Problems in HUMAN HEREDITY

The Cards, Your Heritage: The Play, Your Chance

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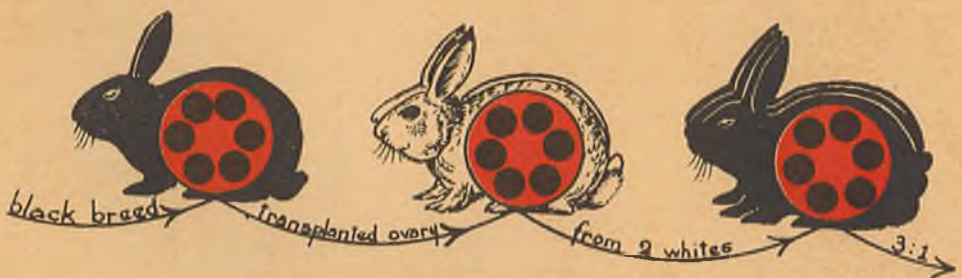

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Problems in HUMAN HEREDITY

(Learning by Thinking)

Reference List p. 26

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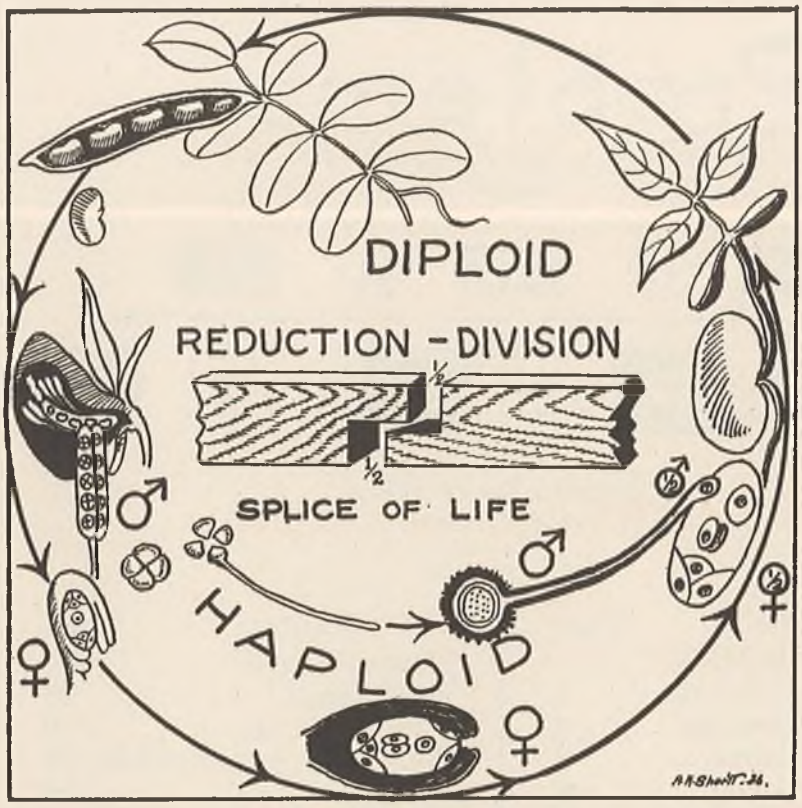
THE WAY OF ALL LIFE



This universal cycle of life, whereby certain cells (sex cells) reduce the number of their chromosomes to one half that they may evenly splice with another half is known as reduction division and common to all forms of life, plant and animal, Algae, Fungi, Mosses, Ferns and flowering plants, as well as the conjugation of Protozoa, the sex cells of Hydra, other Invertebrata and all Vertebrata, indicates a basic scheme of evolution depending upon parentage and consequent variation. The female ova being stationary and nursory are necessarily much larger than the motile sperms, spores, pollen and spermatozoa, but reduction division of each, makes equality of chromosome number and hereditary contribution.

Note the pollen grains forming fours (tetrads) as all sex cells do in Reduction Division during Oogenesis, p. 10. What is gained by this? Why are three of the four sacrificed to make one egg? Note that the embryo sac forms eight—three antipodals, two polar, two synergids, around the mother nucleus, and develop into an endosperm for its nourishment. Why? Why the ovum or ovule so large and the sperm so small? Compare antherozoids and spermatozoa.

In the Splice of Life—Why reduce one-half; what are the discards; the grain; the knots; cousin marriage; crossing of the grain (A-a). Splicing lengthens and strengthens. Explain?

1. Make another life cycle of plant or animal, showing the haploid gametes and state why they are so short-lived. See *Ganong's Botany, pp. 419, 435, 486, 511; Haupt, p. 47,* or *Rice's Biology, pp. 415 and 417.*

2. Do organisms ever live in the haploid condition? Parthenogenesis —(*Haupt's Biology, p. 183*) and drone bees, (*p. 184*), also Loeb's fatherless frogs—but how long did they live?

THE WAY OF ALL LIFE

THE UNIVERSALITY OF SEX indicates .....

.....

THE SIGNIFICANCE OF PARENTAGE is due to.....

.....

THE SPLICE OF LIFE, the crossing of the grain.....

.....

THE SCHEME OF EVOLUTION seems to be.....

.....

THE CARRIERS OF HEREDITY are.....

.....which.....

.....

SEX AND PARENTAGE ARE UNIVERSAL. Every living thing has two parents which contribute equally to its heritage through equal numbers of chromosomes passing unchanged from generation to generation.

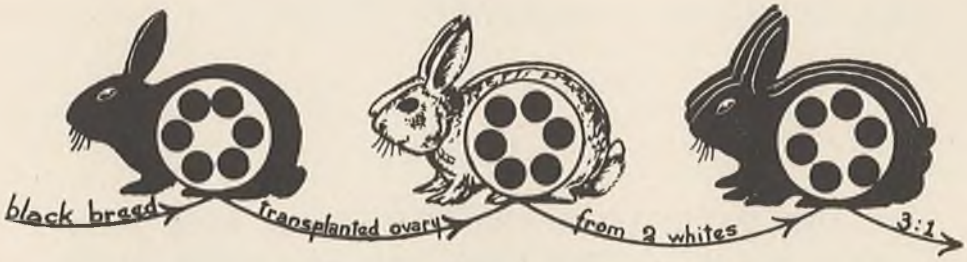
Safeguards of Heredity

Seeking proof of the continuity of the germ plasm (*Weismann 1890*), (*Conklin, et al, 1911*), showed the segregation of the germ cells during the earliest cell divisions and a definite germ track for the continuity of the germ plasm. (See *Quar. Rev. Biol., Mar., 1931, and Morgan, Drosophila, p. 22.*) An ovary with primordial eggs is well developed in the 6½-day chick embryo, and at 3½ days in the pigeon. Copy photos in Dev. of Chick, *Lillie, pp. 398 and 399 and next page.*

DEVELOPMENT OF THE MAMMAL

The carriers of heredity are thus sealed in a cell, in an ovary, in an embryo, in an amniotic sac, on an island separated from the mainland by the Chorion Channel, and the Gulf of Placenta. These are the biological barriers to prenatal influence—the safeguards of the carriers of heredity.

Castle and Phillips, 1911, further showed the continuity of the germ plasm by transplanting the ovary of a black guinea-pig in an albino which, although crossed with an albino male, produced only black offspring.



1. Trace the continuity of the Hapsburg lip through four centuries. *Wiggam, p. 115; Gates, p. 152.*

2. Trace symphalangy, etc., through many generations as cited by *Gates, pp. 151-158.*

3. Show genealogy of white forelock. *Gates, p. 111*, colour-blindness, *p. 82*, haemophilia, *p. 209.*

4. Read "The Immortal Germ Plasm," chap. ix; *Fasten, pp. 150-160* and *pp. 22-29*, and define Weismannism and Lamarckism.

5. Read "Inheritance of Acquired Characters," chap. iii (*Fasten, pp. 32-57*), and account for birthmarks.

6. Read "Prenatal Influence." *Wiggam, pp. 98-108*, and record the advantages of nature's way.

SAFEGUARDS OF HEREDITY

A chick chipped its shell to remark,
How the shocks that they get makes birthmark,
For three weeks before
A slammed 'cubator door
And four score chicks have it in for Lamarck.

three chromosomes in the germ track, one polar body, with two chromosomes.

"In Miastor, when the four first-formed nuclei divide, one of the eight daughter nuclei, moves to one pole of the egg and establishes a germ track for the later division of all of the germ cells." Morgan: Drosophila, p. 22.

The Carriers of Heredity

The Short Chromosome of Drosophila
carrying the genes that make the fly—bare, bent and blind.

The recent finding of giant chromosomes in the salivary glands of the larva of fruit flies reveals the complicated structure of these carriers of heredity. These chromosomes seemingly have divided longitudinally four times without separating, thus making a spindle or cylinder of 16 chromosoma with various discs of chromomeres, grouped almost exactly as they had been mapped by linkage groups and crossovers long before the structure of the chromosome became visible in these compound formations, 150 times the ordinary size. Now, the genes or the discs that carry them can be seen, localized and perhaps altered or translocated, making genetics an exact science, and the carriers of heredity a reality.

1. Make a careful sketch of another giant chromosome under the microscope or from photos in *Journal of Heredity, Feb., April and May, 1935,* or *Snyder's Heredity, p. 302,* or *Rice's Biology, p. 475,* or *Holmes' Human Genetics, p. 13.*

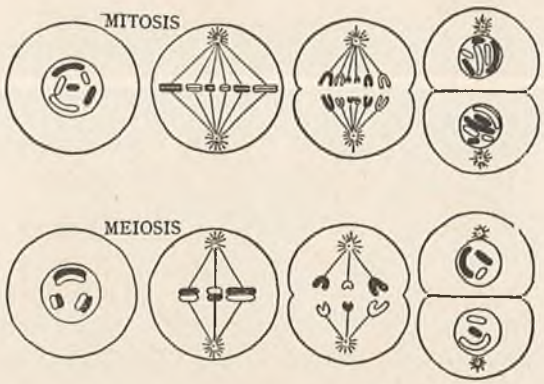
2. Compare the gene group locations with those on chromosome maps made previously. *Snyder, p. 160; Rice, p. 475.*

3. Sketch the famous pairs of Drosophila in outline and large enough to place thereon the more important gene locations. (*Snyder, p. 1358*). Note the Y-chromosome carries very few genes. Why? Compare with human, (*p. 24*).

