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THE EFFECT OF EARLY PREGNANCY AND LACTATION
ON THE GROWTH OF
YOUNG BREEDING ANIMALS.

by

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TABLE OF CONTENTS.

<u>Chapter</u>	<u>Page</u>
I. Introduction-----	1
Growth-----	4
Definition of-----	4
Nature of-----	8
Kinds of-----	9
Cause of-----	10
Methods of-----	14
Senescence-----	15
External Factors Influencing Growth-----	15
Food and Growth-----	16
Stimulants and Growth-----	18
Heat and Growth-----	21
Salts and Growth-----	22
Light, Gravity, Electricity, and Pressure and contact as Factors Influencing Growth---	23
Sex and Growth-----	24
Individuality and Growth-----	26
Pregnancy and Lactation, and Growth-----	26
Measurement of Growth-----	27
Body Weight-----	28
Height Measurements-----	29
Width of Head and Circumference of shin bones-----	30
Length of Body-----	31
Girth Measurements-----	31
Breadth Measurements-----	32

<u>Chapter</u>	<u>Page</u>
Depth of Chest-----	32
Distance from Elbow and Shoulder point down	33
Correlation of Measurements-----	33
II, Gestation-----	37
Definition-----	37
Germ Cells-----	37
Fertilization-----	37
Classification of Mammals-----	38
Foetal Nutrition-----	39
Protein Metabolism in Pregnancy-----	41
Carbohydrate Metabolism in Pregnancy-----	42
Metabolism of Fats in Pregnancy-----	43
Metabolism of Metals and Salts in Pregnancy	44
III. Effect of Pregnancy on Growth-----	46
Effect of Pregnancy on Body Weight of Women	48
Effect of Pregnancy of Growth of Guinea pig	48
Watson's Observations on Growth of the	
White Rat-----	53
Musser's Observations on Dairy Heifers-----	56
Griswold's Observations on Swine-----	59
Observations on Swine at the Missouri	
Station-----	64
IV. Effect of an Early Pregnant Period on Growth	
Rate During a Later Dry Period-----	95
Feed Consumed per 1000 pounds live weight--	103
Feed per 1000 pounds Live Weight when	
pregnant and when open-----	105

<u>Chapter</u>	<u>Page</u>
IV. Lactation-----	107
Physiology and Structure of Mammary Glands---	107
Theories of Secretion-----	107
Composition of Milk-----	108
Duration of Secretion-----	109
Formation of Organic Constituents of Milk----	109
Growth of Mammary Glands-----	110
Commencement of Mammary Secretion-----	111
Factors Influencing Secretion-----	112
VI. Effect of Lactation on Growth-----	114
Regan's Investigation with Dairy Heifers-----	115
Minot's Observations on Lactating Guinea pigs	119
Watson's Observations on White Rats-----	121
Griswold's Observations in Swine-----	21
Results of Swine Breeding Investigation at this Station-----	123
VII. Feed Consumed During Pregnancy and Lactation---	132
Feed Consumed During Successive Pregnant and Lactating Periods-----	135
Feed Consumed by Successive Generations of Immature Factors-----	136
Feed Consumed by Mature and Half Mature Factors During Pregnancy and Lactation-----	145
VIII. The Effect of Pregnancy and Lactation Combined on Growth-----	147
Does early Breeding Stunt Growth-----	147
Observations on the Size of Early Bred Gilts at the Missouri Station-----	152

<u>Chapter</u>	<u>Page</u>
Effect of Early Breeding on Maturity-----	160
Effect of Early Breeding on the Offspring--	161
Early Breeding for the Commercial Hog	
Raiser-----	176
Effect of Early Breeding on Farrowing	
Records-----	181
Effect of the Number of Pigs Raised per	
litter on the Farrowing Records-----	191
Summary -----	200
Conclusions -----	206
Acknowledgement -----	207
References -----	208

