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HANDBOOK

ACCOMPANYING

SCHOOL CHARTS

By

C. P. BLACKER, M.A., M.D.

PUBLISHED FOR THE EUGENICS SOCIETY

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The six charts of which some explanatory notes are here offered, can be used in schools to demonstrate pictorially that heredity plays a part in our lives which we should take into account in the choice of a mate. "Marry wisely" is the lesson to which they point.

Taken as a whole, the charts show :—

How the factors situated in the cells which determine heredity behave in fertilisation, ordinary cell division and the special kind of cell-division by which the gametes* are formed (Chart I); the First law of Mendelian inheritance as exemplified in flowers (Chart II), rats (Chart III), and human beings (Chart IV); and how unfavourable and favourable characters can be transmitted in human families (Charts V and VI).

The six charts will now be discussed serially.

CHART I illustrates the processes of fertilisation and cell-division. It presupposes an elementary knowledge of how children are born. A short pamphlet entitled "Mating and the Birth of Children", (price Id.) produced by the Eugenics Society and written for children of twelve and over, may be found useful in this connection ; so may a pamphlet written for parents entitled "Sex Education of Children".

Figure A illustrates diagrammatically the process by which the mammalian ovum (female gamete) is fertilised by a male sperm cell. The nucleus of the ovum is shown in the diagram to contain one set of three *chromosomes* marked in green, *in which are contained the hereditary factors of the female parent.* The sperm contains a similar set of three chromosomes (shown in red) which contain the hereditary factors contributed by the male parent. In human beings, the gametes contain 24 chromosomes and not three as shown in the diagram, but this large number would be difficult to compress in the space available.

Figures B and C show the fertilized ovum which contains six chromosomes : twice as many as the separate gametes. The actual number in the fertilized human ovum is 48. Figures D, E and F show diagrammatically the first division of the fertilized ovum ; but they will also serve to illustrate the process of ordinary cell division which takes place in body building. Note that each of the

*The term "gamete" is applied to the male and female cells which together accomplish the process of fertilization. The male gamete is called the Spermatozoon or Sperm, the female the Ovum or egg-cell.

six chromosomes splits before cell-division in such a way that the two daughter-cells each acquire exactly the same number as the parent cell. The same number of chromosomes (six in the diagram, but 48 in the human body-cell) is acquired, through the same process of accurate cell-division by each body-cell throughout the process of growth and repair. But at an early stage (long before birth) in the development of the human body are set aside the tissues which are destined to give rise to the individual gametes.

In Figure G is shown the formation of the sperm cells or male gametes. Four are shown at the bottom of Figure G. As has been seen from Figure A the sperm cells and ova contain half the number of cells that are found in the body-cell. If this were not so, the number of chromosomes in the body-cells of each individual would be doubled every time fertilization took place and, after a few generations, the number would increase to enormous dimensions. The process by which the gametes come to acquire *half* the number of chromosomes as the body-cells is shown in this diagram. At one of the last two cell-divisions by which the gametes are formed, the corresponding chromosomes of the two sets contained in ordinary cells come together in pairs, and then, instead of splitting, one member of each pair migrates bodily into one or other secondary cell, with the result that the secondary germ-cells have *half* as many chromosomes as are possessed by all other cells of the body. This is called the " reduction division ". Its occurrence is limited to the formation of the gametes and it has a great importance in the understanding of the principle of Mendelian heredity. In the second of the last two divisions, each of the halved number of chromosomes in the secondary germ-cell divides longitudinally, as in ordinary cell-division.

In Figure H the reduction division is shown for the female gamete or ovum. But here the last two divisions give rise to but one ovum (and not four as occurred in the sperm). The three other products of division are degenerate cells called polar bodies and are lost.

The lesson to be learned from these figures is that the individuality of the chromosomes, wherein are contained the hereditary factors, is carefully preserved from generation to generation.

We are the products of our parents and they of our grandparents ; our chromosomes are derived from our parents' chromosomes, and ours will, in turn, be handed on to our children.

CHART II illustrates Mendel's First law. Mendel was an Austrian Monk who experimented in crossing the garden pea. He discovered that certain hereditary characters are handed on from generation to generation according to a simple law. This law is here illustrated by colour in antirrhinums (snap-dragons). In one of the chromo-

somes of the snap-dragon is a factor or gene which produces colour. In the parental generation is shown a red and a white flower. These are cross-fertilized and give rise, in the F 1 generation, to pink flowers intermediate in colour between the parental flowers. These pink-flowered plants, which are products of a cross between a coloured and a white parent, are called hybrids.

Flowers, unlike animals, can be self-fertilized. If the pink flowers in the F 1 generation are self-fertilized, if large numbers of the resultant seeds are sown, and the plants are examined when they have grown up, it will be found when a sufficiently large number are counted, that they will consist, on average, of a quarter of red flowers, a half of pink flowers or hybrids, and a quarter of white flowers. The red and white flowers, if self-fertilized, will produce nothing but red and white flowers respectively. They will breed true. But the hybrid pink flowers will, on average, produce a quarter of red, a half of pink and a quarter of white flowers. The behaviour of the pink flowers, when self-fertilized, shows that though the hybrid is intermediate in colour between the red and the white parents, nevertheless the factor which makes for colour (redness) and the factor which makes for whiteness, continue to exist in the pink flower, and re-appear in half the progeny in the form that they were contributed by the parents of the hybrid generation. (On average, a quarter of the flowers are red and a quarter white).

