An examination of some recent studies of the inheritance factor in insanity / by David Heron.

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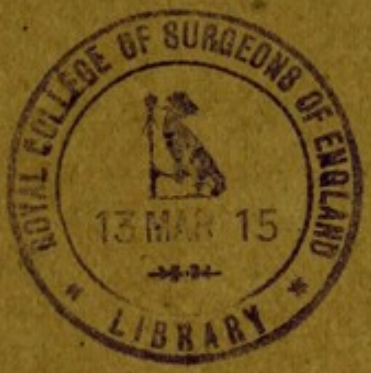
BY

DAVID HERON, D.Sc.



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AN EXAMINATION OF SOME RECENT STUDIES OF THE INHERITANCE FACTOR IN INSANITY

By DAVID HERON, D.Sc.*

In the last few years a number of studies of the inheritance factor in insanity have been published in America, Germany and England. The value of investigation of such a topic cannot be overestimated. We are quite certain that the prevalence of insanity is not falling; many of us indeed believe that the statistics suffice to demonstrate that it is substantially increasing, and that we can attribute this increase not in the first place to the intenser strain of modern life, but to the greater power of modern treatment to check or temporarily cure attack, and thus allow wider possibility of reproduction to members of affected stocks. Indeed the problem seems closely associated with an essential difficulty of modern civilisation, the greater protection of physically and mentally degenerate stocks unaccompanied by any adequate limitation of their thereby increased power of procreation; the inheritance factor thus tends to aid the relatively greater survival of the socially unfit. The studies we have referred to would be of great importance from this aspect of eugenics if (i) the data were collected without conscious or unconscious bias, and (ii) the inferences drawn from them followed logically from the data thus collected.

Unfortunately it is not only in the interpretation of statistics that adequate training is required. It is equally important that in the actual collection of them we should proceed, not only free from the bias which arises from the hurried acceptance of dogmatic theories of heredity, but what is often still more needful, free from the bias which is almost certain to waylay our progress, if we have not initially considered with trained insight the fallacies which may result from our method of recording or even tabulating our material. The day of the amateur in science is gone; no one now pays any attention to men who propound elaborate atomic theories or stellar hypotheses, without having had preliminary training in physical or astronomical science. There are still, however, some who appear willing to accept the statement of statistical data or the inferences drawn from those

* This paper formed the second portion of a lecture given at the Galton Laboratory on March 3, 1914.

data by men who have clearly had no adequate training in statistical science. The craniologist, the anthropologist, even the biological student of heredity and evolution are recognising that a statistical training is needful for the true interpretation of many of the facts in their special fields of research. The physiologist still appears to believe that he can deal with the average effects of diverse dietaries or the pathologist with the "mass-phenomena" of the hereditary factor in insanity without any training in statistical method. A physicist might just as logically assume that without mathematical training he could give an adequate mathematical account of a physical phenomenon, or a cosmic theorist suppose that he was effectively furnished for astronomical research by the perusal of a popular primer on the stars! The statistical calculus cannot be mastered by any easier road than the differential calculus, or, to put a more apt illustration, statistical training is as needful a preliminary to the handling of statistics, as time spent in a physiological laboratory to the effective handling of tissues. In twenty years it will be unnecessary to insist on these points, they will be universally recognised in the courts of science; but at present it is not only necessary to reiterate unpleasant truths, but to emphasise their validity by illustrations which bring home forcibly to scientist and layman alike the danger of amateur statistical handling. To state that a man is in error is not sufficient, if he continues time after time to repeat his assertions, apparently under the belief that incessant repetition will convince the world of the value of his theories.

In the case of the inheritance factor in insanity we are not dealing with any purely academic question of science. We are up against one of the most difficult problems of modern life, where true advice is of urgent importance to the nation as well as to the individual. It is not only the medical man but the layman who seeks guidance in the question of the marriage of members of insane stocks, and a laboratory like the Galton Laboratory knows how often advice on such points is sought. It is disheartening when help is rendered to the seeker to be faced with the criticism: "But Professor ——— says I may marry if I take a wife of sound stock," or "Dr ——— recommends marriage, although my father was insane, because I am over twenty-five and still sane myself." When teaching of this kind, arising solely from false interpretation of defective data, is spread widecast in a dozen different papers or journals, it is not sufficient to issue a brief statement of its futility. It is needful to give it the *coup de grâce* by a more lengthy criticism of its fallacies and their illustration in a form more likely to impress the imagination. The attempt is made in this paper to deal with only one of the authors, who have contributed fallacious eugenic rules to those seeking knowledge on the influence of the hereditary factor in insanity.

In a long series of papers Dr F. W. Mott, Pathologist to the London County Asylums, has stated that when the children of insane parents become insane, they do so at a much earlier age than did their parents, and on the basis of this assertion he has drawn some very sweeping conclusions for practical conduct. Thus in the

British Medical Journal of May 11, 1912 (p. 1060), he states that "this signal tendency of insane offspring to suffer with a more intense form of the disease and at an early age, as shown in the above figures and tables, is of great importance for the following reasons: first, it is one of Nature's methods of ending or mending a degenerate stock; secondly, it is of importance to the physician, for he can say that there is a diminishing risk of the child of an insane parent becoming insane after he has passed 25, a matter of great importance in the question of marriage; thirdly, it is of importance in connection with the subject of social surgery of the insane, for when the first attack of insanity occurs in the parent the children for the most part have all been born....Sterilization would therefore be applicable to relatively few parents admitted to asylums."

Put briefly, Dr Mott's views are that in "Antedating" or "Anticipation," in this alleged tendency of the offspring to become insane at any earlier age than their parents, we have Nature's method of purifying degenerate stocks, that the children of insane parents who are still normal at the age of 25 may safely marry*, and that it is useless to take any special measures to limit the reproduction of the insane since nearly all their children are born before the onset of insanity.

These conclusions, if proved to be correct, would be of the utmost importance to the Eugenist. If the Law of Antedating or Anticipation really acts in the way Dr Mott has suggested, then it would seem to be unnecessary to take any special Eugenic action in the case of the insane and indeed the "Law" has already been used in support of this view. Thus in a leading article in the *British Medical Journal*†, which deals with Dr Mott's work, it is stated that "This intensification of mental disease in the young—this 'anticipation' as it is called, which is one of Nature's methods of ending or mending a degenerate stock, is specially important in connection with sterilization, as the figures given by Dr Mott show that when the first attack of insanity occurs in the parent the children have for the most part all been born. Sterilization, therefore, would be applicable in relatively few cases."

It is at least obvious that when views such as these are taken of the "Law of Anticipation," it merits the most careful examination. Let us consider, then, first of all, Dr Mott's presentation of the case for anticipation. For some years past Dr Mott has been engaged in the collection of cases in which two or more members of a family are or have been resident in London County Asylums, and has noted wherever possible the age of onset of the insanity. Information was thus obtained regarding 217 pairs of father and offspring, and 291 pairs of mother and offspring and the results are summed up in the following table.

Thus in comparing the age at onset of insanity in father and offspring, we find that among the fathers only 1·4 °/₀ became insane before the age of 20, while among the offspring the percentage was 26·2. These figures are also shown graphically in

* See for instance *Problems in Eugenics*, p. 426.

† May 11, 1912, p. 1089.

Figs. 1 and 2*. Here the horizontal scale represents the age of onset in 5-year groups—the vertical scale the percentages of cases occurring in each age group.

TABLE I.

Percentages of Cases whose First Attack of Insanity occurred within Various Age-periods.

Age-periods	Father	Offspring	Mother	Offspring	
	Per cent.	Per cent.	Per cent.	Per cent.	
Under *20* years	1·4	26·2	0·6	27·8	
20—24 years ...	0·4	18·0	3·4	15·7	Adolescence
25—29 „	1·4	18·0	4·4	18·2	Adolescence
30—34 „	9·6	13·0	7·8	13·4	
35—39 „	11·5	7·3	9·2	10·0	
40—44 „	9·2	6·4	10·3	5·8	
45—49 „	14·3	6·0	12·0	3·7	Involutional period
50—54 „	17·5	0·9	12·3	2·4	Involutional period
55—59 „	13·8	3·7	14·0	1·7	
60—64 „	10·1	—	11·6	1·3	
65—69 „	5·0	—	8·8	—	
70—74 „	4·6	0·4	3·1	—	
75—79 „	0·4	—	1·3	—	
80 „	0·4	—	0·6	—	

I have been obliged to follow Dr Mott in treating the "under 20" group as a 5-year group as otherwise my diagrams would bear no resemblance to his, but this procedure is far from satisfactory when such a large proportion of the cases in this group are congenital cases in which the age of onset should be taken at 0 years. The tables and diagrams show that among the parents more than half the cases occur after the age of 50, while among the offspring, more than half occur before 30, and this is taken to prove that there is Anticipation or Antedating in Insanity.

This will perhaps be made more evident if the percentages of those who became insane before the age of 25 are given in each case. Among the fathers, 2 °/₀ and among the mothers, 4 °/₀ became insane before the age of 25. Among the offspring, on the other hand, the percentage is 44. Another way of looking at the matter is to take the average age of onset of insanity in each case. Dr Mott gives a Table showing these averages but unfortunately has omitted the congenital cases so that the extent of anticipation is considerably under-estimated, and the form in which the data are given does not permit of an accurate calculation of the actual averages. From the information given it appears, however, that the average age at onset of insanity among the parents is about 50 years, among the offspring about 26 years, showing an anticipation or antedating of some 24 years.

* I am very grateful to Miss H. Gertrude Jones, the Hon. Secretary of the Galton Laboratory, for the diagrams which illustrate this lecture.

Figs. 1 and 2. Diagrams to illustrate the Distribution of Age at Onset of Insanity in Parent and Offspring. (Mott.)

