

UM Libraries Depository



103224907014

DAS

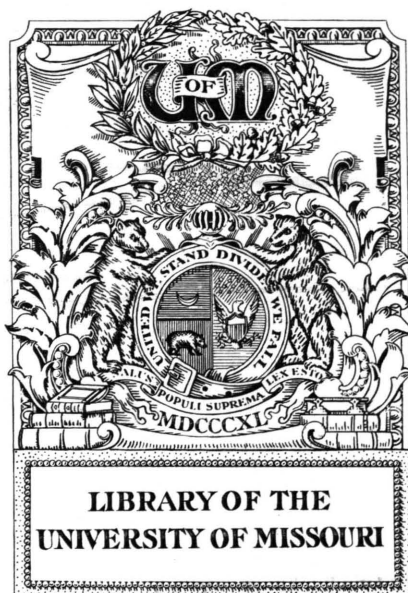
AGE AS A
FACTOR IN
ANIMAL
BREEDING

UMLD

THESIS

378.7M71

XD26



**LIBRARY OF THE
UNIVERSITY OF MISSOURI**

A THESIS.

"AGE AS A FACTOR IN ANIMAL BREEDING."

30
BY

RAJANI KANTA DAS, B.S.

(Ohio State University-U.S.A.)
(University of Calcutta, India)



PRESENTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE
IN
AGRICULTURE.

COLLEGE OF AGRICULTURE
UNIVERSITY OF MISSOURI.

MAY, 1911.

DEPARTMENT OF ANIMAL HUSBANDRY

F.B.MUMFORD, PROFESSOR,

AND

DEAN OF THE COLLEGE OF AGRICULTURE.

AND

DIRECTOR OF THE MISSOURI EXPERIMENT STATION.

"AGE AS A FACTOR IN ANIMAL BREEDING"

Table of Contents.

I. Introduction	Page 1.
II. The View of Biologists	8.
III. The Views of Practical Breeders	12.
IV. Results from Experiments, Observations and Records:	
(1) Poultry Breeding Experiments	16
(2) Observations on Sheep-Breeding	27
(3) The American Poland China Record	36
(4) Growth and Cost of Pigs from Im- mature and Mature Sows	38
(5) Plant Breeding Experiments	40
(6) The Trotting Horse Register	41
(7) The Parentage of the World's Great Men	45
(8) The Age of Marriage among Different Races and Classes of Men	48
V. Swine Breeding Experiment at the Agricul- tural Experiment Station of the Univer- sity of Missouri	50
(I) The Effect of Early Breeding on the Growth of the Mother	56
(II) The Effect of Early Breeding on the Growth of the Offspring	59

(III) The Effect of the Age of the Sows on Their Farrowing Records	66
(a) The Effect of the Age of the Sow on the Total Weight of the Litter	68
(b) The Effect of the Age of the Sow on the Average Weight of Pigs at Birth	68
(c) The Effect of the Age of the Sow on the Percentage of Pigs Raised	70
(d) The Effect of the Age of the Sow on the Size of the Litter	72
(e) The Effect of the Age of the Sow on the Growth of the Litter	75
VI. Criticism and Discussion	77
VII. Conclusion	84
VIII. Bibliography	87.

I.

INTRODUCTION.

The primitive man made a long step towards civilization, when he first domesticated animals. Almost all the species of animals now in the service of man came under domestication in the pre-historic times. When civilization first dawned on the banks of the Nile, Euphrates and Ganges, horses, cattle, sheep and goats were found to have been performing an essential function in their domestic, religious and civic life of the people of those places.

The system of breeding in the beginning was not far away from that in the state of Nature. But as some species or breed of animals responded more readily to his demand than others and some individuals appealed more to his attention, the primitive man also unconsciously exercised selection in breeding and rearing of certain classes and individuals of animals in preference to the others.

Crossing was also extensively used in the ancient times. The primitive man distributed many animals in his extensive ramble over the world. The same role was played by the invaders and colonists later on. The Persians, Romans, Moors and Turks as well as the Phoenicians and Sabacens distributed many animals and plants from the East and South to the North. In the later days of the mediaeval and early part of the modern time, importation, especially of the horse, was also extensively going on.

The results of this broadcast distribution of domestic animals was the blending together of the different bloods and formation of new breeds which have come down to the present time or formed the foundation stock for some other improved breeds. There is scarcely any improved breed today, which is still in its "native" nor pure state.

The importance of form and function of the animal body, was not unknown among the ancient people of Egypt, Babylonia and India though it was thoroughly understood first by the Carthagenians.

But it was not until late in the 18th century that breeding was first brought on the scientific basis. From that time until the middle of the 19th century, almost all the improved breeds were established. The main object of the period was to fix certain function in a certain breed of animal and develop it along that line. Among those who early devoted their life to this purpose, the name of Robert Bakewell comes foremost.

The systems of breeding which the breeders of this time followed were chiefly selection, crossing, line-breeding, in-breeding, etc. The purity of the breed was most religiously followed in certain breeds, as in the case of the island cattle.

After the development of the most of the breed, the breeding problem appeared in the three distinct phases:-

- (1) How to adapt these breeds to the new environment.
- (2) How to use these ^{breeds for the improvement of the} so-called "native breeds"
- (3) How to preserve, and, if possible, to improve these breeds.

The first is a general question concerning many countries like Japan, Mexico, South America etc., where the importation and adaptation of horses and cattle have received Government attention. The adaptation of cattle to Texas was a difficult problem ^{few} years ago, until the importation of the Brahmanibulls from India partially met the situation.

The second is a question of a country like India, where the wholesale disposal of the existing native stock and extensive importation of the foreign breed are both impracticable.

The third is the problem which ^{faces} every breeder of England and America and some advanced countries of the Continent.

The preservation of the domestic animals becomes all the more important, when we consider the fact that the modern improved breeds are a creation of the human ingenuity and not a result from the natural process of development. In fact, man has produced the high milking cow, the high-speed horse, or other live stock of extraordinary quality, in a few centuries, which nature might not have done in ages. In doing

this man, of course, has worked with nature rather than against it. He has brought all favorable conditions and left the rest to be done by nature.

Self preservation and race preservation are two laws with which every organism is endowed by nature. But progress or improvement is not the goal of all. Degeneration and even extinction are as common in nature as the development and formation of new species. Extreme specialisation, through which evolution is passing, has ended in the annihilation of many organisms both in the plant and animal kingdom.

The modern breed is a highly specialized animal. His form, function and even temperament have been changed. Many undesirable features have been bred off and the desirable qualities developed. Though some of them have lost the native vitality, longevity and in some cases even prolificacy, some of the domestic animals have really reached perfection for the most economical service to the human society.

It is a question of vital importance to the modern breeder to preserve and, if possible, to improve these breeds of animals.

The points which have been specially emphasized in breeding during the last few decades, are:-

- (1) The purity of the breed.
- (2) Pedigree
- (3) Individuality.

Within the last 75 years, associations have been formed for almost all the improved breeds and herd books started. They have helped much in keeping the purity of breed. Some of them have already started advanced registry which will undoubtedly lead to the improvement of the breed by the selection of the more efficient ones. The most important feature of these herd books are the record of pedigrees which have also been duly emphasized in breeders' associations and public sales. Individuality ~~ixtix~~ has also received proper attention in the public sale as well as in the show ring.

The next question which naturally comes to the mind of the rational breeder is the importance of age in breeding. Given a purebred animal of high pedigree and an extraordinary individual merit, at what age should he or she be used for breeding to get the best results? In the domestic animals, breeding at the first appearance of puberty or at nature's call is preposterous. The modern domestic animal is as far removed from the state of nature as the civilized man from the savages. Change of climate ^{over-feeding} and ~~and~~ over-care have reduced the age of puberty in domestic animals, as in man. The first sign of puberty is by no means a reliable indication that the animal is old enough to breed.

Later breeding may also be harmful, as in the case of the dairy cows. It is neither economical. On the other hand, early breeding may be detrimental to the growth and efficiency of the parents as well as of the offspring. If the evil effects of early breeding are transmitted, the question becomes all the more important and serious.

Many ~~year~~ breeders believe in the evil effects of early reproduction. It is said that early marriage has led to the degeneracy of many nations. The domestic animals are national assets and their preservation, like the conservation of other natural resources, is a question of vital importance to a country. But, unfortunately, this question has received very little attention among the breeders and biologists. One or two experimental stations did some work along this line, but their work is neither comprehensive nor far-reaching.

Director F.B.Mumford of the Agricultural Experiment Station at the University of Missouri first conceived the idea of conducting an experiment for the determination of the proper age of animals for breeding.

The results of the experiment, when finished will be:-

- (1) A more scientific basis for breeding.

(2) If early breeding is found injurious, it will save both the present and future generations from degeneracy. If not, early breeding may be more universally followed with greater economy.

(3) It will throw a great light on the science of eugenics, the idea of which is gaining ground every day among the rational thinkers.

Unfortunately the experiment has not been more than $2\frac{1}{2}$ years old and data at the disposal of the writer is not at all sufficient to give any conclusive results.

In the following pages, first the views of biologists and practical breeders have been given and then the results of various experiments, observations and records have been gathered. The results of the experiment at the Missouri Station have also been noted as far as possible. Finally a short criticism and discussion has been followed by conclusion.

II.

THE VIEWS OF BIOLOGISTS.

There was a great controversy among the biologists as to the possibility of acquired character and the whole body of the biologists divided themselves either as Neo-Darwinians or Neo-Lamarckian according to their opposition to, or acceptance of, the question. Yet after a controversy of more than 25 years the question is still at issue.

Lamarck in the beginning of the 19th century postulated two laws as to the inheritance of acquired characters. "Nature preserves everything that she has caused the individual to acquire or lose by the influence of circumstances to which the race has been for a long time exposed and consequently by the influence of the predominant use of certain organ."

A diametrically opposite view was held by Weismann whose original position with regard to this matter was that "modification which are wrought upon the formed body, in consequence of external influences, must remain limited to the organisms in which it arose. No such modifications of the same (affected by the environment or by use and disuse) can be transmitted to the germ cells from which the next generation springs".

Lamarck's views have been sharply criticised, but his theory in modified form has still many advocates, at least among the botanists. Even de Vries ~~amongst~~ acknowledged the possibilities of transmission of all fluctuating variations (individual differences), which are of the nature of acquired character. He seemed to have succeeded in showing that the increased bulk following upon better nutrition is inherited. But he also admitted that the amount of change in this way was very slight and the radical change was possible only through mutation.

Weismann also had modified, though had not changed, his views. But the majority of the biologists—especially the zoologists, believe, with him, in the purity of the germ cells, which remain practically unchanged by the changes which take place in the soma or body.

The germ-cell is the only vehicle of inheritance. The somatic cells forming the body are merely incidental, terminating with the death of the individual, while the germ cell passes from generation to generation indefinitely. "The child inherits from the parent germ cell, not from the parent body, and the germ cell owes its characteristics not to the body which bears it, but to its descent from a pre-existing germ cell of the same kind"

The fundamental principle of Weismann's theory has been substantiated by the Mendelian inheritance of definite

character. Bateson and others experimenting on Mendel's law with plants and animals found that many of the characteristics of organisms are of a definite kind and are inherited definitely and their appearance is determined by the presence of definite structures or substances in the germ cells.

But though changes or variations affecting only the somatic body are not transmitted, there is a possibility of the germ cells themselves being affected by such variations. It was admitted even by Weismann that "Temperature and nutrition in its widest sense, affect the whole body of plant—the somatic cells as well as the germ cells". Galton also did not believe in the possibility of any reaction of the body upon the germ cells, but believed in the direct influence of the climate on the germ cells themselves.

Eugene Davenport believes that a modification, or rather modified character, arising either externally or internally, and affecting the germ cell, is transmitted. "The effects of nourishment, temperature, chemical action, etc., are felt even by germ cells, and would certainly be transmitted! "Many modifications of functional activity", he continues, "are of such fundamental nature as to influence the germ as well as soma and such modifications would be transmitted and inherited by the offspring".

If there is any possibility of the germ cells being affected, as Dr. Davenport says, by the functional activities of fundamental character and such internal and external influences as nourishment, temperature, chemical reaction etc., is there no possibility for the age of individuals to affect the germ cells as well? From the fertilization of the ovum until birth and from birth until maturity, the body is undergoing constantly, vital changes, reaching a temporary equilibrium at maturity, which is followed by the gradual breaking down of the whole system. Will the germ cells remain the same during all these changes of the body? If not, the logical conclusion is that the offspring born at these different stages of parents will also vary accordingly. If the ages of maturity and of functional sexual ^{activity} ~~activity~~ would have been the same, the problem would be simpler. But standing as the facts do, the problem becomes all the more complex and can be determined by actual experiments.

III.

THE VIEWS OF PRACTICAL BREEDERS.

The biologists are unanimous, unless we include the Lamarckians, that the age of the parents does not have any effect on their offspring. But there is a division of opinion in the camp of the practical breeders. Of course, the majority of breeders believe that they get better results by mating mature animals. But there have been also a few systematic attempts by prominent breeders to prove that young animals breed as good, if not better, as the old ones.

In the 14th Swine Breeders' Meeting in Indiana, 1990, Mr. T.M.Reveal of Clement advocated the practice of the breeding of swine at an early age. He showed that some very well known Poland China boars and sows were born of very young parents. He mentioned 33 animals of distinction including "Star of West-535" (the most noted boar in cornbelt), "Commander-1385", "Tom Corwin-2nd-575", and sows such as "Lady Pugh", "Queen B.B.Tribe"; "Black Bess" "Bess Stibbens", "F.S.B.Bess", "Lady Duffield", "Ducky", "Darkness-2nd", "Isabell" and others, all of whom were sired by pigs before 12 months old and in many cases the sows were also only eight or nine months old.

In the Swine Breeders' Institute at Dayton, Ohio, 1891, Mr. J.L.Vandavan advocated, on the other hand, the breeding of only fully matured animals in order to produce "strong, healthy and vigorous pigs and larger litters". He also mentioned a list of very noted Poland China boars and sows born of mature parents and included among them

"World Beater-1213", "Tecumseh-3943", "Tecumseh Chip-10211", "Success-1999", "Give & Take-1585", "Seldom Seen-10051", "Last Look-14895" and "Black Joe F.-13407". All of these hogs had parents from two to five years old except in three cases where the parents were only 18 months old.

In contradiction to this latter view, Mr. J.A. MacDonald-King Co., P.S.J., writes in the Breeders Gazette (Vol.-38) "I feel sure that a well grown sow is better by being bred at eight months than to be allowed to come to the age of twelve months". "Young sows are" he continues, "good mothers. In old age they become clumsy and heavy, poor milker and bad mothers".

But the practice of early breeding is again condemned by another swine breeder-Mr.H. Winona of Minnesota, who writes in the following emphatic terms:-
"from the standpoint of one that has bred hogs over a quarter of a century, I say, it is against nature to

a hardy robust animal or race of animals, from the continuous breeding of immature parents".

The same opinion is expressed by Mr. E.B. Watson, Stery Co., Iowa, who says "The foundation of the constitution of pigs is laid in the constitution of their mature parents, the pigs of which are larger, stronger and grow faster. An old sow's pigs are one month old when born".