This is what we should expect from Chart I, D-F, which shows how the chromosomes retain their individuality through the numerous cell divisions involved in body growth. In the same way genes in the chromosomes do not blend but retain their individuality even if they interact in regard to the effects they produce.

CHART III. This shows a slightly different result of the same law, in rats. The result occurs when the effect of one gene is so much stronger than that of the other that it masks it. In the parental generation are shown a white and a black rat. A pair of the chromosomes in the black rat contain a hereditary factor for colour which determines the black colour of the rat. This hereditary factor is shown diagrammatically by the two black dots in the middle of the rat's body (the other chromosomes are, for convenience, omitted). The corresponding chromosomes in the white rats are lacking in the factor which makes the black colour. They are shown as two small white circles.

If these rats are mated, the hybrid offspring in the F 1 generation receive from the black parent the factor which produces colour (black) and from the white parent the factor which produces whiteness. These factors are shown diagrammatically in the rats of the F 1 generation by a black dot and a white circle. But in this case, the hybrids of the F 1 generation are not intermediate in

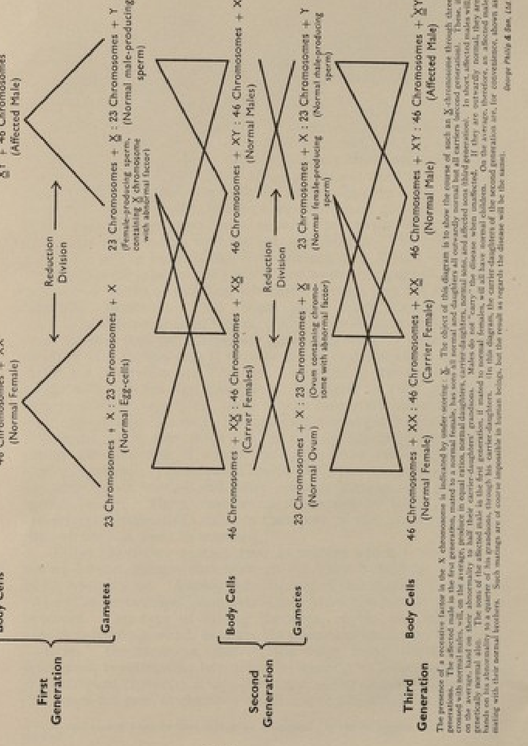
colour between the black and the white parent; they are not grey in colour as the snap-dragons in Chart II were pink. They are as black as their black parent, from which, so far as colour is concerned, they cannot be distinguished. In this crossing, then, black " dominates " white and the factor for black is described as a *dominant* and that for white as a *recessive*.

If now the male and female hybrid rats of the F 1 generation* are mated together in a brother and sister mating (which is done all the time in animals, but is impossible in man), the rats of the F 2 generation will appear in the ratio of three black and one white. The whites, if mated with other whites or back-crossed to the white grand-parent, will give rise only to white offspring. One of the black rats will be a pure black as was the black grandparent; if mated with another pure black or with the purely black grand-parent, he will produce nothing but pure blacks. The other two black rats will be hybrids like their parents, and, if bred together, will produce offspring in the ratio of one white, one pure black and two hybrid blacks as did their parents. Though they are indistinguishable outwardly from their pure black grandparent—indeed the difference from him can only be established by breeding experiments—they will correspond genetically with the pink flowers of Chart II. In this case it is to be noted that the black hybrids of the F 1 generation are " carriers " of white in the sense that if mated with carriers like themselves, a quarter of their offspring will, on average, be white. Some human hereditary characteristics are " carried " in this way. If the character which is thus carried is *harmful* and if, also, it is rare, it will appear more commonly among the offspring of cousin marriages than among those of random matings. (They would appear still more commonly among the offspring of brother and sister matings if these took place in human beings). Hence cousin marriages are to be avoided if hereditary abnormalities exist in that part of the ancestry which the two cousins share in common.

Chart III shows another type of mating which is important among human beings—that between the black hybrid rat and the white recessive rat. Among the offspring of this mating, it will be found that, on average, black hybrid and white rats appear in equal numbers. This type of mating (between, on the one hand, the hybrid individual, which exhibits the dominant character, but also " carries " the recessive, and on the other hand, the recessive individual) is interesting because of its bearing on human matings. If a dominant character is *rare* (and most of the *abnormal* dominant characters are rare, or else they would not be abnormal), it is much

*The dominance of white by black is common in animals. It has no bearing on human race crossings.

FIGURE I. TRANSMISSION OF A RECESSIVE SEX-LINKED FACTOR



more probable that it will appear in the hybrid than in the pure dominant form. The commonest type of mating, therefore, is between a hybrid exhibiting the dominant abnormality and the normal recessive individual. Among the offspring of such crossings, normal and abnormal individuals are found, on average, in equal numbers.

CHART IV. This shows a pedigree of stationary night-blindness, a condition characterized by inability to see in dim light. Night-blindness varies in severity; it also varies in its hereditary transmission, some pedigrees showing an incidence of affected people which conforms to the supposition that night-blindness is handed on as a Mendelian dominant. The pedigree here shown conforms to the supposition that night-blindness is transmitted as a *sex-linked* character. Sex-linkage is a form of Mendelian inheritance which has not yet been considered. It is a little more complicated than the dominant and recessive forms.