4. Linkage implies linked or grouped within the chromosome; independent assortment of Mendelism implies factors in different chromosomes. How was linkage discovered? Why was Drosophila so suitable?

CARRIERS OF HEREDITY

Cell Division: Mitosis and Meiosis



The carriers of heredity keep their identity by **splitting** lengthwise into longitudinal halves, thus keeping the exact linear arrangement of the chromomeres and the genes, during ordinary cell division or growth. Each new cell is an exact replica of the other. This is **Mitosis.**

To reduce the number of chromosomes to one-half, to make possible a new fusion or new deal, there is a **pairing of the chromosomes,** of like pairs, allelomorphic pairs, paternal and maternal, thus giving independent assortment—the basis of Mendelian heredity. This is Meiosis or Reduction Division. Letter the chromosomes—black being dominant. *Haupt. p. 221; Holmes, pp. 13, 73; Fasten, pp. 84 and 87; Rice, p. 468.*

2. A personal biological will is made when these paternal pairs of chromosomes are divided in reduction division. This is the allotment of heritage, of heirlooms. Liken these parental allelomorphic pairs to—knife and fork, cup and saucer, pepper and salt—a table group separated between meals to be re-combined again, often as a different pair, like the gametes and zygote of life. Likewise, pen and pencil, penknife and scissors, compact and mirror, brush and comb, soap and razor, the latter being the X-y unmatched pair, so differently feminine or masculine as to determine the sex. Where y goes, there beard grows. Show this by diagrams. *Haupt, p. 224; Fasten, p. 223; Rice, p. 482.*

4. Note the 24 pairs of human chromosomes with one unmatched pair X and y. *Holmes, p. 9.*

5. If a character depends upon a gene in the Y chromosome, how would be inherited? *See page 20.*

CELL DIVISION: MITOSIS AND MEIOSIS

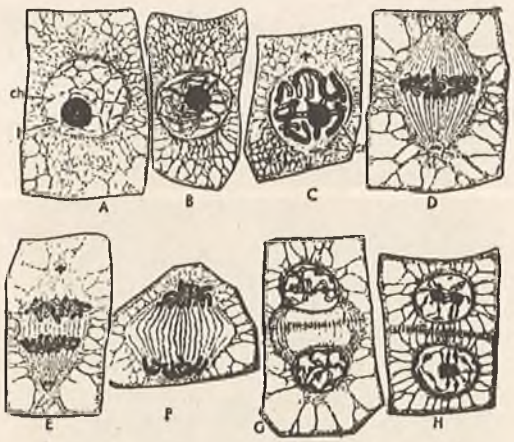
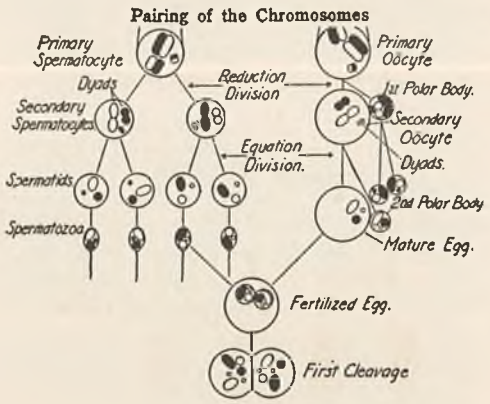


FIG. 4. Nuclear and cell division in the root of corn: cell with prominent resting nucleus (*A*), prophases of nuclear division, spirem (*B*) and chromosome (*C*) stages, bipolar spindle (*D*); early (*E*) and late (*F*) anaphases, telophases (*G*) and first evidence of cell-plate, location of cell-wall clearly defined (*H*). [After Curtis.]

Reduction Division: for a New Deal



Those cells which are in the germ-track of the sex organs, ultimately are forced to reduce their chromosome number to one-half by the **pairing** of homologous or parental pairs (synapsis) and cell division then gives haploid gametes for a new deal. The further division to form **tetrads** simply provides duplicates. Thus all sex cells are formed in fours (tetrads) only the embryo sac forming eights (octads). The three polar bodies in egg formation perish or are re-absorbed—only the one egg cell remains. Why?

1. Why is the egg so large and the sperm so small?

2. What great change is effected by the pairing of the chromosomes?

3. What is the origin of the pairs?

4. What evidence of allelomorphic pairs?

5. What is the presence and absence theory?

6. Why do capitals and small letters so accurately represent allelomorphic pairs?

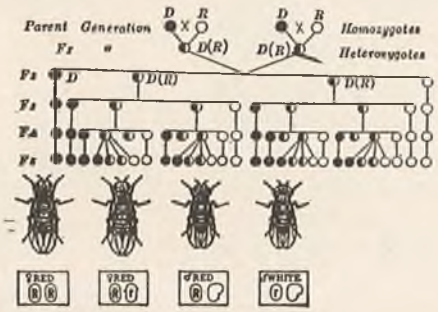
7. A good hostess separates the couples and mixes her party as much as possible. How many ways can three couples be grouped so that the man and wife (the allelomorphic pair) are always separated? (as in all gametes).

ABC, ABc, AbC, aBC, Abc, aBc, abC, abc.

REDUCTION DIVISION: FOR A NEW DEAL

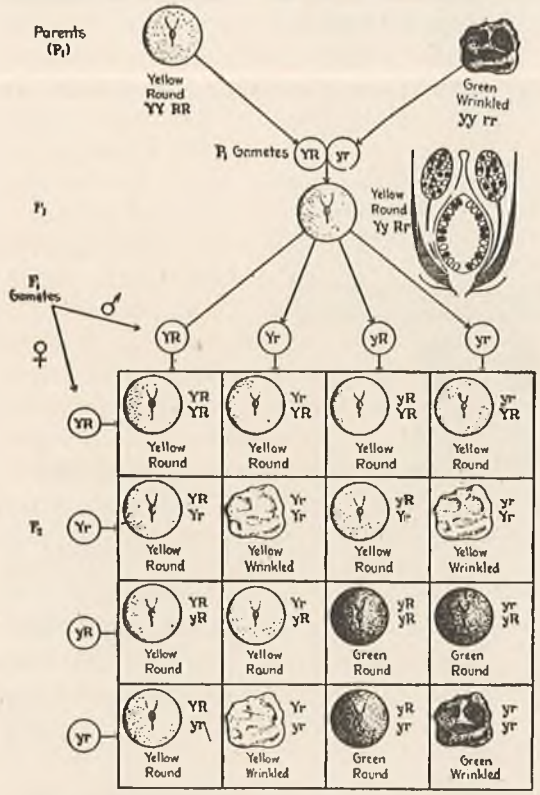
Note the pattern or system and make a similar arrangement for four couples. These groups are the gametes of trihybrids and tetrahybrids and also the phenotypes. The genotypes are all the different combinations that can be made from them. *See pp. 12 and 14.*

8. Show the genotypes in a 3:1 ratio in eye colour, and 9:3:3:1 in dihybrid fruit flies.



Mendelism

Unit characters, passing unchanged, by independent assortment, because indifferent chromosomes.



Allelomorphic pairs or contrasting factors are fittingly represented by dominant capital and recessive small letter. These parental components are paired in the pairing of the chromosomes (p. 6) and, therefore, separated in the gametes—the beginning of independent assortment. The squares on these pages simply provide for all the possible combinations—male gametes along the top, female gametes along the side, and the combinations are visualized in a pattern of genotypes and phenotypes, homozygous on one diagonal, heterozygous on the other, dominants in the upper left—recessives in the lower right. (Colour to more clearly show the ratios.)

1. Letter the 9:3:3:1 phenotypes of dihybrid fruit flies. How many genotypes? How many in a monohybrid?..... In a trihybrid?..... Name the four phenotypes and tabulate the nine genotypes of Drosophila.

2. If colour be involved in the YyRr peas, the gametes will be RYC, ..., ..., ..., ..., ..., ..., ..., ryc, and the phenotypes 27 RYC: 9.....: 9.....: 9.....: 3.....: 3..... 3.....: 1 ryc and the genotypes 8 R-Y-C, 4 R-Y-cc: 4R-yyC-: 4rrY-C. 2R--: 2rYc: 2ryC:1 ryc. Total .....as follows.

Sinnott and Dunn, pp. 67 and 68.

MENDELISM

3. Brown eyes (B) are dominant over blue (b). What are the chances that the first child of two heterozygous brown-eyed parents will be blue-eyed? On squares show the three genotypes. Account for blue-eyed Swedes and black-eyed Orientals. Account for hazel, green and grey eyes. See *Darbishire;* Mendelism—for coloured plates.

4. A brown-eyed, right-handed man marries a blue-eyed, right-handed woman. Their first child is blue-eyed and left-handed. If other children are born, what will probably be their eye and hand traits?

5. A right-handed, blue-eyed man, whose father was left-handed, marries a left-handed, brown-eyed woman of a large brown-eyed family. What ratios of these traits may be expected in the offspring?

6. Why are yellow mice, walnut comb fowls and blue Andalusians unpopular breeds. If these breeds be inbred for five generations, what will be the resulting population? Continue diagrams to fifth generation. See p. 11.