Introduction

Great progress has resulted from the fundamental investigations of geneticists during the past quarter century. These investigations have thrown much light upon the mechanism of heredity and have provided a far more satisfactory basis for an adequate theory of heredity. These investigations have greatly stimulated research in biological science and give promise of finally providing a more satisfactory basis for the practice of plant and animal breeding. In a discussion of the applications of the results from genetic investigations, Castle remarks, "The difference will be that we shall know the reasons for our procedure whereas the breeder of the past did not. We shall continue to produce breeds just as he produced them, but we shall know how we produce them, a thing of which he was largely ignorant. His work was largely haphazard; ours will be orderly. He experimented until he got what he wanted or until he found his ideal unattainable; we shall produce what we want, and knowing what is attainable will not attempt the impossible. He progressed indirectly, awaiting the caprice of chance; we shall go straight to the goal, knowing the way beforehand." It is to be hoped that the practice of plant and animal breeding may become as definite and systematic as indicated in the quotation from Castle, but it must be admitted that up to the present time the

fundamental investigations relating to the transmission of characters in plants and animals have not greatly influenced practice. This is especially true as applied to the practice of animal breeding.

It is true in a very general sense that the principles of heredity are the same for plants and animals, but it is also true that a wide range of phenomena of the greatest practical importance to animal breeders involve problems peculiar to animals and do not come within the range of the investigations pertaining solely to the protoplasmic changes within the germ cell. The relations of such phenomena to heredity and development belong peculiarly to the field of the animal breeder. Among the phenomena influencing the character and development of animals, breeders have long been familiar with the fact that breeding immature animals may have a profound influence upon development, particularly of the mother. It is believed also by many breeders that continuous mating of immature animals will eventually have a material influence upon the race. Just how important this phenomenon may be in the practical breeding of farm animals, it is not possible to say at the present time.

The purpose of the investigation described in this thesis was to determine the effects of early breeding in swine. If breeding immature animals results in evil consequences, these bad results should be observed in one or more of three ways: (1) influences on the pregnant mother; (2) influences on her immediate offspring; and (3) influences on the race.

The particular purpose of this investigation is to determine the influence of gestation and lactation upon the growth of farm animals. To determine the effect of early pregnancy and lactation on growth, is really to determine the cause of the injurious effect of early breeding, if it is injurious, or the beneficial effect, if it is beneficial.

GROWTH.

Chapter 1.

Before taking up the study of the effect of various factors on growth in breeding animals, it will be necessary to make a study of growth. What is meant by growth in farm animals? What is the cause of growth? What are some of the factors influencing growth? When does growth cease? When do we find the greatest rate of growth in farm animals? These, together with a number of other questions which might be asked, must be discussed before the problem "The Effect of Early Pregnancy and Lactation on Growth in Young Breeding Animals," can be taken up.

Definition of Growth: It seems an easy matter on first thought to define growth but as we give the matter a little study the true meaning of growth in the farm animal becomes a more difficult to give. Perhaps the first definition which would come to us would not be unlike that of Webster or Huxley who call growth "an increase in size". This definition would probably be correct and sufficient in most cases, but for our problem it is too indefinite and does not give us the true meaning of growth. For example an animal might be measured before and after eating, or drinking, and the measurements compared. No doubt there would be an increase in size as shown by the increase in weight and girth measurements, yet it would hardly seem reasonable to call this increase in size, growth. It is

very likely that this food and drink will produce a small amount of growth, but not enough to account for the "increase in size" as noted by the measurements.

Sachs**defines growth as "an increase in volume intimately bound up with change of form" and he illustrates the definition by the example of the growth of a sprout from its beginning to its full developement.

C.B. Davenport says:*** "Organic growth is increase in volume. It is not development; it is not differentiation; it is not increase in mass, altho the latter may often serve as a convenient measure of growth."