A character is said to be sex-linked when the factor which determines it is carried in the sex chromosomes; if the character is recessive, it will appear much more frequently in males than in females. Figure I* opposite shows what this means but some preliminary explanation is necessary. As previously remarked the body cells of the human being contain 48 chromosomes. Forty-six of these chromosomes, sometimes called autosomes, are not directly concerned with the determination of sex. This function resides in the remaining pair of chromosomes which are called the sex chromosomes; unlike the autosomes, these differ in the two sexes. Let us consider first the human *male*. His body cells share, in common with those of the female, 46 autosomes. The remaining two chromosomes, the sex-chromosomes, are unequal in size, the larger being called the " X " and the smaller, the " Y " chromosome. In ordinary cell division the two sex chromosomes, the " X " and the " Y " chromosomes, split longitudinally as do the 46 autosomes. But when the reduction division occurs prior to the formation of the sperm cells, the X and Y chromosomes separate bodily from one another (as do the autosomes) and pass into different sperm cells. Thus, prior to the reduction division, the reproductive cells of the male contain 46 autosomes plus an X and Y chromosome. But after the reduction division the sperm cells are of two kinds which appear in equal numbers:—one contains 23 autosomes and an X chromosome, the other 23 autosomes and a Y chromosome. The sperm cells which contain the Y chromosomes, produce males: those containing the X chromosome, females.

Turning now to the *female*, it is noteworthy that the body cells contain 46 autosomes and two X chromosomes which are similar

*This Figure is not reproduced in the charts but for teaching purposes it could be drawn on a blackboard.

to one another and resemble the (larger) X chromosomes of the male. When reduction division occurs prior to the formation of the ova, the two X chromosomes separate bodily from one another, as do the 46 autosomes, so that the female germ cells (the ova) all contain 23 autosomes and an X chromosome. In respect of the sex chromosomes, therefore, the ova are all alike (monomorphic), while the sperm cells are of two kinds (dimorphic) depending on whether they carry an X or a Y chromosome. *The sex of a human being depends on whether the ovum is fertilized by an X-carrying (female-producing) or a Y-carrying (male-producing) sperm. It is the sperm which, in man, determines sex, not the ovum; the male not the female.* If the ovum (which contains 23 autosomes and an X chromosome) is fertilized by a sperm which contains 23 autosomes and a Y chromosome, there will result a *male*, which has the formula 46 autosomes plus XY. But if the ovum is fertilized by a sperm containing 23 autosomes plus an X chromosome, there will result a female which has the formula 46 autosomes plus XX.

It is a remarkable fact that the Y or smaller of the sex chromosome, which determines maleness, appears to contain very few genes; it acts as a sort of dummy. If, therefore, a recessive factor like whiteness in the rat (vide Chart III) were carried on the X chromosomes, it could manifest itself in males which carry a single X chromosome; the Y chromosome does not carry the gene at all. But the character would only manifest itself in the female if the corresponding factor were carried on *both* the X chromosomes.

A *rare* sex-linked and recessive abnormality will therefore be much more likely to appear in males than in females. This is because it will appear in the male if the factor is present in the *single* X chromosome (the *Y* chromosome being as it were a dummy) whereas in the female, it will appear only if the rare recessive factor is present on both the X chromosomes. And if the factor is rare it is much less likely that it will appear on both chromosomes than on one only.

Chart IV* illustrates the type of pedigree which we expect to find in recessive sex-linked inheritance. An affected male I.1 marries a normal female I.2. His daughter II.2 is a carrier who marries a normal husband. We should expect *half* her sons to exhibit her father's abnormality and half her daughters to be carriers. But we must remember that when we are dealing with small numbers the statistical expectations may not be exactly realised. The larger the numbers involved, the greater the chances of the actual ratios corresponding with expectations. Thus, in tossing a coin, the expectation of its coming down heads or tails is the same. But if a coin be tossed a small number of times, say six, the expectation

*The generations are numbered from above downwards in Roman numerals. The members of each generation are numbered from left to right in Arabic numerals.

that it will come down heads or tails with equal frequency may quite likely not be realised. If we toss it 60 times the results will be nearer equality; if 600 times still nearer. Human families are small and are becoming smaller. In Chart IV it will be seen that two of I.1's grandsons are affected (III.5 and III.8) and one is unaffected (III.2). Three of the grand-daughters are carriers (III. 3, III.6 and III.10). One grand-daughter (III.1) may or may not have been a carrier. We do not know because she had no children. Similar considerations apply to the members of generation IV. Here affected males appear with rather less frequency in the first group of four brothers than we might have expected.

Another recessive sex-linked abnormality is haemophilia, a disease characterized by failure of the blood to clot as it normally should. Haemophilics bleed freely and often bleed to death. Their lives may be threatened by cuts or bruises which normal people would regard as trivial. The disease appears in some of the European royal families whose pedigrees have been carefully studied so that very detailed records are available. Like other recessive sex-linked characters it is handed on by affected males, through outwardly normal but carrier daughters, to (on average) a quarter of their grandsons, while (on average) a quarter of their grand-daughters will be carriers.

CHART V. POLYDACTYLISM. Peculiarities of the bony skeleton such as club foot and cleft palate are not uncommon and often occur among several members of the same family. Among these is the occurrence of supernumerary fingers and toes—a condition known as polydactylism. This not only occurs in man; it is also found among monkeys, horses, dogs, cats, birds and other animals.