As if by contradicting these views, Mr. John Hill, a noted Hereford breeder of Marsh Brook House, England, writes "from the long experience of over 35 years with a breeding herd of Hereford, I can confidently say that I never experienced any bad results from using yearling bulls in my herd. I believe throughout the breeding herds of England, there are more yearling bulls used than of any other age. There are many notable instances of Hereford bulls being used continually from yearlings until the end of their career at great age. The best bull, I had, began service at ten months old for ten years and his produce was equally good from first to last"

These are only a few of the many well known and experienced breeders, both in England and America, who

expressed their views in the Breeders Gazette or such other magazines or advocated their practice of system of breeding in the Breeders' Meeting. But they are enough to show that the breeders differ among themselves as to the proper age of animals for the most rational breeding.

IV.

RESULTS FROM EXPERIMENTS, OBSERVATIONS AND RECORDS.

(1) POULTRY BREEDING EXPERIMENT..

Prof. Horace Atwood of the West Virginia Agricultural College made some experiments on "The Effect of the Age of the Parents on the Vigor of Chickens" and read a paper on the first four experiments at the American Breeders' Association in 1909.

The first three experiments were carried on in 1907, and lasted from June 3 to Oct. 5. The fowls selected were pullets, two year old hens and three-year old hens. They were all of Single-comb White Leghorns, "of the same strain and were fed and handled in the same manner". Individuality of males were eliminated, as far as possible, by placing the cocks, which mated with them, alternately in different pens.

The results of the first three tests of this experiment are summarized in Table 1.

Table 1.

Table 1 has been prepared from the first three tests.

Test no.1 began on June 3 and came to an end on July 6th by an accident. Most of the deaths noted in this test were due to digestive troubles.

Test no.2 began on June 19th. The growth of chicks was rather slow due "to the heat of the summer".

Test no. 3 began on September 5th. There were very few deaths within this test except in the pullets, in which five chickens were found huddled together outside the brooder, probably due to cold. The number of eggs cracked is omitted here, as they have not been recorded in all the tests.

A summary of these three tests are given in the last three columns at the end of the table.

See Table 1.

TABLE I.

The Effect of the Age of the Parents upon the Vigor of
Chickens.

(Tabulated from the first three tests of the breeding experiment of the West Virginia Agr. Exp. Sta. Bulletin 124.)

	TEST I.			TEST II.			TEST III.			SUMMARY OF THE THREE TESTS.		
	Pul-lets	2 yr. old hens	3 yr. old hens	Pul-lets	2 yr. old hens	3 yr. old hens	pullefs	2 yr. old hens	3 yr. old hend	Pullefs	2 yr. old	3 yr. old.
1. Total no. of eggs incubated	55	79	74	114	92	88	71	55	57	240	226	219
2. Wts. of eggs per 100	11.5	12.18	14.29	11.71	12.22	13.16	12.21	12.04	13.07	11.8	12.1	13.5
3. Tested out unfertile	8	9	5	19	15	9	18	7	8	45 or 18.75%	31 or 13.7%	22 or 10%
4. Unhatched or cracked	2	10	9		4	5						
5. Percent hatched except cracked eggs	81.8	75.9	81.1	66.7	70.5	77.1	71.8	83.6	68.4	73.4	76.6	75.4
6. No. of chickens	45	60	60	76	62	64	51	46	39	172	168	163
7. Wt. of chickens per 100 (when removed from incubator)	7.33	7.54	8.47	7.64	7.75	8.50	7.64	7.71	8.0	7.53	7.66	8.65
8. Wt. of chickens at 40th day (per 100)				24.7	27.6	35.0						
9. Percent early deaths	21	8	6	12	7	3	5	1	3	38 or 15.8%	16 or 7%	12 or 5.4%

From this table we find that:-

(1) The weight per 100 eggs ranges widely being 11.8 lbs. for the pullets, 12.1 lbs. for the two-year old hens and 13.5 lbs. for the three-year old hens. This gradual increase in weight from pullets to three-year old hens, is also observed in each of the first two tests.

(2) The infertile eggs also run as 18.75% for the pullets, 13.7% for the two-year old hens and 10% for the three year old hens., i.e., the infertility decreases as we pass from pullets to the three-year old hens.

(3) The average hatchability for the three groups, for pullets, two-year old hens and three-year old hens, is 73.4%, 76.5% and 75.4% respectively. The two-year old hens giving the best results.

(4) The average weight per 100 chickens for these groups, when removed from the incubators, ranges as 7.55 lbs., 7.66 lbs., and 8.65 lbs., i.e., a steady increase from the pullets to the three-year old hens. This fact is also corroborated by every one of the individual tests.

(5) The early deaths run as 15.8%, 7% and 5.4%, i.e., decrease steadily from the pullets to the three-year old hens.

(6) The second weights of the chickens at the later stage of development was taken only in the case of Test no.3. It shows that the weight per 100 chicks at the 40th day was 26.7 lbs., 27.6 lbs., and 35 lbs., i.e., a steady increase from pullets to three year old hens.

The last five experiments were performed in the two subsequent years. Eggs from White Leghorn fowls of same strain, were used. Handling and treatment were the same as in the preceding tests. The young hens were six months old at the beginning of the experiments and were mated with cockrels of the same age. The older hens were three years old. The fowls were selected with reference to their large size and vigorous constitution and good health.

The results of these tests are given in Table II.

Table II.

This table has been taken from the last five tests of the experiment.

Test no.4 began on April, 1909. The older hens were all three-year old, but the lot-1 has been kept in a fresh air house in the previous winter and was not fed for egg production. While lot-2 was wintered in a warm house and fed heavily for egg production. The second weight of eggs was taken, when 46 days old and the total number of loss by premature death was also noted at the same time.

The rest of the tests were carried on in 1909. In test no.5, the older fowls were kept in the open shed in winter and fed on whole grain, before they were mated with five cockrels and one three-year old cock. The second weights of the chicks were taken on the 23rd day of hatch-

ing and the number of early deaths

was also noted at the same time.

In test no.6, the eggs from the same fowls as in the preceding tests were used. The second weight and the early death record were ^{taken} in three weeks after hatching.

In test no.7 the pullets were heavily fed before they laid eggs for experiments. The second weight and early death record were taken on the 26th day after hatching.

In test no.8 the eggs from the same hens were used as in the previous test. Early deaths were recorded on the 21st day of hatching. But the second weight of the two groups could not be determined, as some of the chicks were missing.

The number of eggs cracked in turning, is also omitted here for the same reason as before. The last two columns give the summary of these five tests.

TABLE II.

The Effect of the Age of the Parents upon the
Vigor of Chickens.

(From the last five tests of the breeding experiment of the
W.Va.Agr.Exp.sta.Bulletin #124)

	TEST IV.		TEST V.		TEST VI.		TEST VII.		TEST VIII.		SUMMARY		
	Pul- lets	old.		Young	Old	Young	old	young	old	young	old	YOUNG	OLD
		lot-1	lot-2										
1. No.of chickens incu- bated	104	72	72	110	110	180	180	60	60	180	180	634	674
2. Wt. of eggs per 100	9.95	13.5	13.3	10.9	13.09	10.30	13.04	11.7	13.2	12.1	12.5	10.4	13.09
3. Infertile	28	8	36	20	8	22	12	23	9	48	19.0	141	92
4. Dead in shell at end of hatch				15	8	30	14			8	14	53	36
5. No.of chicks	69	86		75	94	127	152	75	39	123	138	419	509
6. Wt. of chicks per 100 (when removed from incubator)	6.46	9.17		6.51	8.24	6.75	9.15	7.00	8.331	7.68	8.24	673	862
7. No.of early deaths	10	2		6	1	14	3	5	2	12	6	47.68	14
8. Wt.of chicks per 100 at 2nd time	30.74	37.32		18.31	25.17	19.0	25.4	22.6	26.9			22.66	28.69

From this table, we find that 634 eggs from pullets and 674 eggs from old hens were incubated in these five tests.

(1) The weight per 100 of the eggs was 10.4 lbs., for the pullets and 13.09 lbs. for the old hens.

(2) The number of the infertile eggs runs as high as 141 in the case of the pullets while only 92 eggs of the old hens were infertile. But if we take into consideration that 36 eggs or half of the number of eggs incubated in lot 2 of the test IV were infertile due to over-feeding of the hens, producing them, the infertility becomes still less in the case of the old hens.

(3) The number of chicks that died in the shell at the end of the hatch, is also large for the pullets, running as high as 53, while in the case of the old hens, it is only 36.

(4) There were only 419 chicks from the eggs of the pullets, while 509 eggs from the old hens hatched successfully.

(5) The weight per 100 of chicks was 6.73 lbs., and 8.62 lbs. for the pullets and the old hens respectively.

(6) The loss caused by early death is only 14 in the case of the old hens while in the case of pullets, it is 47 or more than three times as much.

(7) The weight per 100 chicks at the second time also shows a great difference, being 22.66 lbs. for pullets and 28.67 lbs. for old hens.

The results of all these eight tests are summarized in Table III prepared to bring out distinctly the difference between the pullets and the old hens of two and three-years old.

See Table III on next page.

Table III.

This table is the summary of the two foregoing tables. At a glance we see that the eggs from the old hens are:

- (1) 15.81% heavier
- (2) 37.93% more fertile
- (3) 11.65% more hatchable.

than the eggs from the pullets.

(4) There were 43.89% less deaths in the shell at the end of the hatch in case of the eggs from old hens.

(5) They also yielded 11.28% more chicks on the whole.

When hatched, the chicks from the eggs of the old hens were:

(6) 28.27% heavier, when removed from incubators.

(7) 28.13% heavier at the time of the second weighing.

(8) They also recorded 65.38% less early deaths.

TABLE III.

The Effect of the Age of the Parents upon the Vigor of
Chickens.

Summary of the experiments from the two tables.				
	Pullets.	Old Hens	Difference in favor of old hens	Difference in favor of old hens in%
1. Total no. of eggs incubated less those cracked in turning	871	1094		
2. Av. wt. of eggs per 100	11.19	12.96	1.77	15.81%
3. % xxx of unfertile eggs.	21.36	13.26	8.10	37.93%
4. % hatched eggs incubated	67.8	76.7	8.9	11.65%
5. % deaths in the shell at the end of hatch	6.08	3.29	2.79	45.891
6. % of chicks.	69.00	76.78	7.78	11.28
7. % of chicks dying very early	14.5	5	9.5	65.38
8. Average wt. of chicks per 100 when removed from incubator	7.12	8.28	1.16	16.27
9. Average wt. of chicks at the 2nd weighing, per 100	23.07	29.56	6.49	28.13

These experiments evidently lead to the conclusions that:

(1) The eggs laid by older hens are heavier and more fertile or hatchable than those from the pullets.

(2) The chicks from them are also heavier and larger at the time of hatching, more vigorous, grow quicker and survive the early troubles better than the chicks hatched from the eggs laid by the pullets.

IV.

(2) OBSERVATIONS ON SHEEP BREEDING.

In 1902 Profs. W.L.Carlyle and T.F.McConnell of the Wisconsin University, tabulated some interesting results from the sheep-breeding records of their University flock for a period of 12 years. The results of their tabulation appeared in Bulletin 95 of their Agricultural Experiment Station, Under the title of "Some Observations on Sheep Breeding from the Experiment Station Flock Records". The following two tables show the influence of ^{the} age of parents on their offspring.

TABLE I.

This table has been taken from Table VI of the bulletin and the figures have been rearranged according to the age of the animals instead of calendar years. For the sake of simplicity, only Shropshire and Shropshire-Merino sheep have been included in the table as they formed the majority of the flock.

They were served each year by a Shropshire ram. For six years the ram used was a yearling and for three years the ram was two years old. A three year old ram was used for the remaining three years. "No new families of Shropshire ewes were introduced during the period covered by this data, so that we could not attribute any of

these results to the ewes' influence." In two of the instances where two and three year old rams were used, the same rams were used as yearlings.

See Table 1 on next page.

Two important conclusions from this table are:-

(1) The percent of increase of the lambs sired by the yearling rams is much lower than those sired by two or three year old rams. The latter increased 180%, while the former increased only 150%, or 30% less.

(2) The lambs sired by the yearling rams were heavier than the lambs sired by two and three year old rams, the average weight being 8.5 lbs. in case of the yearling rams and 7.8 lbs. in case of the old rams. This is quite in common with the principle that the average weight of the lambs bears a fairly constant relation to the percent increase for different years, but in inverse ratio, i.e., the larger is the percent increase, the smaller is the average weight and vice-versa.

TABLE I.

THE EFFECT OF THE AGE OF THE RAM ON THE % OF INCREASE
AND BIRTH*WEIGHTS OF THE LAMB.

(From Table VII, Wis. Exp.Sta. Bulletin 95)

Year.	Age of	SHROPSHIRE.				SHROPSHIRE-MERINO.				TOTALS OF BOTH.			
		Ewes	Lambs	% in-crease	Av.wt. of	Ewes	lambs	% in-crease	Av.Wt. of lambs	Ewes	Lambs	% increase	Av. wt. of lambs
1891	1	23	31	134	8.75	24	29	120	6.88	47	60	127	8.05
1892	1	24	43	165	8.36	7	8	114	9	31	51	164	8.46
1893	1	15	21	140	9.56	11	15	136	9.33	26	36	138	9.46
1894	1	18	25	139	8.76	7	12	170	7.57	25	37	148	8.35
1895	1	24	38	158	8.7	12	18	150	8.33	36	56	156	8.61
1901	1	22	35	159	8.19	12	23	191	8.03	34	58	170	8.12
TOTAL										199	298	149	8.5
AVERAGE													
1896	2	19	35	184						19	35	184	
1899	2	20	39	195	7.28	11	18	163	8.16	31	57	184	7.56
1900	2	17	33	194	7.63	10	15	150	8.21	27	48	178	7.87
TOTAL										77	140	182	7.71
AVERAGE													
1897	3	23	40	174	8.35	13	20	153	7.75	36	60	167	8.3
1901	3	15	27	180	7.98	13	22	169	7.54	28	49	175	7.78
1902	3	19	37	194	7.9	12	23	191	7.88	31	60	19.3	7.89
TOTAL	239									95	169	178	7.99
AVERAGE										371			

Percentage of increase--(1 yr.)----- 149
(2 & 3 yrs.)- 180

Av. wt. of lambs----- (1 yr.)----- 8.5
(2 & 3 yrs.)- 7.88

TABLE II.

THE EFFECT OF THE AGE OF EWES ON % INCREASE AND
SEX OF LAMBS.

(Taken from Table VIII of Wis. Exp.Sta.Bulletin-95)

Age	2 years		3 years		4 yrs.		5 yrs.		6 yrs.		7 yrs.	
	no.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Single lambs	62	44.6	30	31.9	21	30.4	14	28.5	9	33.3	6	60
Pairs of twins	72	52.5	53	61.7	42	60.8	32	65.3	15	55.5	3	30
Sets of triplets	4	2.9	6	6.4	6	8.8	3	6.2	3	11.2	1	10
Rams	96	49	75	51	71	57.2	45	51.7	24	53.3	10	66.7
Ewes	100	51	72	49	53	42.8	42	48.3	21	46.7	5	33.3
% of increase	158		174		178		177		178		158	

TABLE II.

The table has been gathered from Table VIII. of the bulletin to show the average percent of increase by ewes of various ages. Here also the rate of increase for ewes of different ages closely resembles the rate of increase as in the case of the rams.

