WORK-IN-PROGRESS (OCTOBER 15, 2019) PARALLEL CHART FOR

Chapter 17 — Secondary Sexual Characters

from *The Truth About Heredity: A Concise Explanation of Heredity for the Layman* (1927)
by
William S. Sadler, M.D., F.A.C.S.

Sources for Chapter 17, in the order in which they first appear

(1) Herbert Eugene Walter, *Genetics: An Introduction to the Study of Heredity* (New York: The Macmillan Company, 1913)

(2) Thomas Hunt Morgan, *The Physical Basis of Heredity* (Philadelphia: J. B. Lippincott Company, 1919)

Note: This source is coded Morgan1.

(3) Thomas Hunt Morgan, Ph.D., *Heredity and Sex* (Second Revised Edition) (New York: Columbia University Press, 1913)

Note: This source is coded Morgan2.

(4) F. A. E. Crew, "Complete Sex-Transformation in the Domestic Fowl," in *The Journal of Heredity,* Vol. XIV, No. 8 (November, 1923)

(5) Charles A. L. Reed, M.D., F.C.S., *Marriage and Eugenics: Laws of Human Breeding and Applied Eugenics* (Cincinnati, Ohio: The Galton Press, 1913)

(6) Horatio Hackett Newman, *Readings in Evolution, Genetics, and Eugenics* (Chicago: The University of Chicago Press, 1921)

Key

(a) Green indicates where a source author first appears, or where he/she reappears.

(b) Yellow highlights most parallelisms.

(c) Tan highlights parallelisms not occurring on the same row, or parallelisms separated by yellowed parallelisms.

(d) An underlined word or words indicates where the source and Sadler pointedly differ from one another.

(e) **Bold type indicates passages which Sadler copied verbatim, or nearly verbatim, from an uncited source.**

(f) Pink indicates passages where Sadler specifically shares his own experiences, opinions, advice, etc.

(g) Light blue indicates passages which strongly resemble something in the Urantia Book, or which allude to the Urantia phenomenon.

(h) Red indicates an obvious mistake, in most cases brought about by Sadler's miscopying or misunderstanding his source.

X: THE DETERMINATION OF SEX (Walter 197)

3. The Statistical Study of Sex (Walter 200)

[contd] From statistical sources it has been ascertained that

ordinarily there is produced a practical equality in the numbers of the two sexes (W 200).

[contd] Oesterleben in Europe summarized the data for nearly sixty million human births

and found that an average of 106 males are born to every 100 females (W 201).

[contd] According to various authorities,

the relative number of males per 100 females is given

for horses as 99,

for cattle 94,

and poultry 95,

while in pigs, rabbits, pigeons, and greyhounds the corresponding number of males is slightly over 100 (W 201).

XVII — SECONDARY SEXUAL CHARACTERS

17:0.1 The statistics of sex show that

males and females are produced in practically equal numbers.

Oesterleben summarized the data from almost sixty million European human births

and found that one hundred six males are born to every one hundred females.

17:0.2 The studies that have been made in the animal world have shown that

for every one hundred females of various species we have the following number of males:

horses, ninety-nine;

cattle, ninety-four;

poultry, ninety-five;

while in pigs, rabbits, pigeons, and greyhounds, the number of males is a trifle over one hundred.

SEX RATIOS

[contd] This practical equality of the sexes in all sorts of natural environments

17:1.1 This almost perfect equality as regards the number of the two sexes,

in both man and other species of animals,

indicates the improbability of the assumption that external conditions determine sex (W 201).

constitutes in itself almost conclusive proof that external, environmental, or other haphazard conditions can have nothing whatever to do with sex determination.

These proportions remind one too strongly of the mathematical exactitude of Mendelian ratios, and suggest very strongly that the control or determination of sex is a matter of such precision that it can only be accounted for by some law of unerring procedure which operates in the germ cells, and which (as we have already noted) is all set and predetermined even before fertilization takes place.

XIV: SEX-CHROMOSOMES AND SEX-LINED INHERITANCE (Morgan1 165)

SEX RATIOS (Morgan1 197)

17:1.2 There are certain complex problems which arise as we proceed with our study in sex ratio.