Polydactylism in man may affect one or more of his four limbs. It is sometimes found in association with syndactylism (webbing of the toes or fingers) and other malformations such as hare-lip, split foot, and even total absence of fingers and toes. The type and situation of the abnormality vary much from individual to individual in the same pedigree.

Chart V shows the incidence of polydactylism in five generations, wherein it is occasionally associated with cleft palate and syndactylism. It will be observed, that with the single exception of the three affected people in generation IV (IV.1-3), who are the offspring of a normal father, every affected person in the pedigree has an affected parent. With this exception, therefore, the pedigree conforms to the hypothesis of Mendelian dominance. The affected person is genetically a hybrid; the normal person is a recessive. Crosses between these result, on average, in equal numbers of affected and non-affected offspring. Allowing for the effects of chance, it

will be seen that these expectations are roughly realised in the pedigree. The type of inheritance in the pedigree is similar to that in Chart III, wherein is shown the result of mating a black hybrid rat with a white recessive rat, among whose offspring black hybrids and white recessives appear in equal numbers on average (See Chart III, last generation).

The following particulars indicate how the affected members of this pedigree show the abnormality :—

First Generation

I.1. Woman with extra digits.

Second Generation

II.1. Woman with six toes on each foot.

Third Generation.

III.3. Man with six toes on each foot.
III.7. Man with hare-lip and six toes on each foot.
III.8. Woman with six toes on each foot.
III.10 and 12. Women with six fingers on each hand.

Fourth Generation.

IV.1-3. Three persons, sex unknown, nature of deformity not stated.
IV.10-12. Three persons, sex unknown, nature of deformity not stated.
IV.24, 27, 30, 33. Three males and one female with extra toes.
IV.39 Woman with one extra finger.
IV.40. Man with six toes on one foot, seven toes on the other, five fingers and a thumb on each hand.
IV.45. Man with six toes on one foot, seven on the other. Toes webbed. Five fingers and a thumb on each hand.

Fifth Generation.

V.1. Man with five fingers and a thumb on each hand.
V.2. Man with extra fingers and toes.
V.5. Man with extra toes on both feet.
V.18. Man with hare-lip and cleft palate; web between first and second toes of each foot.
V.22. Man with five fingers and a thumb on each hand ; six toes on each foot ; webbed toes.

CHART VI is a pedigree of the Phelps family, which contains many celebrated oarsmen. Nine of its members have won the Dogget Coat and Badge trophy.

The race for the Dogget Coat and Badge was established by Thomas Dogget, comedian of Drury Lane, in the year 1715, to commemorate the accession of King George I. At this time the Thames watermen took the place of the present-day London taxi-drivers.

The " wager " was to be competed for by six young watermen in the first year of their freedom out of their apprenticeship. This race has been rowed on the Thames on the first of August every year since 1715.

The Phelps family have been on the Thames since the thirteenth century, and have been boatmen, watermen, lightermen, boat-builders and professional scullers. For generations they married the daughters of watermen and sailors, and unconsciously they followed the tendency of like to marry like, thus passing on the magnificent physique that is their great inheritance. In this century the Phelps family has produced six winners of the race for the Dogget Coat and Badge and, in the latter part of last century, three. The family has also produced two professional sculling champions of England and one of the world.

The family business of boat-building (including in modern times that of motor-launch building) has also been handed on. In two generations there have been four managers of the business who were members of the family.

" Bossy " Phelps, the head of the family, is the King's Bargemaster. This is a very responsible post, because, on State occasions, such as Coronations and the opening of Parliament, he is in charge of the Crown Jewels.

The distinguished members of the family are shown in the large chart by special marks. Some personal particulars of the individuals in this pedigree are appended.

Generations.

I.1. Waterman.
I.2 Lighterman's Daughter.
II.1. " Honest " John.
II.2 Fred.
II.3. Lighterman's Daughter.
III.2. Henry ; winner of the Dogget Coat and Badge, 1850.
III.3. " Old " Bossy : Royal Waterman : head of a boat building firm at Putney.
III.4. Lighterman's Daughter.
III.5. William ; winner of the Dogget Coat and Badge, 1875.
III.6. Charles ; winner of the Dogget Coat and Badge, 1884 ; boat builder.
IV.1. " Young " Bossie ; present head of the family ; Royal Bargemaster; in the Royal Navy for five years ; pilot to Oxford coxwains ; boat and launch builder at Putney.
IV.2. Seaman's Daughter.
IV.4. Henry Thomas ; winner of the Dogget Coat and Badge, 1919 ; Bargemaster to the Fishmonger's Company.