The latter definition is essentially the same as that of Huxley or Webster. In the case of Sachs' definition, two phenomena are distinguishable: first, increase in volume, and, second, the filling out of the details of form. This interpretation of growth is more definite but still does not satisfactorily meet the requirement in the case of farm animals.

Pffeffer's definition differs still more widely from the ones given above. He defines growth as a change in form in the protoplasmic body; and goes on to say that increments of volume and mass are not proper criteria of growth. Pfeffer illustrates this statement by the following example: a plant stem or a cell membrane can be permanently elongated by extension beyond the limits of elasticity without

** Davenport: Experimental Morphology. *p- date ?*

*** Davenport: Experimental Morphology.

the volume necessarily increasing; and he apparently means to include such an artificial deformation in his definition of growth. "And", he continues, "under certain circumstances a diminution of volume of a plant segment can indeed occur as a result of growth, when, for example, the elasticity of the wall is increased by growth, and water is pressed from the cell until equilibrium is restored." It would seem that this definition of growth could be more accurately applied in the case of farm animals than any of the previous ones and yet it is not broad enough to be entirely satisfactory.

Vines offers a definition which is intermediate between that of Sachs and that of Pfeffer. "By growth," he says, "We mean permanent change of form, accompanied by increase, usually by increase in bulk. Nor does this increase even of the organized structures of an organ, that is of the growing protoplasm and the cell wall, necessarily imply that it is growing." This definition does not give us a clear understanding of what is meant by growth in farm animals.

Burlingham and Gillette* define growth as being the sum of the changes through which the animal body must pass in its progress to maturity. It is the means by which an animal reaches its final size, and consists primarily in increasing weight and stature by the formation of new tissues. They say further: "It may be said

* Burlingham and Gillette: Thesis, University of Missouri. *into*

to be the increase in body weight or stature which can be estimated by weights and skeletal measurements." This definition is broad enough but is somewhat indefinite.

It is very difficult to find or form a good definition of growth. To do so would require a thorough knowledge of nutrition, chemistry, and physiology of the animal body and would also require extended research along this line.

There seems to be little doubt that by "growth" in farm animals we mean skeletal growth. An animal might increase in volume, if its volume were accurately determined, in weight, in stature, or undergo a change of form, without any change in skeleton. This is especially true in an animal such as the hog which may increase its height by several inches by the deposition of fat and muscle. Any animal may be far past the growth period in age and still increase in weight, volume, etc., to a very large degree. Tho there is, no doubt, growth going on in the various tissues, growth which we could define by some of the foregoing definitions, still this is not growth as we ordinarily think of it, the method by which an animal reaches maturity from birth.

Aron * says of growth: "Force called growth tendency is more noticeable in the skeleton than in other parts of the body. When fasting, an animal's skeleton grows at the expense of the rest of the body." In his opinion the force which produces growth is resident in the skeletal framework, the muscular tissue possessing no specific growth tendency but follows the skeleton in growth if there is suf-

* Aron: Experiment Station Record XXIV, page 765.

ficient nutrition.

The foregoing definitions of growth are, no doubt, correct in a general way, but they do not seem broad or definite enough to meet the requirements of a satisfactory definition of growth in farm animals. By combining some of the definitions one may be found which, it seems, will give a better conception of growth in farm animals as we ordinarily think of it.

Growth, I should say, is a permanent change in form of the protoplasmic body, as indicated by increase in stature, volume, and weight. Increased stature, volume and weight may take place in animals beyond the growth age but this could not be called growth, as in some of the other definitions, because it does not represent a permanent change, but a temporary one caused by environmental conditions. Growth, by this definition would largely represent skeletal growth because it is due to the skeletal growth that a permanent change is produced.

The above definition is practically the same as that of Vines but is more inclusive, and gives a broader view of the process. What we ordinarily think of as being growth Davenport may call developmental growth.