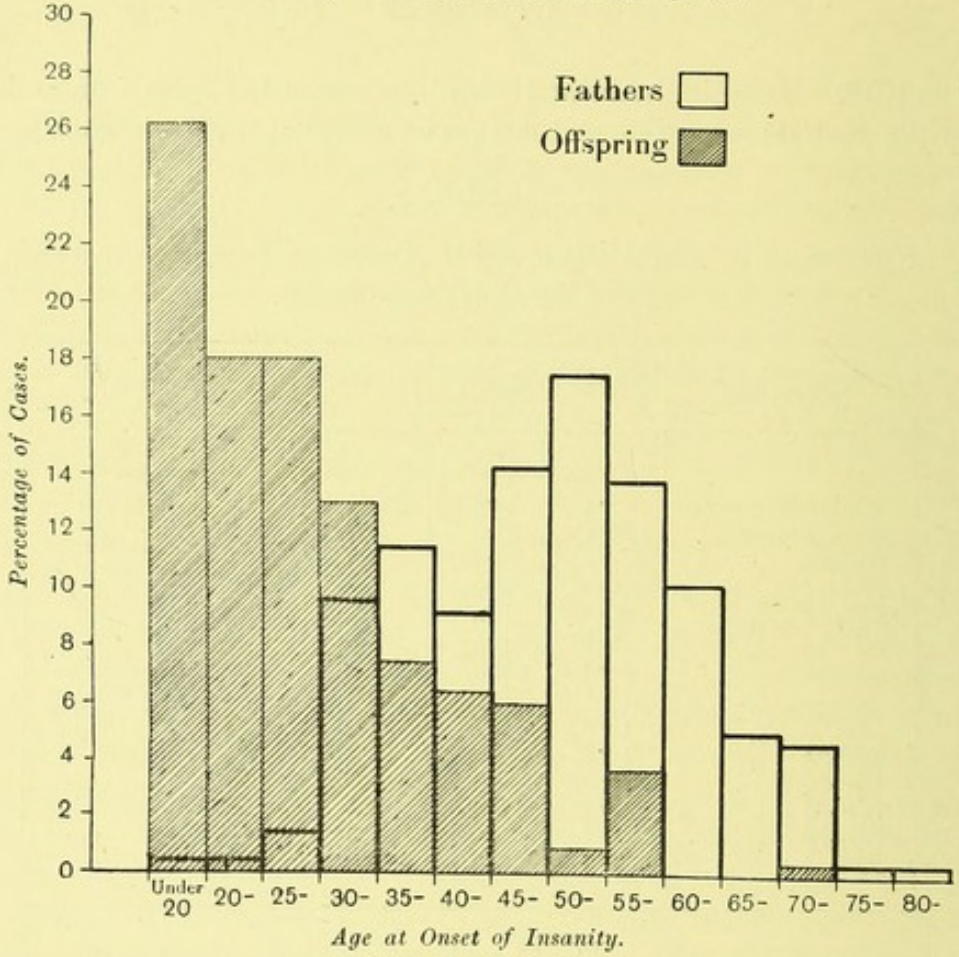


Fig. 1.

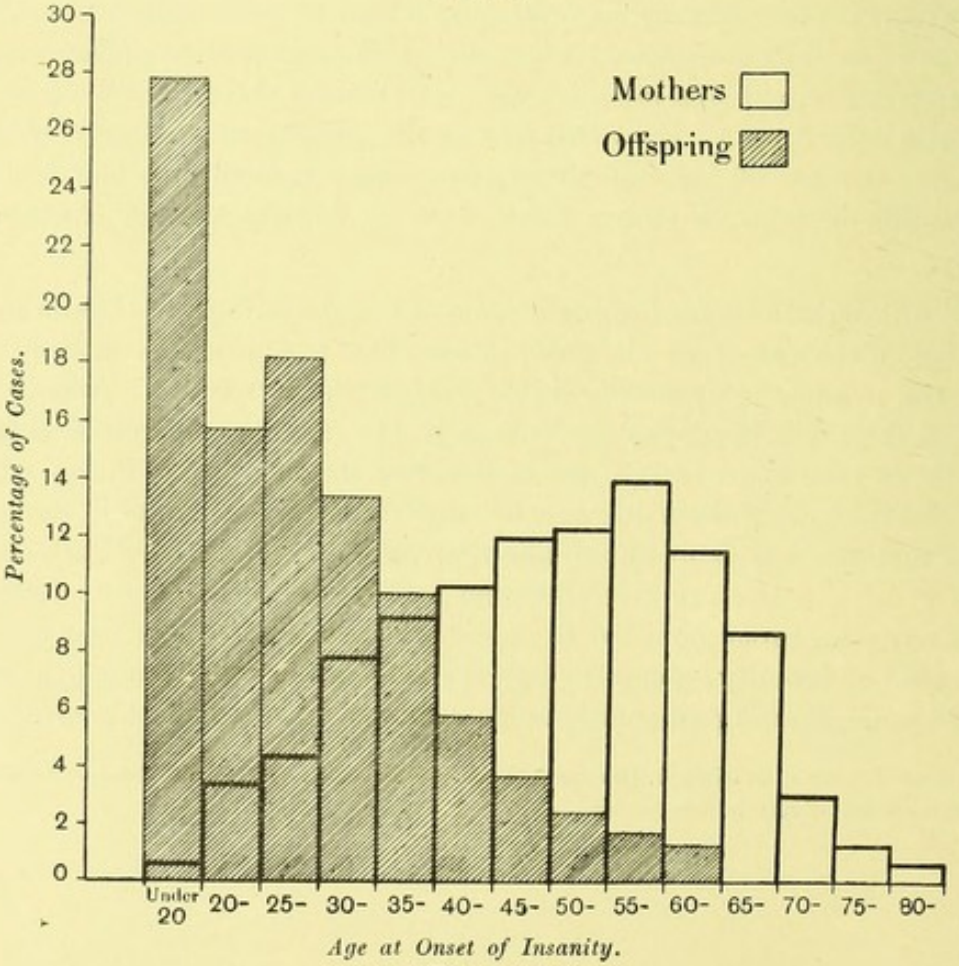


Fig. 2.

Now these conclusions, if satisfactorily demonstrated, would obviously be of the highest importance, but they were immediately challenged by Professor Karl Pearson in a letter which appeared in *Nature* of November 21, 1912 (p. 334). Professor Pearson's letter is as follows:

On an Apparent Fallacy in the Statistical Treatment of "Antedating" in the Inheritance of Pathological Conditions.

The problem of the antedating of family diseases is one of very great interest, and is likely to be more studied in the near future than ever it has been in the past. The idea of antedating, i.e. the appearance of an hereditary disease at an earlier age in the offspring than in the parent, has been referred to by Darwin and has no doubt been considered by others before him. Quite recently, studying the subject on insanity, Dr F. W. Mott speaks of antedating or anticipation as "Nature's method of eliminating unsound elements in a stock" ("Problems in Eugenics," papers communicated to the First International Eugenics Congress, 1912, p. 426).

I am unable to follow Dr Mott's proof of the case for antedating in insanity. It *appears* to me to depend upon a statistical fallacy, but this apparent fallacy may not be real, and I should like more light on the matter. This is peculiarly desirable, because I understand further evidence in favour of antedating is soon forthcoming for other diseases, and will follow much the same lines of reasoning. Let us consider the whole of one generation of affected persons at any time in the community, and let n_s represent the number who develop the disease at age s, then the generation is represented by

$$n_0,\ n_1,\ n_2, \ldots\ n_s, \ldots\ n_{100},\ \text{say}.$$

Possibly some of these groups will not appear at all, but that is of little importance for our present purpose.

Let us make the assumptions (1) that there is no antedating at all; (2) that there is no inheritance of age of onset; thus each individual reproduces the population of the affected reduced in the ratio of p to 1. Then the family of any affected person, whatever the age at which he developed the disease, would represent on the average the distribution

$$pn_0,\ pn_1,\ pn_2, \ldots\ pn_s, \ldots\ pn_{100}.$$

The sum of such families would give precisely the age distribution at onset of the preceding generation.

Now let us suppose that for any reason certain of the groups of the first generation do not produce offspring at all, or only in reduced numbers. Say that q_s only of the n_s are able to reproduce their kind; then of the older generation, *limited to parents*, the distribution will be

$$q_0n_0+q_1n_1+q_2n_2+\ldots+q_sn_s+\ldots+q_{100}n_{100},$$

but the younger generation will be

$$p\,(q_0n_0+q_1n_1+q_2n_2+\ldots+q_sn_s+\ldots+q_{100}n_{100})\,(n_0+n_1+\ldots+n_s+\ldots+n_{100}),$$

i.e. the relative proportions will remain absolutely the same.

The average age at onset and the frequency distribution of the older generation, that of the *parents*, will be entirely different from that of the offspring and will depend wholly on what values we give to the q's. If frequency curves be formed of the two generations they will differ substantially from each other. This difference is not a result or a demonstration of any physiological principle of antedating but is solely due to the fact that those who develop the disease at different ages are not equally likely to marry and become parents.

A quite striking instance of the fallacy, if it be such, would be to consider the antedating of "violent deaths." Fully a quarter of such deaths in males, nearly a half in females, occur before the age of twenty years. Consider now the parents and offspring who die from violent deaths; clearly there would be no representative of death from violence under twenty in the parent generation, and we should have a most marked case of antedating, because the offspring generation would contain all the infant deaths from violence.

In the case of insanity, is the man or woman who develops insanity at an early age as likely to become a parent as one who develops it at a later age? I think there is no doubt as to the answer to be given; those who become insane before twenty-five, even if they recover, are far less likely to become parents than those who become insane at late ages—many, indeed, of them considering the high death-rate of the insane, will die before they could become parents of large families. Now Dr Mott took 508 pairs of parents and offspring, "collected from the records of 464 insane parents whose 500 insane offspring had also been resident in the County Council Asylums," and ascertained the age of first attack. As at present advised, it seems to me that his data must indicate a most marked antedating of disease in the offspring, but an antedating which is wholly spurious. There is, I think, a further grievous fallacy involved in this method of considering the problem, but before discussing that I should like to see if my criticism of this method of approaching the problem of antedating can be met.

KARL PEARSON.

Biometric Laboratory,
University College, London,
November 11, 1912.

Dr Mott has referred to this letter in his *Report* for 1912*, but it will be more convenient to deal with his reply after we have examined the method by which his data have been collected and the use made of the data. Let us consider first of all how the data were obtained. Dr Mott in describing his material says that it consists of a collection of cases in the London County Asylums where two or more persons are related to one another. Thus Dr Mott has dealt—not with a series of complete pedigrees in which every member is included, whether insane or normal, but with a series of cases in which two or more members of a family are known to have been in London County Asylums. No notice is taken of those who are normal throughout their lives and no allowance is made for those who are normal at the time the record is made but who may afterwards become insane.

Do cases selected in this way provide a complete or impartial view of the facts? Some of Dr Mott's own comments on his data throw a considerable amount of light on this point. In his *Report* for 1909† he says: "From all the Asylums I have received valuable reports, but in the case of the older asylums it has been a matter of the utmost difficulty to trace the records of so many years back," and in his *Report* for 1910‡ he says, "Some of the asylum authorities have gone through their case books for a number of years back, but the results have not been satisfactory owing to the difficulty of obtaining particulars without a living representative of the family being resident in the asylum—for instance, 110 old cases

* *Annual Report of the London County Council for* 1912, Vol. II. p. 62.
† *Twentieth Annual Report of the Asylums Committee of the L.C.C.*, p. 90.
‡ *Twenty-first Report of the Asylums Committee of the L.C.C.*, p. 94.

reported from Bexley have been rejected as the relatives in the other London County Asylums could not be traced, for no instance has been included unless full particulars could be obtained."