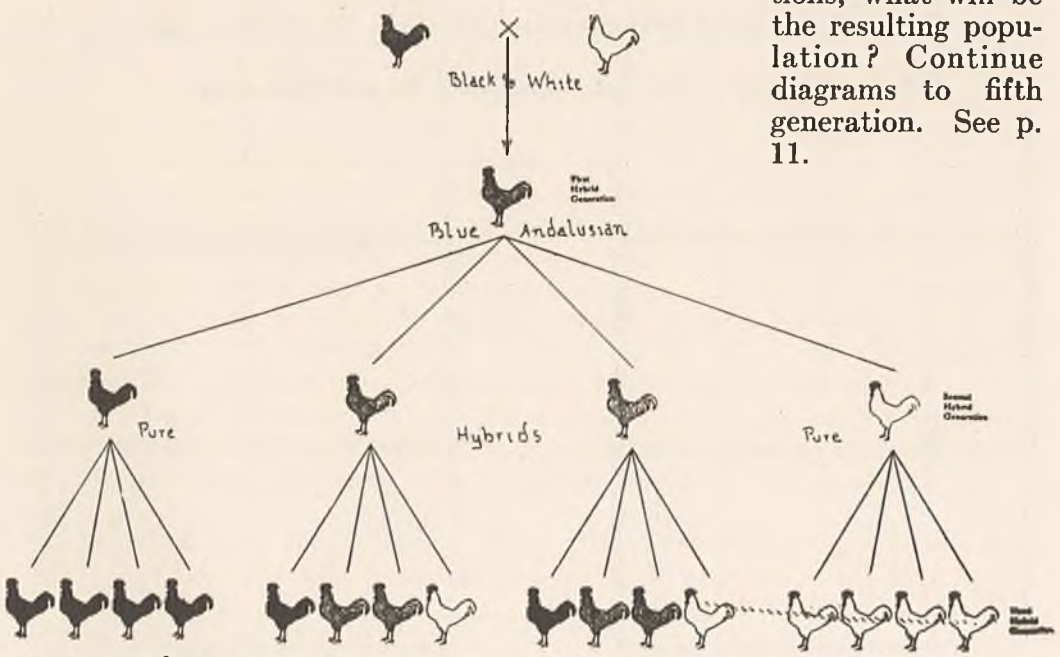


FIG. 2 – DIAGRAM TO ILLUSTRATE THE MENDELIAN INHERITANCE OF COLOUR IN THE ANDALUSIAN FOWL

Interaction of Factors

1. Bates, on crossing two different varieties of white sweet peas, got the wild ancestral Sicilian purple, the F_2 of which gave 9 purples : 7 white. The colour evidently depends upon the presence of some other factor or condition, as phenolphthalein purple in alkaline solution. Label two test tubes C and P, C for condition, water slightly alkaline, and P, with phenolphthalein solution. Both are clear but when mixed give purple. Now mix gametes in the same way. CP, Cp, cP and cp on the checkerboard as for dihybrids and note the 9 CP:7 where Condition and Purple do not meet. With acid as Inhibitor, what ratios would you get (4)?

2. Under what conditions a 9:3:4 ratio?

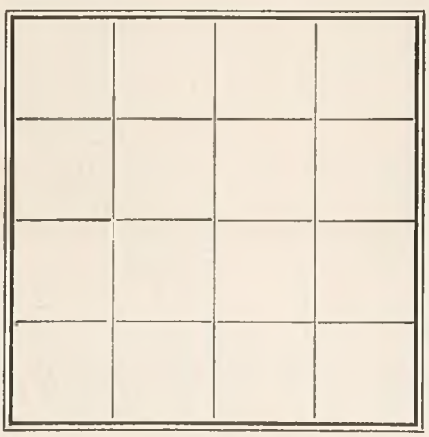
3. Under what conditions a 9:3:3:1 ratio?

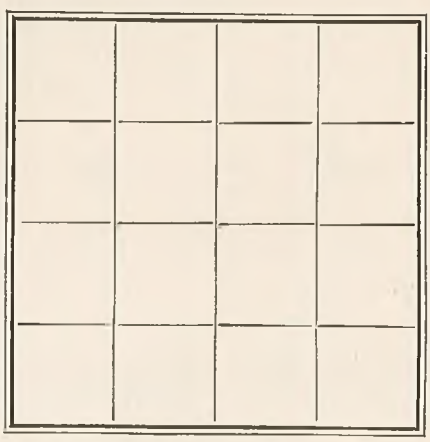
4. Under what conditions a 13:3? *See Sinnott and Dunn, pp. 74, 77, 81, 84.*

5. Cuenot breeding yellow house mice always obtained two yellow to one of another color. Why not 3:1? He later found that the homozygous yellow were stillborn; Y being a lethal gene. Now explain the 2:1 or see *Dunn and Sinnott, p. 97, and Sc. Monthly, Nov. 1936, p. 418.*

6. Cite other cases of lethal genes. *Gates, pp. 30, 82, 84; Snyder, p. 78.*

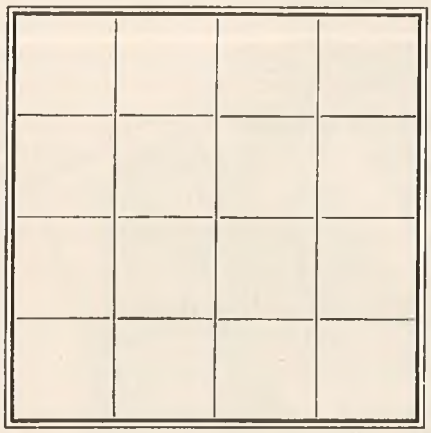
7. Why is Haemophilia not considered as a lethal gene?



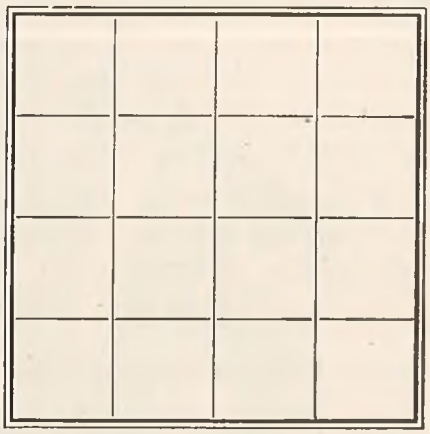


INTERACTION OF FACTORS

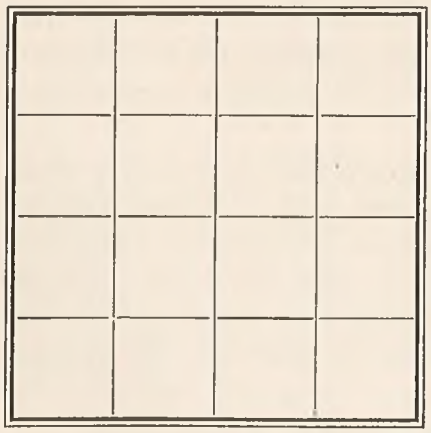
Sinnott and Dunn, pp. 73-97.



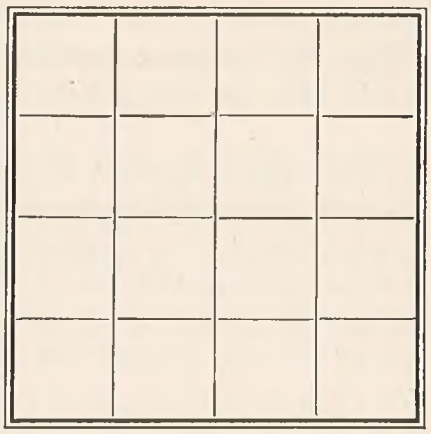
9..... : 3..... : 3..... : 1.....



9..... : 7.....



9..... : 3..... : 4.....



13..... : 3.....

Bridge of Life

The cards, your heritage: the play, your chance.

Rules of the Game:—48 cards, same number as human chromosomes, the carriers of heredity. Two colors, red and black, maternal and paternal. Hearts, the maternal grandmother; Diamonds, the maternal grandfather; Spades, the paternal grandfather, and Clubs, the paternal grandmother.

The Deal (reduction division) gives you one-half, and your partner one-half. The Bid depends upon the cards you hold, and what you can surmise about your partner's hand from past performance (ancestry) and her previous bids (brothers and sisters, the more the better). Neither overbid your cards (your heritage) nor overlook your partner's bid. The two of you are playing the world—the game of your life. No bluffing; don't kid yourself if you have no honors; don't weaken if you have; the cards are your heritage; the play is making the best of it.

On the night of September the twentieth
All honors fell to Leonardo de Vincieth;
He moistened his thumb,
And pulled forth the plum,
Saying, "Such a Grand Slam only comes once a centurieth."

LAWS OF CHANCE

1. Toss two coins fifty times and tabulate results as like pairs and mixed pairs. Compare with Mendel's 1hh : 2ht : 1tt. Read *Snyder, p. 59*, on Probability.

2. From a sack of 50 white and 50 black beans thoroughly mixed, pick blindly 50 pairs and compare with Mendel's peas; 1bb : 2bw : 1ww. If contact with black shaded the white, what would the ratios be?

3. Three of a kind are less frequent than two pairs—1bbb : 3bbg : 3bgg : 1ggg (*p. 34*). In families of three, how often all girls or two girls and a boy? *Snyder, p. 60.*

Poker is based upon the Law of Chance.

4. Four of a kind, less frequent than a trio and a pair—1bbbb: 4bbbg : 6bbgg : 4bggg : 1gggg (*p. 34*). *Sinnott and Dunn, p. 93.*

In families of four how often all boys or 3 boys and a girl? *Snyder, p. 60.*

In a maternity hospital eight girl babies were born in succession. How often does this happen? *Snyder, p. 60.*

For degrees of coat colour in mice, see *Sinnott and Dunn: Genetics, p. 86.*

For incidence of disease, see *Human Heredity, pp. 507 and 523.*

For coefficient of correlation, *see Human Heredity, p. 537.*

For problems in probability, see *Snyder, p. 62.*

5. If skin colour depends upon four allelomorphs, or multiple quantity factors—a(lbino), B(lack), C(oloured), W(hite), then mulatto is Aa Bb Cc Ww. Quadroon..... Octoroon..... Sambo (*Gates, p. 314*).....and the proportions....., ..., ..., ..., one white or one pure Indian to.....metis, and.....mestizo.