Nature of Growth: C.B. Davenport gives a good account of the nature of growth:

"In analyzing the processes of growth in organisms we must recognize at the outset that organisms are composed of living matter and formed substance, and that growth may therefore result from the increase in volume of either of

these. The living matter, in turn, is composed of two principal substances: the plasma and the enchylema or cell sap; so growth may be due to the increase of either of these substances, - may result either from assimilation, or more strictly from the excess of the constructive over the excretory processes of the plasma, or from the taking in of water."

Water constitutes a large proportion of the animal body. The importance of the part that it plays in the growth of animals was first noticed by Loeb, who showed how, in the withdrawal of water by plasmolytic methods, growth was interfered with. Davenport** performed experiments with frogs and toads to determine the part played by water in the growth of an animal. From the results of his work he concluded that water is a very important factor in growth. He found that in the period of most rapid growth, there was an increase of from fifty-six to ninety-six per-cent in the amount of water. The per-cent of water decreased with the development. Davenport further concludes that growth is affected by water more than by assimilation. The results indicate that during later development growth is largely affected by excessive assimilation or by storing up formed substance.

Kinds of Growth:- Davenport***recognizes two kinds of growth: one a transitory growth, after which the enlarged organ may return to its former size, and the other

* (Page 8) Davenport: Experimental Morphology.

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a permanent or developmental growth, which is a persisting enlargement, and plays an important part in development.

It is this latter form of growth with which we are concerned in the data to follow. It is this form of growth to which we usually refer in speaking of growth in farm animals. Davenport divides growth further into diffused growth and localized growth. In the former the entire individual is involved while in the latter the process is confined to a limited region.

Cause of Growth:- According to Davenport* growth may or may not be accompanied by cell division. But sooner or later cell division usually occurs in the growing mass.

Marshall ** says, "Growth in embryonic stages is characterized by the increase in the number of cells. In the later stages of development, growth occurs largely thru cell enlargement and the deposition of intercellular substance."

There seems to be no doubt that growth is caused by cell division and cell enlargement. What it is that causes this growth to be greater at one time than at another ~~es~~, and what it is that causes growth to cease after a given time, remains to be determined.

Minot *** conducted extensive experiments to study growth in Guinea pigs. His experiments demonstrated two facts:- first, the rate of growth diminishes almost ~~interrupt-~~edly from the time hence when the animal recovers from the

* Davenport: Experimental Morphology.

** Marshall : Physiology of Reproduction.

*** Journal of Physiology, Vol. XII: Senescence and Rejuvenation.

post-natal loss of weight; second, the diminution is rapid at first but slower afterwards. He adds, "It is conclusively established that there is in guinea pigs a progressive loss in the power of growth, beginning almost immediately after birth."

Minot says further, "the loss of growth power as will be shown in subsequent articles is equally demonstrable in the case of man, of other animals, and there can be but little doubt that it is true at least of all mammals. This conclusion raises the question whether other animals do not obey the same law, and sets, too, the more general problem whether in all living beings there is not a certain impulse given at the time of impregnation, and whether this impulse does not gradually fade out so that from the very beginning of the new growth, there occurs a diminution in the rate of growth."

Minot^{*} estimates from his studies on embryo chicks, and rabbits, that over 98 per cent of the original power of growth is lost before hatching or birth. In the case of man he says, "We start out at birth with less than two per cent of the original growth power with which we were endowed. Over 98 per cent of the loss is accomplished before birth, - less than 2 per cent after birth."

Davenport^{*} does not agree with Minot's theory. He cites as an objection to the theory the case of growth in the tips of plants such as trees which grow for centuries

* Journal of Physiology: Senescence and Rejuvenation. Vol. XII

** Davenport: Experimental Morphology.

go on growing. He says, "Some of the protoplasm at the tip is, however, constantly falling back to form part of the stalk; this part soon ceases to grow, undergoing histological differentiation. The reason why the animal ceases at length to grow is the same as the reason why the differentiated tissue below the tip of the epicotyl ceases to grow, - not because there is a necessary limit to growth, but because of a certain distance from impregnation, but because it is in the nature of the species that the individual should cease to grow at this point. The indefinite growth of this part, the limited growth of that, are as much group characters as any structural quality."