It is thus clear that not all the cases could be traced and that there was special difficulty in tracing the older cases. What is the effect of a selection of this kind? A study of the following hypothetical cases may serve to throw some light on this point.

TABLE II.

Anticipation or Antedating in Insanity. Hypothetical Examples to show the Effect of Dr Mott's Selection of Cases.

		First Example	Second Example
Mother:	Born	1873	1833
	Married	1893	1853
	Became Insane and admitted to Asylum	1913	1873
	Age at First Attack	40	40
	Died	1914	1874
Son:	Born...	1894	1854
	Became Insane	1894*	1914
	Admitted to Asylum	1914	1914
	Age at First Attack	0	60

The mothers in those two examples have exactly parallel careers. In each case the mother became insane at the age of 40 and only lived one year in the asylum. In the first case the son was a congenital idiot but was only admitted to an asylum at the age of 20. The age of onset in this case is taken at 0 years and the case shows marked "anticipation." In the second case the mother also became insane at the age of 40, the son not till the age of 60, 40 years after his mother's death. The second example thus tells against the Law of Anticipation. Are these two cases equally likely to appear in Dr Mott's data?

In the first case mother and son are in the asylum at the same time and were admitted within a year of each other. It is very improbable that the relationship would escape notice and such a case is almost certain to be recorded. In the second case, however, the son is not admitted to an asylum till 40 years after his mother's death. Even if the family remained in the same area for 40 years after the mother's death, it would obviously be very difficult to connect the histories of mother and son. This case, which tells against the Law of Anticipation, is almost certain to escape notice. A spurious anticipation or antedating is thus inevitable owing to the method of collecting the data.

It has also been pointed out that Dr Mott has made no allowance for those who are mentally normal at the time the record is made but may subsequently

* Congenital Idiot.

become insane, and this introduces further spurious anticipation. Another hypothetical example will perhaps make this clear. Let us take the case of a mother with six children, five of whom have become insane as follows:

TABLE III.

	Mother	Children					
		1	*2*	*3*	*4*	*5*	*6*
Born	1830	1850	1852	1854	1856	1858	1860
Became Insane ...	1860	—	1872	1896	1914	1888	1860†
Age at Onset of Insanity	30	—*	20	42	58	30	0

The extent to which this family would show anticipation or antedating would depend very largely on the time at which the record was made as is shown in the following table.

TABLE IV.

Date of Record	Age of Onset of Insanity in		Average for Children	Amount of Anticipation
	Mother	Children		
1860	30	0	0	30
1872	30	0, 20	10	20
1888	30	0, 20, 30	16·7	13·3
1896	30	0, 20, 30, 42	23 0	7
1914	30	0, 20, 30, 42, 58	30	0

If the case were noted in 1860 then the age of onset of insanity in the mother is 30 years—of the child 0 years—a clear case of anticipation, and nothing would be known of the fact that four other children will afterwards become insane and will bring the average age of onset in the children up to 30 years—exactly the same as that of the mother. Nor is the record even now complete for if the eldest child ever becomes insane, the age of onset in his case must be at least 64 years and this will further increase the average age of onset in the children. It is thus clear that in dealing with incomplete families and ignoring the possibility that those who are normal at the time of record may afterwards become insane, Dr Mott has introduced a further spurious anticipation or antedating.

If we examine carefully the first pedigree given by Dr Mott at the Eugenics Congress‡, we see clearly how probably much of the anticipation recorded by

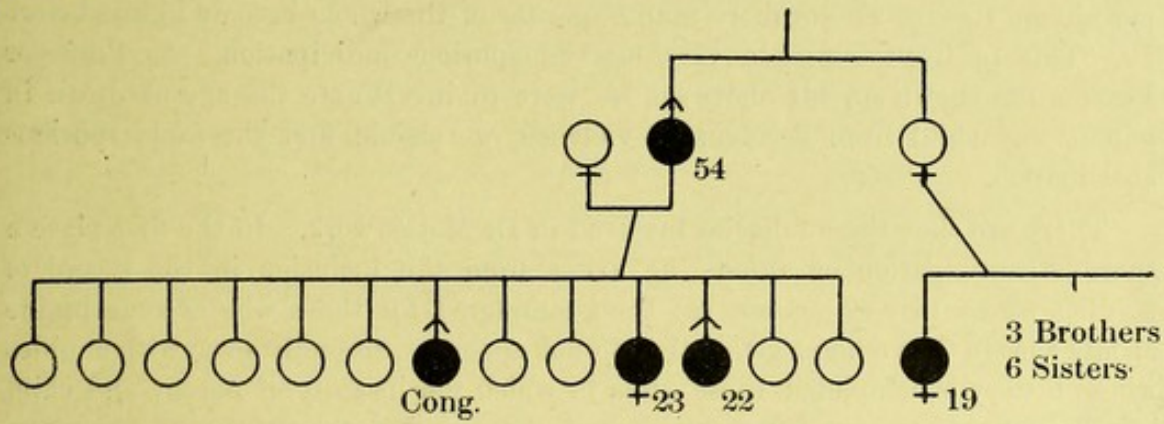
* Alive, 64 years of age and still normal.

† Congenital Idiot.

‡ *Problems in Eugenics*, p. 413.

Dr Mott has arisen. Unfortunately this is the only pedigree for which sufficient details have been given to enable its completeness to be tested. The pedigree and Dr Mott's description of it are as follows:

"A.B., an alien Jew, aged 54, was admitted to an asylum for the first time suffering from involutional melancholia; he has a sister who has not been in an asylum, but, as events turned out, bore the latent seeds of insanity. The man is married to a healthy woman who bore him a large family; the first five are quite healthy, then comes a congenital imbecile epileptic (cong.)*, then two healthy children followed by a daughter who becomes insane at 23, then a son insane at 22, and lastly two children who are up to the present free from any taint. The sister of A.B. is married and has a family of ten, seven girls and three boys; one of the females was admitted to the asylum at the age of 19, and since this pedigree was constructed a brother of hers has been admitted aged 24. Half-black† circles are insane. The pedigree is instructive; it shows direct and collateral heredity; it also shows remarkably well the signal tendency to the occurrence of insanity at an early age in the children of an insane and potentially insane parent."



● = Insane.

13 children: 9 Alive, 4 Sons, 5 Daughters. 4 Dead. 3 Insane.

Fig. 3. Pedigree to illustrate the effect of Dr Mott's selection of cases.

F. W. Mott: "Heredity and Eugenics in relation to Insanity." *Problems in Eugenics*, p. 413.

This pedigree was given as above in July 1912, and in an address previously delivered before the Manchester Medical Society on Oct. 4, 1911, Dr Mott gave the same pedigree, but without any reference to the nephew of A.B. (brother of the girl who became insane at 19) who became insane "since the pedigree was constructed," so that this man became insane between 1911 and 1912 and this serves to "date" the pedigree.

Now it should be noted that at least five of the children of A.B. are over 23 years of age and up to the present time healthy. But all these children are alive and if any one of them afterwards becomes insane, the average age of onset of insanity in the children will be raised—and it is clear that the more incomplete the pedigree the greater the amount of spurious anticipation. Again Dr Mott states that in

* This does not agree with Dr Mott's pedigree which gives the congenital case as the seventh instead of the sixth child.

† According to our usual custom, they are represented by full black circles in Fig. 3.

nephews and nieces the age of onset is earlier than in uncles and aunts. In 1911 this pedigree gives a case in which an uncle became insane at 54, his niece at 19—but one year later a nephew who became insane at 24 has to be added, thus raising the average and there are eight more children some at least of whom may become insane at later ages. As before the incompleteness of the pedigree introduces an artificial and spurious anticipation or antedating. The remedy is obvious; we must only deal with completed families.

A further fallacy involved in Dr Mott's method of work must now be noted. In directly comparing the age of onset in parent and child, Dr Mott has ignored the fact that in the parent the incidence of insanity is for all practical purposes limited to the age of 20 and over since cases of congenital defect and of adolescent insanity hardly ever marry. Among the general population of asylums, however, 12 °/₀ become insane before the age of 20 and in Dr Mott's selected data the percentage rises to 27—or more than a quarter of the whole become insane before 20. This in itself causes a very marked spurious anticipation. As Professor Pearson has shown (p. 361 above) if we were to investigate the age at death in parent and child from accident or violence, we should find the same spurious anticipation.

There are thus three fallacies involved in Dr Mott's work. In the first place a spurious anticipation or antedating arises from the inclusion in the record of families whose history has not yet been completed, for those who become insane at late ages in the younger generation do not appear. Secondly, even with families whose history is completed, those cases in which the insanity of parent and child is contemporaneous are far more likely to be recorded than those in which the child becomes insane long after the parent*, and thus the cases which show anticipation are more likely to appear in the record than those which tell against Dr Mott's views. Thirdly, by directly comparing parent and child, he has practically limited one of the two groups which are being compared to ages at onset of over 20 years and has thus obtained further spurious anticipation.

Dr Mott also lays stress on the appearance of insanity in a more intense form in the younger generation. "I have proved," he says†, "that there is a signal tendency in the insane offspring of insane parents for the insanity to occur at an earlier age and in a more intense form in a large proportion of cases, for the form of insanity is usually either congenital imbecility, insanity of adolescence, or the more severe form of dementia praecox, the primary dementia of adolescence, which is generally an incurable disease." But we have already seen that Dr Mott's method of collecting his data is such that an enormous preponderance of early cases of insanity in the younger generation is inevitable and of course such cases are largely incurable. Type of disease is very closely related to the age of onset and

* Dr Mott states (*Archives of Neurology*, Vol. VI. p. 82) that "the main bulk of the cards (i.e. his records), however, refer to parents and offspring admitted to the asylums within the last fifteen years."

† *Archives of Neurology*, Vol. VI. p. 82.

by selecting the latter we can alter the proportion of any particular type of insanity. Dr Mott has obtained his material in such a way that, in the younger generation, cases of insanity coming on late in life are much less likely to be recorded than those which appear in early life, and hence the early cases are in a majority, but the change in age of onset, and consequently of the type, is entirely spurious and arises solely from the way in which the material has been obtained.

We can now deal with the reply Dr Mott has made to Professor Pearson's criticisms. In his *Annual Report* for 1912 (p. 62), Dr Mott says: "Professor Karl Pearson, writing to *Nature*, November 21, 1912, 'On an apparent fallacy in the statistical treatment of "Antedating" in the inheritance of pathological conditions,' criticises on mathematical grounds the evidence of anticipation. I do not feel myself competent to reply to the opinion of such an eminent authority on mathematics applied to biometrics, but it does not militate against my conclusions, nor explain away the fact that a large proportion of the insane offspring of insane parents are affected with imbecility or adolescent insanity; for granting the assumption that there is no antedating at all, we might rightly expect the ages at onset of insane offspring of insane parents to be comparable with the ages at onset of all the admissions to the asylums during the same period*. This is by no means the case, for amongst the insane offspring there is a far greater proportion affected early in life, as is shown in the following figures and curves" (they appear here as Fig. 4 and Table V).