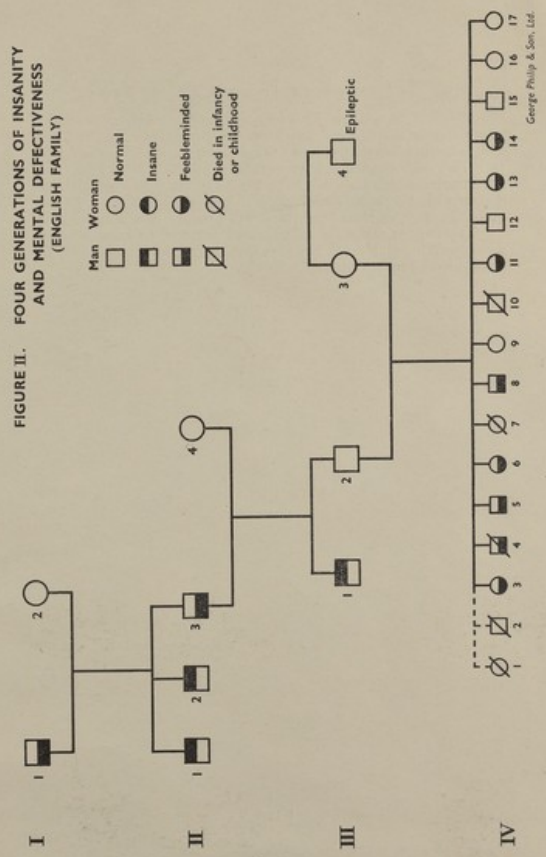
IV.5. Thomas James ; winner of the Dogget Coat and Badge, 1922 ; boat and motor launch builder.
IV.6. Richard ; winner of the Dogget Coat and Badge, 1923.
IV.7. John ; winner of the Dogget Coat and Badge, 1928.
V.1. Edward Alexander, "Ted" ; winner of the Dogget Coat and Badge, 1930 ; Royal Waterman ; pilot to the Cambridge coxwains; professional sculler and ex-world champpion.
V.2. Eric Leslie ; winner of the Dogget Coat and Badge, 1933 ; professional sculler ; English professional sculling champion, 1937.

FIGURE II. PEDIGREE SHOWING THE INHERITANCE OF FEEBLE-MINDEDNESS. The pedigree shown below has not been repoduced in chart form because it was felt that it might unduly alarm children who had, as relatives, persons who are mentally defective. If, however, teachers should feel that a useful lesson should be learned from it, they could, if they wished, copy out the pedigree on a blackboard. The facts given in this pedigree have been authenticated and confirmed by the Eugenics Society.

The significance of the pedigree will be clear from the key. Four generations are shown. The paternal great-grandfather (I.1) was feeble-minded. He had three sons, two of whom became insane (II.1 and 2), the third being feeble-minded (II.3). This last had two sons (III.1 and 2) of whom one (III.1) became insane and the other (III.2) was outwardly normal, but a heavy "carrier" of defect. This man married a normal woman (III.3) who has a brother who was epileptic. The outcome of their marriage is shown in generation IV. Seventeen children were born. Here are particulars :—

IV.1. Daughter, died in infancy } illegitimate.
IV.2. Son, died in infancy }
IV.3. Daughter ; mentally defective and in an institution.
IV.4. Son ; an imbecile; died at the age of 11.
IV.5. Son ; mentally defective and in an institution.
IV.6. Daughter ; an imbecile.
IV.7. Daughter ; died in infancy.
IV.8. Son ; an imbecile.
IV.9. Daughter ; normal and in service.
IV.10. Son ; died in infancy.
IV.11. Daughter ; mentally defective and in an institution.
IV.12. Son ; normal.
IV.13. Daughter } mentally defective and in an institution.
IV.14. Daughter }

FIGURE II. FOUR GENERATIONS OF INSANITY AND MENTAL DEFECTIVENESS (ENGLISH FAMILY)



IV.15. Son.
IV.16. Daughter } too young to know how they will develop.
IV.17. Daughter }

It would be impossible to exaggerate the tragic possibilities which this family history may hold for the future. The children now in institutions may return to their home on reaching the age of 16. They will doubtless have benefited by the special education and training which they will have received ; but it is very doubtful if they will ever make satisfactory citizens, and it is far from improbable, that, in their turn, they will produce deficient children.

The mother (III.3) is sufficiently "witted" to know what is wrong with her children. She says that their defects come from the "bad blood" in her husband's family.

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HEREDITY CHARTS

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I. Fertilization, Cell Division and Chromosome Reduction.
II. Mendel's First Law without Dominance.
III. Mendel's First Law with Dominance.
IV. Stationary Night Blindness.
V. Polydactylism (Extra Fingers or Toes).
VI. Winners of the Doggett Coat and Badge—The Phelps Family.

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Eugenics Society Heredity Chart

I. Fertilization, Cell Division and Chromosome Reduction

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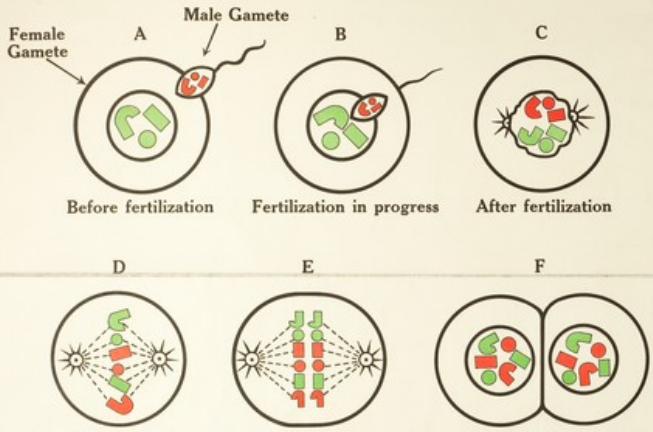
Eugenics Society Heredity Chart