6. The most traceable racial crossing is on isolated Pacific Islands. Polynesian crossed with white on the Island of Gaum (*Gates, p. 344*) [(p x W) x W] daughter x (p x W) son. What is the colour factor for each and their offspring? What segregation of other characters?

7. Kate [(p x W) x W] marries Rufus [(p x W) x Negro]. (*Gates, p. 345.*) What segregation in their offspring and what colour factors? Read *Gates, pp. 328-362.*

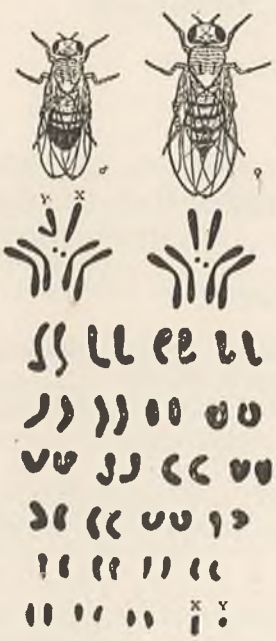
8. Mentality is commonly graded into eight grades from idiot to illustrious (see *Third Eugenic Congress, p. 414*) and mediocre represented as AaBbCcDdEe with a frequency of 243 as compared with 45 dull or able, 15 moron or brilliant, 5 imbecile or eminent, aabbccDd or AABBCCdD. *Galton, p. 30.*

See also *Human Heredity, pp. 630-653* on Racial Psychology.

Sex Determiners

The 50:50 ratio of the sexes indicates a set mechanism of alternative chromosomes as sex determiners. In 1891 Henking noted an extra chromosome which he called X, in half the male gametes of certain insects, but it was 1905 before Wilson showed the significance of dimorphic spermatozoa, and unimorphic ova (or vice versa as in Aves) as a 50:50 sex determiner. Soon it was found that most plants and animals had this X-y pair of unmatched chromosomes which at reduction division gave X and y gametes the sex determining alternative. Drosophila with only four pairs has a large X-y pair with a readily observable bent. Painter, 1923, and Evans and Swezy, 1929, have definitely shown that there are 24 pairs of chromosomes in man and that the one unmatched pair X-y gives X or y gametes as in all other animals investigated.

Drosophila



The 24 Human Chromosome Pairs

1. Show how this unmatched X-y pair gives a 50:50 sex ratio. See *Hurst, p. 50*, for X-y in ten animals.

2. Compare vital statistics of Winnipeg over a period of 40 years and account for the almost constant 103:100 ratio in all large cities and throughout the world.

3. What, therefore, is the possibility of sex control or of what avail the praying of 60 million for a prince for the future throne of Japan?

4. On what chromosome is sex-linked, color-blindness and haemophilia carried? What proof? See *Fasten, pp. 216 and 315; Guyer, p. 113; Holmes, pp. 42-50; Hurst, p. 240.*

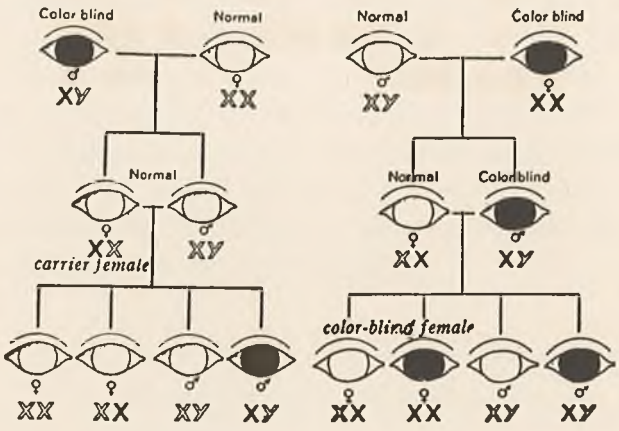
5. How is the higher death rate of males counterbalanced?

6. For discussion of sex, read *Fasten, pp. 92-115.*

SEX DETERMINERS

Colour-Blindness

Since four per cent of the male population are colour-blind to traffic lights, this sex-linked hereditary defect is of genetic interest. Passing from father to daughter as a carrier and thence to her sons only, it must be carried to the X chromosome as shown below.



1. With what parentage does the female inherit colour-blindness and how rarely? Reconcile your estimate with Howell's "One in a thousand."

2. In Oslo the incidence is 8% for males and .5% for females. Likewise in mountain valleys in Switzerland. Account for this.

3. The colour-blind female transmits it to **all** her sons and all her daughters are carriers, and if her husband were colour-blind..... but that would only happen once in.....

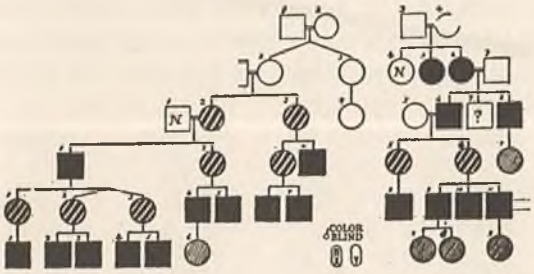
4. A man's mother and her father were colour-blind. Show the genotypes of three generations.

5. A girl whose father was colour-blind marries a man whose father was also colour-blind. What ratios of colour-blindness in the offspring?

6. Show three pedigrees for colour-blindness, as in (*Gates, pp. 82, 88; Castle, p. 362; Snyder p. 70; Human Heredity, pp. 85 and 259*). Is it dominant or recessive?

Haemophilia: also X-carried (sex-linked). Blood will not clot; fibrinogen missing. Carrier females, sub-lethal; blood clots in 3-10 minutes. Read (*Gates: "Heredity in Man," pp. 205-213*), and show pedigree of Mampel and Jasper families, (*pp. 209 and 210*). Only 47 out of 524 bleeders left offspring, thus holding this lethal gene in check. List other lethals.

COLOUR-BLINDNESS



Blood Groups

In 1900 Landsteiner discovered that the blood of certain humans agglutinates that of others. During the past thirty years, this has been given world-wide test with all races and thousands of cases and four *blood groups* established in which anti-bodies aA and bB are incompatible.

Group	*Aggluti-nates*	*Aggluti-nated by*	*Parents*	*Child*	*Antigens*
O	A, B, AB	None	OxO	O	A, B, AB
A	B, AB	O, B	OxA	O or A	B, AB
B	A, AB	O, A	AxA	O, A	B, AB
AB	None	O, A, B	BxB	O, B,	A, AB
			AxB	O,A,B,AB	....
			OxAB	A, or B	O, AB
			AxAB	A, B, AB	O

Since aA and bB act as anti-bodies, and agglutinate each other, any one blood can have only one of each, not both—ab, Ab, aB or AB.

Transfusions, therefore, can only be made with blood of same group, or Group AB which, having neither a or b, has no effect on the corpuscles of any of the other groups. This, then, is the blood most desired for transfusion and now kept on hand in hospitals.

1. What other groups are compatible for transfusion?

2. Why are Group O called "universal donors"?

3. In the famous Chicago case, mother OxO was given baby A, and baby O was given to mother ABxO. Show that this was an easy case for definite adjustment.

4. OxAB (174 families) gave 5.5% O, 45.6% A, 43% B, 5.9% AB. Explain crossover.

5. OxA (1018 families) gave 42% O, 58% A. Explain. See *Gates, p. 196.*

6. In forensic law blood groups may offer evidence of parentage. If the child's blood be AB and the mother's O, the father's must be ..... Show why.

7. If child is A and mother O, the father must be..... or..... See *Fasten, p. 318*, or *Snyder, p. 97.*

8. Tabulate the blood groups of the various races of man as in (*Gates' Heredity in Man, p. 199*, or *Snyder, pp. 93-101*).

Note—N. A. Indians, 79-91% O, other aborigines, 53% O, whereas Nordics, 40% O, 42% A, 17% B, 6% AB, and Asiatics, 30% O, 20% A, 38% B, indicating that A had its origin in Europe, and B in Asia, and that the Gypsies are of Asiatic origin (39% B). As AB blood is seldom over 7% of any race it indicates..... and 1 or O blood must have been .....

9. State further serological significance of the above data. (*Gates, p. 200*). Account for a 62.6% A blood in Sweden and a 91% O blood in N. A. Indians.

10. Show pedigrees of Haemophilia showing it sex-linked and how transmitted.

See *Fasten, p. 314; Gates, pp. 205-216.*

BLOOD GROUPS

Physical Defects

While some heritable physical defects may not be a serious handicap, many of them are, and all show the positiveness of heredity in a readily observable and traceable defect, often linked with a mental one.

1.

	Cretinism	*No Cretinism*	*Yule's Coefficient of Correlation.*
Goitre.	80 (a)	684 (b)	$\frac{ad-bc}{ad+bc}=.98$
No Goitre. .	7 (c)	33,784 (d)	

What does this imply?

Of the 87 cretins, ... had goitre, and of the 764 goitres only ..... were..... Explain.

See *Human Heredity, pp. 340 and 537,* and show goitre-cretin pedigree, three generations.

2. Of 50,000 deaf-mutes in Germany, 30% were feeble-minded, whereas only about 1.5% of the general population were feeble-minded. What is the possible correlation? What common factors involved? Other causes of deafness?

In Swiss communes of less than 100, 1% are deaf-mutes.

In Swiss communes of less than 400, 34% are deaf-mutes. Explain.