According to these figures the onset of insanity among the *recorded* insane offspring of insane parents is considerably earlier than among the general admissions to asylums, but it has already been shown that this is due to the fact that the data have been selected in such a way that the early cases in the younger generation are the most likely to appear. Further, if Dr Mott's argument be a valid one, we might also expect the ages at onset of the insane parents of these insane offspring to be comparable with the ages at onset of all the admissions to asylums during the same period. This is by no means the case as is shown in Fig. 5 below (see also Tables I and V). We see here that the insanity of the parents comes on at a much *later* period than among the general admissions to asylums and that there is a far less proportion affected early in life. If Dr Mott's method of argument be sound, he has not only to deal with an antedating of insanity among the offspring but also a post-dating of insanity among the parents. Both are of course spurious and arise from the peculiar selection of the data and from the fact that, owing to differential death-rates, the ages at onset of "admissions" will never be the same as the ages at onset of the admitted—i.e. the asylum population—at any time.

* "We might rightly expect" these ages to be different, because "admissions" are not the same as the population in the country who have at one time or another been insane. The percentages of total cases of acute mania, of senile insanity, of congenital idiocy, and of melancholia, who reach the asylums, are not the same. The reader has to distinguish between the population of admissions, the population of admitted, and the insane population of the country. A sample of the latter may be reached from completed family histories, but not from records on admission or from records of an asylum population

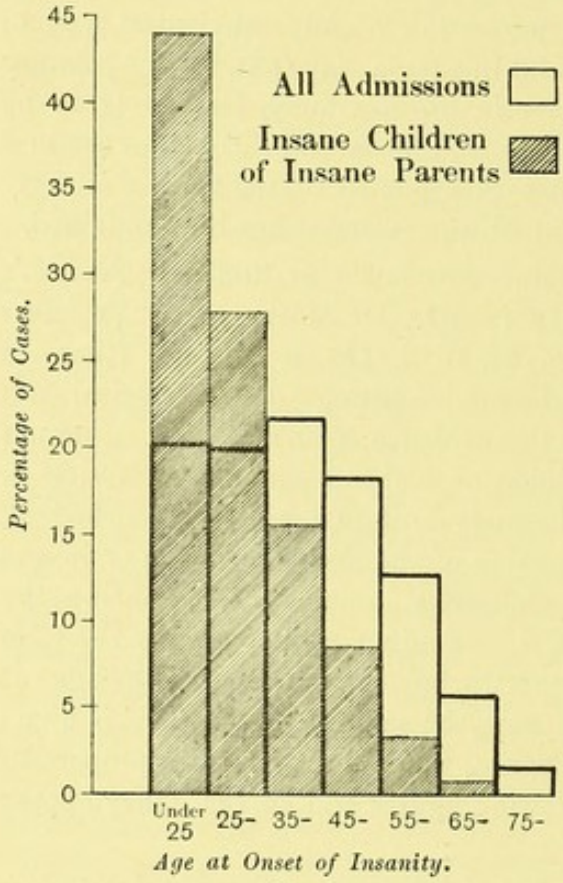


Fig. 4.

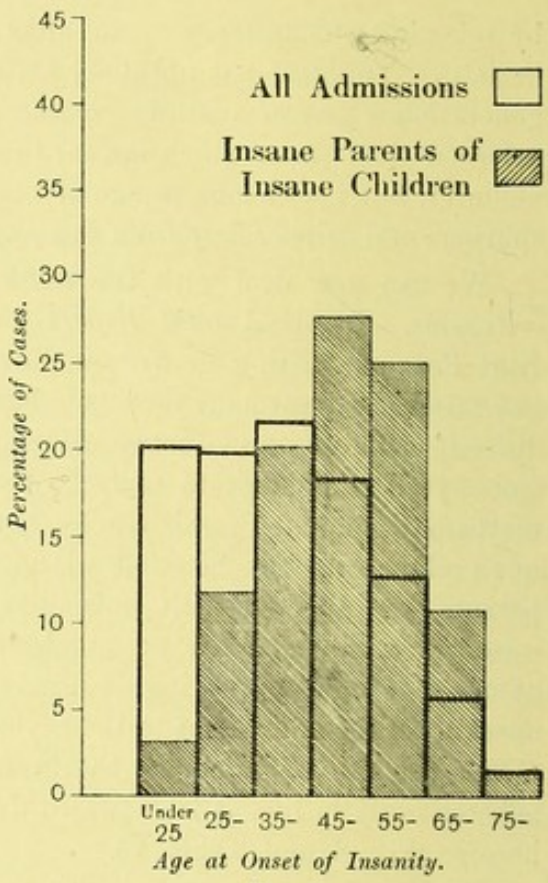


Fig. 5.

Diagram to illustrate the Distribution of Age at Onset of Insanity among:
(1) The Insane Offspring of Insane Parents.
(2) The Insane Parents of Insane Offspring.
(3) All Admissions to L.C.C. Asylums.

TABLE V. *Percentage Comparison of the Age at time of Onset of Insanity in the Insane Offspring of Insane Parents and the General Admissions to the London County Asylums.*

Age at Onset of Insanity	Male		Female		Total	
	4482 direct admissions during last four years	274 insane offspring of insane parents	5097 direct admissions during last four years	389 insane offspring of insane parents	9579 direct admissions during last four years	663 insane offspring of insane parents
Under 25	20·0	43·8	20·2	44·2	20·1	44·0
25—34	19·9	27·7	19·9	28·0	19·9	27·9
35—44	21·9	13·8	21·5	16·7	21·7	15·5
45—54	17·7	10·2	18·6	7·4	18·2	8·5
55—64	13·3	3·6	12·4	2·8	12·7	3·2
65—74	5·7	0·7	5·9	0·8	5·8	0·7
75	1·5	—	1·6	—	1·5	—

41 male	imbeciles out of	274	offspring
54 female	„	„	389	„
95 male and female	„	„	663	„

It is possible to illustrate the various fallacies which vitiate Dr Mott's conclusions regarding anticipation by considering the age at death of parent and child. I do not know whether it is generally recognised that it is exceedingly difficult to get any considerable body of data in which the ages at death of a parent and all his children are given, for of course the record is incomplete and biassed until the death of the last surviving member, and in some cases to get a complete record we must trace the history of a family for over 150 years. George the IIIrd, for instance, was born in 1738 and all but one of his 15 children were still alive in 1810, 72 years afterwards, and the last surviving son, Duke of Cumberland and King of Hanover, did not die till 1851, 113 years after his father's birth—and this is by no means an extreme case. In the material I am about to describe I found one case where the interval was 160 years.

Another difficulty which arises is the tendency in practically all family histories to omit infant deaths, so that we do not get a complete record. It seems probable that the deaths of minors are not represented in such records in anything like their true proportion and that the differences are greater than might be expected to arise from differences of physique and nurture due to class. Thus records of the Landed Gentry give 31 deaths per 1000 males under 20 years* while actual experience shows 163 to 197 per 1000†. But in the records of the reigning families of Europe we get a practically complete record of all members and therefore from von Behr's *Genealogie der in Europa regierenden Fürstenhäuser*‡, I have extracted particulars of the age at death of over 2000 individuals—all belonging to the 18th century. There was here no selection—every child was entered and every family had been traced from the birth of the parents till the death of the last survivor.

Now in Dr Mott's data we have already seen that cases in which the age at onset of insanity in parent and child is contemporaneous are most likely to be recorded. We can test the effect of a selection of this kind by investigating the effect of selecting, from our data regarding the age at death among those royal families, only those individuals who died within a certain number of years of their father's death, and the results are given below in Table VI, p. 370.

When we deal with the whole of the data, absolutely unselected, every family being complete and traced to the death of the last surviving member, we find that 680 out of 1829 or 37·2 °/₀ died under 20 years of age. Let us now apply a very slight selection to the data and reject the 92 cases in which the interval between the deaths of father and child was at least 60 years. We find now that 680 out of the remaining 1737 died under 20 years of age—or 39·1 °/₀. Thus the effect of a selection of this kind is to cause a slight increase in the proportion of deaths at the early ages. If we make the selection slightly more stringent, by taking only those who died within 40 years of their father's death, the percentage of individuals dying under 20 years of age rises to 46·7 and if we go still further and consider

* See Pearson: *Proc. R. S.* Vol. 65, p. 291.

† *Statistics of Families*, p. 73.

‡ Tauchnitz, Leipzig, 1870.

TABLE VI.

Illustrating the Effect of Selection of Material on the Distribution of Age at Death.

(Reigning Houses in Europe—18th Century.)

Age at Death	All Cases Unselected Data		Children who died: within 60 years of their father's death		within 40 years of their father's death		within 20 years of their father's death		in their father's lifetime	
	Numbers	%	Numbers	%	Numbers	%	Numbers	%	Numbers	%
Under *20*	680	37·2	680	39·1	680	46·7	680	62·4	648	82·7
20—39	277	15·1	277	15·9	277	19·0	254	23·3	121	15·4
40—59	336	18·4	336	19·3	274	18·8	127	11·7	15	1·9
60—79	450	24·6	395	22·7	214	14·7	29	2·7	—	—
80 and over	86	4·7	49	2·8	10	·7	—	—	—	—
Totals	1829	—	1737	—	1455	—	1090	—	784	—
Average Age at Death*	35·9		33·7		26·9		16·2		7·7	

only those who died in their father's lifetime, then the percentage rises to 82·7 %. Looking at the matter in another way we find that the average age at death has fallen from 35·9 years to 7·7 years.

The same facts are given in Fig. 6, which shows that as the selection of cases becomes more stringent, there is a regular increase in the proportion of deaths at the younger ages. In exactly the same way, the fact that cases where the insanity of parent and child is contemporaneous are the most likely to appear in Dr Mott's records causes a spurious exaggeration of the cases of insanity at early ages in the younger generation and consequently a spurious exaggeration of the number of cases of imbecility and adolescent insanity.

We can also investigate directly the question of anticipation or antedating on this material. In order to avoid the heavy weighting of large families which would arise if every child were entered, I have taken only one child from each family. Let us consider first of all the distribution of age at death of Fathers and their First-born Children. The facts are given in Table VII.

We have altogether 294 cases in which we know the age at death of a father and his first-born child. None of the fathers died before 20 but of the children

* These averages were calculated, not from the five age groups given above, but from the same material classified in 15 age groups.

106 out of 294 or 36·1 °/₀ died before 20. The average age at death among the fathers is 61 years, but among the children it is only 36 years, so that there is an anticipation of 25 years. To borrow Dr Mott's words, the figures clearly show the signal tendency among the offspring to die at a much earlier age than their parents; that is to say, anticipation or antedating is the rule.