The two evident conclusions are that:

(1) The percentage of increase of the lambs increases from two-years old ewes until they are six years old, after which the increase drops down. The two-year old ewes have an increase of 158%, the three year old ewes, of 174. The ewes ranging from 4 to 6 years made the greatest average increase. On the other hand, the 7 year old ewes made an increase of 150% only.

(2) "A greater portion of ram lambs were dropped by the older ewes, though this may be accidental".

In 1907, Profs. Humphrey and Kleinheinz of the Wisconsin Agricultural Experiment Station, resumed the observations on sheep-breeding for the following five years beginning from 1902. The results of their observations were published under the heading of "Observations on Sheep-breeding from the record of the University Flock" in the 24th Annual Report of the Agricultural Experiment Station of Wisconsin. The observations include interesting results on various subjects of which the relation of age with the percent of increase of lambs is a very important one.

TABLE III.

EFFECT OF ^{the} AGE OF EWES ON ^{the} PERCENT INCREASE
AND ON SEX OF THE LAMB.

(From table-10, Page 36, 24th Annual Report of Wis.
Agr. Exp. Sta.)

Ewes Producing Lambs.

Age of ewes	Single		Twins		Triplets		Rams		Ewes		Increase in percent
	no.	%	No.	%	No.	%	No.	%	No.	%	
2 years	24	58.5	29	41.5			47	47.4	52	52.6	141
3 years	24	46.1	27	51.9	1	2.0	36	44.4	45	55.6	156
4 years	16	30.7	35	67.3	1	2.0	48	53.9	61	46.1	171
5 years	12	32.4	23	62.1	2	5.5	33	51.5	31	48.5	173
6 years	6	25	14	58.3	4	16.7	26	56.5	20	43.5	192
7 years	6	54.5	5	45.5			10	62.5	6	37.5	165

Total number of lambs--205; 51.1%

ewes---196; 49.9%

The tables III and IV are taken from tables X and XI of the article in the above report. As the eight and nine year old ewes were used only four times and the lamb rams only five times, they are omitted from the table given here.

Table III shows that:-

(1) The percent of increase in lambs steadily increases with the increase in the ages of ewes - being 141% for two year old ewes and 192% for 6 year old ewes.

(2) "The number of ewes producing single lambs decreases with age up to 7 years. While with the ewes which produce twin and triplet lambs, this is just the reverse"

(3) "There is a gradual increase in the percent of ewes which produce ram lambs as the age of the ewe advances"

Table IV. shows that:

(1) There is a gradual increase in the percent increase of lambs, as the age of the ram serving them rises from one to three years, after which it declines.

(2) The age of the ram does not seem to have any effect on the sire of the lamb.

TABLE IV.
 EFFECT OF ^{the} AGE OF Ram ON THE PERCENT OF INCREASE
 AND ON THE SEX OF THE LAMB.

(From Page 37-Table XI of the 24th An. Report of the
 Wisconsin Agr. Exp.Sta.)

RAMS GETTING LAMBS.

Age of Rams	Singles		Twins		Triplets		Rams		Ewes		Increase in percent
	no.	%	no.	%	no.	%	no.	%	no.	%	
1 year	11	51.4	10	47.6			13	57.1	9	42.9	131
2 years	19	19.5	62	73.1	9	7.4	55	61.1	35	38.9	164
3 years	35	23.9	106	69.1	12	6.6	75	50	75	50.0	166
4 years	35	29.4	78	65.4	6	5.2	56	46.5	63	53.5	156
Over 4 years	3	33	6	67.0			5	55.5	4	44.5	150

The foregoing are conclusions from the observation on sheep-breeding record of about 700 ewes covering a period of 17 years and they clearly show that:

(1) The age of the parent sheep, both ram and ewes, has a distinct influence on the percent increase of lambs.

From this, it follows that the age of parents also influence the weight of lambs at birth, as the single lambs weigh heavier than the twins and the twins in turn, weigh heavier than the triplets. As far as the percent increase is concerned, a ram is at his best at two and three years of age and a ewe is at her best from four to six years of age.

(2) The percentage of ram lambs increases and percent of the ewe lambs decreases as the age of the ewe advances.

IV.

(3) THE AMERICAN POLAND CHINA RECORD.

In the American Breeders' Association, 1907, Mr. Geo. M. Rommel presented a paper on the "Inheritance of the Size of Litters in Poland China Sows". In this connection, he prepared some very interesting tables, which distinctly show the relation between the age of sows and the size of their litters.

All the litters studied were farrowed in 1902 and are recorded in the "American Poland China Record". There were 6145 cases observed from sows ranging from 1 to 5 years of age. Litters from sows over 5 years of age are also recorded in the Herd Book, but they are so few in number that no accurate results could be obtained from them. They have accordingly been eliminated from these calculations.

The table given here is based on Mr. Rommel's tables in the Annual Report of the American Breeders Association for 1907. It shows that there were 2110 yearling sows recorded in the Herd Book in 1902. The average size of their litters was 6.6 pigs. The litters of 15-20 sows or of 75.49% of the total ranged from 5 to 8 pigs.

The Record for 2 year old sows was 2047, which had litters of 7.5 pigs on the average, or a gain of .9 pig

THE EFFECT OF THE AGE OF THE SOW ON THE
SIZE OF THE LITTER.

Size of litter	1 yr old sows		2 year old sows		3 year old sows		4 year old sow		5 year old sow		1 to 5 year old sow	
	No. of sows having litters of same size	% of the total	No. of sows having litters of same size	% of the total	No. of sows having litters of same size	% of the total	No. of sows having litters of same size	% of the total	No. of sows having litters of same size	% of the total	No. of sows having litters of same size	% of the total
1	3	.15	2	.1	4	.34	0	0	0	0	9	.14
2	16	.8	15	.7	4	.34	2	.33	3	.92	40	.65
3	41	2.04	28	1.4	15	11.33	3	.49	1	.30	88	1.43
4	152	7.56	69	3.37	30	2.59	16	2.64	7	2.15	274	4.46
5	299	14.75	150	7.0	80	6.91	46	5.99	15	4.64	580	9.44
6	431	21.44	306	14.95	141	12.2	60	9.9%	32	9.85	970	15.8
7	463	23.03	431	21.86	217	17.7	87	14.36	48	14.8	1246	20.3
8	327	16.27	426	20.8	230	19.9	118	19.47	64	19.7	1165	19.0
9	172	8.55	319	15.6	208	17.3	41	18.32	61	17.7	863	14.9
10	70	3.48	168	8.2	131	11.3	107	17.66	43	13.2	519	8.45
11	30	1.49	87	4.25	68	5.88	36	5.94	28	8.62	249	4.05
12	3	.15	28	1.37	18	1.47	16	2.64	12	3.69	77	1.25
13	3	.15	12	.59	12	1.04	5	.82	7	2.15	39	.65
14			4	.2	3	.26	8	1.32	3	.9	18	.29
15			2	.1	2	.17	1	.16	1	.3	6	.08
16					1	.08					1	.01
17					1	.08					1	.01
Total	2010		2047		1157		606		325		6145	
Av. size of litters	6.6		7.5		7.9		8.3		8.7		7.4	
Range in the size of litters	5 to 8 pigs	For 1530 or 75.49% of the total	6 to 9 pigs	For 1482 or 72.41% of the total	6 to 10 pigs	For 919 or 78.4% of the total	7 to 10 pigs	For 423 sows 69.61% of the total	6 to 11 pigs	For 276 or 83.87% of the total	5 to 9 pigs	For 4824 sows or 79.44% of the total

per litter over the yearling sows. The litters of 1482 sows or 72.41% of the total ran from 6 to 9 pigs.

There were 1157 three year old sows with litters averaging 7.9 pigs. This is a gain of .5 pig per litter over the two-year old sows. 919 sows or 78.4% of the total had litters ranging from 6 to 10 pigs per litter.

Four year old sows numbered 606 on the record and the ~~size~~ average size of these litters was 8.3 pigs or an advance of .4 pig per litter over three year old sows. The range of the litters of 423 sows or 69.61% of the total was from 7 to 10 pigs.

The average size of 325-five year old sows was 8.7 pigs, showing a gain of .4 pig per litter over the 4 year old sows. 276 sows had litters ranging from 6 to 11 pigs. The range became too wide.

It is also seen that the size of litters of all sows from 1 to 5 years of age is 7.4, which is practically the same as in the case of 2 and 3 year old sows.

Summarizing the results, we learn that:

- (1) The size of litters steadily increases from 1 to 5 year old sows.
- (2) The range of production varies in sows of different ages, being comparatively steady and narrow in the sows from 2 to 4 years old. They may be consequently regarded as more reliable breeders.

IV.

GROWTH AND COST OF PIGS FROM MATURE AND
IMMATURE SOWS.

(4) Pig Feeding Experiment.

In 1888, the Kansas Experiment Station began an experiment, the object of which was "to ascertain by actual trial what results could be obtained by breeding and feeding animals from mature and immature parents". The plan adopted was to select two closely related purebred Berkshire sows, one mature and the other young. The mature sow was to be bred to a mature boar and the young sow, to a young boar.

The mature sow selected was "Perfection 12630", $3\frac{1}{2}$ years old and was bred to "Royal Peerless 18183". The young sow was "Prince's A. 2nd 18493", 7 months old and was bred to "Hermit 184911", 8 months old. The mature sow farrowed 9 pigs and the young sow, 8 pigs.

The pigs were fed and handled as nearly alike as possible and accurate records were kept of feed consumed and of gain made.

At the end of the experiment, the pigs from the mature sow gained 2165 lbs., at the cost of 2.25¢ per pound, while the pigs from ^{the} immature sow gained, in the same length of time, only 1411 lbs., at the cost of 2.50¢ per pound, showing $1/3$ ¢ less cost per pound of gain in the case of pigs

from the mature sow. Furthermore only one death occurred in the litter of the old sow, while three pigs of the young sow were lost by disease.

In 1889, the experiment was renewed. The mature sow was "Princess A.2nd-18493", 20 months old and was bred to "Duke of Carlisle-20191", 15 months old. The mature sow was "Princess B.", 8.5 months old—a daughter of the above sow. She was bred to "Novice-21365", 7.5 months old. There were 9 pigs in the litter of the mature and 7 pigs in that of the immature.

At the end of the trial, the pigs from the old sow gained 787 lbs., at the cost of 2.8¢ per pound and the pigs from the immature sow gained 640 lbs., at the cost of 2.86¢ per pound, showing only .06¢ less cost per pound per pound gain in the case of the pigs from the mature sow. The pigs from the old sow all reached maturity, while one pig of the young sow died early.

The difference between costs per pound of gain in this trial is rather trifling. But it should be noted that both the boar and the sow used for mature parents in this trial, were rather young. It is also said that neither litter fed satisfactorily during this trial.

The results of these experiments showed that:

(1) Pigs from the mature parents weighed more at birth, ate more feed and made greater gain for feed consumed.

(2) A larger number of pigs from mature sow attained maturity.

IV.

(5) PLANT BREEDING EXPERIMENTS.

No work has yet been done to show what advantage the seed from old plants has over those from young plants as far as the propagation is concerned. In fact, the terms "mature" and "immature" are not so readily applied to plants as they are to animals, though seed are often designated so.

It is however, a well known fact, that immature seed give "a feeble and precocious progeny". Unripe seeds from fruit, green and not fully developed, do not weigh as much as those from ripe fruit. They germinate readily and fruit early and abundantly. But the plantlets lack constitutional vigor and hardiness. The gardeners have long known this peculiarity but nobody verified its truth until recently, when Sturtevant, Arthur and Goff made critical examination and extensive experiment on the subject. In connection with the propagation of tomatoes, from unripe seed, Goff remarks that "the increase in the earliness of tomatoes is accompanied by a marked decrease in the vigor of plant and in the size, firmness and keeping quality of the fruit".

IV.

(6) THE TROTting HORSE REGISTER.

In the "Horse World" of Feb. 27, 1906, Mr. C.L. Redfield published an article on the "Dynamic Theory of Development" which means that age and activity develop certain kinds of force, power or energy in an animal and this acquired force power or energy is transmitted from parents to offspring at the time of reproduction. He based his theory on the statistics of the age of sires of the average and of the prominent trotting horses. It naturally follows from this theory that, other things being equal, an old horse will produce a better colt than a young horse and a race horse will produce a faster colt than a horse not used to racing.

He selected the first thousand trotting horses from the "Index Digest" of the "Register" and found that the average age of their sires was 9.43 at the time of service. He then calculated the age of all the male progenitors of 2,10 trotting horses for six generations. There were about five thousand horses and the average time between generations in the male line was found to be approximately 14 years, i.e., the sires were, in this instance, about 13 years old at the time of service. The difference between 9.43 and 13 years, as the age of the sires of the average and of 2,10 horses gives an advantage of about "40%" over the former

in favor of the latter. Mr. Redfield explained this remarkable difference as the indication of the inheritance of acquired dynamic development.

In the "American Naturalist" of January, 1909, Prof. F.R. Marshall of the Ohio State University criticised the data for Mr. Redfield's theory of dynamic development. He rightly pointed out that in the case of the average horses represented by the first thousand in the Index Digest, the ages of the immediate sires only were computed, whereas in the case of the 2.10 horses all the male progenitors for four generations were brought in.

Back in the sixties and seventies, the trotting horses were in the formation period. "Hambletonian 10" and his sons and grandsons were in great demand for stud service until their death and it is only recently that younger stallions of well known families, have been used for breeding purposes to a large extent. This change of conditions gave the immediate sires of the average horses a shorter average age at the time of service.

In his second article in the "American Naturalist" of July, 1910, Prof. Marshall tabulated, for four generations the average age of all the male progenitors of the 2.10 trotting list as published in the "Year Book" Vol. 23. This list consists of 279 horses, 37 of which failed to show any accurate age.

The age of the sires of the remaining 242 horses, are shown in the following table:-

1		was sired by		2		year old stallions.	
11	"	"	"	3	"	"	"
17	"	"	"	4	"	"	"
30	"	"	"	5	"	"	"
19	"	"	"	6	"	"	"
21	"	"	"	7	"	"	"
21	"	"	"	8	"	"	"
25	"	"	"	9	"	"	"
14	"	"	"	10	"	"	"
17	"	"	"	11	"	"	"
8	"	"	"	12	"	"	"
13	"	"	"	13	"	"	"
8	"	"	"	14	"	"	"
9	"	"	"	15	"	"	"
6	"	"	"	16	"	"	"
6	"	"	"	17	"	"	"
1	"	"	"	18	"	"	"
4	"	"	"	19	"	"	"
3	"	"	"	20	"	"	"
0	"	"	"	21	"	"	"
6	"	"	"	22	"	"	"
2	"	"	"	23	"	"	"

Prof. Marshall compared these 242 horses with the first 242 horses registered in Vol.15 of the "Register", first showing , in the following table, that they were contemporaneous:-

	Foaled Before 1880	Foaled 1880-85	Foaled 1886-1890	Foaled 1890-1895	Foaled 1896-1900
2.10 horses	2	12	40	95	81
Average horses from Vol.15	2	3	14	116	107

He then gave the average age of all stallions in each line of pedigree.