It remains to explain why in some cases the machine fails to give equality of the two sexes; why, for example,

For instance,

we have found that there are certain species, such as

all fertilized eggs of phylloxerans and aphids, or daphnians, or rotifers, or bees, are female;

aphids, rotifers, and bees, where all fertilized eggs turn out to be female,

and we are confronted with

why certain mutant races of flies give twice as many daughters as sons;

why other races of flies produce nearly all sons;

why the sex ratio in man is about 106 males to 100 females (M1 197).

certain mutant races of flies where we have twice as many daughters as sons,

while certain other species of flies produce nearly all of the male sex;

and even in man, it appears that we have a sex ratio of one hundred six males to one hundred females.

17:1.3 About the only satisfactory explanation which has been offered, to account for

In man and in several other mammals there is at birth a slight excess of males over females (M1 199).

the slight excess of males in the human race,

has been brought forward since the recent discoveries which have made it probable that we have both male and female determining sperms; and that explanation is to the effect that

Several possible solutions suggest themselves.... [S]ince the spermatozoa must, by their own activity, travel the entire length of the oviduct to reach the egg as it enters the tube, the greater size or weight of the female-producing sperm

the female sperm may be slightly larger than the male,

and is, therefore, somewhat handicapped in the long journey through the oviduct to meet the female egg,

may give a slight advantage to the male-producing sperm in the long trip up the tube (M1 199-200).

and so a slightly increased number of males win in the race

and thus give us, at birth, the slight excess of males as compared with females;

although this advantage, from the standpoint of fertilization, is offset by the fact that

Since male babies die oftener than females, the difference has been said to be an "adaptation," with the implication that it calls for no further explanation (M1 199).

more male babies die than females.

The female in the human species tends better to survive, so this is probably what evens matters up.

THE SEXUAL INSTINCT

I: THE EVOLUTION OF SEX (Morgan2 1)

THE SEXUAL INSTINCTS (Morgan2 31)

It is only in the lowest forms that the meeting of the egg and sperm is left to chance.

17:2.1 It is only in the lower orders of animal life that the meeting of the sperm and the ovum is left to chance.

Among the higher animals there has developed the mating instinct,

The instincts that bring the males and females together at the mating season,

an instinct which serves to bring male and female together at certain seasons,

the behavior of the individuals at this time in relation to each other,

and the behavior of the different sexes of the animal species during the mating season

forms one of the most curious chapters in the evolution of sex,

presents one of the most interesting and sometimes mysterious of all biologic phenomena.

17:2.2 It would seem that even among many species of lowly animal life, as well as among our lesser brethren of the higher species,

for it involves courtship between the males and females;

there is to be found a courtship and lovemaking phase of life

which, in many instances, seems strikingly human.

SOURCE	17: THE TRUTH ABOUT HEREDITY
the pairing or union of the sexes	The pairing and the union of the two sexes,
and subsequently the building of the nest,	the subsequent building of the nest,
the care, the protection and feeding of the young, by one or both parents.	the tender care and faithful feeding of the young by one or both parents,
	and sometimes even the loyalty of the male animal to his mate—even presenting such a picture of fidelity as to shame many a renegade of the human species—all of this presents a picture that is curious, inspiring, and even fascinating;
	and of course we are puzzled with the problem as to
The origin of these types of behavior is part of the process of evolution of sex; the manner of their transmission in heredity	how such instincts are transmitted by heredity from parent to offspring,
and their segregation according to sex is one of the most difficult questions in heredity—one about which nothing was known until within recent years, when a beginning at least has been made (M2 31-32).	how they are segregated according to the sex,
	for there is in practically all species one behavior which is characteristic of the male and another of the female.
	17:2.3 For example, let us look for a moment at the sex life of bees.
In bees, the sexual life of the hive is highly specialized. Mating never occurs in the hive,	It would seem that mating never occurs in the hive.
but when the young queen takes her nuptial flight she is followed by the drones	When the young queen starts out on her nuptial flight, she is followed by the drones,

that up to this have led an indolent and useless life in the colony.

who, before this important occasion, have led a lazy and useless life.

Mating occurs high in the air.

Mating occurs high up in the air.