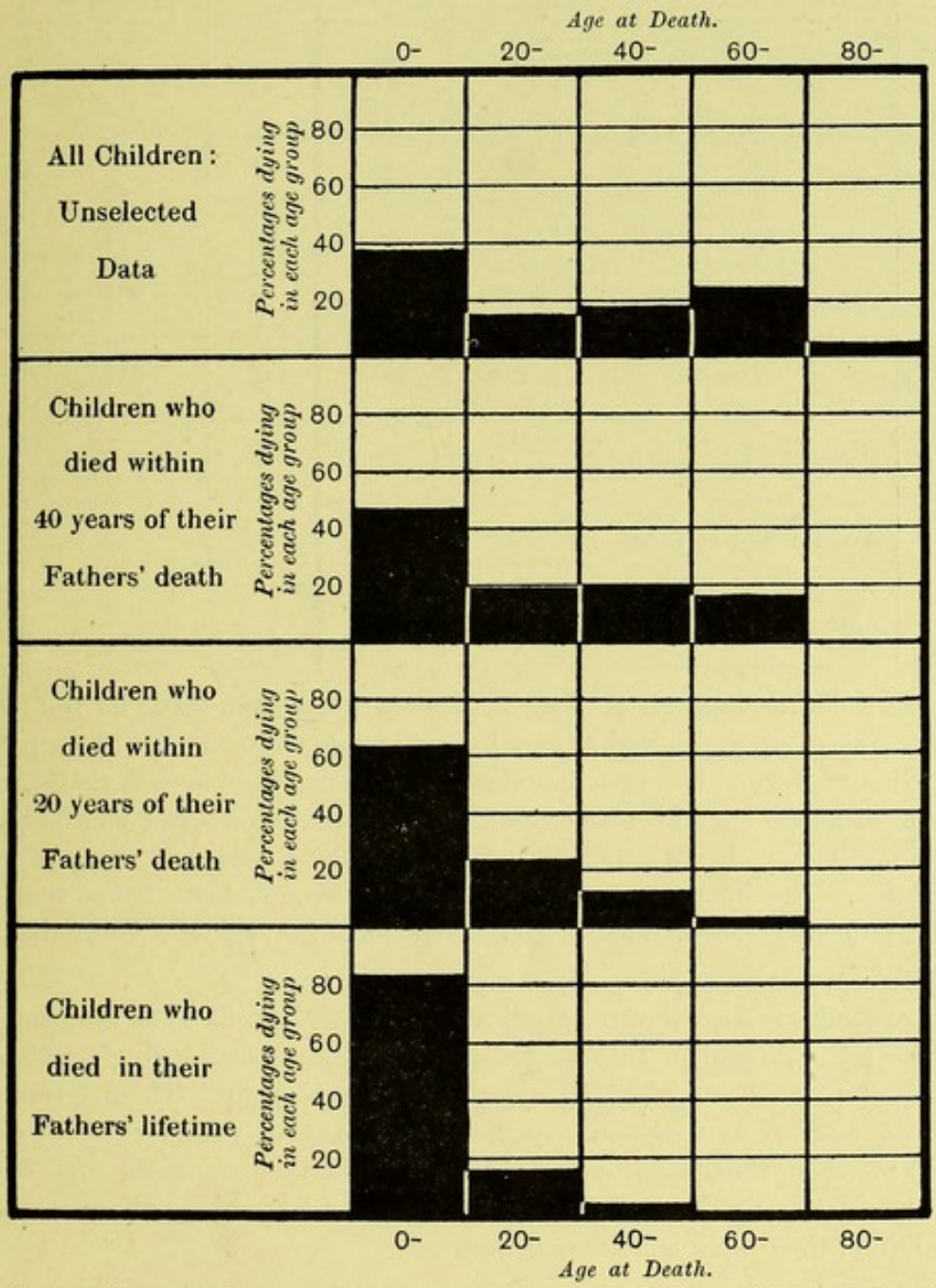


Fig. 6. Diagram to illustrate the Effect of Selection of Material upon the Distribution of Age at Death. (Reigning Houses in Europe, 18th Century.)

Now in this material there is no selection of families. Every family was taken and the age at death of every first-born is known, so that we are only left with the

TABLE VII.

Showing Anticipation in Age at Death. A. Fathers and Children.

(Reigning Houses in Europe—18th Century.)

Age at Death	Fathers	First-born Children	Fathers	First Sons who had children
0— 9	—	95	—	—
10—19	—	11	—	—
20—29	6	21	4	8
30—39	16	18	8	15
40—49	45	31	31	39
50—59	70	34	54	39
60—69	77	37	58	44
70—79	62	33	46	54
80—89	18	14	12	13
90 and over	—	—	—	1
Totals	294	294	213	213
Percentage dying under *20*	0	36·1	0	0
Average Age at Death ...	61	36	60	59
Anticipation	25		1	

third of Dr Mott's fallacies, in that no allowance has been made for the fact that the parental group is limited to ages over 20 while more than a third of the offspring die under 20. The effect of this selection can be removed almost entirely by taking instead of the first-born child, the first son who married and had at least one child. There are in all 213 such cases and we see that there is now no anticipation. The difference between the average ages at death is less than a year and by removing the artificial selection we have got rid of all anticipation or antedating.

These facts are also shown graphically in Figs. 7 and 8. The horizontal scale gives the age at death in 10-year groups while the vertical scale gives the actual numbers of parents and offspring dying in each age group. The diagram on the left shows marked anticipation, and should be compared with Dr Mott's diagram (Fig. 1) in which the ages at onset of insanity of father and child are compared. When, however, we get rid of the selection of cases by taking only sons who have had children, then there is no anticipation.

If we compare the distributions of age at death in mothers and children we get exactly the same results. The facts are shown in Table VIII.

We see that the first-born children died on an average 18 years before their mothers, but when we compare the age at death of mothers and the first son in

REIGNING HOUSES IN EUROPE — 18TH CENTURY.

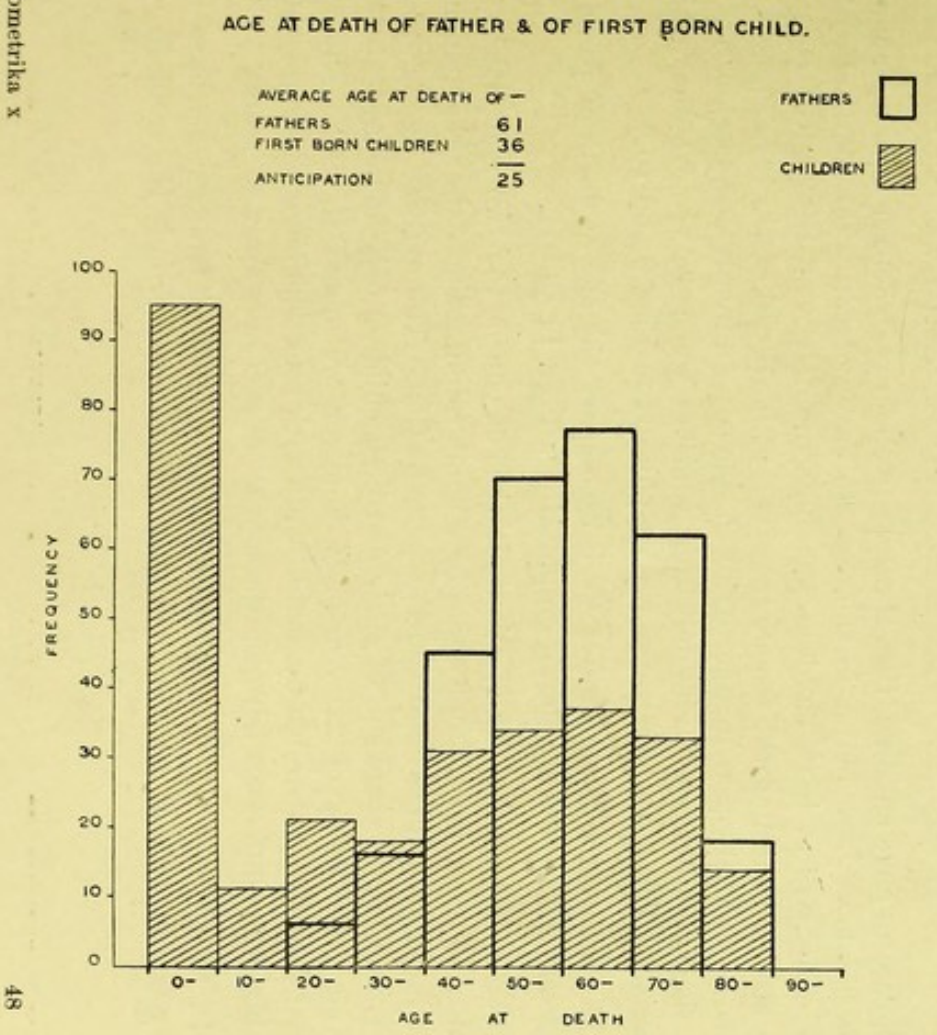


Fig. 7.

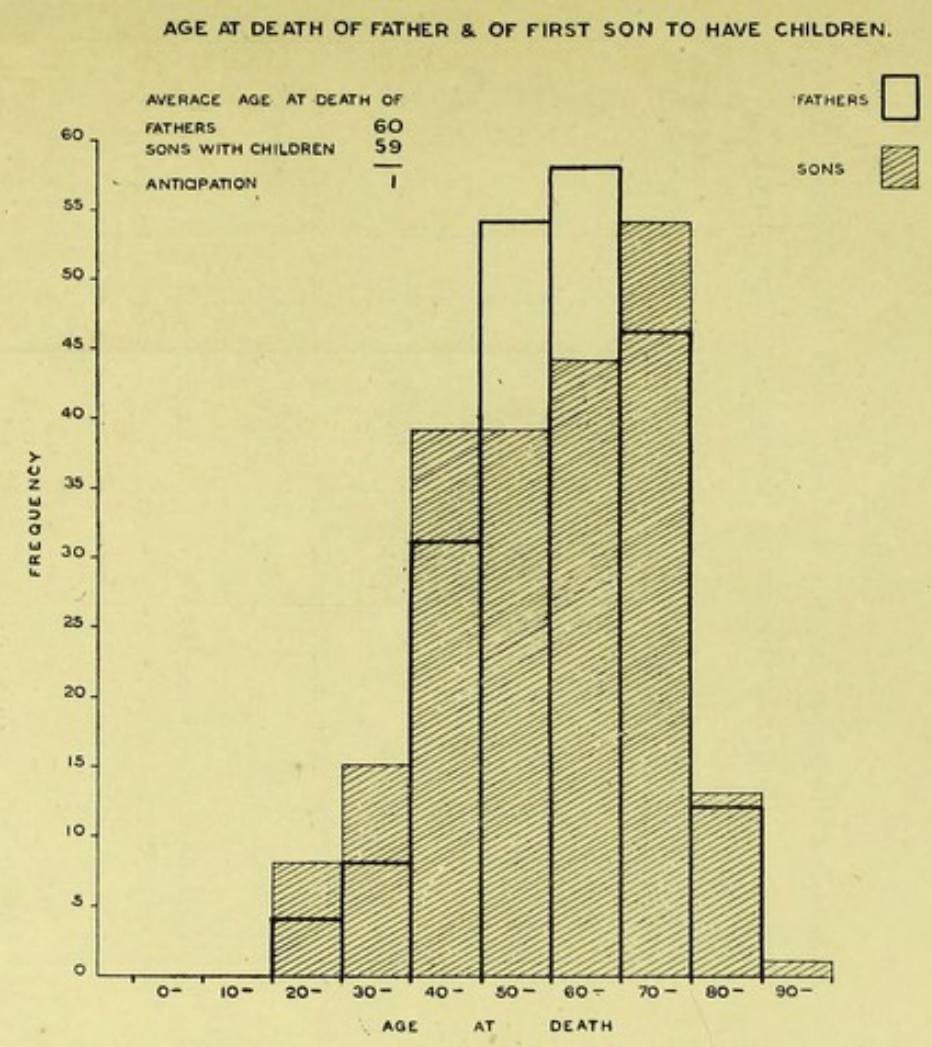


Fig. 8.