	Sires	Grand-sires	Great-Grand-sires	Great-great Grandsires
2.10 horses	9.4	11.5	12.5	13.5
Average horses from Vol.15	8.28	10.65	11.64	12.78

At a glance it is seen that the average age of successive generations in both cases, has gradually decreased. There will evidently be a great difference between the average age of the immediate sires in one instance and of the four generations in the others.

A logical procedure demands that either only the immediate sire or all the four generations in both instances should be used for fair comparison. Assuming 9.43 to be correct for the average age of the sires of the first thousand horses in the Index Digest, the figure is almost the same as, or even a little bit higher than, 9.41 which Prof. Marshall tabulates to be the correct average age of the immediate sires of 2.10 trotters.

The superiority of the 2.10 trotting horses over the average ones as a result of the older age of their sires at the time of service is erroneous.

IV.

(7) THE PARENTAGE OF THE WORLD'S GREAT MEN.

In 1902, Mr. C.L.Redfield published a book under the title of "Control of Heredity" in which he tried to prove that heredity is dynamical as well as structural. The structural heredity relates to the "size, form and color of an organ without regard to the force or energy that may reside in it"; while the dynamical heredity relates to the "force, power or energy of an organ without regard to its size".

In connection with dynamical heredity, Mr. Redfield mentions that:

(1) Heredity is the product of the length of time elapsing between generations and the degree of activity which characterizes the individuals of successive generations.

(2) The conditions which characterize parents at different ages, are transmitted to the offspring, which are produced during their ages.

(3) As long as the parents maintain vigor, the older they are at the time of reproduction, the greater is the average length of life of their offspring.

Upon these "facts", as he calls them, Mr. Redfield tries to establish two "laws":-

(1)"The mental ability of the offspring is dependent upon the age of the parent at the time of reproduction"

(2) "Mental aptitude of the child is influenced by the age of the parent at the time of its birth"

In order to prove his first theory, Mr. Redfield collected the names of a large number of the great men of the world and found that almost all of them had great "birth-ranks" by which he means that they were born at an advanced age of their parents. He tabulated the birth-ranks of 354 eminent men from all nations, showing a gradual increase in the number of eminent men, as fathers grew older and a very pronounced increase at the extreme old age.

Mr. Redfield also insinuates that the modern people have acquired a higher intellectual capacity through the "law" of this dynamic heredity and men of genius have really increased as the world has progressed.

Mr. Redfield's second theory is a corollary to the first. According to the predominant disposition of the mind he divided life into four periods, such as the stages of: (1) Militarism or aggressiveness, (2) Statesmanship and practical intelligence, (3) Arts and literature and (4) Philosophy and religion.

He assigned the first stage to the first thirty years of age and each one of the following three stages to the three successive decades. In connection with each stage, he also quoted a group of prominent men such as Napoleon, Shakespeare, Bismarck and Aristotle and tried to show that these men had their particular aptitude because they were born in one or the other stage in the life of their parents.

"Surely" says Mr. Redfield, "this cannot be a matter of chance. What occurs regularly can no longer be a question of probability, but must be dependent upon some law", by which he means the "law" of dynamic heredity.

IV.

(8) RACES OF MEN.

The age of marriage differs in different races ~~xx~~ as well as in different countries. As a rule the people in cold countries marry later than the people in the warm countries. Considering the length of life and the age of puberty, this seems to be natural.

The age of marriage ^{also} differs among different classes of people in the same nation. In England the progressive class of people marry later than merchants and merchants marry later than the laboring classes. This may be said of other countries as well.

The age of puberty does not determine the age of marriage in modern society. In Paris, a few years ago, the age of puberty was given as 13 years and eight months for 14 years and 5 months for middle classes, upper classes, and 14 years and ten months for lower classes. But marriage takes place just in the reverse order.

Late reproduction was characteristic of the ancient Hindus, Greeks, Romans and probably also of the Egyptians. It is true even at the present time that the more advanced nations reproduce late in life, while the Chinese, Modern Hindus and Egyptians marry comparatively early.

Among uncivilized people, early reproduction is the custom among Eskimos, South American Indians, some negroes of Central Africa, Bushmen, Andamen Islanders and others. On the other hand, North American Indians, Polynesians and some other races reproduce rather late.

Some of the races having early births show lower grade of intelligence than those having rather late reproduction. This led Mr. Redfield to conclude that the higher grade of intelligence depended upon the custom of marrying late in life.

V.

SWINE BREEDING EXPERIMENT.

At the Agricultural Experiment Station
of the University of Missouri.

In 1909, Director F.B.Mumford of the Agricultural Experiment Station of the University of Missouri, began a very elaborate and scientific experiment on the Breeding of Swine. The object of this experiment is to determine the effect of breeding immature animals for successive generations, upon the constitution, vigor, maturity and development of parents themselves as well as their offspring.

THE PLAN OF INVESTIGATION.

The experiment started with the plan of selecting six animals of the same age and quality and breeding them in three groups of two each at immature, half-mature and mature ages. They were to be fed on standard rations and records kept as to feed, weight, measurement, farrowing, and other important points.

Care and treatment were to be as much alike as possible in every case. Two sows from the first litter of each group, were to be bred just like their mother at about the same age and a check kept in each generation of all groups. Sows were to be mated with boars of their same

age in all cases. Each sow was to be bred several times after the first litter to notice any farther results. All pigs not used for breeding were to be fattened for pork and fed according to their appetite, after a weight of 125 lbs., had been reached.

The size, constitutional vigor, fecundity, prepotency and inferiority of both parents and their offspring were to be carefully noted.

(1) SELECTION AND BREEDING.

Six purebred Duroc-Jersey sows were selected with special reference to vigor, thrift and close relationship in blood. They were all sired by Col. Cronje-62523 and farrowed in 1908, being practically $4\frac{1}{2}$ months old on Jan. 15th, 1909, when the experiment began. They were divided into three groups, of two each, according to the age at which they should be bred such as:-

- (1) Mature parents
- (2) Half-mature parents
- (3) Immature or young parents.

In order to eliminate any influence of individuality, three sows were chosen from the same litter and were placed one in each group. Two sows in the group I and II are also litter sisters.

GROUP-1 MATURE PARENTS.

The two sows in this group were named Factor IV and Factor VIII, the former being a daughter of Nokomi III-197646 and the latter of Gold Lee II-197642. They were to be bred at the age of 30 months but Factor IV was accidentally bred at 24 months to University King and farrowed her first litter in January last. Factor VIII has recently been bred. The only living pig of Factor IV has recently been attacked with cholera.

GROUP-II. HALF-MATURE PARENTS.

The sows in this group were Factor III and Factor VII. The former is a litter sister to Factor VIII and the latter, to Factor VII. They were to be bred at 18 months, but Factor III was accidentally bred at 9 months and aborted three months later. At the second time she was bred at 21 months and farrowed in October last. Factor VII could not be bred before 21 months. She farrowed her first litter in December last. Her pigs died later on. All six living pigs of Factor III have lately been attacked with cholera.

GROUP-III IMMATURE PARENTS.

The two sows in this group were named Factor V and VI. Factor VI was a litter sister to Factors IV and VII, while Factor V was a daughter of Nokomi IV-197648. They

were bred at the first sign of puberty to Choice Wonder., and farrowed their first litter-Factor VI at 9 months and Factor V at 10 months-early in summer of 1909. Since then they have been bred every fall and spring and have each raised three litters, farrowing the 4th in March last.

Four sows from the first litter of Factor VI, all farrowing May 30th, 1909, were selected for further experiment. The ^{other} pigs of these and other subsequent litters have been fed on the standard ration ~~to~~ to the weight of 250 lbs for sale.

One of the sows, selected for the first generation of immature parents, was kept as a check. Another was bred the first time and then kept as a check. Both these sows were not doing well and have recently been discarded.

The remaining two sows, Factors XI and XIV, were bred at first heat to University Rover-10th, 93939 and farrowed their first litters early in the spring of 1910. Three sows from the first litter of Factor XIV and one from that of Factor XI were selected for further experiment. The rest were treated as before.

Of the four sows selected to be the immature parents of the 2nd generation, one was kept as a check, but she died in April last and another broke her leg and was disposed of for pork.

were bred at the first.

The remaining two sows, Factors XXI and XXII, were bred at first heat and farrowed their first litters in February, last.

The pigs of these sows will be treated in the same way as before.

(2) Feeding.

All the animals in the experiment are fed on standard rations, which have been classified in three groups.

(1) For brood sows with pigs and for breeding pigs up to 150 lbs., and fattening pigs up to 125 lbs. in weight, 20 parts shorts, 10 parts corn meal, bran 10, oilmeal 5, a ration a little narrow with 1:494 nutritive ratio.

(2) For breeding animals of all sorts over 150 lbs. in weight on dry lot and not suckling pigs—corn 13 parts, shorts 10, bran 5, alfalfa meal 5,—a bulky ration with a nutritive ratio of 1:6044.

(3) For dry sows on grass and fattening hogs over 125 lbs. in weight, corn 6 parts, oilmeal 1 part—a ration with a nutritive ratio of 1:671. Pasture

Pasture is taken advantage of, whenever possible.

(3) Keeping Records.

Records are kept on the following points.

(1) Feed- The feed records are kept of all breeding animals as well as of sows and barrows that are fattened.

(2) Weight- All animals are weighed every week and all pigs are weighed at birth.

(3) Measurements-All the breeding sows are measured once a month from the time of their entry into the experiment until 12 months old, after which they are measured once in three months. The measurements are taken on the following points:-Height at withers and croup; breadth at shoulder, shoulder points, hams and hip-bones: girth at heart, paunch and flanks; depth of chest; length of body; length of head from snout to the pole and snout to the eye; width of head; circumference of the rear and fore shinbone; and distance from elbow down and shoulder points down.

A cross sectional diagram of the fore, and paunch and hind-flanks is taken at every time of measurement.

(4) Miscellaneous record as to the age of apparent puberty, period of gestation, size of litters, number of pigs raised and the condition of pigs and sows, are also regularly kept.

V.

(1) THE EFFECT OF EARLY BREEDING ON THE GROWTH
OF THE MOTHER .

The weight and measurement records of the sows give us ample data to compare the three groups of animals and find out accurately whether the early breeding has any deleterious effect on the body of the mother or not.

As the measurements at several places are more or less variable, only the height at withers, breadth at shoulder, depth of chest and heart-girth have been chosen for comparison.

The first five plates show graphically the comparison of the six sows on these four points of measurement as well as on weight. The sows are represented by different color lines.

Factors V and VI, as stated before, were bred at six and five months and Factors III, IV, and VII at 21, 25 and 22 months respectively. Factor VIII has not yet been bred. Taking these last ⁴sows as standard, we can very well compare Factors V and VI with them.

Factor V weighed higher than three of the standard sows before breeding, but soon after farrowing her first litter at ten months, she sank down and lost 14 lbs.

of her weight, and though she made up her loss for awhile, a second breeding at 15 months, put her down again below the three standard sows. She lost 35 lbs., in weight this time. The indigo line in Plate I, clearly marks her position.

Factor VI is the litter sister to Factors IV and VII and was a very good individual, weighing the same as Factor IV at five months. She farrowed her first litter at 9 months—a very early date indeed—and sank down from 172 to 121 lbs. in the following three months. The second breeding at 14 months also tells heavily on her body causing a loss of 78 lbs. Her weight line in Plate I, indicated by violet color, shows that she is far below the rest of the sows.

The green line, representing Factor III shows that she went down even lower than Factors V and VII. But that has probably been due to the rather unusual heaviness of her litter, the total weight of which was 29.20 lbs.

The injurious effect of early breeding is also seen in the weak and stunted constitution of the animals. This is clearly shown in the next four plates.

At the age of $6\frac{1}{2}$ months, Factor V was highest at withers, broader than the three standard sows at shoulder, largest in heart-girth, and deeper than three sows in chest. But after farrowing her first litter at 10 months, she was lower than the three standard sows at withers and at 29 months, during

which time she farrowed four litters, she was ^{the} lowest at withers, narrowest at shoulders and shallowest in chest.

Factor III, of course is not included in this comparison, on account of her unusually run-down condition.

Factor VI was, at $6\frac{1}{2}$ months, higher than Factor III and VIII, at withers, broader than three of the sows in chest and largest in heart girth, but farrowing her first litter at 9 months, she came down from 54 to 51 c.m. in height at withers, from 101 to 85 c.m. in heart-girth, ^{and} 32 to 29 c.m. in depth of chest. The second breeding at the fourteenth month, also impaired her body very much. The violet lines in Plates II to V clearly show that she occupies the lowest place among the other sows.

Comparing Factors V and VI, it is found out that Factor VI was bred at 5 months or about a month and -a-half-earlier than Factor V. Before breeding she was not much inferior to Factor V. But after breeding, she occupies a much lower position in almost all the cases throughout her life.

The comparison of the three groups of animals, as shown in the first five plates, clearly brings about the fact that early breeding decreases the size, impairs the constitution and stunts the growth of the mother.

V.

(2) THE EFFECT OF EARLY-BREEDING ON THE GROWTH
OF THE OFFSPRING.

One of the main objects of this experiment is to determine the effect of early breeding on the growth of the offspring.

For this purpose, the sows, Factors V and VI, were bred at the first appearance of puberty and the sows Factors XI and XIV—daughters of Factor VI, were also bred very early. The sows, Factor XXI and XXII—selected from the first litters of Factors XI and XIV respectively, were in turn bred at the age of six months.

(A) The comparisons of these first and second generations of continuous early breeding with the original stock, are shown in Plates VI to IX. Each color line represents one sow and cross marks represent the time when they were bred, farrowed or weaned.

(See the plates at the end.)

(a) The comparison of the three groups of sows on body weight.

All the sows of the original stock as well as of the 1st generation, were 20 months old and had already farrowed their second litter, when the comparison was made.

The sow, Factor XI, of the first generation was heavier, than both the sows of the original stock at five months of age, but she sinks down below the sow Factor V, as she becomes older, and ~~although~~ though she occasionally becomes heavier owing to pregnancy, her weight line is much lower than that for Factor V, throughout the rest of the twenty months. But she weighs heavier than Factor VI almost all the time.

It should be remembered again that Factor VI is broken down, as a result of too early breeding.

The sow, Factor XIV of the 1st generation also weighed much heavier at five months but falls down below Factor V, as she becomes older, though pregnancy raises her up once in a while.

The sows of the second generation, Factors XXI and XXII were 13 months old at the time of comparison and both of them farrowed their first litters about the same time as Factors V and XIV, though a little earlier than Factor XI and one month later than Factor VI.

Both Factors XXI and XXII were much heavier than Factors V and VI, XI and XIV at five months and continue to be so throughout the rest of the twelve months.

The comparison of the three groups of sows on body weight shows that the first generation is inferior to the original stock while the second generation is superior to the other two groups.

(b) The comparison of the three groups of sows on constitution.

At five months of age, Factors XI and XIV were lower than Factors V and VI in height at withers; narrower in breadth at shoulder and shallower in depth of chest and continued to be so all through the rest of twenty months, though in some respects they show superiority over the broken down sow, Factor VI.

In height at withers, Factors XXI and XXII were lower than Factors V and VI, but higher than Factors XI and XIV at five months and they continue to be so throughout the rest of 12 months. But both of them were broader at shoulder and deeper in chest than the sows of the other two groups.

The four plates show that the sows of the first generation are weaker in constitution than the sows of the original stock. But the sows of the second generation are heavier in weight than the sows of the other two groups. In constitution, the sows of the second generation grew stronger than the sows of the 1st generation and equal to, if not better than, the sows of the original stock.