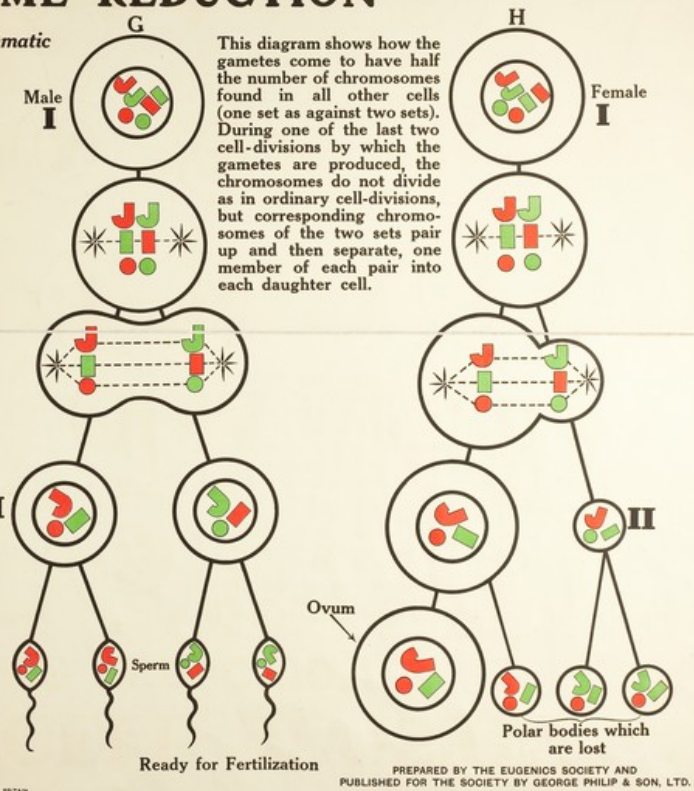
VI. Winners of the Doggett Coat and Badge—The Phelps Family

(I) FERTILIZATION, CELL DIVISION AND CHROMOSOME REDUCTION

Diagrammatic



Figs. A-C show fertilization. Figs. D-F show division of cells in body-building. The chromosomes (coloured bodies) in the male and female cells contain the hereditary elements which are contributed equally by both parents. All the tissues of the body are made up of cells which grow from the fertilized cell D, the first division of which is shown in Figs. D-F. The two daughter cells in Fig. F will later divide in the same way and increase in number until a new individual is formed. Therefore in every one of the multitude of cells in the body are found equal parts of the original father and mother cells.



This diagram shows how the gametes come to have half the number of chromosomes found in all other cells (one set as against two sets). During one of the last two cell-divisions by which the gametes are produced, the chromosomes do not divide as in ordinary cell-divisions, but corresponding chromosomes of the two sets pair up and then separate, one member of each pair into each daughter cell.