In Berlin, 27 deaf-mutes per 10,000 Jews, 6 per 10,000 Gentiles. Explain. One-third of deaf-mutism traceable to heredity and over one-quarter to consanguineous marriages. Why? See six pedigrees of deaf-mutism. *Human Heredity, pp. 262-267.*

3. Of the 7 albinos in the Manefield family of 26 kin (*Human Heredity, p. 226*), 6 had definite nystagmus, whereas its normal frequency is only about 1 : 10,000, and that of albinism 1 : 15,000. What is the correlation? Myopia is also often correlated with albinism. *Human Heredity, p. 228.*

The children of myopic parents are myopic. See *Human Heredity, pp. 229, 230-232.* Show two pedigrees. What do these indicate, D or r? Compare with congenital cataract (*p. 242*); blindness (*p. 245*); retinal atrophy (*p. 250*); night-blindness (*p. 253*); glaucoma (*Holmes, p. 103*).

4. Of 13 blue sclerotics in a family of 24 (*Holmes, p. 108*), ten had fragile bones. What does this indicate? *Gates, p. 90.*

5. Three generations of two families (*Holmes, p. 107; Rice, p. 00*), both had 50% cancer. Another family 27 cases of cancer of the stomach (*Human Heredity, p. 394*). Macklin cites a case of identical sisters who both had cancer of the breast at 17 (*Human Heredity, p. 397*). Make three pedigrees. (*Holmes, p. 107; Human Heredity, pp. 394-397*). Is cancer hereditary, or is it the susceptibility of certain tissues that is "transmitted unchanged"? And the cause merely chronic irritation? *The tuberculin test, the Schick reaction, etc., are simply advance proof of constitutional susceptibility.*

PHYSICAL DEFECTS

6. In the Schofield family (*Castle, p. 37*), all the boys (14 in three generations) had "webbed toes." Show chart. How this father to son inheritance?

See Syndactyly (*Holmes, p. 101);* Polydactyly (*Human Heredity, p. 287);* Brachydactyly (*Human Heredity, p. 290*).

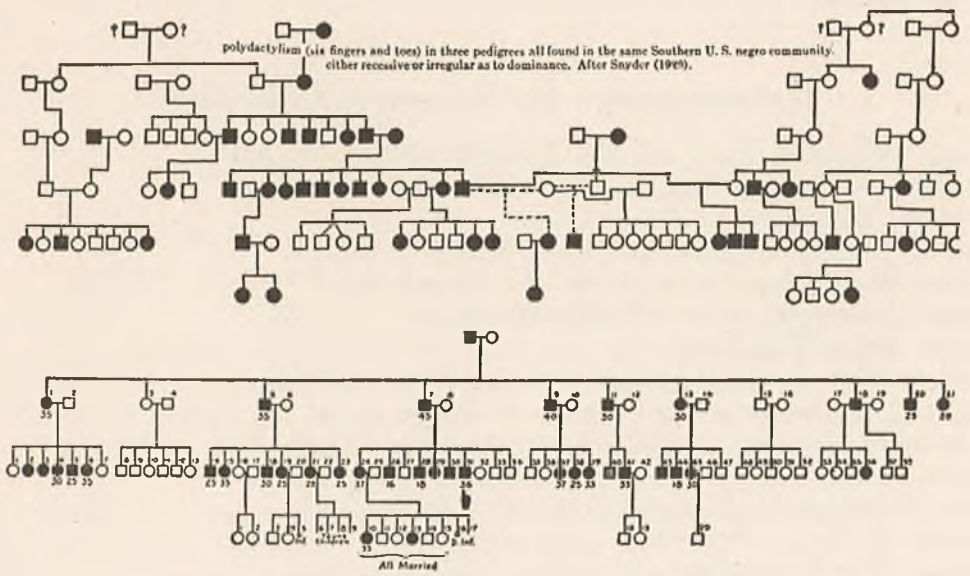
See list of inherited characters. *Castle, p. 343.*

See *Human Heredity* for discussion and pedigree of club-foot, *p. 293;* harelip, *p. 301;* dwarfism, *p. 320;* twinning, *p. 323;* eczema, *p. 327;* adenoids, *p. 330;* rickets, *p. 334;* goitre, *p. 338;* apoplexy, *p. 351;* diabetes, *p. 353;* gout and hay fever, *p. 361;* migraine, *p. 363;* gall-stones, *p. 366;* jaundice, *p. 367;* heart failure, *p. 373;* susceptibility to disease, *pp. 378-390.*

7. How does the pedigree show whether dominant or recessive? Whether due to a single gene or to a multiple factor? Why is a coefficient of correlation between parents and offspring not an adequate measure of the "strength of heredity"? *Holmes, p. 95.*

8. Your probable longevity is the average of that of your ancestors. *Galton; Average Contribution of Ancestors, Proc. R.S. of London, 1897 (61) pp. 401-413.* Mother's sibs, average, 83.5; kin, 88; and father's, 72 and 78. Compute longevity.

9. To 70% of the general population, crystals of phenyl-thio-carbamide produce a bitter taste. How would you proceed to find if taste is hereditary or sex-linked, and if so what correlation? *Castle, p. 370; Snyder, p. 349.*



Pedigree of Huntington's chorea, a simple dominant character. Numbers below individuals indicate approximate age at which choreic symptoms became evident. After Clarke and MacArthur (1924).

Mental Defects

Microcephaly, mongoloid idiocy and cretinism are three readily observable hereditary brain formations (*Holmes, p. 128*), showing relation of form and function. Why should not the finer and more complex functions be inherited as with other organs? Migraine, a localized cerebral disorder, is definitely hereditary through many generations (*Human Heredity, p. 363*). Stammering, like myotonia, is lack of co-ordination of mind and muscle, and both have been traced through six generations in many cases (*Human Heredity, pp. 420 and 424*). Thirty-seven cases of Huntingdon's chorea in one family (*Holmes, p. 141*), and epilepsy (*p. 144*). Of 250 children at the Rostock School for feeble-minded, 60 had feeble-minded fathers, 80 had feeble-minded mothers and 29 had feeble-minded fathers and mothers: 67.6% hereditary. *Human Heredity, p. 430.*

1. Copy Kallikak chart. *Wiggam, p. 8; Holmes, p. 133; Fasten, p. 328.*

2. Read *Human Heredity, pp. 426-459* on dementia praecox, schizoids, epilepsy.

3. Tabulate the grades of intellect with I.Q. mental age and frequency. See *Child Heredity, p. 167.* Read *pp. 134-168. Snyder, p. 328. Galton, p. 30.*

4. Why is it more difficult to establish the hereditary basis for mental traits than for physical traits? Why is it easier to trace mental defects than talents?

5. Musical talent. *Human Heredity, p. 568; Goethe, p. 574; Darwin-Galton, p. 576,* and *Fasten, p. 294; Holmes, p. 153.*

6. What effect will treatment of insanity have upon the genetics of the malady?

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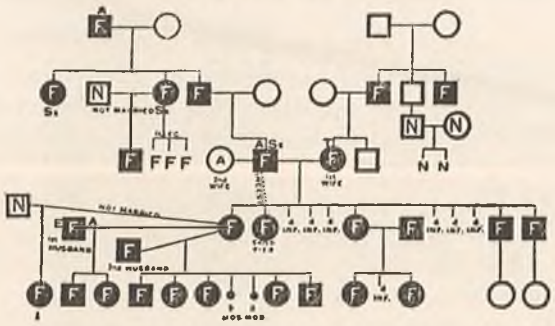
MENTAL DEFECTS



Sterilization and its Effect

	Males	*Females*	*Total*
California (1909-33)	4,423	4,081	8,504
Connecticut (1909-33)	18	320	338
Indiana (1909-33)	159	58	217
Indiana Radium Therapy	...	230	230
Kansas (1913-33)	588	388	976
Michigan (1913-33)	264	819	1,083
Minnesota (1925-33)	72	621	693
Virginia (1925-33)	479	854	1,333
36 States. Total	7,000	9,296	16,296

1. Why should California lead in sterilization? Why Alberta, in Canada?

2. Why such disproportion of females in Connecticut, Minnesota, and 9,067 : 7,000 in all U.S.A., and nearly equality in California, with emphasis on vasectomy, which is much simpler and more justifiable than salpingectomy. Indiana, 230 radium sterilizations of females for therapeutic reasons. Sterilization in South Dakota. *Journal Heredity, October, 1936.*

3. Germany, starting in 1933, on a ten-year plan, to lessen mental defectives, sterilized 45,000 the first two years, only one-tenth of the objective. Assuming all mental defects as recessive (a) and 10% of the population of sixty million, how effective will the German plan be? See *Journal Heredity, December, 1935.*

See type solution on opposite page.

(b) Why is it impossible to completely eliminate a recessive?

(c) If defectives are only one per cent, how will the problem be affected?

" Halved in Six Generations " *J. B. S. Haldane, p. 184,* and *A. E. Watkins, p. 168.*

(d) If a recessive defect is present in 1/16th of the population, what proportion will be carriers?

4. The high incidence of infant mortality among feebleminded tends to offset the higher birth-rate. To what extent? Why is differential birth-rate the most dysgenic factor? Why is birth control perhaps the least with this class? Read *Wiggam, pp. 317-328.* What other factors involved?

5. Give statistics of mental defectives in Manitoba, Saskatchewan and Alberta, and Canada (*Canada Year Book*).

6. What physical defects warrant sterilization? *Snyder, p. 342.*

7. The children of congenitally deaf parents are deaf. See pedigree in *Snyder, p. 47.* What should be done in such cases?

Two deaf mutes, a priest and the bans,
Solemnized the prompting of glands;
Children seen, not heard,
Was the unspoken word
And some seven now talk on their hands.

Eliminating Recessives and Hereditary Defects

Type solution of problem 3.

Assuming a heterozygous population:—1AA+2Aa+1aa, in which the recessives are sterilized or otherwise prevented from procreating; then after the first selection the gametes will be A+(A+a) and the next generation will be:

F_2—$(2A+a)^2$ or 4AA+4Aa+1aa (discarded) leaving third gen.
F_3—$(3A+a)^2$ or 9AA+6Aa+1aa (discarded) and $\frac{15}{16}$ dominant.
F_4—..... " " $\frac{24}{25}$ "
F_5—..... $\frac{35}{36}$ "

See diagram, p. 11.