(B) A more accurate and exact comparison of these three groups of sows is brought about in the following two tables. All the sows were entered into the breeding test at five or six months of age and since then, they have been

weighed every week and measured once a month or two. The table shows the average heights and measurements for each sow from the time of ^{her registry} comparison until the time of comparison. The average weight and measurement for each group are given in the last two or three columns. In case of weight, the average monthly record has been computed instead of the weekly.

The measurements at these points only are considered, which are comparatively steady and certain and not so easily fluctuating. The comparison of the individual sows have already been discussed before and so are omitted here.

See Table I on next page.

(a) In table I, the first generation is compared with the original stock, from 6 to 20 months. All the sows raised their second litter at 20 months, while Factors XI and XIV, representing the first generation, were pregnant for the third time.

The last two columns of Table I clearly shows that the first generations of sows has a little advantage over the original stock in the weight of the body, breadth at shoulder and is almost equal to it in heart-girth. But it is much inferior in height at withers, breadth at shoulder points and hip bones and depth of chest.

Considering the broken down condition of Factor VI of the original stock, the inferiority of the first generation becomes still more greater.

TABLE I.
THE EFFECT OF EARLY BREEDING ON THE GROWTH OF THE
OFFSPRING.

(The average record of the sows from 6 to 20 months of age)

Name of sow	Original stock		1st generation		average	
	V.	VI.	XI.	XIV.	Original stock	1st generation
No. of record	8	8	9	9	8	9
(1) Wt. of the body	193.8 ⁽²⁾	173.6	194.7	190.6	183.7	192.6
Height at withers	56.8	54.6	50.4	53.2	55.7	51.8
Breadth at shoulder	30.00	28.00	30.8	29.7	29.0	30.2
Breadth at shoulder points	28.5	25.6	26.5	25.0	27.10	25.75
Breadth at hip-bones	24.9	23.7	22.6	21.8	24.3	22.2
Heart Girth	107.8	100.5	105.6	103.3	104.3	104.4
Depth of Chest	36.0	33.2	33.1	32.8	34.6	32.9

(1) The number of records for height was 18.

(2) All weights have been taken in pounds, the others figures in centimeters.

TABLE II.
THE EFFECT OF CONTINUOUS EARLY BREEDING ON THE
GROWTH OF THE OFFSPRING.

(The average records of the sows from 6 to 10 months of age)

Name of Factors	Original stock		1st generation				2nd gene- RATION		AVERAGE	
	V	VI.	XI	XIV	XXI	XXIII	origi- nal stock	1st gen.	2nd gen	
No. of records	3	3	3	3	4	4	141.8	148.7	188.2	
(1) Wt. of body	152.3	131.3	151.7	145.7	194.2	182.2	141.8	148.7	188.2	
Ht. of body	54	52.5	47.1	47.10	50.2	50.2	53.25	47.10	50.20	
Breadth at shoul- der	27.6	26.5	28.1	27.1	32.0	31.2	27.10	27.6	31.6	
Breadth at shoul- der points	25.6	24.8	25	23.8	25.3	25.0	25.20	24.4	25.15	
Breadth at hip- bones	22.6	22.8	21.0	21.8	22	22	22.7	21.4	22	
Heart-girth	97.6	99	96.3	93.6	102.75	103.75	98.30	94.85	103.25	
Depth of chest	30.8	30.5	29.6	28.5	32.2	32.0	30.65	29.2	32	

(1) The number of average weights is 8

(2) Figures for weights represent lbs. while others figures
are in centimeters.

(6) The three groups of sows are again compared in Table II. They are all ten months old and have already farrowed their first litter except Factor XI which farrowed a few days later.

At a glance it is seen from the last three columns of the table that the second generation of sows has advantage over the original stock in the weight of the body, breadth at shoulder, depth of chest and heart girth and is almost equal in breadth at shoulder points. It falls down below the original stock only in height at withers and breadth at hipbones.

Comparing the second generation with the first, it is at once seen that the former has decided advantage over the former in all respects.

The results from the comparison in these two tables are almost the same, we have found out from the graphical representation in the four plates.

CONCLUSION.

From the comparison of the three groups of animals on the body, weight and constitution, as represented in the four plates and two tables, we find out that:-

(1) The first generation of animals from immature parents is inferior to the original stock.

(2) The second generation of animals as the result of continuous early breeding, is equal to, if not better than, the original stock, while it has decided superiority over the first generation.

(3) THE EFFECT OF THE AGE OF SOWS ON THEIR
FARROWING RECORDS.

The farrowing records of the sows under the experiment reveals some important facts as to the influence of the age of the sow on the offspring.

Table I contains the farrowing record of 19 litters of pigs from 9 sows. Two of them farrowed four times, two, 2 times, and the rest only the one time. The fourth litters of Factor V and VI and the third litters of Factors XI and XIV have not yet been raised.

The number of pigs in these nineteen litters was 127, of which 108 were alive and 19 dead. 59 of the live pigs were boars and 49 sows. Of the dead, 6 were boars, 8 sows and 5 of the unknown sex.

(a) THE EFFECT OF THE AGE OF THE SOW ON THE
TOTAL WEIGHT OF THE LITTER.

Table I shows that the total weight of the litter does not bear any definite relation to the age of the sow.

The weight varies from 5.25 lb. to 29.20 lb.. Factors V, XI and XXI had litters of 7.75, 8 and 5.25 lbs. each respectively at 10 months, while Factor XXII produced a litter of 14.7 lbs at ten months and Factor VI, a litter of 16.14 lbs. even at nine months.

TABLE I.
FARROWING RECORD.

Factor	no. of litter	Age of sow in months	Period of gestation	Size of litters	At birth				After 12 hrs.				Weight in lbs.			Pigs raised			
					no. living		no. dead		No. living		no. dead		Total	Aver. boar	Aver. sow	No.	%		
					boar	sow	boar	sow	boar	sow	boar	sow							
III	1st	25	115	9	7	2			7	2			29.20	3.28	3.12	6	66.66		
IV.	1st	28.5	112	5	3	1			3		1		13.5	2.70	2.70	1	25		
V	1st	10	115	3	1	2			1	2			7.75	2.75	2.50	3	100		
	2nd	18.5	114	7	5	2	/		5	2			12.1	1.70	1.80	5	71		
	3rd	24	113	10	7	3			7	3			18.3	1.8	1.9	3	30		
	4th	30	115	9	4	1			4		4		19.0	2.25	2.00	5	x		
VI	1st	9	113	8	2	6			2	6			16.14	1.5	2.19	8	100		
	2nd	17.75	113	8	1	6			1	6			17.38	2.33	2.12	7	100		
	3rd	25	116	10	6	4			6	4	1		15.96	1.66	1.5	4	40		
	4th	30	113	8	5	3			5	4			17.00	2.6	2.0	7	x		
VII	1st	26½	115	7	1	1		5	1	1	5		9.8	1.4	1.4	2	100		
XI	1st	10	113	3	2	1			2	1			8	2.75	2.5	3	100		
	2nd	16.5	114	6	2	4			2	4			12.9	2.25	2.1	5	100		
	3rd	22	112	4	3	1			3	1			13.32	3.33	3.33	4	x		
XIV.	1st	10	114	6	1	4		1	1	4	1		13.50	2.5	2.12	5	100		
	2nd	16.5	112	7	2	5			2	5			18.56	2.63	2.7	7	100		
	3rd	22	113	9	6	3			6	3			21.96	2.66	2.60	7	x		
XXI	1st	10	112	2				1		1	1		5.25	2.75	2.5				
XXII	1st	10	112	6	1			3		2	2		14.7	2.4	2.5				
				127	59	49	6	5	8	59	49	6	5	8	aver.	2.38	2.24		

-80

From the table it is also seen that:

(1) The boar pigs tend to be heavier than the sow pigs.

In nine litters out of nineteen, the boar pigs were heavier than the sow pigs on the average, while in four litters, they were equal. In five cases only, they were lighter than the sow pigs. One case failed to show any accurate result. The average weight of 65 boar pigs is 2.38, while of 57 sow pigs, 2.24. There is, thus an advantage of ~~kk~~ .14 lb. in favor of the boar pigs.

(2) The number of the boar pigs tend to be larger than that of the sow pigs.

There were 65 boar pigs and 57 sow pigs and 5 pigs of the unknown sex. Even adding these five pigs to the number of sow pigs, the boar pigs remain still higher in number.

(b) THE EFFECT OF THE AGE OF THE SOW ON THE
WEIGHT OF THE PIG AT BIRTH.

In Table 11, all the pigs in 19 litters have been arranged and the total weight of the litters and the average weight of the pigs have been given. The age of the sows have been arbitrarily divided into four periods according to the time when most of the sows farrowed. At the bottom, the total number of pigs in each period, total weight of the

TABLE II.
THE EFFECT OF THE AGE OF THE SOW ON THE WEIGHT
OF THE PIG AT BIRTH.

Age in Months.												
NAME OF SOW	I.			II.			III.			IV.		
	9 to 10			16 to 19			22 to 25			26 to 30		
Factor	no. of pigs in litter	Total wt.	Average Wt.	No. of pigs in litter	Total wt.	Average Wt.	No. of pigs in litter	Total wt.	Average Wt.	No. of pigs in litter	Total wt.	Average Wt.
III.							9	29.20	3.24			
IV.										5	13.5	2.68
V.	3	7.75	2.58	7	12.10	1.72	10	18.30	1.83	9	19.0	2.11
VI.	8	16.14	2.17	8	17.38	2.17	10	15.96	1.59	8	17.10	2.12
VII.										7	9.8	1.4
XI.	3	8.10	2.66	6	12.90	2.15	4	13.32	3.33			
XIV.	6	13.50	2.25	7	18.56	2.65	9	21.96	2.44			
XXI.	2	5.25	2.67									
XXII.	6	14.70	2.45									
Total	28	65.35	2.33	28	60.94	2.17	42	98.74	2.35	29	59.30	2.84

5

7

8

6

litter and the average weight of the pigs have also been given.

The table shows that:

(1) The weight of pigs varies from 1.4 to 3.33 lbs. at birth.

(2) The size of the litter does not seem to have any effect on the weight of the pig. One pig in a litter of 9 ^{pigs} weighs 3.24 lbs. while another in a litter of 7 weighs 1.4. ~~xxxxxx~~ On the other hand pigs from litters of 2 and 3 weigh 2.67 and 2.50 lbs. respectively.

(3) The average weight of pigs from sows of 9 to 10 months, is 2.33 lbs. It falls down to 2.17 lbs. in the second period of age, rises up to 2.35 lbs. in the third period of age and sinks down again in the 4th period of age i.e., when the sows are 25 to 30 months old.

It is seen from the ~~data~~ data at our disposal that the age of the sow does not have any effect on the weight of the pig at birth.

(c) THE EFFECT OF THE AGE OF THE SOW ON THE PERCENTAGE OF PIGS RAISED.

In Table III is shown the number of pigs alive after 12 hours of birth and the number and percent of pigs raised. Of 19 litters, so far recorded in the experiment,

TABLE III.

(c) THE EFFECT OF THE AGE OF THE SOW ON THE PER*
CENTAGE OF PIGS RAISED.

AGE OF SOWS IN MONTHS.									
Name of Sow	9 to 10			16 to 19			22 to 25		
FACTOR	No. of pigs alive after 12 hrs	No. of pigs raised	% of pigs raised	No. of pigs alive after 12 hrs	No. of pigs raised	% of pigs raised	No. of pigs alive after 12 hrs	No. of pigs raised	% of pigs raised
V.	3	3	100	7	5	71	10	3	10
VI	8	8	100	7	7	100	12	4	40
XI.	7	3	100	6	5	86			
XIV.	5	5	100	7	7	100			
III.							9	6	66.6
XXII	1	0	0						
TOTAL	20	19	95	27	24	88	29	15	51.7

4 have not yet been raised, as stated before. In one case, the pigs were born dead. Litters of sows over 25 months old have not been included, as there were only two instances. The remaining 12 litters are represented in the table.

The age of the sows has been arbitrarily divided as before.

The table shows that the sows of 9 and 10 months old raised 95% of their pigs, 16 to 19 months old sows raised 83% and the older sows, only 51%, i.e., a gradual decrease in the percent of pigs raised from the young to the older sows.

The young sows seem to be better mothers.

These results correspond to the views of the breeder quoted above (Chap. III) that young sows are good milkers and good mothers.

(d) THE EFFECT OF THE AGE OF THE SOW ON THE SIZE OF THE LITTER.

In Table IV, are arranged all 19 litters of pigs to show the increase of their size as the sow grew older. The age of the sow has been arbitrarily divided as before.

The table clearly shows that the litters had, on the average, 4.6 pigs in the first period of the age of the sows, 7 pigs in the second period, 8.25 pigs in the third period and 7.2 pigs in the fourth period.

The litters in the third period of age were the largest. Making allowances for individuality, which is possible in such a small number of instances, it may safely be said that the size of the litter increases with the age of the sow.

This is exactly what Mr. Rommel has found out from the Poland China Record of 1902 (Chap. IV, Sec.3)

TABLE IV.

(d) THE EFFECT OF THE AGE OF THE SOW ON THE
SIZE OF LITTER.

FACTOR.	Age in months.			
	9 to 10	16 to 19	22 to 25	26 to 30
III			9	
IV				5
V	3	7	10	9
VI	8	8	10	8
VII				7
XI	3	6	4	
XIV	6	7	9	
XI	2			
XII	6			
Total no. of pigs	28	28	42	29
No. of instances	6	4	5	4
Av. size of litters	4.6	7	8.25	7.2

TABLE V.

THE EFFECT OF THE AGE OF THE SOW ON THE GROWTH OF THE LITTER.

Age of pigs	FACTOR V.				FACTOR VI.				AGE OF SOW	
	1st litter of 3 pigs		2nd litter of 5 pigs		1st litter of 8 pigs		2nd litter of 8 pigs		9-10 mos.	17½-18½ months
	total of litter	av. per pig	total of litter	av. per pig	total of litter	av. per pig	total of litter	av. per pig	Av. per pig	aver. per pig
Wt. at birth	7.75	2.58	12.25	1.75	16.25	12.71	19.75	2.19	2.18	2.5
1st wk.			20.25	4.1	36	4.5	35	4.8		4.25
2nd wk.	25	8.3	31	6.1	52.5	6.5	53	6.6	7.14	6.4
3rd wk.	37	12.3	45	9	71.5	8.9	77	9.6	9.8	9.3
4th wk.	46	15.3	59	11	85	10.5	86	10.7	11.9	11.1
5th wk.	51	17	77	15.4	110	13.7	102	12.7	14.6	13.7
6th wk.	67	22.3	97	19.4	147½	18.4	158	19.7	19.5	19.6
7th wk.	67	22.3	120	24			205	25.6		25
8th wk.	80	26.7	143	28	184	23	240	30	24	29.4
9th wk.	86	28.7	178	35	209	26.1	276	34.5	26.8	34.9
10th wk.	103	34.3	193	38.6	235	29.37	320	40	30.7	39.4

(e) THE EFFECT OF THE AGE OF THE SOW ON THE
GROWTH OF THE LITTER.