TABLE VIII.

Showing Anticipation in Age at Death. B. Mothers and Children.

(Reigning Houses in Europe—18th Century.)

Age at Death	Mothers	First-born Children	Mothers	First Sons to have Children
0— 9	—	122	—	—
10—19	2	13	1	—
20—29	47	26	21	8
30—39	49	22	30	16
40—49	43	32	25	41
50—59	52	35	39	40
60—69	80	42	52	46
70—79	52	36	41	54
80—89	18	17	10	14
90 and over	2	—	1	1
Totals	345	345	220	220
Percentage dying under *20*	·6	39·1	·5	0
Average Age at Death ...	53	35	55	59
Anticipation	18		−4	

each case to have children, then the sons live four years longer than their mothers. It would have been better in this case to have compared the mothers with the first daughters to have children but unfortunately von Behr gives very little information regarding the female lives, except in special cases. The figures show a marked anticipation in age at death when we directly compare, as Dr Mott has done, mother and child, but this vanishes when we remove the arbitrary selection. The same facts are shown graphically in Figs. 9 and 10.

If we combine these figures we can compare the age at death of parent and child and the results are shown graphically in Figs. 11 and 12.

Fig. 11 shows that Dr Mott's limitation of one of the two generations he is comparing to adults, without imposing a similar limitation on the other generation, introduces an artificial and spurious anticipation. The average age at death of the parents is 56 years and of their first-born children only 35 years—so that we get an anticipation of 21 years. If, however, we make the two generations almost directly comparable by dealing only with sons who have children—there is no significant difference between the two averages (58 against 59 years).

In these cases we have dealt only with completed families and have taken every family without selection. If, however, we consider only the cases in which

REIGNING HOUSES IN EUROPE — 18TH CENTURY.

AGE AT DEATH OF MOTHER & OF FIRST BORN CHILD.

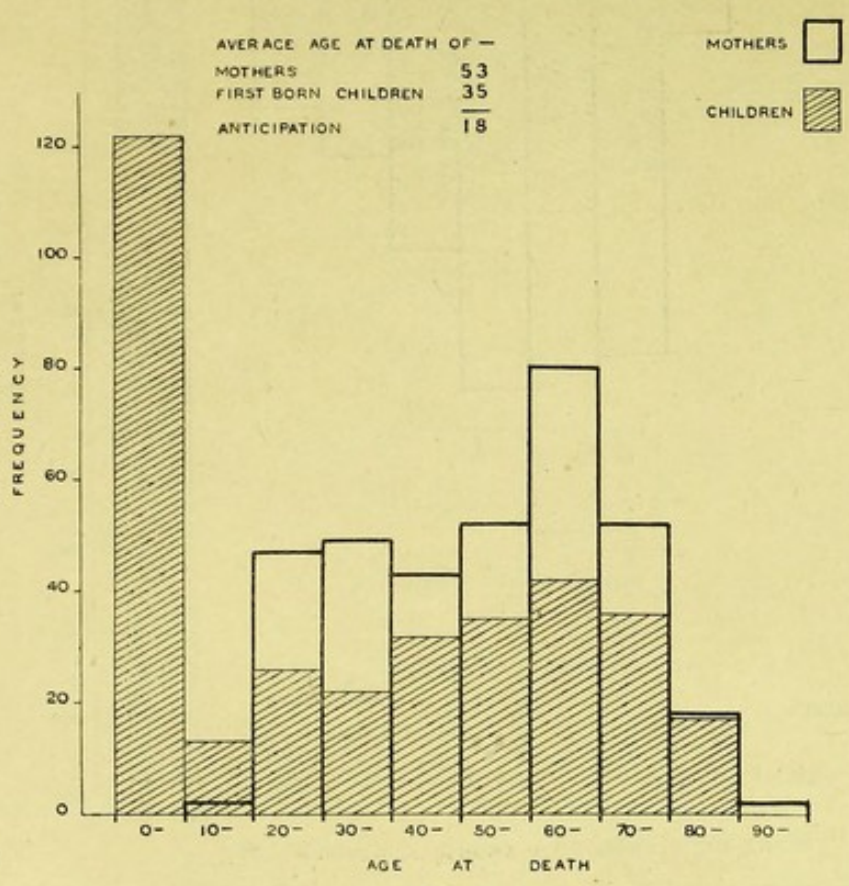


Fig. 9.

AGE AT DEATH OF MOTHER & OF FIRST SON TO HAVE CHILDREN.

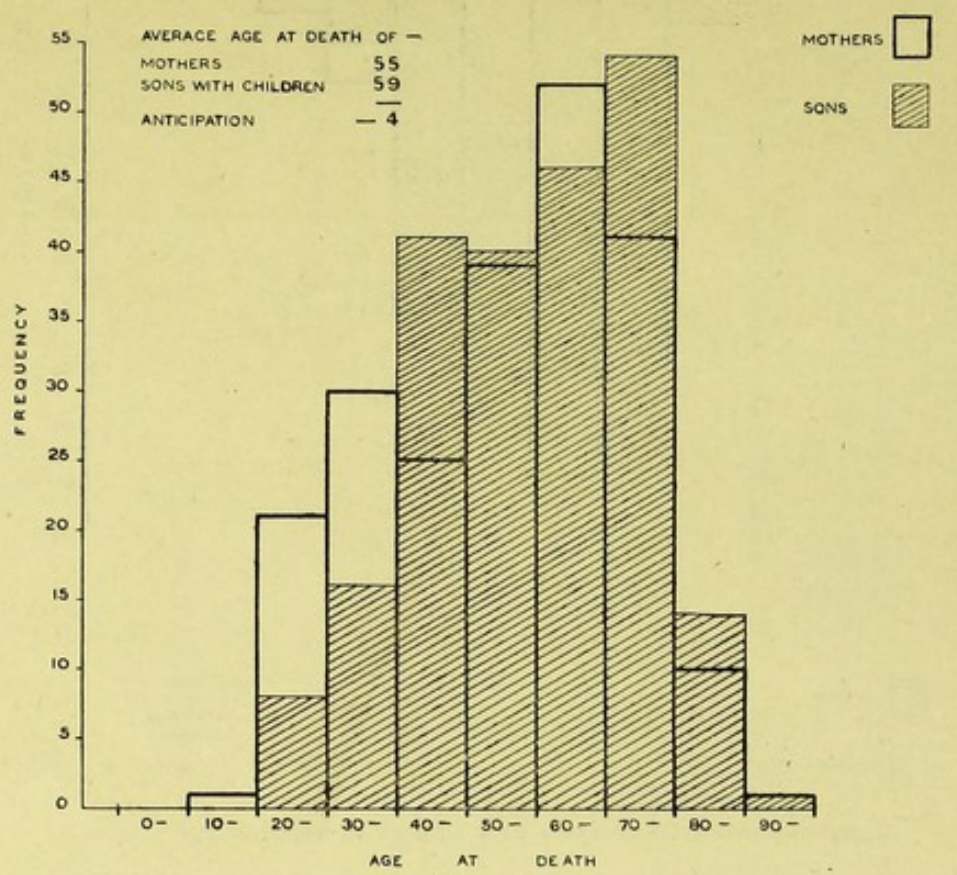


Fig. 10.