Davenport offers no theory to replace that of Minot other than saying that "the nature of the species" determines growth.

Miss Ferry * carried on extensive experiments to determine the rate of growth in the albino rat. She says, "these experiments prove conclusively that the power of growth is not lost so early in life as one would be led to suppose from a study of the curves of normal animals only. Whether or not it is ever lost is a question which can only be answered by extensive studies of experiments in which the animals are stunted until a very late age before being placed under conditions suitable for growth. The rate of growth is not, however, a function of age, but of size. Every animal apparently has a certain normal size which it endeavors to reach in spite of vicissitudes during its early life. To what degree it is successful in its endeavor is probably dependent upon the extent of the injury inflicted upon it by its early

*Marshall: Phys. of Reproduction.

experiences and the favorableness of the external conditions during its period of growth."

In regard to his studies, Minot* says: "During the growth of the guinea pigs one point comes out clearly, viz., that each individual appears to be striving to reach a particular size. Thus if an individual grows for a period excessively fast, there follows a period of slower growth; and, vice versa, those that fall behind make it up later, if they remain in good health." He also says, "It is probable that the same is true of man, and that the usual and even the severer illnesses of childhood and youth do not greatly affect the ultimate size of the adult."

Minot does not state how the "impulse to grow" is affected when some condition causes a check in growth. It would seem that if this impulse was dependent on age, an animal whose growth was seriously checked while young would never attain normal size. On the other hand if the impulse is checked or remains inactive during times of unfavorable conditions, and then produces excessive growth from the energy stored up during its inactive period, the individual should reach normal size, but at a later age. In this case it would seem that the impulse is dependent on size rather than age. Even tho an animal may strive to reach a certain size, numerous experiments indicate that an individual may be set back so much that recovery is never complete, in other words, never reaches normal size. Whether this is due to the loss of

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Senescence and R^ejuvenation: Journal of Physio. Vol. XII

impulse from age or to some other factor is obscure.

It seems very questionable to consider the "growth impulse" dependent on age entirely, but, on the other hand, age seems to be an important factor.

It is apparent that a large amount of investigation must be done before an entirely satisfactory explanation of the growth process can be given.

The problem undertaken here is not a study of the rate of growth in swine. As will be shown later, the data seem to indicate that an animal strives to reach a certain size, but that growth may be hindered to such an extent that normal size is never attained.

Methods of Growth:- There are two ways of attaining large size. First, by a rapid growth for a short period, second, thru a long period of growth. This is best illustrated by a comparison of growth in the rabbit, guinea pig, and man. Morgan* states, "A guinea pig reaches its full size by the end of the first year when it weighs about 775 grams. A rabbit is full size a year after birth, and weighs 3500 grams. Man may be said to be full grown at the end of twenty five years, and has then an average weight of 63,000 grams. If we add to these times the length of the period of gestation, and divide the weights by these numbers we obtain the average rate of growth a day.

Guinea pig	$775 \div 365 \div 67$ days	= 1.82 per diem.
Rabbit	$2500 \div 365 \div 30$ days	= 6.30 per diem.
Man	$63,000 \div 9139 \div 280$ days	= 6.69 per d.

* Experimental Zoology -- Morgan.

The calculation shows that man is larger than the rabbit because he grows for a longer period; but the daily increments are nearly the same for both. On the other hand, rabbits attain a larger size than guinea pigs, not because they grow for a longer time, but because they grow faster."

Senescence: After reaching a certain stage in their growth, some organisms begin to "grow old." In some species the individual passes through a period, following growth, in which there is no noticeable change before old age begins to show. In other species the decline follows very soon after maturity.