In Table V are compared the first litters of Factors V and VI with their second litters. The first litters were farrowed at 9 and 10 months of age and the second litters, at 17 and 18 months. The comparison is made from the time of birth until the weaning time.

There were 11 pigs in the two first litters and 13 pigs in the two second. In the last two columns are given the average weight of pigs in the first and second litters.

Comparing the first litter of Factor V with her second litter, we find that pigs at birth were much lighter in weight in the second litter than in the first. But still after six weeks of age, the pigs in the second litter make much more gain and weigh heavier than the pigs in the first litters.

A comparison of the first and second litters of pigs of Factor VI results in the same conclusion. At the end of ten weeks of age, the pigs in the second litters weigh 38.6 and 40 lbs., per head against 34.3 and 29.37 lbs. respectively in the case of the first litters.

From the last two columns, it is seen at a glance that the pigs farrowed at 17 and 18 months of the age of ^{steadily} sows became heavier than those farrowed at 9 and 10 months of age, weighing, at the end of 10th week, 39.4 lbs. per

head in the case of the former as against 30.7 lbs. in the case of the latter.

It is seen from this comparison that the pigs from old sows have a tendency to be more vigorous, grow faster and make more gain than the pigs from the young sows.

This is exactly what has been found by the Kansas Agricultural Experiment Station and which corresponds with the views of the breeders quoted above. (Chap. III and IV-Sec. 4)

Summarising the results of the Farrowing Record we find that:-

(1) The age of the sow does not seem to have any effect on the total weight of the litter.

(2) The age of the sow does not seem to have any effect on the average weight of pigs at birth.

(3) The young sows seem to be good milkers and better mothers raising more percent of pigs born alive.

(4) The size of the litter increases with the age of the sow.

(5) Pigs from old sows seem to be more vigorous, grow faster and make more gain than the pigs from young sows.

VI.

CRITICISM AND DISCUSSION.

In the foregoing chapters, we have seen the views of the biologists and breeders as well as the results of the different experiments, observations and records. Before we enter into their criticism and discussion, we must understand the scope and nature of the subject.

The importance of age as a factor in animal breeding may be observed from the standpoint of parents, especially of the mother or of the offspring.

(1) The early breeding may stunt the growth and impair the body, ^{and} decrease the vitality of the mother.

(2) The immature body of the mother may not sufficiently nourish the fetus in the womb or the infant after birth, thus causing the lack of vigor and vitality in the offspring.

(3) The germ cells of the parents may not be properly "ripe" enough to reproduce any normal offspring, in which case, not only the immediate offspring but all the successive generations after them are to suffer from the improper breeding.

The evil effect of the early breeding may be seen either in one or two or even in all phases. It should be

remembered that if there be any effect, especially of the heredity nature, it will take generations to bring about the perceptible changes. No effect can be noticed in a single generation. Nature is not so easily out-witted and its laws are not so easily set aside by whims of an individual.

(1) Biologists are indeed the best authorities to speak on the subject. Their familiarity with the organic life and the cytological researches, give them the best advantage to pass their opinion on the subject. But :-

(a) The biologists differ among themselves.

(b) Their theory is based mainly on logic rather than on actual facts. The experimental work for the study of heredity, have only begun recently.

(2) The practical breeders have ample opportunity to study the subject as some of them breed hundreds of animals every year. But:-

(a) Their object is rather to make money than to study biological phenomena.

(b) Many of them do not keep any record, except what is necessary for registration in the herd book.

(c) Many of them are guided by personal liking and are not acquainted with animals other than what they themselves breed.

(d) Many of them are apt to overlook many facts and jump at conclusions too quickly.

Between the biologist and practical breeder ^{are} the workers in the experimental stations, whose scientific knowledge on one hand and practical training on the other, afford them excellent opportunity to study the subject.

(3) The most conclusive results have been found by the poultry breeding experiment at the West Virginia Station. Both eggs and chicks from old hens have been found to be superior to those from pullets. But:-

(a) Their study was restricted to the immediate offspring only.

(b) Even in that, they did not take any notice of the chicks after three or four weeks. The inferiority of the eggs and chicks from pullets may be only due to the insufficient food supply for the embryo in the egg.

(4) The observations on sheep-breeding at the Wisconsin Station are really interesting. The influence of the age of parents both on ^{the} percent increase and sex of lambs are questions of biological interest.

If accessory chromosome be regarded as the basis of sex determination in the case of sheep, then there must be some change in the germ cells at least of the quantitative nature, which cause the aged ewe to produce more ram lambs.

The result that a ram is at his best at 2 or 3 years of age is quite at variance with the opinion held by sheepmen who think a strong and vigorous yearling to be the best sire.

(5) The experiment at Kansas Station with the pigs from mature and immature parents as to their growth and cost of production, does not amount to much. One or two instances do not give any data for conclusion of any great importance. Even the two tests did not give the same results

(6) The experiments with plants from immature seeds are significant of great biological importance. The unripe seed may not produce a vigorous plant, ^{but} it still remains to be explained why the fruits from the plants of immature seeds are inferior. Successive breeding from these plants will reveal truths of great significance.

(7) Swine breeding experiment at Missouri Station has begun work on a scientific basis. When finished, it will contribute profitable results both to agriculture and biology.

One weak point of the experiment has been that while the age of both parents have been taken into consideration, individuality of the sire has not yet been noted. Measurements of dams at several places are taken every month but sires are left out.

Results that have been noted here were based on only a few instances, which are not ~~six~~ enough to form any data for a conclusion.

(I) Mr. Redfield's theory that the age of the parents influences the mental ability and disposition of the offspring seems to be plausible from the number of instances he has cited.

But Mr. Redfield has not been able to prove it:

(a) Simple enumeration of instances is not enough to prove a fact.

(b) Unless one of the phenomena has been traced to another by the elimination of the rest, a causal relation cannot be said to have been established between the two.

(c) The inheritance from fathers and mothers is potentially equal. The mother's side has not been considered in most of the cases.

(d) The notion that civilization has progressed due to the increasing mental ability of the people, arises from the confusion between "Intellect" and "Culture"; one is intrinsic, while the other is advantageous.

(e) Mr. Redfield's theory will also lead to the conclusion that mental ability of the men of genius has increased in the modern time. But history has not yet given any proof for it. A Buddha, an Aristotle and a Bacon are as unique characters today as they were a hundred years before.

(f) The increasing record for the men of genius in the modern history does not mean the rarity of such men in earlier days. Want of well authenticated record ^{for} those days makes the main difference. The limited field of action presented very little opportunity to the ancient people to stamp their name on the pages of history. Marshal Oyama and Admiral Togo could have slipped away from World's memory but for the Russo-Japanese War

(9) The relation between the custom of early marriage and the physical and mental degeneracy of a race or class of men is a hard thing to prove. The real cause of degeneracy among savages is still harder to ascertain. It is not safe to say that early marriage has caused physical degeneracy among the Chinese. The physical degeneracy of the Hindus is a well known fact either in comparison with other Caucasian races or with their own ancestors. But whether it is due to early marriage or the accumulated effect of climate or not, has not been determined yet.

But it may be said with greater safety that the Chinese and Hindus have not degenerated mentally. The intelligence of the Chinese is well known. The University ^{ies} of Great Britain and Ireland have also been well convinced of the high intelligence of the Hindu students, hundreds of ^{whom} which go there every year.

Francis Galton believed that high intelligence of the offspring is inherited from the high intelligence of the parents only and advocated early reproduction among the intelligent classes of men as a means of improving the race.

VII.

CONCLUSIONS.

It has been mentioned before that very little work has been done to determine the effect of the age of parents on their offspring. It is too hasty and hazardous to postulate any law of great biological significance from the meagre data at our disposal. But our investigation and experiment lead us to conclude that;-

(1) The offspring of the mature parents seem to be more vigorous than those from the immature parents.

This is shown by the poultry breeding experiment of the West Virginia Station. The eggs from old hens weighed heavier and were more fertile and when hatched, the chicks also weighed heavier and grew faster than those in the case of the pullets or immature hens. The vigorousness of the offspring from mature parents was found to be the case also by the experiments with swine at the Kansas and Missouri Stations.

The plant breeding experiment also arrived at the same results.

(2) The age of the parents has a tendency to influence the percent increase of the offspring.

This refers, of course, to animals producing offspring more than one at a ~~time~~ single birth. The sheep breeding records at the Wisconsin Station for 17 years showed that rams from 2 and 3 years of age and ewes of 4 to 6 years of age made the most increase. The Poland China record for 1902 also showed that the size of the litter steadily increased from 1 to 5 year old sows. The experiment with swine at the Missouri station has also shown a similar tendency.

(3) Early breeding has a tendency to act deleteriously on the growth of the mother.

The swine breeding experiment under investigation at the Missouri Station gives data for such a conclusion. But whether the longevity or even vitality of the mother is impaired or not, the experiment has not yet gone far enough to prove.

(4) The age of the mother has also a tendency to influence the sex of the offspring, at least in certain classes of animals.

This is shown by the sheep breeding record at the Wisconsin Station, where they found that the percentage of ram lambs increased and of the ewe lambs decreased, as the age of the ewes advanced.

Whether the breeding of immature animals for successive generations has any effect on the constitution, vigor maturity and longevity of the offspring or not, is a problem

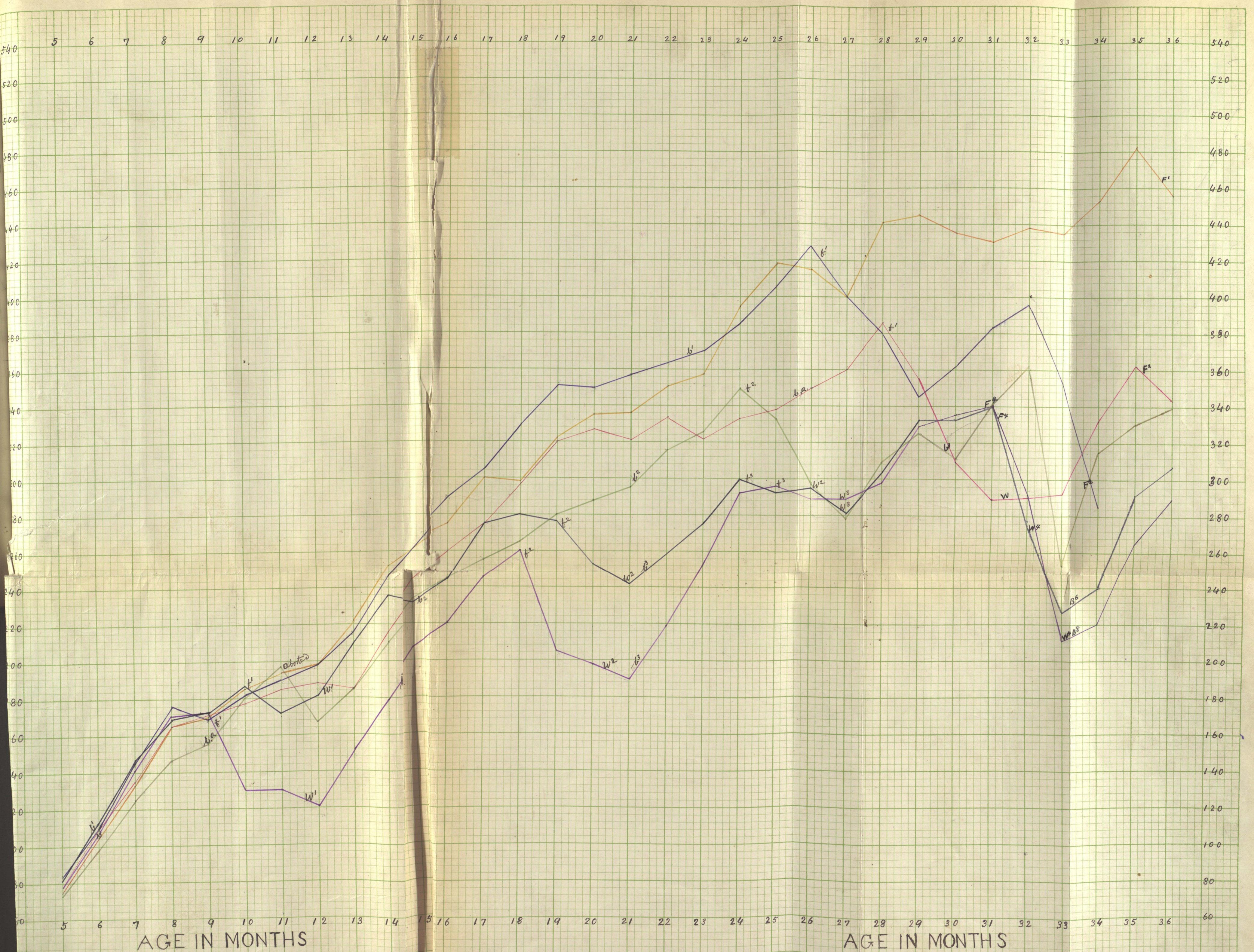
that has not yet been investigated properly. The experiment at the Missouri Station, so far as it has gone, has shown that while the first generation from the early bred sows was inferior to the original stock, the second generation from the continuously early bred sows gave the contrary result, being superior to the first generation and equal to the original stock. But a single instance like this is not at all enough to give the data for the positive or negative conclusions on such a vast subject.

But as far as we have been able to find out from the results of our investigation and experiment, we conclude that the mature animals are by far the more desirable stock for breeding from the standpoint of vigor, growth and percent increase of their offspring and the importance of age as a factor in animal breeding should be considered by every rational breeder.

BIBLIOGRAPHY.