The queen goes to the new nest

The queen then goes to the new hive,

and is followed by a swarm of workers who construct for her a new home.

escorted by a swarm of worker bees who proceed to construct and furnish the domicile of the new queen.

This new home is, after all, a prison,

Here she remains for the rest of her life,

for here the queen bee remains the rest of her life,

fed and cared for by the workers, who give her the most assiduous attention—

to be dutifully fed and cared for by the worker bees, who are extremely attentive.

an attention that might be compared to courting

In fact their attention is so peculiar and impelling that it would remind us of courting,

were it not that the workers are not males but only immature females (M2 33).

were it not for the fact that the workers are not males, simply undeveloped females,

which fact only makes their behavior all the more mysterious.

NON-HEREDITARY SEXUAL CHARACTERS

THE SECONDARY SEXUAL CHARACTERS (Morgan2 26)

17:3.1 As we have just noted in connection with the bee, the development of the sex glands may have a determining influence on the entire life conduct and behavior of the individual.

SOURCE	17: THE TRUTH ABOUT HEREDITY
[contd] In the most highly evolved stages in the evolution of sex	As we ascend the animal scale,
	we find that this question of sex glands, their secretion, and their influence on the subsequent development of
a new kind of character makes its appearance. This is the *secondary sexual character.*	that vast group of distinguishing animal features which we commonly call "secondary sexual characters,"
	becomes more and more striking.
	That is, the higher we ascend the zoologic scale, the more markedly separated become the two sexes of any given species.
In most cases such characters are more elaborate in the male,	17:3.2 In most species, the secondary sexual characters are more marked and striking in the male,
but occasionally in the female.	but occasionally this is reversed and the female presents quite the most striking picture.
	These secondary sex characters consist of
They are the most astonishing thing that nature has done: brilliant colors, plumes, combs, wattles, and spurs,	brilliant colors, plumes, combs, spurs,
scent glands (pleasant and unpleasant);	odoriferous glands—both pleasant and unpleasant—
red spots, yellow spots, green spots,	various colored spots on the skin or plumage,
topknots and tails, horns,	topknots, tails, horns,
lanterns for the dark,	
songs, howlings, dances and tourneys—a medley of odds and ends (M2 26).	songs, howlings, dances,

and even lanterns to carry in the dark for such seems to be the purpose of the firefly's illumination.

[contd] The most familiar examples of these characters are found in vertebrates and insects,

17:3.3 The most striking examples of distinguishing sex characters are found among the insects and the higher vertebrates.

while in lower forms they are rare or absent altogether.

Take for example,

In mammals the horns of the male stag are excellent examples of secondary sexual characters.

in mammals, the horns of the male stag which are a typical illustration of sexual secondary characters.

The male sea cow is much greater in size than the female, and possesses long tusks.

The male sea cow is much larger in size than the female, and possesses much longer tusks.

The mane of the lion

In the lion, the characteristic mane

and fringes of hair along the flanks of the male

is absent in the lioness (M2 26-27).

are absent in the female.

17:3.4 To revert again to

The phosphorescent organ of our common firefly, *Photinus pyralis,*

the phosphorescent organ of the common firefly or lightning bug,

is a beautiful illustration of a secondary sexual character.

which is now regarded as being a secondary sex character,

we find that

On the under surface of the male there are two bands

on the under surface of the male there are two bands of illumination,

and of the female there is a single band that can be illuminated (Fig. 18).

while the female possesses only a single band.

SOURCE	17: THE TRUTH ABOUT HEREDITY
At night the males leave their concealment and fly about.	At night the males it would seem, come out from their hiding and fly about in the air,
A little later the females ascend to the tops of blades of grass and remain there without glowing.	while the females subsequently climb up to the tops of the blades of grass and remain there without glowing.
A male passes by and flashes his light; the female flashes back.	The male flies by and flashes his light, then the female flashes back.
	Could we conceive of a behavior more strikingly analogous to flirting?
Instantly	Instantly
	upon recognizing the female flash,
he turns in his course to the spot whence the signal came and alights.	the male firefly steers his course straight for the spot from whence came the courting signal.
He signals again. She replies. He ascends the blade, and if he cannot find her, he signals again and she responds.	If he fails quickly to locate his mate he signals again and she replies,
The signals continue	and so this signaling back and forth keeps up
	while the male continues his search for the particular blade of grass at the top of which the female is perched.
until the female is found, and the drama of sex is finished (M2 28-30).	
[contd] Mast has recently	17:3.5 Mast has recently
	called our attention to a still more wonderful feature of behavior in the female firefly,
shown that the female firefly does more than simply respond to the signal of the male.	showing that she does more than simply respond to the male signal.