Some individuals appear to grow as long as they live. Such examples are the lobster, crab, etc. Whether growth continues throughout life or whether these individuals live to such an old age that the period of senescence has not been noted, is not clear.

Minot* looks upon senescence as the loss of power to grow.

External factors Influencing Growth:- Morgan** mentions the following as external agents which affect the rate of growth: (1) food; (2) stimuli; (3) salts; (4) heat; (5) light; (6) gravity; (7) electricity; (8) pressure and contact.

To these may be added other factors which could not be classed as external but seem to influence growth. A number of investigators have found that sex

* Senescence and Rejuvenation: Jour. Of Physio. Vol. XII.

** Morgan: Experimental Zoology.

is a factor influencing growth. Pregnancy, lactation and individuality should be considered as factors influencing growth.

Food and Growth: Of all factors which may influence growth, food unquestionably stands first. Deprive an individual of food, and growth cannot take place. An individual may be deprived of food for a time and continue to grow but in this case the reserve tissues are drawn upon. As the reserve tissues are formed from food, it is easily seen that growth could not take place without food. The germ cell of the female must be supplied with food to nourish the embryo during the first stages of growth.

"It is clear that if less food is obtained than needed to make new tissues, the rate of growth must slacken.* On the other hand if more food is given than can be assimilated, the rate of growth is not thereby increased.** Morgan* states that an animal has a regulative power, and may store up reserve material in the form of fat, when food is abundant, which may be drawn upon later if the food supply temporarily diminishes.

Waters** has shown that an animal kept on a maintenance ration, or even starved, increases in stature by drawing on the tissues of the body. A steer in prime condition at the beginning of an experiment was so emaciated at the end of the experiment that it was classed as a canner tho it had increased several inches in height.

* Morgan: Experimental Morphology.

** H.J. Waters: Capacity of Animals to Grow under Adverse Conditions.

The check in the rate of growth does not take place in proportion to the decrease in the amount of feed given. It has been shown from digestion trials that when less than the optimum of food is given, more substance is digested and when more than the optimum is given, less is digested. *

According to Morgan, the size of the adult among some of the lower animals, is greatly affected by the amount of food that is obtained. There is, however, an upper limit that is quickly reached when food is abundant that cannot be surpassed.

In regard to the influence of ration upon rate of growth in dairy animals, Eckles ** concludes that "the heavy ration results in a more rapid growth of skeleton especially during the period of most rapid development. Later the heavy ration resulted in the animals becoming much fatter. The animals receiving the light ration grew less rapidly but growth continued longer. The light fed group never attained the size of those having the heavier ration when young. The difference between a heavy and light ration for growing heifers shows more strongly upon the weight than upon the rate of skeleton growth. One cause of small cows in commercial herds is the character of the ration during the growing period."

There seems to be little question that the kind or quality of food affects the rate of growth as well as the quantity. If this were not true, the so-called "balanced rations", used extensively in feeding our domestic

* Ill. Bul. 172; Nev. Rept. 1907; N.Y. (Geneva) Bul. 141.

** Mo. Bul. 135.

animals, would be of little value.

It is hardly necessary to cite specific cases to show the effect of different kinds of food on growth rate but one or two cases will be mentioned. Young* fed tadpoles on several kinds of food. Fed on beef the tadpoles grew nearly three times as fast as on plant food. The large tadpoles transformed first, but the smaller ones not until they had grown large. This indicates that early maturity in tadpoles is brought about by nitrogenous food.

Experiments made by Lawes and Gilbert have shown that "growth tends to increase with the quantity of nitrogenous food."

Prösher ** compared the length of time required by different mammals to double their weight with the composition of the milk of the mother. He found that the rate of growth is proportional to the amount of albumen in the milk. He says, "It is improbable that the results are due solely to this factor, but that an internal factor largely regulates the growth of the young. Were this not the case, we should find that a baby fed on sheep's milk would double its weight eighteen times as fast as a baby^{fed} on human milk."