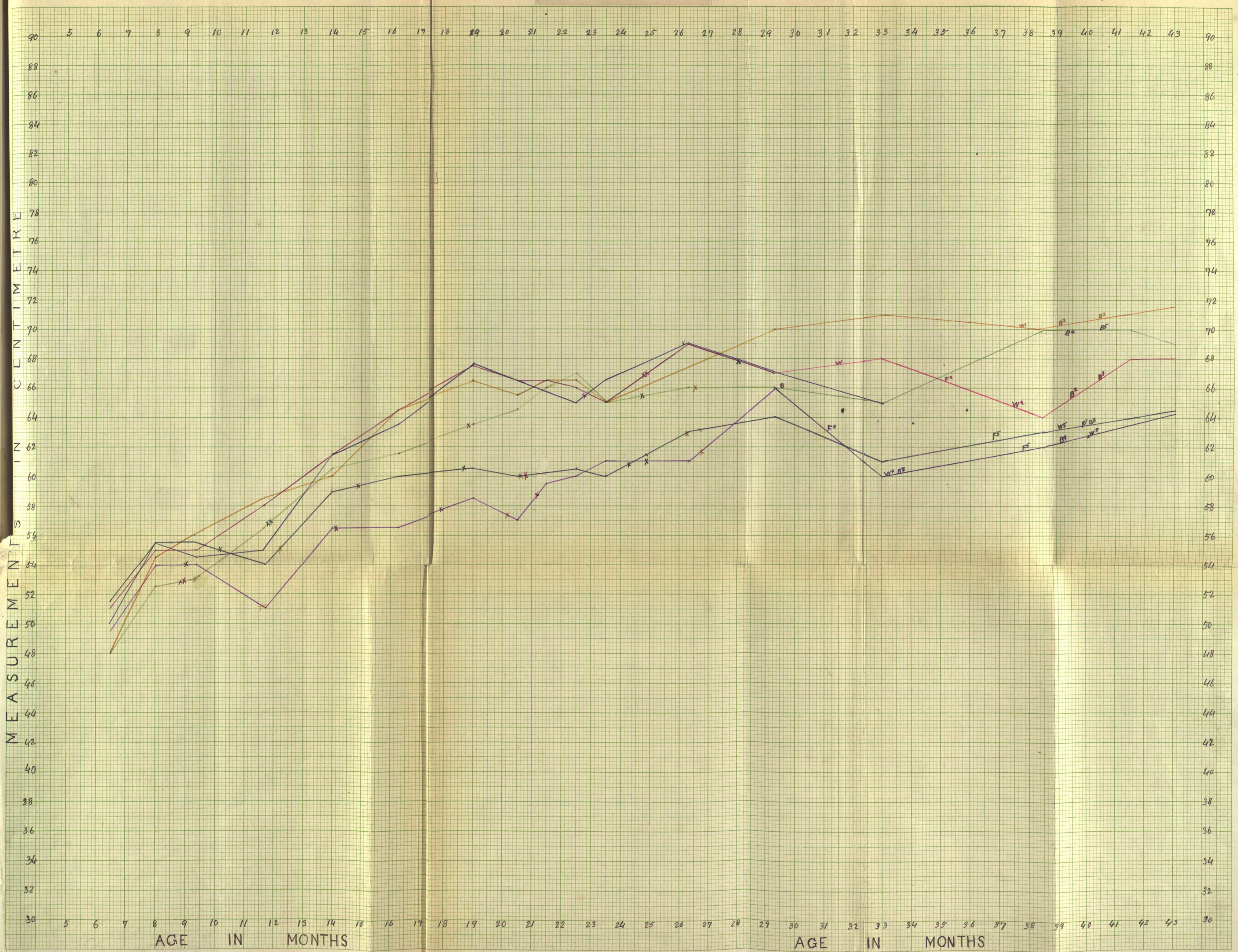
- (1) "Variation, Heredity & Evolution"
R.H.Lock. Chap. I, III, IX.
- (2) "The Cell in Development and Inheritance"
E.B.Wilson, (p.13, Chap.1)
- (3) "Heredity" — J.A.Thomson, (Chap.VII, p.163, 167, 170)
- (4) "Principles of Breeding"
E. Davenport--(P.417-Chap.11)
- (5) "Germ Plasm", A. Weismann, (p.400-406)
- (6) "An Examination of Weismannism" --G.J.Romanes, Vol.1.
- (7) "Plant Breeding"--Prof. L.H.Bailey-p.103
- (8) "Pigs from Mature and Immature Parents"
The 2nd annual Rpt.of the Kans.Exp.Sta.(pp.79 to89)
- (9) "Control of Heredity"
By C.L.Redfield, Introduction and Chap.
VII, VIII, IX, X, and XI.
- (10) "Observations on Sheep Breeding from Record of the
University Flock"--24th Annual Rpt.of the Agr.Exp.
Sta. of Univ. of Wis.-1907. (pp.25 to 40)
- (11) "Some observations on Sheep Breeding from the Experiment
Station Flock Record"--Bulletin 95 of the Agr.Exp.Sta.
of the Univ. of Wis.-1902.
- (12) "The Inheritance of Size of Litters in Poland China
Sows" by Mr. Geo.M.Rommel--The Annual Rpt.of the
American Breeders' Association-Vol.111.1907.
- (13) "A Few Preliminary Experiments on the Effect of the
Age of the Parents upon the Vigor of the Chickens"
By Prof.Horace Atwood-the Annual Rpt.of the
American Breeders' Association-Vol.V., 1909.
- (14) "Some Factor Influencing the Vigor of Incubator Chickens"
Bulletin 124, of the Agr.Exp.Sta.of the W.Va.
University-1909.

- (15) "Inheritance of Dynamic Development in Trotting Horses"
Mr.C.R.Redfield-"The Horse World"
Feb.27, 1906.
- (16) Also in the American Naturalist-May, 1910.
- (17) "Age of Trotting Horse Sires"-by Prof.F.R.Marshall-
The American Naturalist-Vol.XLIII-Jan.1909
- (18) "Hereditiy Genius"-By Francis Galton, Chapter on
Judges and Statesmen.
- (19) "The Types and Breeds of Farm Animals"* C.S.Plumb.
- (20) "The American Breeders Magazine" Vol.1,pp.91-96.
- (21) Breeders Gazette-
Vol. V, p.690; Vol.IV,p.357; Vol.XVII,p.103;
Vol. XIX, p.89; Vol.39, p.554 and 605, Vol.45,
p1216; Vol.54, p.959.
- (22) The Record books of the Swine Breeding Experiment
at the Agr.Exp.Station of the University of
Missour.
- (23) The Yearbooks of the U.S.Department of Agric ulture.
- (24) Experiment Station Records.



MATURE { Factor-IV = HALF MATURE { Factor-III =
 Factor-VIII = Factor-VII = MATURE { Factor-V = CROSS SECTION
 Factor-VI = 8x8 TO ONE INCH
 N° 320

b^1, b^2, b^3 = bred first, second or third time.
 f^1, f^2, f^3 = farrowed " " "
 w^1, w^2, w^3 = weaned " " "
 $b.a.$ = bred accidentally.

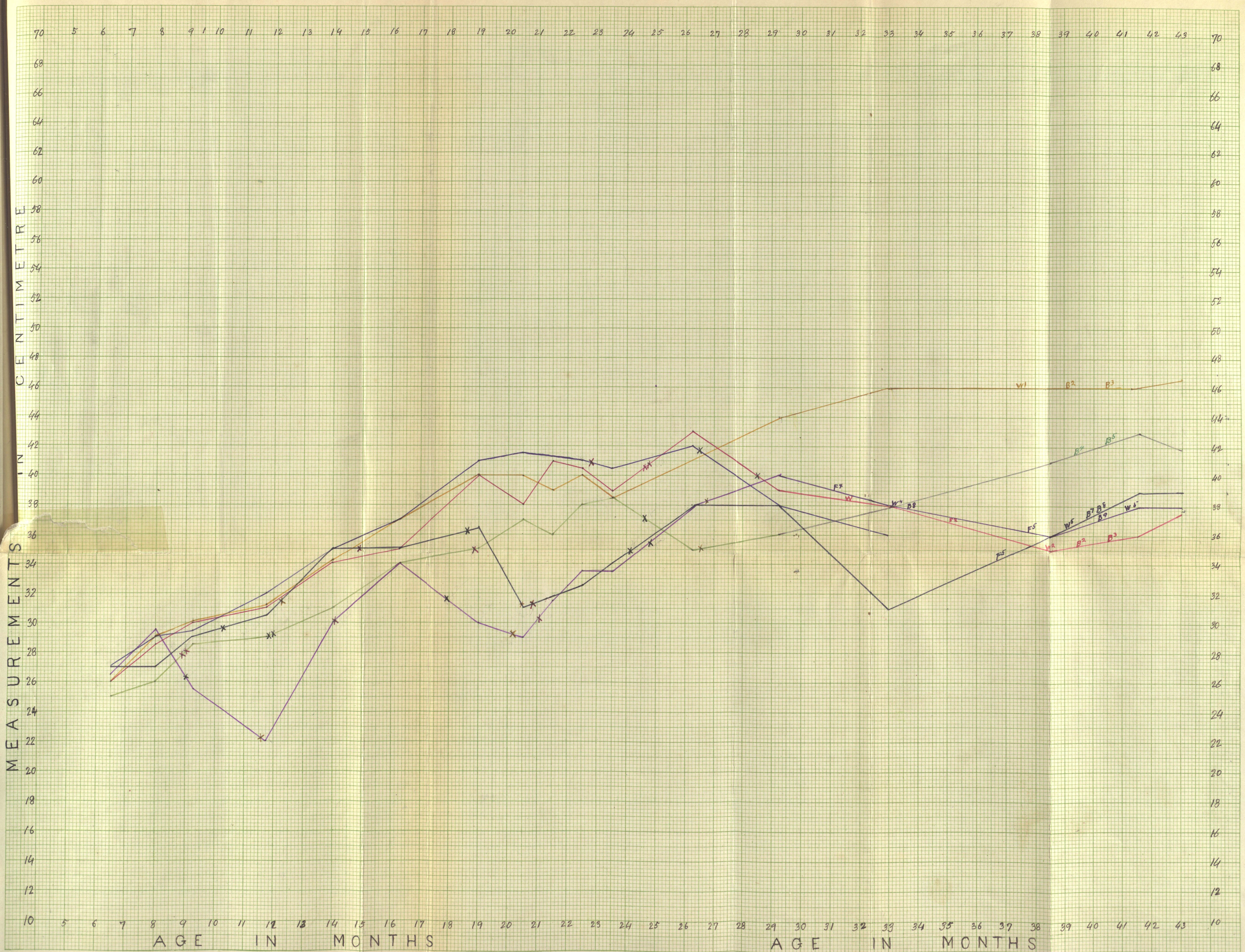


MATURE - { Factor - IV =
Factor - VIII =

HALF-MATURE - { Factor - III =
Factor - VII =

IMMATURE - { Factor - V =
Factor - VI =

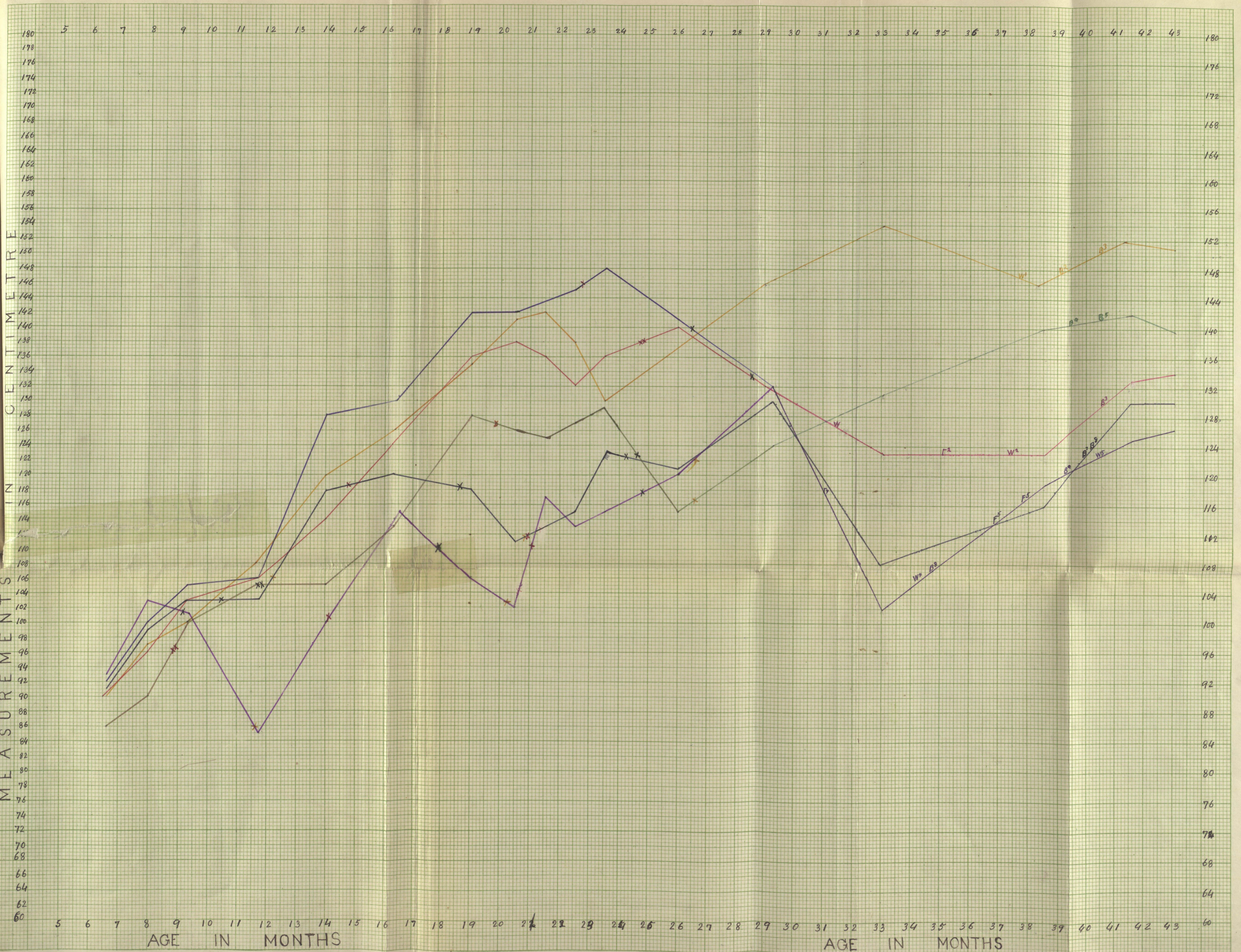
Bred = x, accidentally = xx.
Farrowed = x, aborted = xx.
Weaned = x.



MATURE - { Factor - IV = — Factor - VIII = — HALF-MATURE - { Factor - III = — Factor - VII = — IMMATURE - { Factor - V = — Factor - VI = —

CROSS SECTION 16*16 TO ONE INCH No 318

BRED = x, accidentally = xx FARROWED = x, aborted = xx WEANED = x

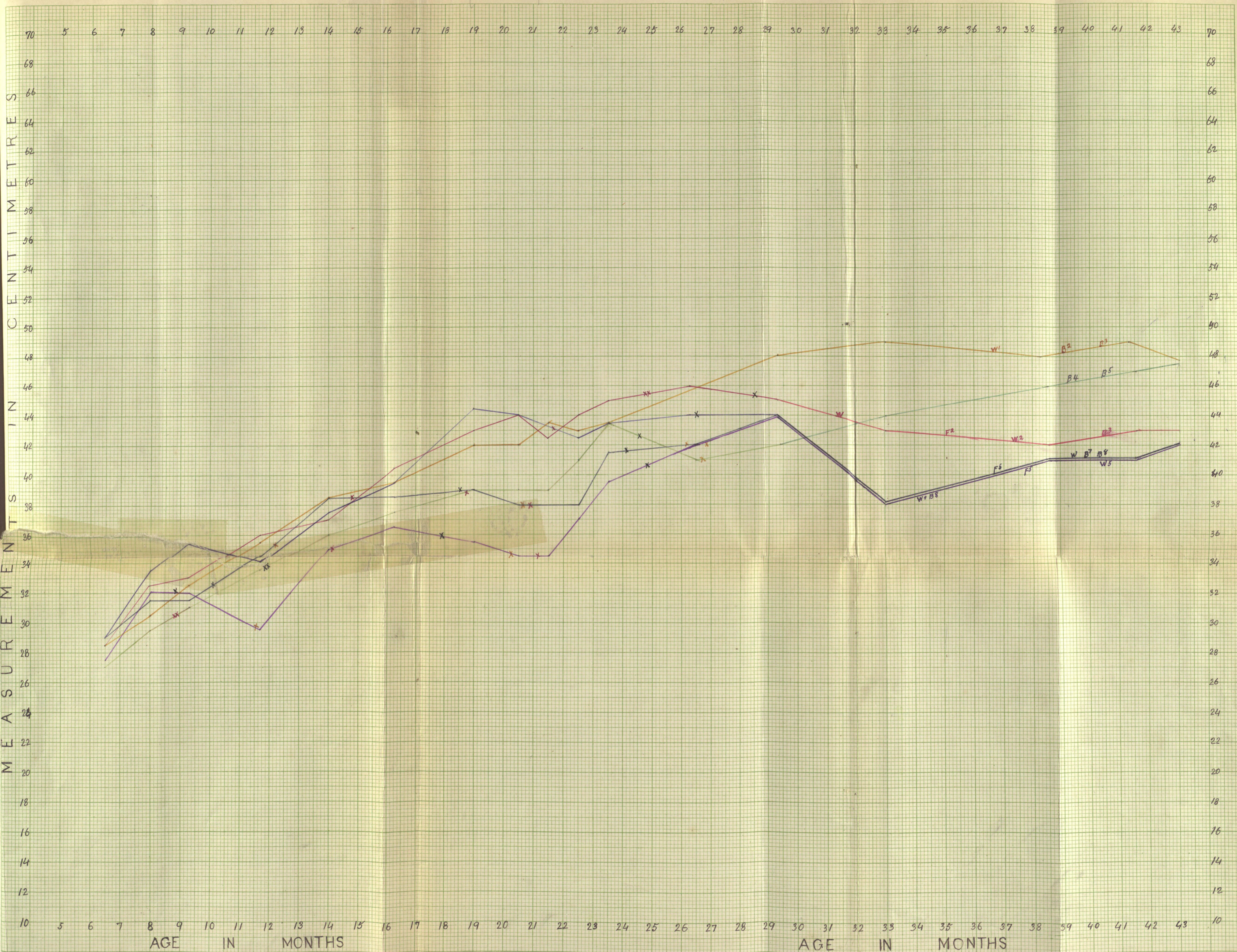


MATURE { Factor-IV = — Factor-VIII = —
 HALF MATURE { Factor-III = — Factor-VII = —
 IMMATURE { Factor-V = — Factor-VI = —