He has observed that

If a male flies above and to the right of the female, she bends her abdomen so that its ventral surface is turned upward and to the right.

“if a male flies above and to the right of the female, she bends her abdomen so that its ventral surface is turned upward and to the right.

If the male is above and to the left, the light is turned in this direction (M2 30-31).

If the male is above and to the left, the light is turned in this direction.”

So these flirtatious flashes continue back and forth until the two fireflies have found each other and this lowly, but none the less interesting and fascinating drama of sex—this courtship of insects—has been successfully consummated.

INFLUENCE OF THE SEX GLANDS

V: THE EFFECTS OF CASTRATION AND OF TRANSPLANTATION ON THE SECONDARY SEX CHARACTERS (Morgan2 132)

OPERATIONS ON MAMMALS (Morgan2 133)

17:4.1 That these so-called secondary sexual characters are due to the influence of the internal secretions found in the sex glands, is proved conclusively by the effects which follow the operation of castration on various animals.

[contd] In the deer, the facts are very simple. If the very young male is castrated before the knobs of the antlers have appeared,

For instance, if a young male deer is castrated before the knobs of the antlers appear,

the antlers never develop (M2 133).

his horns never develop,

SOURCE	17: THE TRUTH ABOUT HEREDITY
[contd] If the operation is performed at the time when the antlers have already begun to develop, incomplete development takes place (M2 133).	and if the operation is performed at the time they are partly developed, further growth ceases.
If the adult stag is castrated when the horns are fully developed,	If the adult stag is similarly operated upon,
they are precociously dropped, and are replaced, if at all, by imperfect antlers, and these are never renewed (M2 133-34).	his horns are prematurely lost.
A similar operation was also carried out on females.	17:4.2 A similar operation (ovariotomy) when carried out on female sheep
Three Herdwick ewe lambs (about 3 months old) were operated upon. After ovariotomy, the animals were kept for 17 months, but no horns appeared,	does not, however, result in the appearance of horns,
although in one, small scurs developed, in the other two scarcely even these (M2 135).	though aborted attempt at their development is sometimes manifested.
[contd] Now, the interpretation of this case can be made only when taken in connection with experiments in heredity.	There are other experiments which will not be noted but which go to show that in some cases horns and hornlessness are inheritance factors and not always secondary sexual characters,
There is a crucial experiment that bears on this question. Arkell found when a Merino ewe (a race with horned males and hornless females)	one illustration being the case where a merino (a race with horned males and hornless females)
was bred to a ram of a hornless breed, that the sons had horns.	was bred to a ram of a hornless breed and the sons had horns.
In this case the factor for horns must have come from the hornless mother,	In this case the factor for horns must have come from the hornless mother,

while the development of the horns was made possible by the presence of the male glands (M2 135).

while their development was made possible by the development of the male sex glands.

Seemingly, in this case, there was a double cause for the horns, one directly hereditary, the other the influence of the sex glands.

Steinach removed the sex glands from the male guinea pig and rat

17:4.3 Steinach removed the sex glands from a male guinea pig

and transplanted into the same animals the ovaries of the female, which established themselves.

and transplanted into the same animal the ovaries of the female,

Their presence brought about remarkable effects on the castrated male. The mammary glands, that are in a rudimentary condition in the male, become greatly enlarged (Fig. 71).

with the result that the rudimentary male mammary glands became greatly enlarged,

In the rat the hair assumes the texture of that of the female.

the hair took on the texture of the female,

The skeleton is also more like that of the female than the male (M2 140).

and the skeleton itself was likewise influenced.

Finally, in their sexual behavior, the feminized rats were more like females than like males (M2 140).

Even the sexual behavior of this feminized male came to resemble that of the female.