Stimulants and Growth: According to Morgan *** growth depends in some cases on a response to a stimulus, and the amount of food stuffs converted into tissue sometimes

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Morgan: Experimental Zoology.

depends on the presence of a stimulus." He explains that certain chemical substances which are not themselves foods may stimulate the growth process by accelerating the metabolic processes. He cites cases where various chemicals have been found to increase the growth activities in some of the simple forms of plants and animals.

Danilewsky* found that lecithin in water in which tadpoles were kept produced a marked influence on the rate of growth. He claims to have obtained similar results with young rabbits and dogs by injecting solutions of lecithin into them at intervals. Desgrey and Zaky * have also studied the influence of lecithin on growth, and reach the conclusion that the beneficial effect is due to the stimulating effect of the substance.

Prof. E.A. Schäfer ** is of the opinion that the activity of the growth cells is controlled to some degree by chemical stimulants, which he calls "hormones", circulating in the blood.

Some of the important internal secretory glands mentioned by Schäfer ** are the thyroid, pituitary body, parathyroids, pancreas, testes and ovaries. Of these the pituitary body seems to have the most marked effect on growth.

"The thyroid is an internally secreting gland which is essential to life, or at least to its maintenance in a normal condition." He explains that deficiency of

* Morgan: Experimental Zoology.

** Nature: Vol. 90, p. 16-17.

secretion of this gland or its removal, causes a form of idiocy known as cretinism. "Enlargement of the gland and increased secretion cause nervous excitation and similar symptoms are produced by excessive administration of glandular substance by the mouth."

Of the parathyroids he says, "Small as they are their internal secretion possesses hormones which exert a powerful influence upon the nervous system. Like the hormones of the thyroid itself, therefore, those of the parathyroids produce effects upon the nervous system, to which they are carried by the blood; altho the effects are of a different kind."

"Another internally secreting gland which has evoked considerable interest during the last few years is the pituitary body. This is a small structure no larger than a cob-nut attached to the base of the brain. Its removal has been found to be fatal within two or three days. Its hypertrophy, when occurring during the general growth of the body, is attended by an undue developement of the skeleton, so that the stature tends to assume gigantic proportions. Both "giants" and "acromegalists" are almost invariably found to have an enlarged pituitary."

Schafer says that these glands mentioned have no other known function than that of secreting these chemical substances for the influencing of other organs, to which they are conveyed by the blood.

"Besides the secreting of the pancreatic juice the pancreas furnishes an internal secretion containing a

hormone which is essential to the proper utilization of carbohydrates in the organism."

Nearly all authorities recognize the testes and ovaries as internally secreting organs which produce a marked effect on the individual. Chief among these effects is the effect upon the secondary sexual characters so often spoken of. Nearly all male animals will fail to develop the secondary sexual characters if the testes are removed when young. If the ovaries are removed from the female the individual tends to become masculine in appearance. The absence of masculinity in steers, wethers, geldings, etc.; failure of wethers to produce horns in species in which the males are horned; absence of beard in eunuchs; tendency of the plumage of the female to resemble the male upon the removal of the ovaries in some species of birds; are examples.

Heat and Growth: Morgan. * mentions heat as being one of the most influential external factors which affects the rate of growth. "Since heat facilitates chemical reactions, it is generally assumed that it acts in the same way in the organism."

Owing to the difficulty of the experiment and the expense involved, little has been done to determine the effect of heat on growth in farm animals. It is generally recognized that animals in the colder countries do not attain as large a size as is found among the same species in warm climates, but whether this is due to temperature or some other factors would be hard to determine.

Since a certain percent of the food consumed

must be used to produce heat energy, it is reasonable to believe that an animal will grow faster at a moderate temperature where so much food is not required to produce heat, than at low temperature.

Some experiments have been carried on with frogs and toads to determine the effect of different degrees of temperatures on growth. Knowlton and Hertwig* found that the rate of growth decreases up to 30° C. and then decreases.