CROSS SECTION
 16x16 TO ONE INCH
 No 318

Bred = x, accidentally = xx
 Farrowed = x, aborted = xx
 Weaned = x

watch



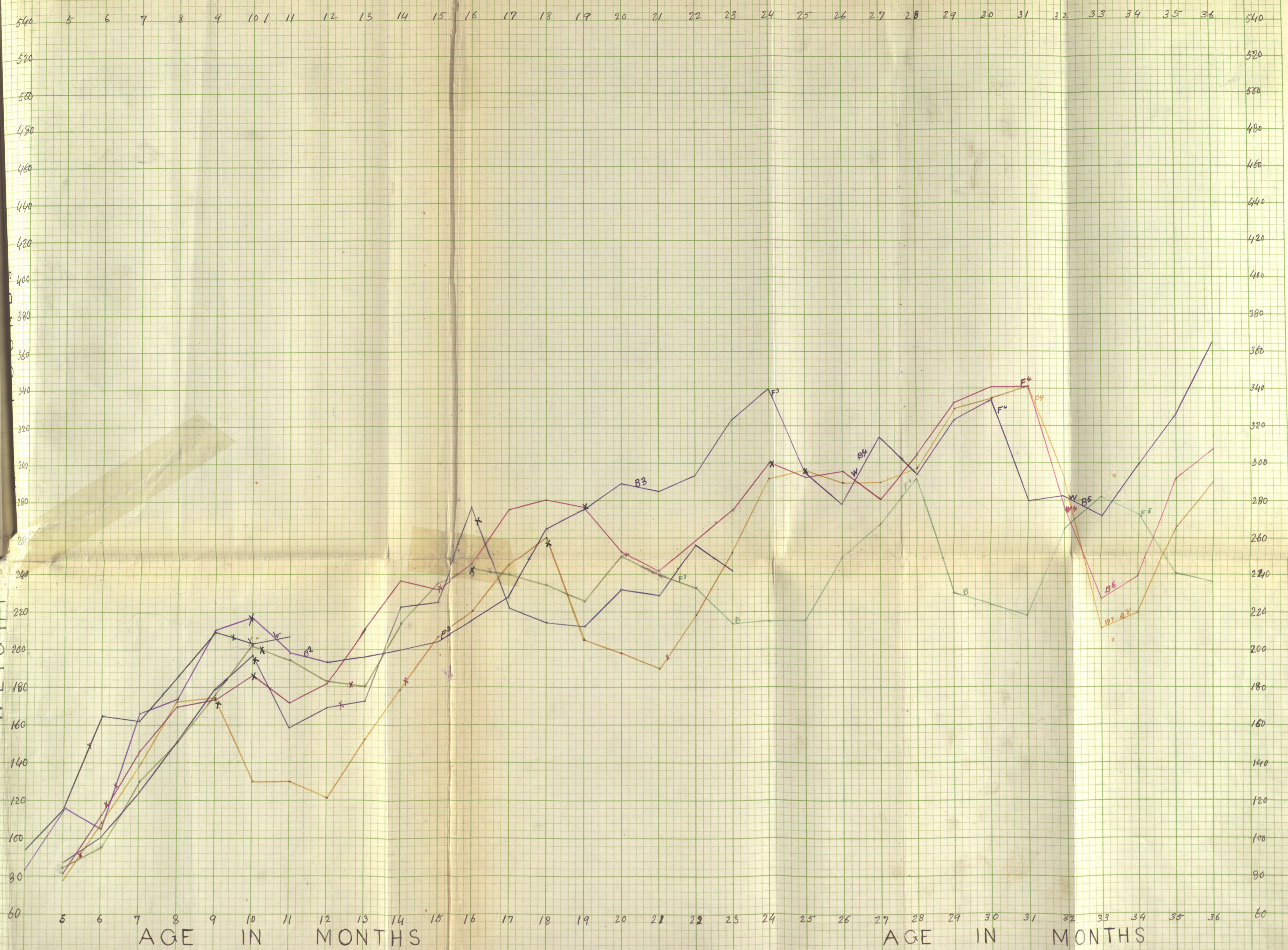
MATURE - { Factor-IV = — Factor-VIII = —
 HALF-MATURE - { Factor-III = — Factor-VII = —
 IMMATURE - { Factor-V = — Factor-VI = —

CROSS SECTION
 16*16 TO ONE INCH
 No 318

Bred = X
 Farrowed = X
 Weaned = X
 Bred accidentally = XX
 aborted = XX

THE EFFECT OF CONTINUOUS EARLY-BREEDING ON THE GROWTH OF THE MOTHER

WEIGHT OF THE BODY



IMMATURE BREEDING

IMMATURE - 1st Generation

IMMATURE - 2nd Generation

CROSS SECTION
8x8 TO ONE INCH
N° 320

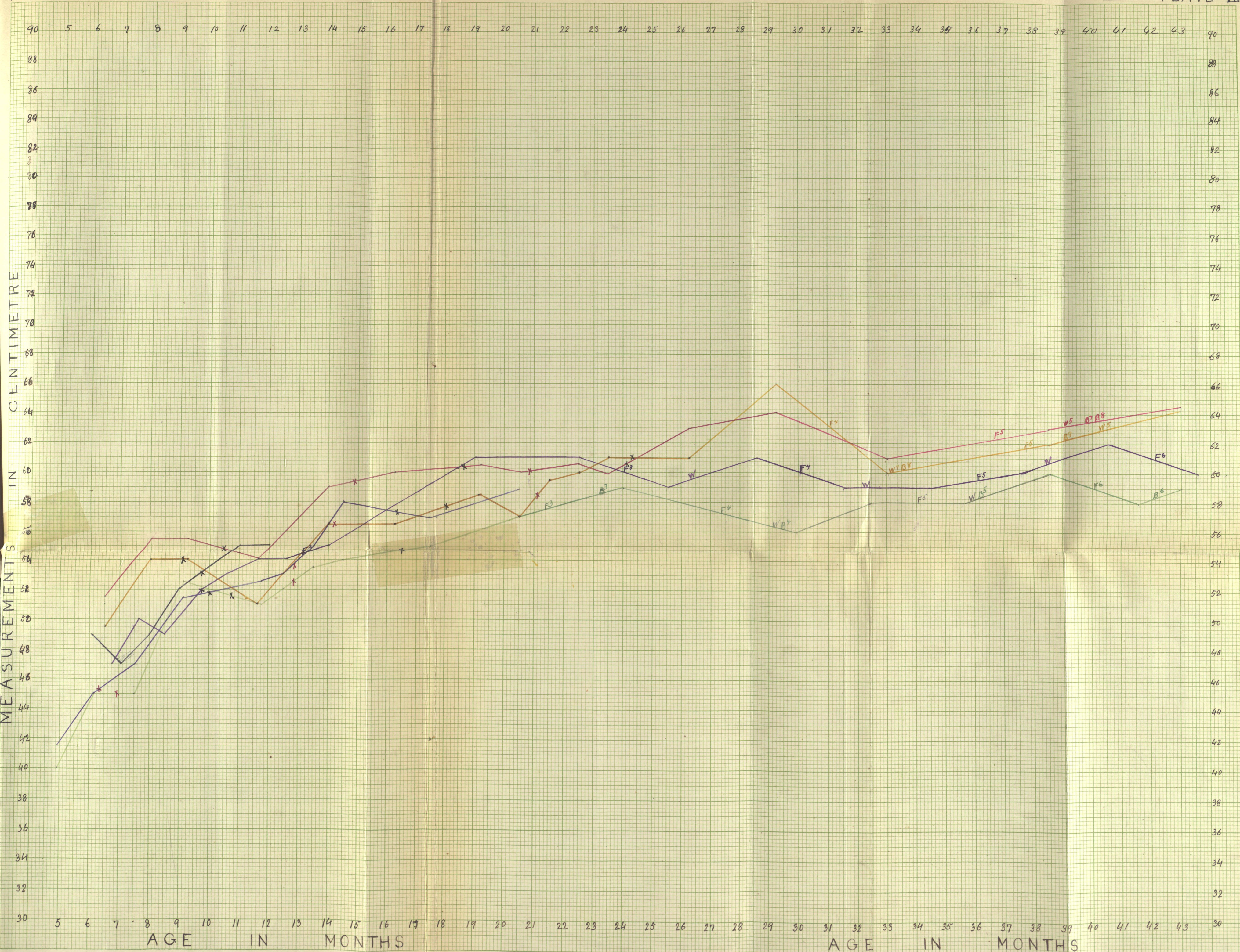
IMMATURE - 2nd Generation

Factor - XXI
Factor - XXII

Bred = X
Farrowed = X
Weaned = X

THE EFFECT OF CONTINUOUS EARLY-BREEDING ON THE GROWTH OF THE MOTHER

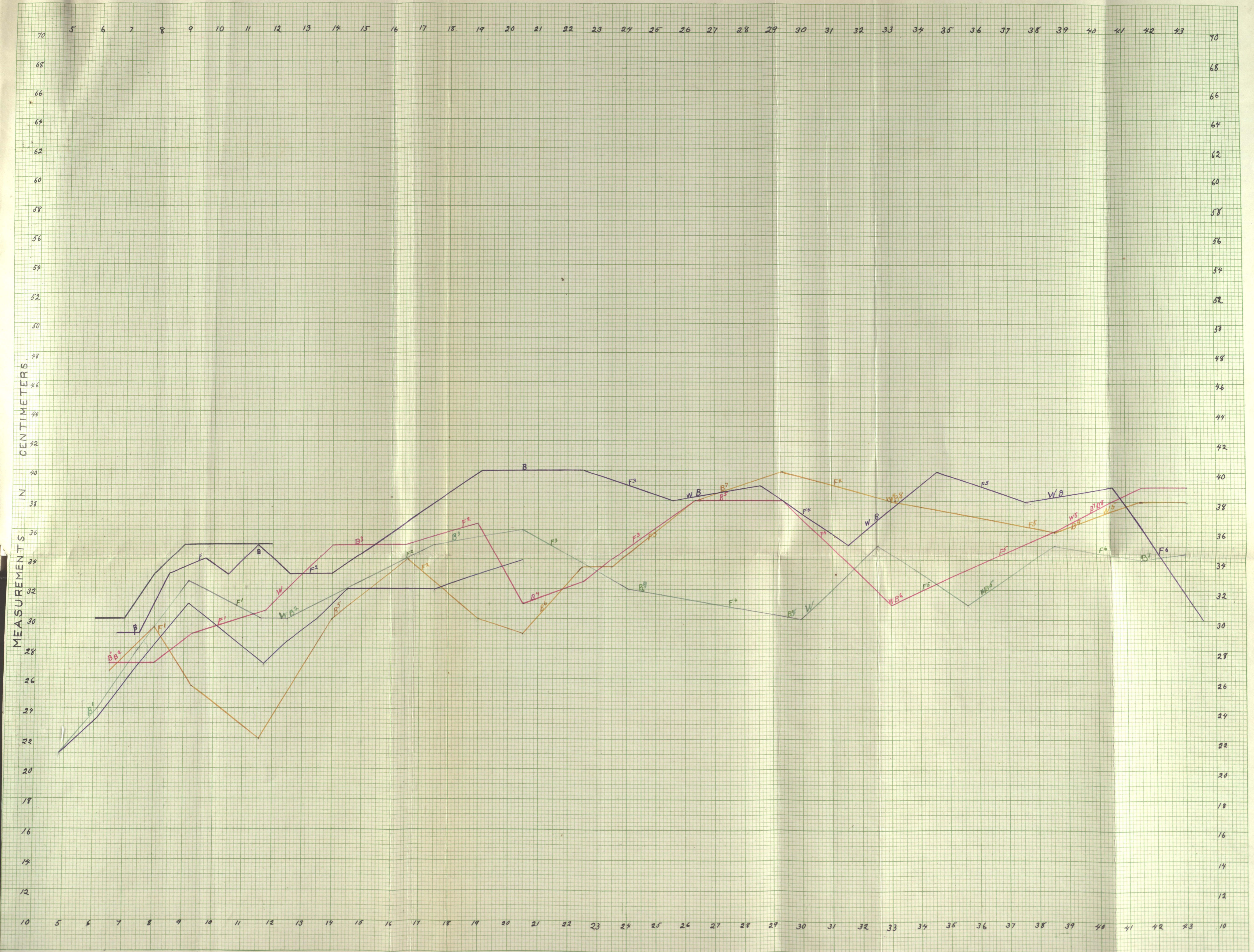
HEIGHT AT WITHER



IMMATURE-BREEDING ORIGINAL STOCK - { Factor - I =
 Factor - II = } 1st Generation { Factor - III =
 Factor - IV = }

CROSS SECTION 2nd Generation - { Factor - V =
 Factor - VI = }
 16 x 16 TO ONE INCH
 No 318

Bred = x
 Farrowed = x
 Weaned = x



IMMATURE BREEDING

IMMATURE { FACTOR-V (red line)
 FACTOR-VI (orange line)

IMMATURE-1st GEN. { FACTOR-XI (green line)
 FACTOR-XIV (purple line)

CROSS SECTION
 16x16 TO ONE INCH
 No 31B

IMMATURE-2nd GEN { FACTOR-XXI (brown line)
 FACTOR-XXII (blue line)

B = BREED
 F = FARROWED
 W = WEANED

DUE	RETURNED
MU JAN 27 2012	

BOOKS MAY BE RECALLED
BEFORE THEIR DUE DATES