Make a graph showing above rate of elimination and compare with *Watkins, p. 168,* or *East & Jones, Inbreeding and Outbreeding.*

STERILIZATION AND ITS EFFECT

Vital Statistics and Sex Ratios

1. Live births Winnipeg, 1912-1935 (24 years), 61,307 male, 57,913 female. Total 119,220. What is the ratio of males per 100 females? How does this compare with London, New York, Berlin, Tokio? See *Canada Year Book, 1936, pp. 149 and 156.*

2. The nearest equal ratio was 1935—1,897 and 1,894; 1924—2,386 and 2,376; 1931—2,221 and 2,201, but always a slight excess of males. Why so nearly 50 : 50? See *Sex Determiners, p. 18.* What factors favor an excess of males? Define Law of Chance.

3. The still births 1912-1935 was 2,736 males and 2,081 females or.....males : 100 females. Still births average..... per 1,000 live births. Why all birth records given per 1,000?

4. Infant mortality for 24 years—3,720 males, 2,863 females, or .....males : 100 females. There has been a steady decline from 1,006 in 1912 to 163 in 1935. Account for this. How will this affect the average span of life or longevity of the individual? *Holmes, p. 246.*

5. The birth rate 1912-1922 averaged 30 per thousand and then steadily declined to 17. Account for this great decline in birth rate and how general is it throughout civilized countries? See *Holmes, pp. 198, 212, 222.*

6. During these 24 years there have been 120,000 births, including 1,431 twins (average 60 yearly) and 8 triplets. What is the incidence of each, i.e., the ratio to single births? See *Canada Year Book, 1936, pp. 152 and 153.*

VITAL STATISTICS AND SEX RATIOS

Population and Birth-Rate

That birth-rate varies with conditions is clearly shown in vital statistics (*p. 30*), and *Canada Year Book, pp. 146-161.* The population of the world has doubled during the last century, one billion in 1836, two billion 1936 Europe has trebled, 150 million 1814 (Waterloo) and 450 million 1914 (The Battle of the Marne), and no doubt the primary cause, over-crowding and unrest. The birth-rate of Germany dropped from 36 to 14.7 (1900-1935); England 30 to 14.4 (*Holmes, p. 198*). Winnipeg from 27 to 17 per thousand during the past ten years (1925-1935). Populations are nearly stationary with such low birth-rate.

1. Chart the population growth of Great Britain, Germany, U.S.A. and Canada, and note the marked similarity in form—a logistic curve.

	1800	1835	1870	1905	1936	Per sq. mi.
England	8.8 million	13 million	20 million	33 million	40 million	664
Germany	20 "	30 "	40 "	60 "	70 "	348
U.S.A...	5 "	15 "	40 "	80 "	126 "	38
Canada .	....	....	3.6 "	6 "	11 "	3

Holmes, pp. 298, 300.

2. Why have birth control clinics been established in Holland since 1906?

3. Why is Canada so tardy about birth control and sterilization?

4. Why did Alberta take the lead? Why is birth control a two-edged sword? *Wiggam, p. 317.*

5. What is differential birth-rate and why the major social problem? See *Holmes, pp. 216-237.*

6. If average age of marriage of proletariat is 22 and of professional class 33, the former will increase, at least, 2½ times as rapidly. Explain fully. See *Galton, p. 340.*

7. If the average family of intelligensia be 2 and that of the feeble-minded 6, what will the proportions be in 5 generations? $(1/3)^6$. Explain. See *Holmes, pp. 218, 232 and 316.*

8. If defectives constitute 10% of the population and intellectuals 10% and the differential birth-rate be 4:1, what will be the proportions of each in the third generation?

9. The natural increase in U.S.A. has steadily declined from 30 per thousand in 1860 to 6.4 in 1932. What are the factors involved? Compare other countries (*Holmes, p. 298*) and the future. *Holmes, p. 303.*

10. Account for the changing age groups (*Holmes, p. 304*) and other problems, *p. 318.*

11. What is the effect of urbanization upon birth rate, homogeneity, immigration. *Holmes, pp. 319-329.*

POPULATION AND BIRTH-RATE

The Incidence of Twins and Triplets

Fifty twins per year in Winnipeg (pop. 220,000) and a birth-rate of 20 per thousand, means that twins occur about once in ..... births, and this is the average for the nation, and other countries. On the chance of independent assortment twins should be $(b+g)^2$ or 1bb+2bg+1gg, that is twice as many boy-girl twins as either boy pair or girl pair. But the twins of the U.S.A. now total:

Twin boys	Girl twins	Boy-girl twins
234,497	219,312	264,098
Expect 132,000	132,000	264,000
Excess 102,000	87,000	(due to monoval twins)

Total like pairs (which must be monoval twins)—189,000 in 718,000 twins, or 26% of twins are monoval. Professor Newman of Chicago University finds 25% identical by finger print and other physical tests.

1. Germany (1906-1911) tabulates twins as: 49,425 boy twins, 46,637 girl twins and 58,382 boy-girl twins. What percentage were monoval? Show your methods of reasoning on opposite page.

2. What proof of monoval origin? See *Anatomical Record, p. 245,* and finger prints, *Applied Eugenics, p. 110.*

3. Armadillo quadruplets are always on one chorion. What does this indicate? *Shull, p. 101, and Fasten, p. 126.*

4. Why are monoval twins of such great genetic interest? *Wiggam, pp. 114-137.*

5. Who is collecting data for America? What results? See *Journal of Heredity, 1932, Jan., July and Aug.; 1931, Jan., Feb., July and Aug.; 1930, April and Oct.; 1929, Feb.; 1927, May, Sept.* Dr. Madge Macklin of Western University, London, Ontario. *Amer. Jour. Med., 1929, p. 315.*

6. There were 42 twins born in Winnipeg 1935 (pop. 220,000—birth-rate 17). What incidence?

7. Of the 166 triplet recipients of the King's Bounty in England in 1927, 30 were boys, 31 girls, 49 two boys and a girl, 56 two girls and a boy. What percentage were identical, and what the incidence of triplets, if the birth-rate is 30 and the population 40,000,000? This is the square of the incidence of twins—coincidence or probability? 1bbb : 3bbg : 3bgg : 1ggg.

8. $(b+g)^4 = bbbb + 4bbbg + 6bbgg + 4bggg + gggg$. What chance of quadruplets being all girls like.....?

9. $(b+g)^5 = b^5 + 5b^4g + 10b^3g^2 + 10b^2g^3 + 5bg^4 + g^5$. What chance of quintuplets being all girls like the Dionnes?

What chance of these girls being identical?

THE INCIDENCE OF TWINS AND TRIPLETS

Social Heritage

Social heritage is *accumulative* through the ages until now its proportions stagger the imagination. The Temples of Karnak, the toys of King Tut, the Parthenon and the Golden Age of Greece, the epics of Homer and the wisdom of Plato, the songs of Virgil and the Glory that was Rome are still with us. Yes, and the art of Leonardo, of Angelo, and the cathedrals of their time; the dramas of Shakespeare and the discoveries of Galileo, Kepler, Newton and Napier all added to our own, makes a thousand Manhattans, a sky-line of pinnacles and of fame. But literature and culture is still classic, religion is still Buddha, Christ, Mohammed, architecture is still Grecian, Roman or Gothic; our ideal of physical and mental perfection is still Apollo and Athena. Truly:

> "*We stand upon the shoulders of our ancestors,*
> *And we see farther, but we are no taller.*"

1. What has radio added to our culture, our stature, our nature?

2. Or, thirty million motor cars and 600,000 miles of motor roads?

3. Or, Carnegie libraries, Rockefeller universities, Rhodes scholarships?

4. Or, four billion spent on medical care *annually* (U.S.A.)

5. Or, monumental institutions for 320,000 insane inmates, 184,000 confined criminals and 2,000,000 feeble-minded dependants?

6. Compare wisdom of $35,000 for a new breed, or for a new treatment.

7. What is the great difference between biological inheritance and social heritage?

SOCIAL HERITAGE

Social Welfare

"To awaken a social mind ready to undergo sacrifices on behalf of future generations" is worthy of the concern of statesmen and progenitors of the future—the long-distance view of racial betterment as compared with emergency continuum for the needy, the unlucky, and the unaware.

A people which fosters its superior stocks will be twice blessed—with leaders to leaven society and raise human endeavour and genius to change its destiny. The laws of life are as immutable as the laws of nature. The sins of the fathers are visited unto the third and fourth generations—the good also. Eugenics deals only with the good, a purposeful attitude towards the next generation, seeing immortality through the continuity of the germ plasm, making progress through sensible, assertive mating, conscious of a responsibility as a trustee of good parentage, carrying a generation farther the banner of advance and betterment, and giving children a heritage that will not be trodden under by the great advance of civilization.

1. The E—s, of Erie, adopted two orphan girls of unknown parentage, gave them every advantage in society and education; toured Europe; sent home from private schools three times for misconduct, ladder exit for after-midnight frolics; eventual disgrace of the name of E—, but carrying the name have ample opportunity to multiply the deception. Cite other cases of misplaced philanthropy.

2. Galton said—"You marry a family, not an individual." Explain fully, showing the disadvantage of the only daughter, and the value of the family album or genealogical tree.

3. List the hereditary defects which should bar marriage.

4. Louisiana and Maryland have a legal age of marriage at twelve, New Hampshire at thirteen, five States set no age limit, and 20 States have a legal age under sixteen. What is the social import of this?

5. Is racial betterment coming through education or legislation? Why?

6. Why has prohibition failed? Why should it fail as a selective factor?

7. Why have "save the baby" campaigns been less active of late? *Holmes, pp. 270 and 360.*

8. Idiots have 1 : 3 chance of living to be ten; imbeciles, 2 : 5 chance; morons a 7 : 8 chance." (*Hoover Committee on Social Trend*). What is the eugenic import?