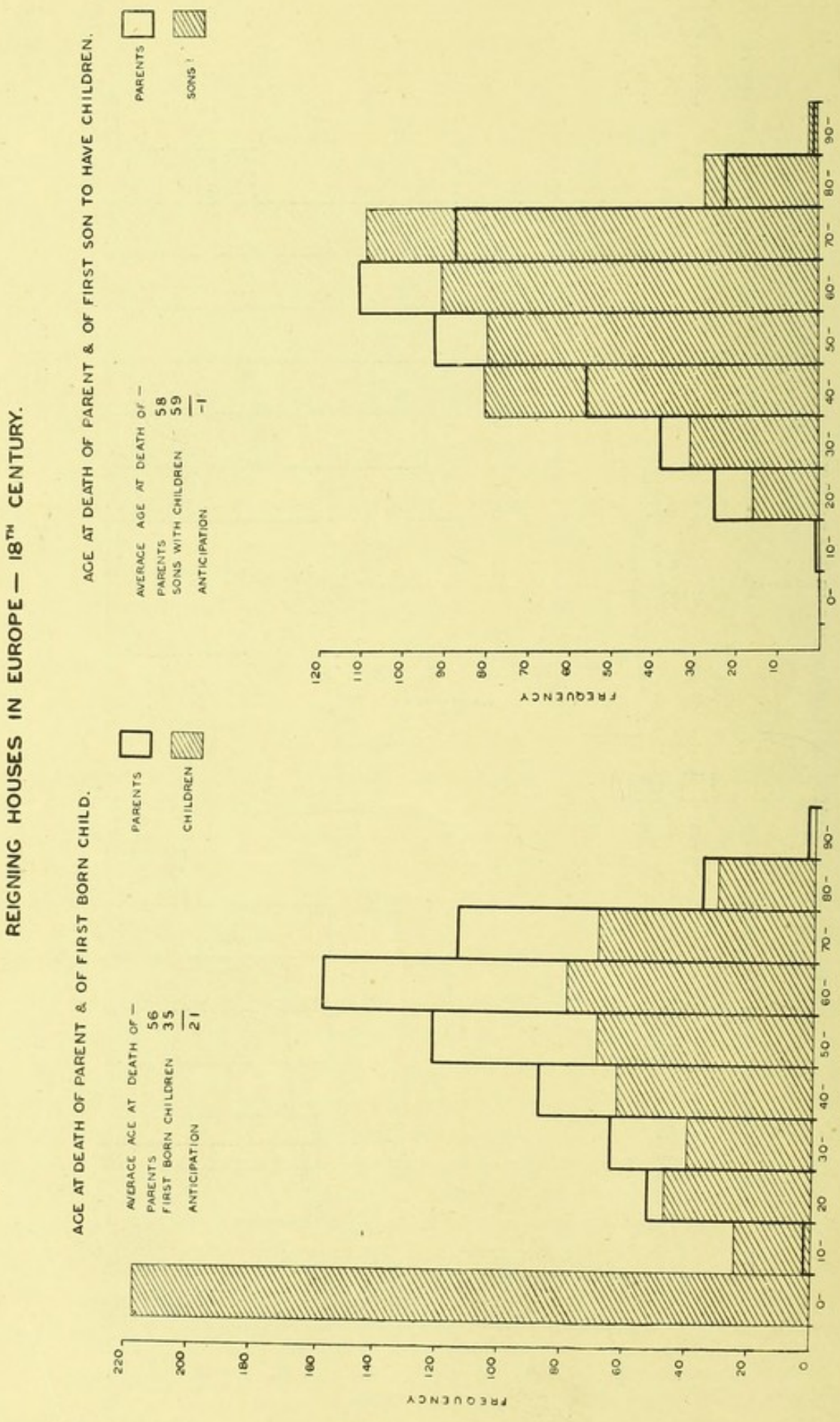

REIGNING HOUSES IN EUROPE — 18TH CENTURY.
AGE AT DEATH OF PARENT & OF FIRST BORN CHILD.
AVERAGE AGE AT DEATH OF —
PARENTS 56
FIRST BORN CHILDREN 35
ANTICIPATION 21
PARENTS
CHILDREN
FREQUENCY
AGE AT DEATH
AGE AT DEATH OF PARENT & OF FIRST SON TO HAVE CHILDREN.
AVERAGE AGE AT DEATH OF —
PARENTS 58
SONS WITH CHILDREN 59
ANTICIPATION -1
PARENTS
SONS
FREQUENCY
AGE AT DEATH

Fig. 11.

Fig. 12.

the eldest child died in his father's lifetime the amount of anticipation is greatly increased. The facts are shown in Table IX and in Fig. 13.

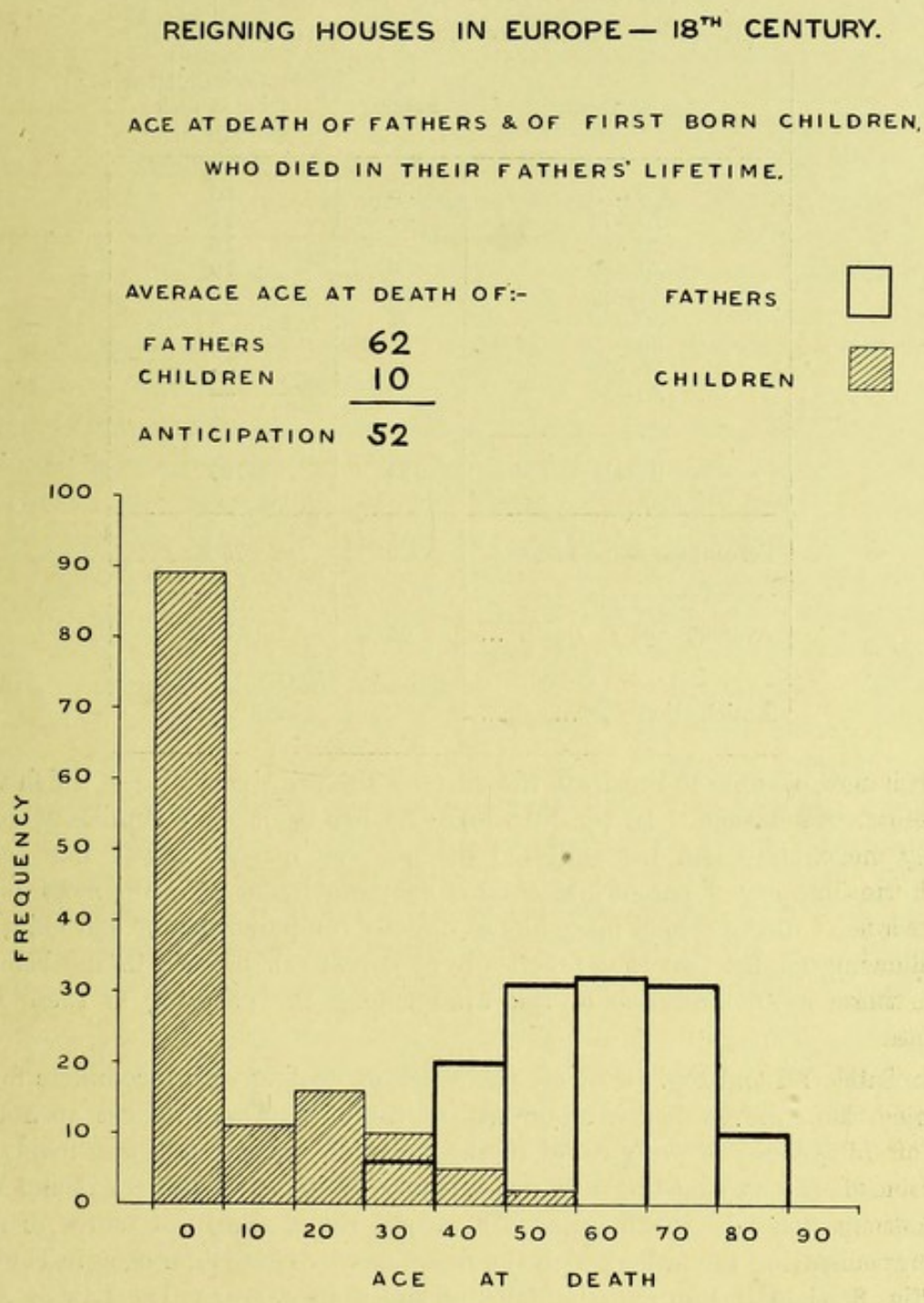


Fig. 13.

We see here that among the fathers none died under 30 while 87 °/₀ of their children died under 30; the average age at death among the fathers was 62— among the children only 10, showing an anticipation of 52 years.

TABLE IX.

Showing Anticipation in Age at Death. C. Fathers and First-born Children who died in their Fathers' Lifetime.

(Reigning Houses of Europe: 18th Century.)

Age at Death	Fathers	First-born Children dying in their Fathers' lifetime
0— 9	—	89
10—19	—	11
20—29	—	16
30—39	6	10
40—49	20	5
50—59	32	2
60—69	33	—
70—79	32	—
80—89	10	—
Totals	133	133
Percentage dying under *20*	0	75·2
Average Age at Death ...	62	10
Anticipation	52	

It is now possible to illustrate the effect of the principal fallacies which vitiate Dr Mott's conclusions. In the first place he has dealt with families which are largely incomplete and has collected his material in such a way that cases in which the insanity of parent and child is contemporaneous are the most likely to be recorded; in the second place he has directly compared parent and child without allowing for the fact that practically no *parent* can become insane before 20, while there is no limitation of this kind among the offspring of these insane parents.

In Table IX and Fig. 13 we see the effect of dealing with incomplete families in which the children died in their fathers' lifetime. There we get an anticipation of 52 years. If we get rid of the first and second fallacies involving a selection of cases by dealing with every family, as shown in Table VII and Fig. 7, the anticipation falls to 26 years. If we get rid of the third source of fallacy also, by comparing the fathers with the first sons who have children, as in Table VII and Fig. 8, then the anticipation falls to less than a year. The Law of Anticipation or Antedating has thus in Dr Mott's case no foundation, in fact it is a spurious result of the mode of collecting and interpreting data.

Now Dr Mott has not only asserted that this "Law" applies to insanity but has also drawn the conclusion that the offspring of insane parents if still normal

at the age of 25 may safely marry. In an address delivered before the First International Eugenics Congress*, he said: "You will observe that 47·8 °/₀ of the 500 offspring had their first attack (of insanity) at or before the age of 25 years and as you see in the curves of parents and offspring, the liability of the child of an insane parent becoming insane tends rapidly to fall. Now besides the fact that this shows Nature's method of eliminating unsound elements of a stock, it has another important bearing, for it shows that after twenty-five there is a greatly decreasing liability of the offspring of insane parents to become insane and therefore in the question of advising marriage of the offspring of an insane parent this is of great importance. Sir George Savage recently said that this statistical proof [*sic*!] of mine entirely accorded with his own experiences, and that if an individual who had such an hereditary history had passed twenty-five and never previously shown any signs (of insanity) he would probably be free and he would offer no objection to marriage."

Now I entirely fail to understand how anyone could recommend marriage in such cases, even on Dr Mott's own figures; for if it be true that 48 °/₀ become insane before 25, it must be equally true that 52 °/₀ become insane after that age and this very important point seems to have been forgotten. These figures, however, are taken from Dr Mott's selected data, selected in such a way that the early cases are enormously exaggerated. Until Dr Mott publishes a series of *complete* pedigrees, it will be safer to assume that the age at onset of insanity among the offspring of insane parents does not differ widely from that of all admissions to Asylums and there we find that only 21 °/₀ become insane before 25, and 79 °/₀ after 25.

But surely at a Eugenics Congress of all places some thought might have been given to the mental condition of the children resulting from such matings, before advising marriage. It would not have been difficult for Dr Mott to have extracted all the available cases of this kind from his collection of pedigrees, i.e. all cases in which an individual had an insane parent and was normal at the age of 25, and so have discovered the probable fate of the offspring from such matings.

Unfortunately the details given by Dr Mott regarding his pedigrees are usually so scanty that little use of them can be made, but two at least show the danger of the matings Sir George Savage and he sanction; these two pedigrees were given by Dr Mott in his lecture on *Heredity in Relation to Insanity*, delivered to the members of the London County Council. The first is shown in Fig. 14. (It appeared as Fig. 11, p. 18 of Dr Mott's lecture.) In the first generation a man who became insane at 70 had four children. The eldest, a girl, became insane at 68 and was therefore normal long after the age of 25. Dr Mott does not state whether the marriage of this woman preceded or followed the onset of insanity in her father, but even if her father had become insane before her marriage, Dr Mott

* *Problems in Eugenics*, p. 425. This is one of many illustrations of the evil done by that Congress; attention was directed and much weight given to hasty statements and ill-digested material.

would have raised no objection to the marriage since the woman herself was not insane. There were in all six children from this marriage of which Dr Mott would have approved. Two became insane, three were blind and five are said to have been paupers.