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II

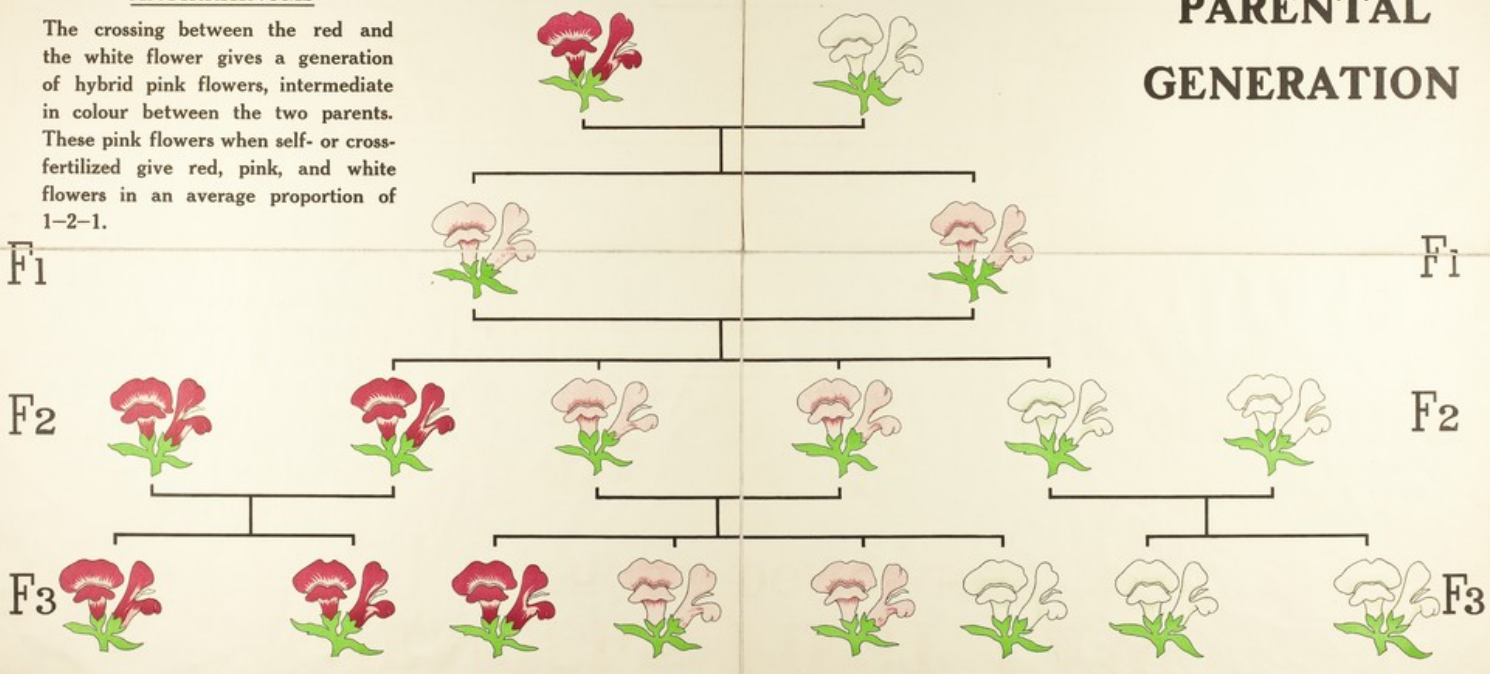
MENDEL'S FIRST LAW

WITHOUT DOMINANCE

ANTIRRHINUMS

The crossing between the red and the white flower gives a generation of hybrid pink flowers, intermediate in colour between the two parents. These pink flowers when self- or cross-fertilized give red, pink, and white flowers in an average proportion of 1–2–1.

PARENTAL GENERATION



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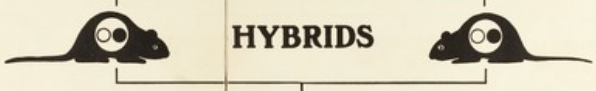
III

MENDEL'S FIRST LAW

WITH DOMINANCE

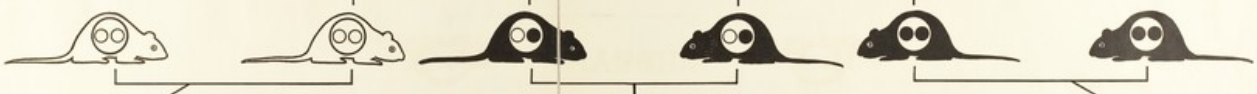
RECESSIVE DOMINANT

F1

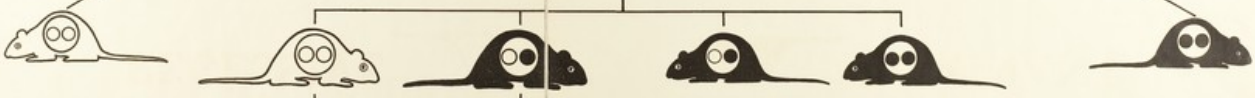


HYBRIDS

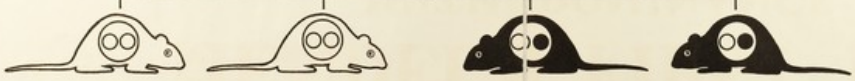
F2



F3



F4



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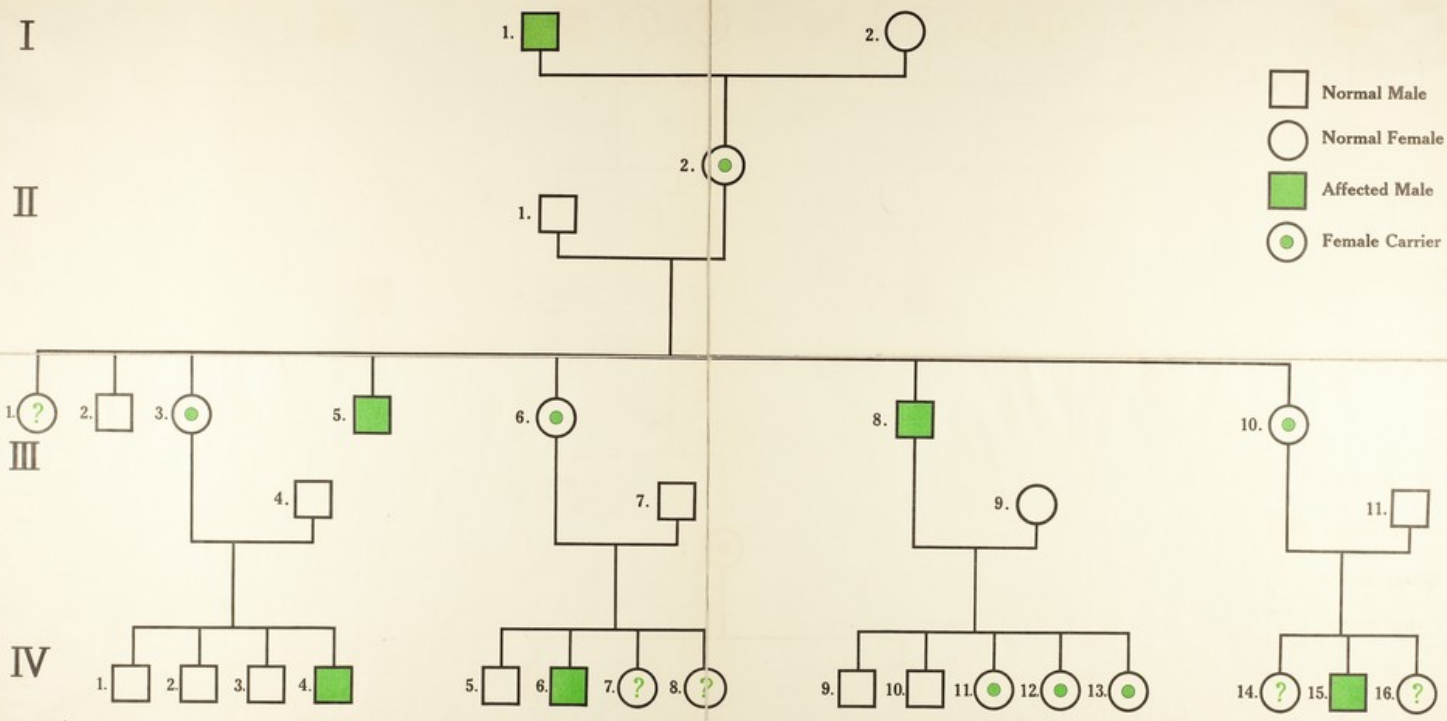
IV

STATIONARY NIGHT BLINDNESS



Note that in this pedigree only males are affected, and that the condition is transmitted by female carriers.