9. High infant mortality is a check on feeble-minded increase. To what extent?

10. What will be the racial effect of obstetric advance to facilitate child birth? Compare with New Zealand.

SOCIAL WELFARE

Nature or Nurture

Mozart—mother and father musicians, and the boy composing at four, famous minuet at five, concert tour at six, and honoured by Empress Maria Theresa at Court, first symphony at eight. Nature or nurture? Copy genealogy of Mozart and Bach families. *Human Heredity, p. 568.*

Stalin—flamboyant youth, disappointed mother and church; dismissed from seminary, socialist leader at 17, exiled at 18, escaped five times, met Lenin at Stockholm, 1905; Dictator of U.S.S.R., 1925.

To what is his destiny due? To his mother or his nurture? Weigh likewise Lenin, Kemal, Mussolini, Napoleon, and other men of action.

Hitler—surly, indifferent pupil, flair for painting even during the war (*Life, Nov. 30*), suddenly an orator at Munich, treason and prison, "*Mein Kampf*," 3,000,000 copies; secret Nazi army, 6,500,000 votes, 1930; Dictator, 1933—"a bolt out of the blue." Nature or nurture?

Newton discovered integral calculus at 19; Galileo, the isochronus pendulum at 18; Galois, quadratics at 16; Pascal's, "Geometry" at 12, "Conics" at 16, computing machine at 18; Gauss, cube root mentally at 8.

Aristide Gromer, at 12, played twenty tables of chess, simultaneously, with experts. A Winnipeg prodigy, Abraham Yanofsky, at 12, plays twelve tables of chess simultaneously.

Clerk-Maxwell discussed oval curves before the Royal Society of Edinburgh before he was 15.

Perkins made the first synthetic aniline dye at 17.

Linneaus—collecting and describing plants before he was 10.

1. Cite other pre-school prodigies.

2. Also Barnard, the hatter; Burrett, the blacksmith; Loupe de Guerre, Silver Spot and Lobo.

3. Explain: "To them that hath shall be given." *Sc. Mo., Nov., 1936, p. 418.*

4. Weigh all achievement as to nature and nurture.

5. The relative costs of each: Education, 3 billion; Medical Care, 3.7 billion (U.S.A.)

And then—*Prothero, "He was a very devil,*
On whose nature, nurture would not stick."

6. The cost of Red Ryan, Dillinger, the Strangler, the Killer, and other recidivists?

7. Why Sing Sing, San Quentin and a Baume law? Cost of crime in U.S.A. *Fasten, p. 8:* 184,000 criminals in penal prisons in 1934. Cost, $16,000,000,000.

A descendant of crime, in Australia,
Held four crime, four kills and five alia.
The game seemed a cinch
Till the judge, in the pinch,
Said "Baume Law" and the game was a falia.

NATURE OR NURTURE

Eugenic Problems

1. What is the eugenic importance of an increasing interest in Genealogy and pedigree records? (See 130 pedigree charts in *Human Heredity, pp. 224-447.*) *Treasury of Heredity* (*Pearson*) now numbers 10 vols. and contains over 600 pedigrees of albinism in families, and more of physical and mental defects.

2. Why is marriage among the wage-earning classes usually earlier than among professional classes? *Holmes, p. 192; Galton, p. 344.*

3. What is the probable eugenic effect of old-age pensions? (*Holmes, 304.*) Of "motherhood pensions"?

4. Which is the more deceptive—the crinoline or the compact?

5. Do you think that a legal prohibition of marriages between cousins is eugenically sound? Explain. Read *Wiggam, Fruit of the Family Tree, pp. 138-152.*

6. What is the eugenic effect of pedagogical and ecclesiastical celibacy? *Applied Eugenics, pp. 237-254; Galton, p. 344.*

7. What do you think is the effect of modern warfare? Explain Kipling—"We've given our best to the sharks and the gulls,
And what remains is the rest of us."

How does this differ from the eugenic effect of warfare in the days of small professional armies?

8. What is the eugenic effect of greatly increased facilities for transportation? Cite Mrs. W. S., Clare Sheridan, Jean Batten and others.

9. What is the historic eugenic effect of inter-racial miscegenation? See *Second Eugenic Congress, Vol. 11, pp. 41, 90, 175; Journal Heredity, August, 36.*

10. What will probably be the eugenic effect of equalizing opportunity and education for women and men? Note the growth of Feminism in Turkey and Japan. Read *Baroness Ishimoto: Facing Both Ways.*

11. Which do you think is eugenically superior, a city environment or a country one? Read *Holmes, 319-329. Cook: Journal of Heredity.*

12. What advantages and what disadvantages will a genetically mixed (highly heterozygous) population be likely to have as compared with one that is relatively pure genetically. *Holmes, pp. 330-348.*

13. Give a list of topics of discussion at Second and Third Eugenic Congress, N.Y., 1923 and 1932.

14. What was the theory of Malthus with regard to population? *Galton, p. 343.*

15. Distinguish between biological and social inheritance.

Eugenic Drift

As social heritage accumulates and the tempo of life quickens, it becomes more imperative that each succeeding generation be able to cope with the great advance of civilization. "To them that hath (talent) shall be given . . . and to them that hath not, shall be taken away . . ." A pyramiding of aristocracy, a more beautiful world ahead for all of ability to meet its exactitude and competitiveness, alleviated by a humanistic religion of loyalty to the species, the service of the lowly and the altruism of the lucky.

"She is a trifler, with but little thought of duty or responsibility, who having ability as a heritage, does not scan with care the genealogical record of the family into which she enters."

EUGENIC PROBLEMS

Dysgenic Drift

An increasing differential birth rate is the major check on race betterment, families of six or seven among the lower levels and less than two among the intelligensia when over three is necessary to maintain the stock.

The proletariat, as the name implies, are prolific and social welfare makes it more possible. Four billion spent in medical care annually in U.S.A. 320,000 insane and 90,000 feeble-minded in mental hospitals, U.S.A., 1934. Twice as many as in 1904, with little attempt to check the procreation of their kind.

Wish-thinking and the ego that outbids the truth is perhaps a greater barrier to human improvement. It dims the facts, blurs the hand-writing on the wall and obscures a vision of the future. Mistaking accumulating social heritage for biological advance, we glory in a glittering civilization that is the accumulation of all the ages, forgetful that man himself has made the least advance in this social heritage. Since the Golden Age of Greece, wild grasses have been made grain, wild fruits made to our liking, large, luscious and seedless, the cow's value increased tenfold, the wild jungle fowl to a hen worth a thousand and producing 350 eggs a year, a thousand breeds of dogs from the Great Dane to the tiny Chihuahua.

Why should man be the exception to the laws of heredity—to the universal plan—of evolution? Why cannot the brain be as inheritable as mother's smile, or grandmother's asthma? Or, the will-to-do as heritable as father's eyes or grandfather's chin?

Or, "free-will" . . . . "unto the third and fourth generation?"

If sensitivity to allergic weakness and susceptibility to cancer can be traced through five and six generations, why not willpower and temperament, which is one of the causal factors of cancer?

How many generations of prohibition would be necessary to strengthen willpower against temptation?

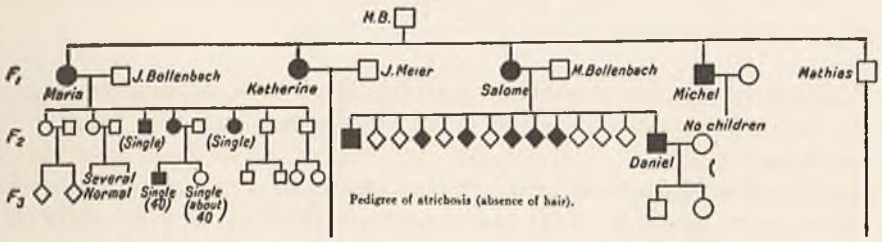
How many generations of orange juice will be necessary to put enamel on teeth of children whose grandparent, and great-grandparent, had enamel-less teeth? Snyder, p. 314.

How many generations of spinach to bring the stature of the bowery up to that of Park Row? How soon may we expect the docking of lambs' tails to produce a tail-less breed? Or, the pinching of feet, a Cinderella? How only can such ideals be obtained? Distinguish between mutilations and mutations. (Holmes, pp. 25 and 78). Between acquired characters and inherited characters; between legislative prohibition and innate inhibition.

That love of laughter and of mirth
Came with him on his day of birth,
In many a fault and many a whim
I see myself reborn in him,
And it's unfair to scold a lad
For merely being like his dad.

Edgar A. Guest.

DYSGENIC DRIFT



Examination, April, 1931

1. Show clearly reduction division of three allelomorphic pairs of traits and also how brown-eyed parents may have a blue-eyed child.

2. Comment upon:
   (a) "You marry a family, not an individual."
   (b) "We stand upon the shoulders of our ancestors and we see farther, but we are no taller."
   (c) "Science should take a holiday." Why?
   (d) "Impulse is first nature (innate): habit is second nature. "Once Lamarckian always Lamarckian."

3. Discuss:
   Pedagogical celibacy and feminism; religion and eugenics; cousin marriages; the Baume law (N.Y.); "Recidivists"; assortative mating; Mendelism; birthmarks; acquired characters.

4. Demerec staining the pollen grains of a starchy-waxy hybrid corn with iodine, got a 50 : 50 ratio, and Wodsedalek measuring spermatozoa of domestic animals got bimodal graphs. What is the genetic implication?

5. In federal asylums it was found that of the men, 4296 were bald and 5794 non-bald; and of the women, 875 were bald and 10,885 non-bald. To what extent is this trait sex-linked and what correlation. Page 24.

Eugenics, Dec., 1936

1. What are the biological barriers to the inheritance of acquired characters and prenatal influence and what experiments have been made to prove their effectiveness?