OPERATIONS ON BIRDS (Morgan2 142)

I am fortunate in being able to refer to several cases—the most successful on record—carried out by my friend, H. D. Goodale, at the Carnegie Laboratory at Cold Spring Harbor. One "case" is that of a female Mallard duck from which the ovary was completely removed when she was a very young bird.

17:4.4 Goodale removed the ovaries from a young mallard duck

which subsequently developed the male characteristics,

SOURCE	17: THE TRUTH ABOUT HEREDITY
Figure 16 illustrates the striking difference between the normal male and the female Mallard. In the spayed female the plumage is like that of the male.	including the plumage,
	and the same experiment was found to work out in the same way as concerns chickens,
Goodale also removed the ovary from very young chicks. He found that the female developed the secondary sexual plumage of the cock.	the spayed female developing the sexual plumage of the cock.
How shall we interpret these cases ? It is clear that	It would seem, in these cases, that
the female has the potentiality of producing the full plumage of the male,	the female fowls have the potential for producing the full male plumage
but she does not do so as long as the ovary is present.	but they refrain from doing so under the influence of the ovarian secretion
The ovary must therefore be supposed to prevent, or inhibit, the development of secondary sexual characters	which seems to serve as a preventer or inhibitor of these secondary sexual manifestations
that appear therefore only in the male (M2 142).	which are characteristic of the male.
"COMPLETE SEX-TRANSFORMATION IN THE DOMESTIC FOWL" (Crew, in *The Journal of Heredity* 361)	
[See footnote.]	This is further illustrated by the case recently reported of the hen that became a rooster as a result of ovarian tuberculosis.[1]

V: THE EFFECTS OF CASTRATION AND OF TRANSPLANTATION ON THE SECONDARY SEX CHARACTERS (Morgan2 132)

The converse operation—the removal of the male glands from the male—is an operation that is very common among poultrymen.

The birds grow larger and fatter. They are known as capons.

In this case the male assumes his full normal plumage with all of his secondary male sexual characters.

It is said that the comb and wattles and to some extent the spurs are less developed in the capon than in the normal male. But aside from this it is quite certain that the development of the secondary sexual plumage in the male is *largely* independent of the presence of the sex glands (M2 142-43).

17:4.5 This unsexing operation, when performed upon the male of poultry,

produces the well-known capon, a bird which grows larger and fatter.

Such birds possess their plumage and other secondary sex characters in almost full degree,

showing that such secondary characters are not entirely dependent upon the sex secretion.

17:4.6 It is evident, from even the little we know of the cause and development of secondary sexual characters, that of the various groups of animals such as mammals, birds, insects, etc., this phenomenon rests on a separate basis in each different group. At least in some animals the secondary sexual characters are not directly dependent upon the sex glands but are determined by the same inheritance factors that determine sex.

XXXIII: SEX DETERMINATION (Newman 449)

SEX DIFFERENTIATION (Newman 453)

17:4.7 *The freemartins.*

A beautiful experiment conducted by nature herself helps to drive home the *hormone theory of sex differentiation.*

A common experiment conducted by Nature herself helps to illustrate the hormone theory of sex differentiation.

In cattle, as shown recently by F. R. Lillie,

In cattle, as shown recently by Lillie,

twins occur in a small percentage of cases and involve the simultaneous fertilization of two eggs.

twins occur in a small percentage of cases and involve the simultaneous fertilization of two eggs.

These eggs lie as a rule in opposite horns of the forked uterus,

These eggs lie, as a rule, in opposite horns of the forked uterus,

but owing to the growth of their embryonic membranes the two individuals come to fuse circulations so that there is an admixture of blood (Fig. 95).

but owing to the growth of their embryonic membranes the two individuals come to fuse circulations so that there occurs an admixture of blood.

The result is that if the twins are zygotically of the same sex no untoward effect of blood admixture is apparent,

Now, when the twins are of the same sex, no untoward effect of blood admixture is apparent,

but when the twins are zygotically a male and a female,

but when the twins are a male and a female,

the female individual is always stopped in its female differentiation and becomes more or less completely transformed in a male direction.

"the female individual is always stopped in its female differentiation and becomes more or less completely transformed in a male direction."

