sqrt{\eta}} \cdot 67449$).

If we evaluate the correlation ratio

$$\eta \text{ (husbands' mothers)} = \cdot 06496 \pm \cdot 0181.$$

The linear prediction formula is $Y = 28 \cdot 484 + \cdot 01831\ X$ years.

We conclude that a small association does exist but that the regression is probably not strictly linear. Turning now to the age of the father, we have the following coefficients :

Age of father at birth of husband, and age of father at birth of wife :

$$r = \cdot 0524 \pm \cdot 0221.$$

Coefficient of contingency $C_2 = \cdot 1954 \pm \cdot 02799$.

If corrected $C_2 = \cdot 0931$ and the correlation ratio for arrays of husbands' fathers

$$\eta = \cdot 1233.$$

If corrected $\eta = \cdot 0997 \pm \cdot 02184$.

The association between age of father at birth of husband and age of father at birth of wife is more marked than in the case of mothers.

TABLE XV.

Age of father at birth of husband.

Age of father at birth of wife	20 & under	21—25	26—30	31—35	36—40	41 & over	Totals
20 & under	2	8	9	10	5	3	37
21—25	9	46	39	28	36	25	183
25—30	11	50	69	47	30	22	229
31—35	8	52	81	47	22	19	229
36—40	5	26	28	30	32	15	136*
41 & over	6	24	34	33	27	15	139
Totals ..	41	206	260	195	152	99	953

$C_{2(r)} = \cdot 1954 \pm \cdot 02799$. Order of probability about $\cdot 1$. $\sigma_{\text{wife}} = 1\cdot 1411$. $\sigma_{\text{husb.}} = 1\cdot 3717$.

$r = \cdot 0524$. $\eta_{\text{wife}} = \cdot 1223$. $\frac{\sqrt{n}}{\cdot 67449} \frac{1}{2}\sqrt{\eta^2 - r^2} = 2\cdot 5287$.

* Calculated by Blakeman's Formula.

TABLE XVI.

Age of mother at birth of husband.

Age of mother at birth of wife	20 & under	21—25	26—30	31—35	36—40	41 & over	Totals
20 & under	23	32	28	23	20	8	134
21—25	41	101	95	62	35	23	357
26—30	49	91	97	51	39	16	343
31—35	26	90	80	58	25	13	292
36—40	22	31	46	39	19	6	163
41 & over	9	23	30	13	15	5	95
Totals ..	170	368	376	246	153	71	1384

$C_r = \cdot 1654 \pm \cdot 0214$. $\sigma_{\text{husb.}} = 1\cdot 3554$. $\sigma_{\text{wife}} = 1\cdot 3801$. $r = \cdot 01798 \pm \cdot 0194$.
$\eta_{\text{husb.}} = \cdot 06496$. Linearity $= 1\cdot 7$. Equation $Y = 28\cdot 484 + \cdot 01831\, X$.

If then it can be assumed that these coefficients are not dependent on any statistical fallacy, they lend support to the original proposition, namely that the age at which mating occurs is to some extent determined by the ages of the parents when the parties concerned were born.

I am aware of, and have done my best to emphasise, the defects inherent in the data used in the present enquiry, and a necessary consequence of these imperfections is that several inferences can only be drawn with hesitation.

I think, however, that the concordance of the various results is sufficient to allow me to conclude that

(1) The ages of parents at the time of birth of their offspring are sensibly correlated with the latter's length of life, the sign of the

association being negative. The absolute value of the correlation is, however, small.

(2) This unfavourable influence acts principally at the beginning of life, becomes less marked during the adolescent period and perhaps again becomes prominent at the end of life.

I hope in a subsequent communication to deal with other aspects of this problem.

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