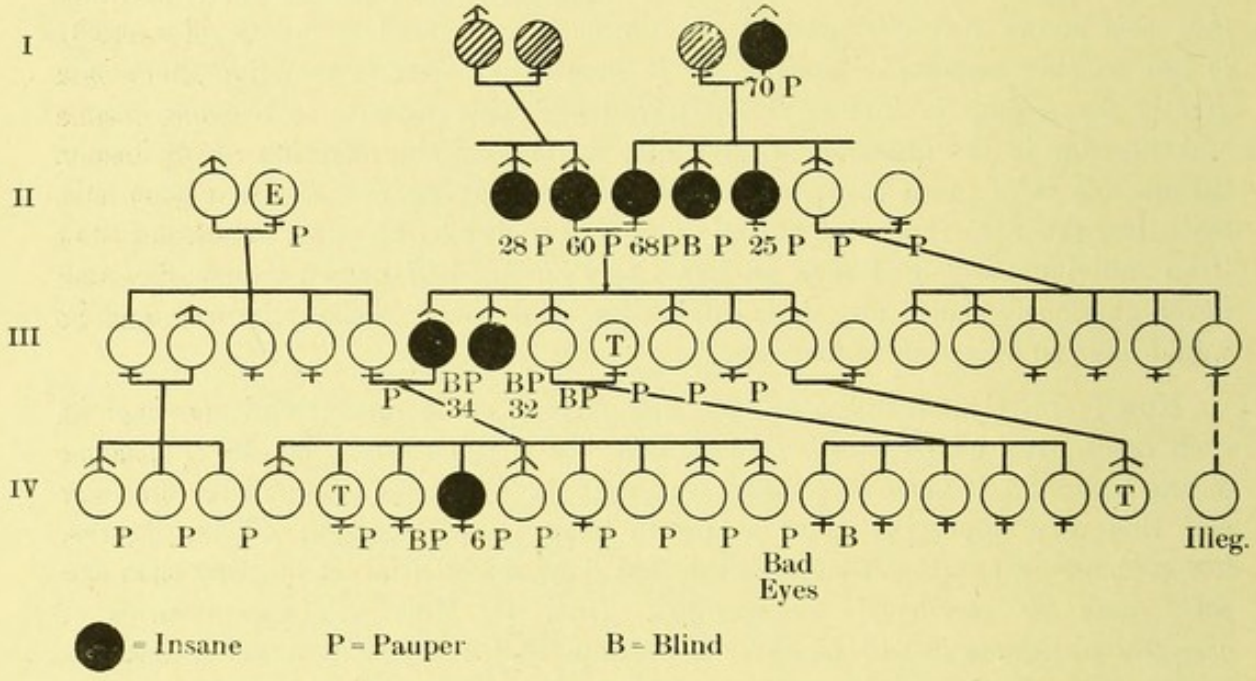


Fig. 14.

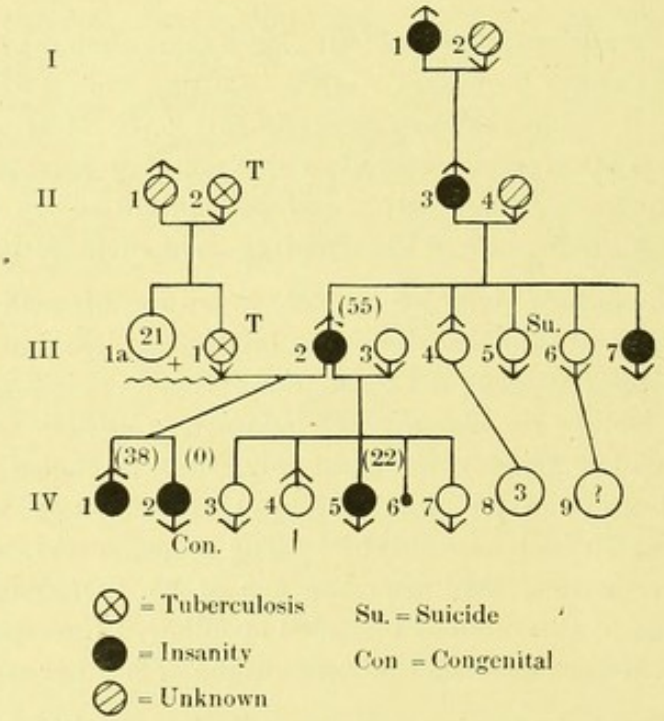


Fig. 15.

The eldest child remained normal till the age of 34 and although both his parents became insane Dr Mott apparently would not have objected to his marrying. He did so and one of his children became insane and eight out of nine are said to be paupers. These nine children are apparently still young so that their ultimate fate is still uncertain.

The second pedigree I shall quote was given as Fig. 28, p. 33 of Dr Mott's lecture, and appears here as Fig. 15.

A man who had an insane father and an insane grandfather became insane at the age of 55. He was therefore normal at the age of 25* and Dr Mott would have sanctioned marriage in his case. He actually married twice. His first wife was tuberculous but not insane; they had two children, both insane. His second wife was normal and it is definitely stated that there was no insanity in her family; they had five children and one of these became insane. Yet Dr Mott would permit the children of insane parents to marry if only they are normal at the age of 25!

Again, Dr Mott has stated that it is useless to attempt to limit the fertility of the insane since most of their children are born before the onset of insanity, and therefore before any action can be taken. From his statistics of relatives in L.C.C. Asylums, Dr Mott has calculated the proportion of offspring who were born after the first attack of insanity in the parent and found that "Forty-six offspring out of 581 were born after the first attack of insanity in the parent, i.e., 7·9°/₀. That is to say in the case of 529 insane parents, *the birth of only one-twelfth of their* 581 *insane children would have been prevented by sterilisation or life segregation of the parent after the first attack of insanity.* These figures refer to the offspring which become insane, *but there are a large number of offspring which do not become insane and these would be cut off if life segregation or sterilisation were adopted*†."

But here again Dr Mott is using the data obtained from his index of relatives which shows a greatly exaggerated number of cases at the earlier ages among the offspring, and he thus greatly exaggerates the number of cases in which the children were born *before* the onset of insanity. No conclusion can be drawn from any but complete records of families. But apart altogether from this, many of these parents are themselves the children of the insane and much could be done to discourage such marriages. Unfortunately as we have seen Dr Mott directly sanctions marriage to those who remain normal till the age of 25.

In further support of his view Dr Mott has stated that out of 642 females admitted to three London County Asylums in 1911, 148 were recurrent cases and of these 32 (21°/₀) had children between their respective dates of admission. "The inference that can be drawn," he says, "is that about one-fifth of the recurrent cases, or approximately one-twentieth of the female admissions have

* If the term "age at onset" has any real meaning.

† The italics are Dr Mott's.

children after their first attack of insanity and of 31 such cases examined, 73 children were born after the first attack of insanity in the parent."

But have these 148 recurrent cases been followed up to the end of the reproductive period? Not at all. No ages are given and the cases are merely those which were admitted to Asylums in 1911, Dr Mott's remarks being made in June 1912, so that no attempt has been made to follow them up. There is no justification for Dr Mott's advice.

There are many other points in Dr Mott's work which deserve detailed examination, but time will not permit more than a brief account of a few of them.

It should be noted, for instance, that Dr Mott has used his index of relatives in London County Asylums as an argument in favour of the importance of the inheritance factor in insanity. His argument is as follows:

"At the present time in the London County Asylums there are 725 individuals so closely related as parents and offspring, brothers and sisters. *A priori*, this, to my mind, is striking proof of the importance of heredity in relation to insanity, for we cannot suppose that 20,000 of the 4½ millions of people in London brought together from some random cause would show such a large number closely related as 3·6 %."

But Dr Mott has not attempted to give, and I doubt if he ever will be able to give, a satisfactory estimate of the number of relatives in even a random sample of the population, and the population of asylums is far from being a random sample of the general population—there is for instance an extraordinary divergence in age. Yet without definite information on this point it would be impossible to say whether insanity is inherited or not—that is if we had to depend solely on Dr Mott's data.

It should also be noted that in these cases Dr Mott has clubbed together every form of insanity, from congenital idiocy to senile dementia, except of course cases due to specific infections or trauma. I myself think that course is the only possible one. To anyone who has studied even a few pedigrees of mental defect, nothing is more striking than the extraordinary number of different forms of mental defect that may appear in the same family.

Seven years ago, in a *First Study of the Statistics of Insanity and of the Inheritance of the Insane Diathesis**, I was confronted with the same problem, and after a full consideration of all the available data and of the opinions of those medical men who were best qualified to express an opinion came to the conclusion that the only possible course was to group all forms of insanity together, with, of course, the exceptions I have already indicated. The whole question was discussed very fully in my paper and it was there suggested that an even broader classification might be of service. This point of view met with some criticism at the time but nothing has occurred to alter it, and the study of the inheritance of

* *Galton Memoirs*, No. II. (Dulau and Co.)

insanity in general or of an even broader degeneracy must always remain the first object of our studies.

Any investigation of the inheritance of special types of insanity or degeneracy can only be carried out however on unselected material—on the records of complete families. The type of insanity is so closely related to the age of onset that any tendency to exaggerate the number of early cases, as in Dr Mott's material, will entirely vitiate the conclusions drawn. Thus Dr Schuster's conclusions as to the inheritance of special types of insanity based upon Dr Mott's data* must also be rejected on the above grounds.

Dr Mott's index of relatives in London County Asylums is unfortunately of very little value in the study of inheritance in insanity. Progress can only come from the study of complete pedigrees in which every member of the family is entered, whether insane or normal, and the ages of the normal at the time the record was made are just as important as the age at onset of insanity in the insane members, for a statement that a young man of 20 has not been insane is of a very different degree of importance from the statement that a man of 70 has not been insane.

In the papers I have cited the children of the insane if normal at 25 are advised to marry, and it is asserted that it is useless to attempt to discourage the reproduction of the insane since most of their children are born before the onset of insanity, and that we should rely on the Law of Anticipation to end or mend degenerate stocks.

I have shown, I think, that the Law of Anticipation as applied to the insane has no foundation in the facts provided and that the advice given as to the marriage of the insane and of their normal offspring is fundamentally unsound and directly cacogenic. Much yet remains to be learnt regarding the inheritance of the insane diathesis, but no one who has studied the family histories of the insane can doubt that in inheritance we have by far the most important element in the production of insanity, and in view of all the facts it is the obvious duty of the Eugenist to discourage, rather than to encourage, procreation by the insane and even by those of their offspring who appear to be normal.

* *Report on the Statistical Investigation of Relative Cards*, 21st Annual Report of the London County Council Asylums Committee (1910), p. 95.