It appears, however, that at the time when blood admixture occurs,

It appears, however, that at the time when blood admixture occurs,

the female individual has already differentiated so far with respect to the external genitalia and in other respects that,

the female individual has already differentiated so far with respect to the external genitalia and in other respects that,

even though subsequent development be entirely male in character,

even though subsequent development be entirely male in character,

the resultant individual is always a sterile creature, neither fully a female nor a complete male.

neither fully a female nor a complete male.

Such individuals have long been known as "freemartins."

Such individuals have long been known as "freemartins."

As a rare exception to the general rule an occasional case has appeared in which a male and a female pair fail to undergo blood admixture.

17:4.8 As a rare exception to the general rule, an occasional case has appeared in which a male and a female pair fail to undergo blood admixture.

In such cases both develop into normal animals.

In such cases both develop into normal animals.

Says Newman:

It now appears that the reason why the female sex is the one to suffer is that the male gonads differentiate precociously, before the female,

17:4.9 It now appears that the reason why the female sex is the one to suffer is that the male gonads differentiate precociously, before the female,

and inhibit the subsequent development of female gonads.

and inhibit the subsequent development of female gonads.

Hence the only hormones in the blood of both twins are the male hormones.

Hence the only hormones in the blood of both twins are the male hormones.

[contd] In conclusion we may say then that, in mammals, though chromosomes tend to determine the primary sex differences,

In conclusion we may say, then, that in mammals, though chromosomes tend to determine the primary sex differences

they have no effect on the differentiation of secondary sexual characters.

they have no effect on the differentiation of secondary sexual characters.

These are due to substances secreted by the gonads that have been called hormones (N 456).

These are due to substances secreted by the gonads that have been called hormones.

III: SEXUAL EFFICIENCY (Reed 37)

17:4.10 Sexual efficiency is dependent on the normal presence and working of a large group of factors, which are quite different as concerns the two sexes. Healthy offspring—in the human species—depends on compliance with these essential conditions and they may be summarized as follows:

I. LAWS OF SEXUAL EFFICIENCY IN MAN

LAW OF SEXUAL EFFICIENCY IN THE MAN (Reed 37)

(1) *The germplasm must exist in the testes.*

17:5.1 **1. The germ plasm must exist in the testes.**

(2) *The germplasm must be capable of cell proliferation and of thus forming normal spermatozoa.*

17:5.2 **2. The germ plasm must be capable of cell proliferation, and of thus forming normal spermatozoa.**

(3) *The germplasm forms spermatozoa from the period of relatively nature growth (adolescence) to the period of decline incident to old age (senility).*

17:5.3 **3. The germ plasm forms spermatozoa from the period of relatively mature growth (adolescence) to the period of decline incident to old age (senility).**

(4) *The ducts leading from the testes must be sufficiently open to permit the free discharge of the spermatozoa.*

17:5.4 **4. The ducts leading from the testes must be sufficiency open to permit the free discharge of the spermatozoa.**

(5) *These ducts must be free from secretions that are poisonous to the spermatozoa.*

17:5.5 **5. These ducts must be free from secretions that are poisonous to the spermatozoa.**

(6) *The ability must exist so to deposit the spermatozoa within the vagina that they can migrate thence upward into the uterus to fertilize the ovule* (R 38-39).

17:5.6 **6. The ability must exist so to deposit the spermatozoa within the female sexual passages so that they can migrate thence upward into the uterus to fertilize the ovum.**

II. LAWS OF SEXUAL EFFICIENCY IN WOMAN

LAW OF SEXUAL EFFICIENCY IN WOMEN (Reed 40)

(1) *The period of relatively mature growth (puberty) must have been attained,*

and the period of the change of life (the menopause) must not have been attained.

17:6.1 **1. The period of relatively mature growth (puberty) must have been attained,**

and the period of the change of life (menopause) must not have been passed.