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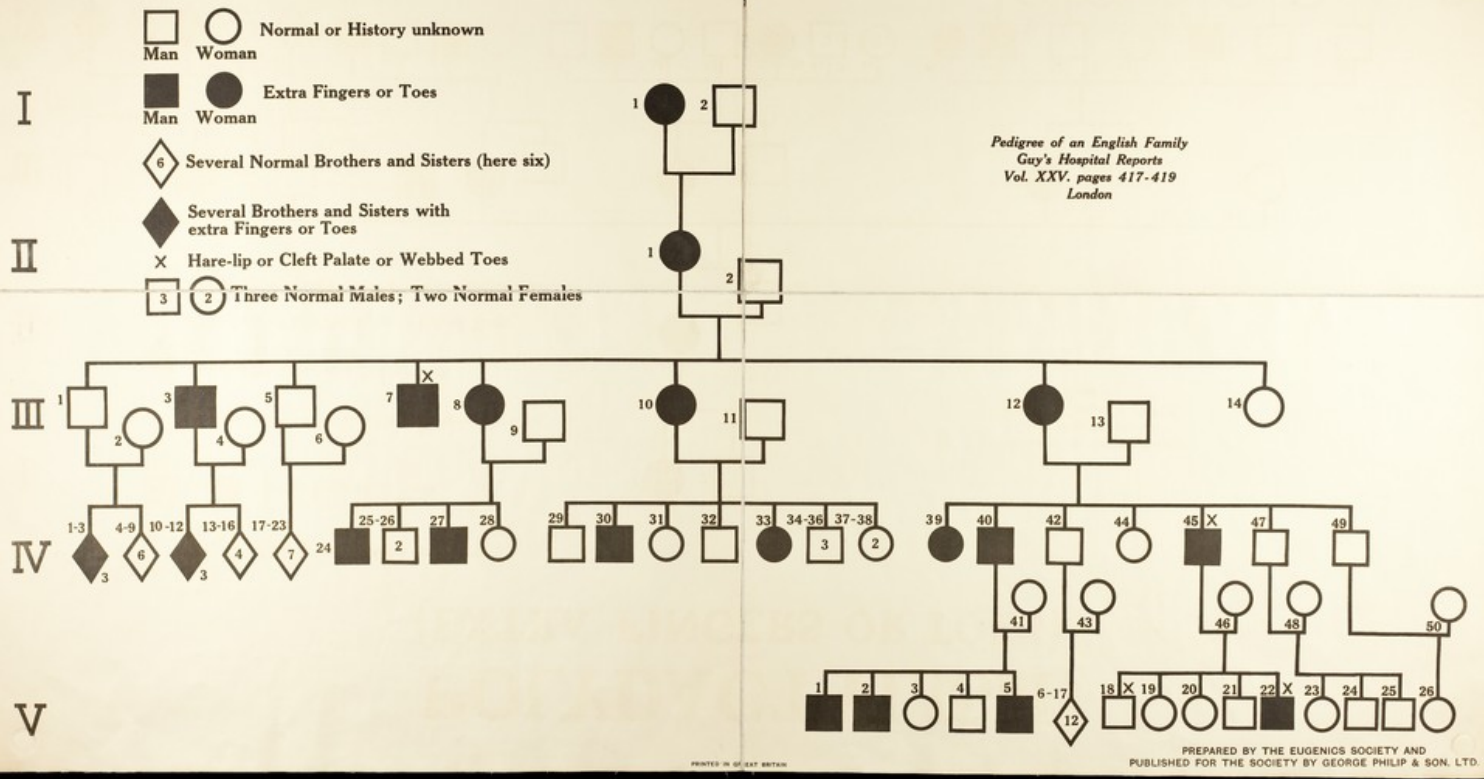
V

POLYDACTYLISM
(EXTRA FINGERS OR TOES)



Pedigree of an English Family
Guy's Hospital Reports
Vol. XXV. pages 417-419
London

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VI

WINNERS OF THE DOGGETT COAT & BADGE

THE PHELPS FAMILY

I

II

III

IV

V

VI

Honest John 1

Fred 2 3

Margaret 1

Barrett

Henry 1850 2

Old Bossie 3 4

William 1875 5

Charles 1884 6

Young Bossie 1 2

3

Henry Thomas 1919 4

Thomas James 1922 5

Richard 1923 6

John 1928 7

Edward Alex: "Teddy" 1930 1 2

Eric Leslie 1933

3 4

- Winner of the Doggett Coat and Badge
- Royal Bargemaster
- One of H.M. Royal Watermen
- Bargemaster Fishmonger's Company
- Boat or Launch Builder
- Lighterman's Daughter
- Seaman's Daughter

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