2. What is the significance of reduction division in the formation of gametes, and its bearing upon Mendelism?

Why are letters suitable symbols for factors, and illustrate their use in above explanation?

3. Illustrate the interaction of factors by means of phenol and ammonia, and show a 9:7 colour reaction. How does this also clearly show the difference between phenotype and genotype? How would a dominant colour-inhibitor affect the phenotypes?

4. Helga Capone (page 48) or 7 or 8.

5. Tell how genes have become associated with chromomeres, and just how they have been located in the chromosomes and a tentative map made of them.

6. "Inbreeding purges a race of its heterozygous or hybrid characters." Show how rapidly, and why mental defects are so difficult to eradicate in human society.

7. Show the different kinds of twins, triplets, and quadruplets that may occur and in what proportions, and reconcile with the following statistics: (Germany, 1906-11), 49,025 male twins, 47,037 female pairs and 58,382 male-female twins; 30 boy triplets, 31 girl triplets, 50 two boys and a girl, 55 two girls and a boy.

8. Demerec stained the pollen grains of a heterozygous starchy-waxy corn with iodine and found them 50-50 stained and unstained. What genetic bearing has this, and apply it to sex ratios and sex-linked colour-blindness.

Final Examination, April, 1936

1. "The serum of the mother agglutinates the child's blood in every case where this was expected from the blood groups of the mother and the child." (*Koller, 1928.*) What bearing has this upon heredity, prenatal influence and the inheritance of acquired characters?

What are the various blood groups and their racial relationships?

2. Decandolle, in his survey of eye-colour in Western Europe found that families from brown X brown gave 80% with brown and 20% with "clear" or blue eyes, and that brown X blue gave brown and blue in about equal numbers. Account for this and state what is known of the inheritance of eye-colour and of colour-blindness.

3. What are the eugenic and dysgenic tendencies of modern society and show the relative amounts or efforts spent upon the nature and the nurture of society? What is the present status of sterilization in Canada and U.S.A. and its bearing on the differential birth rate?

4. How would a cognizance of heredity affect our educational system and home discipline? Give Biblical quotations to show that heredity has been recognized in the past. Why more then than now?

Eugenics, Final Examination, April, 1936

5. Discuss morbific heredity under the headings: body defects, endocrine influence and mental grades, with special reference to the various phases of insanity and schizophrenia. Give specific cases or genealogy where possible.

6. Under the caption, "To them that hath" discuss the inheritance of talent and its bearing on education.

Or—Show why it is "Better to look up your genealogical tree than down." The top can be budded and grafted, the bottom is rooted in the past.

Genetics and Eugenics, Xmas Exam., Dec., 1935

1. Show clearly how reduction division takes place in the female gamete or ovum, and the genetic change involved in fertilization. What is the significance of reduction division in the formation of gametes and its bearing on Mendelism?

2. Show the F_2 dihybrid generation from a cross between a black vestigial-winged Drosophila and a white normal-winged female, white and normal wing being dominant, and in different chromosomes.

Distinguish between the genotypes and phenotypes in this generation and give a formula for the ratios of each in all cases.

3. Discuss linkage and give examples of sex-linked characters and common correlations in humans.

Show how colour-blindness is transmitted and why females are so rarely colour-blind, and under what conditions. Make a chart.

4. (a) What are the biological barriers to the inheritance of acquired characters, and state how Weismann, DeVries, and Morgan dispelled this Lamarckian belief?

(b) Distinguish between biological and social inheritance.

5. Give an account of giant chromosomes, their discovery, revelation and significance in relation to the gene theory.

6. Construct a chart showing the results of inbreeding and a formula for the proportion of heterozygous to homozygous, at the end of ten generations.

Discuss the purposes of Inbreeding and of Outbreeding and cite cases when each are to advantage.

7. "Eugenics is awaking a national mind ready to undergo sacrifices for the future generations." What are some important sacrifices that will have to be made, and how may this best be achieved—by legislation or by education?

8. (a) Discuss the heredity of blood and its clinical significance.

(b) Cite the known dangers of consanguinity, giving the pedigree of a few cases.

Racial Problems---II M (Prof R. A. Wardle)

1. Helga Capone, of Swedo-Sicilian parentage, is apparently normal, although her black-eyed father was an epileptic. Her husband, of pure Sicilian stock, had a tuberculous mother. Calculate the phenotypic and genotypic possibilities among their eight children as regards eye colour, epilepsy, and susceptibility to tuberculosis, assuming the two latter characteristics to be simple Mendelian recessives.

2. Margarita Neilson, of Italo-Japanese parentage, is apparently healthy, although her father was tuberculous. Her husband is a son of six-fingered Olaf, a blonde polydactylous Swede, his mother being a Chippewyan squaw. Calculate the phenotypic and genotypic possibilities among their eight children with regard to eye colour, susceptibility to tuberculosis (recessive) and polydactyly (dominant).

3. Assume, for the sake of argument, that skin colour and hair-shape in man are simple Mendelian characters, and that frizzy hair in the negro is dominant over straight hair in the Amerindian, and both dominant over wavy hair in the European, and that dark skin in the negro is dominant over copper skin in the Amerindian, and both dominant over white skin in the European.

The son of a blonde Swedish father and a Chippewyan mother married the daughter of a pure blood negro and a Cherokee squaw. What was the distribution of skin colour and hair-shape among the sixteen children of the marriage?

4. Mr. Smith had a feeble-minded mother and a colour-blind father. His father-in-law was a skin bleeder. He had four sons. What was the genetic constitution of each of the sons as regards colour-blindness, feeble-mindedness and skin-bleeding. Colour-blindness and skin-bleeding are sex-linked and transmitted through the females to the males; feeble-mindedness is a recessive character.

5. Greta Etukisuk, a half-breed Eskimo girl, whose father, a Swedish blonde, died of acute alcoholism, married a mulatto sailor known as Harold the Webbed, so-called because he had inherited from his negro father the condition of syndactyly, his fingers and toes being partly connected by skin.

Calculate the phenotypic ratio among their sixteen children for eye-colour (Duplex dark-D, or simplex blue-d), alcoholism (recessive), -n, and syndactyly (dominant), -S.

Type Solution **Male Allelomorphs** **Female Allelomorphs**

Parental somatics Dd, NN, Ss. Dd, Nn, ss.

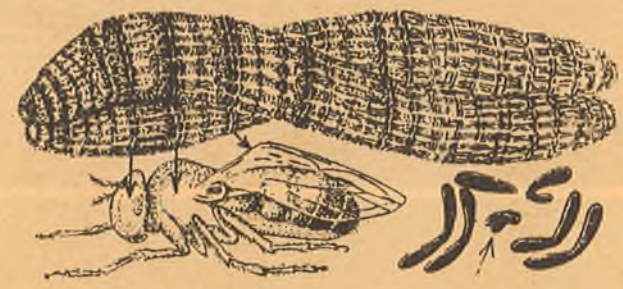
P. germ cells. DNS, dNS, DNs, dNs. DNs, Dns, dNs, dns.

F_1 somatics.

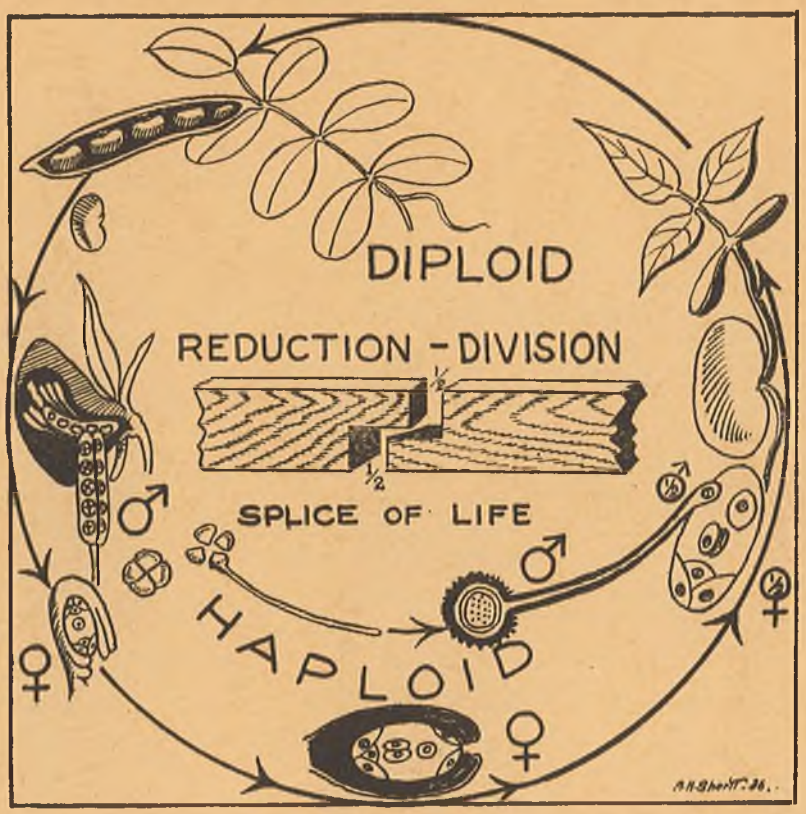
		DNs	*Dns.*	*Egg Cells dNs.*	*dns.*
Sperm Cells	*DNS*	DD*NN*Ss	DDNnSs	Dd*NN*Ss	DdNnSs
	dNS	Dd*NN*Ss	DdNnSs	dd*NN*Ss	ddNnSs
	DNs	DD*NN*ss	DDNnss	Dd*NN*ss	DdNnss
	dNs	Dd*NN*ss	DdNnss	dd*NN*ss	ddNnss

Phenotype Ratio:—4 dark eyes (DD); 8 hazel (Dd); 4 blue (dd); 8 with weakness for alcohol Nn; 8 normal (NN); 8 syndactylous; 8 normal fingers.

The Carriers of Heredity



The Short Chromosome of Drosophila
carrying the genes that make the fly—bare, bent and blind.



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