(2) *The germplasm must exist in the ovaries.*

17:6.2 **2. The germ plasm must exist in the ovaries.**

(3) *The germplasm must be capable of proliferating and thus forming ovules.*

17:6.3 **3. The germ plasm must be capable of proliferating and thus forming ova.**

(4) *The ovules thus formed must escape from the wall of the ovary.*

17:6.4 **4. The ovules thus formed must escape from the wall of the ovary.**

(5) *The Fallopian tubes must be capable of conducting and must conduct the ovules to the uterus.*

17:6.5 **5. The Fallopian tubes must be capable of conducting and must conduct the ovules to the uterus.**

(6) *The uterus must be free from poisonous secretions that would destroy either the ovule or the spermatoza.*

17:6.6 **6. The uterus must be free from poisonous secretions that would destroy either the ovule or the spermatozoa.**

(7) *The uterus must be sufficiently normal to carry the new child (fetus) until it has matured—a period of about 280 days (pregnancy).*

17:6.7 **7. The uterus must be sufficiently normal to carry the new child (fetus) until it has matured a period of about 280 days (pregnancy).**

(8) *The neck of the uterus, the vagina and the bony pelvis must be in such condition as to permit the child to be born at the expiration of pregnancy* (R 40-41).

17:6.8 **8. The neck of the uterus, the vagina, and the bony pelvis must be in such condition as to permit the child to be born at the expiration of pregnancy.**

SUMMARY OF THIS CHAPTER

1. The study of sixty million births shows the sex ratio to be about equal—one hundred six males to one hundred females.

2. In different species, to every one hundred females we have males as follows: horses, ninety-nine; cattle, ninety-four; poultry, ninety-five; pigs, rabbits, and greyhounds, a trifle over one hundred.

3. Sex ratios follow too closely the exactitude of Mendelian behavior to be dependent on external or haphazard causes.

4. Sex ratios are confused by the fact that in bees and certain other species, all fertilized eggs turn out to be females.

5. Female producing sperms are supposed to be slightly larger than male producing sperms, therefore they are handicapped in reaching the ovum—wherefor the slight excess of males over females in the human species.

6. Courtship, mating, home building, and love of offspring, are instincts common to many animal species—and present a curious and fascinating inheritance study.

7. The influence of the sex glands and their secretions has much to do with the development of so-called secondary sexual characters.

8. Secondary sexual characters are usually more marked in the male, and consist of: plumes, combs, tails, horns, plumage, songs, and even lanterns to carry in the dark.

9. The phosphorescent organ of the firefly is a sex-signaling apparatus to assist in courtship and mating.

10. The operation of castration proves that many (though not all) of these secondary sexual characters are due to the secretion of the sex glands.

11. Transplantation of female glands into the male has produced typical female development of certain sexual characters.

12. The female sometimes develops male characteristics upon the removal of the ovaries; thus showing that ovarian secretion is inhibitory to potential male tendencies.

13. The behavior of the capon proves that not all sex characters are dependent on sex secretions—some are directly hereditary.

14. It is apparent that the development of "secondary sexual characters" is dependent on entirely different causes in the various species, such as mammals, birds, insects, etc.

15. The freemartin is one of Nature's experiments illustrating the influence of hormones on the development of secondary sexual characters.

16. Sexual efficiency is dependent on numerous conditions which differ greatly for the two sexes; but without which reproduction is impossible.

[NOTE: The chapter just concluded (No. XVII) dealing with secondary sexual characters, really completes our systematic and progressive study of genetics. The concluding chapters comprise a more full discussion and consideration of the Weismann theory of the germ plasm, the inheritance or noninheritance of acquired characters, prenatal culture, the application of genetics to man, etc., and while in a way directly connected with the study of genetics, are more in the nature of an introduction to the subject of applied eugenics; but I deem it appropriate to discuss them at the conclusion of this volume.]

1. On sectioning [the dead hen/rooster], the tumor mass proved to be an ovary practically completely destroyed by tuberculosis; the testes-like bodies proved to be testes in a phase of reduced activity....

The bird described had been, up to the age of three and a half years, an unremarkable hen; she had laid many eggs and had raised many of her own offspring.... In the autumn of 1920 she began to suffer from disease of the ovary; the ovarian tissue was progressively destroyed, and the effects of this pathological destruction were seen. But the conditions which were created were those favorable for the differentiation and growth of spermatic tissue. New sex-cords developed from the epithelium and spermatic tissue was differentiated both in the left gonad and also in the atrophic right. The bird become anatomically equipped to function as a male.... The bird functioned as a male and actually became the father of chickens (C 362).