"The optimum temperature for development of the hen's egg is about 38° C., but it will slowly develop at 25° C. The maximum point at which development takes place normally is 42° C."

Most animals and plants require a certain temperature for development but the range at which normal development takes place is probably much wider.

Salts and Growth: Very little has been done to determine the value of salt in the ration for the growing animal. It is possible that salt should be classed as a food, but owing to the wide difference of opinion as to its value, it will be or is briefly discussed here.

Babcock and Carlyle of Wisconsin ** fed dairy cows a normal ration excepting that no salt was given. From the experiment they reached the following conclusions: "In every case the cows exhibited an abnormal appetite for salt after having been deprived of it two or three weeks, but in no case did the health of the animal, as shown by the general appearance, live weight, or yield of milk, appear to be affected until a much longer time had elapsed.

* Morgan Experimental Zoology.

** Henry and Morrison: Feeds and Feeding.

This period of immunity varied with individual cows from less than a month to more than a year. There was finally reached a condition of low vitality in which a sudden and complete breakdown occurred. This stage was marked by loss of appetite, a generally haggard appearance, lusterless eyes, a rough coat, and a very rapid decline in both live weight and yield of milk. The animals recovered rapidly when salt was supplied."

"The pigs require less salt than the other farm animals, they should be supplied with it regularly." In a trial by Evvard at the Iowa Station * pigs allowed free access to salt made better gains than those receiving no salt, or others getting allowances of one sixty-fourth, one thirty-second, or one-sixteenth ounce per head daily.

These experiments were not carried on for the purpose of determining the effect of salt on growth but it is reasonable to conclude that it must be considered an important factor in the growth process.

Light, Gravity, and Electricity, Pressure and Contact as Factors Influencing Growth: These factors influence the rate of growth to a greater or lesser extent. Of these, light has, probably, the most influence. There is no data to show the part taken in growth by these factors in the higher animals. It is well known that the higher forms of plants will not grow without light. Some work has been done with the lower animals which tends to show that light increases the rate of growth.

* Henry and Morrison: Feeds and Feeding. 7

Gravity, Electricity,^{and} Pressure and Contact have been shown to have some influence on growth. However, it may be said that the influence of these on growth in the higher animals is probably so small that it is unimportant.

Sex and Growth: Among the factors influencing the rate of growth may be mentioned sex. Minot* found that male guinea pigs were slightly heavier than females at birth. "Male guinea pigs lose weight, as do new born children, for a variable period of a few days, after birth." The following table gives the weights of males and females during the first five days.

Age in days	MALES			FEMALES		
	No. obs.	Ave.	Increase	No. obs.	Ave.	Increase
0	200	70.8		172	70.1	
1	47	68.9	-1.9	53	72.0	1.9
2	43	70.0	1.1	53	73.8	1.8
3	48	73.4	3.4	54	77.6	3.8
4	44	77.3	3.9	54	82.2	4.6
5	48	82.6	5.3	54	86.9	4.7

"From this table we learn that there is a very marked difference between males and females for the former lose, the latter gain in weight the first day, so that tho the females begin with less average weight than the males, yet by the end of the first day they are heavier. The advantage is long maintained. One might say therefore

* Senescence and R^ejuvenation: Vol. XII Jour, of Physio.

that the beginning of growth in one sex is the reverse of that in the other, being negative in the male and positive in the female. The statement, however, involves an obvious error, for the question of signs, plus or minus, is not essential. It is essential to observe the relative growth immediately after birth, compared with that a few days later. Such comparisons show at once that in both sexes the growth is retarded by birth, but much more in the male than in the female, so much, in fact, that there is an actual loss. Not always, however, does the male lose, on the contrary in a few instances, the retardation is insufficient to produce a negative change; in certain rare cases there is a positive gain, tho slight, as in the female. In not a single case male or female does the retardation fail to be well marked, that is to say the growth during the first two or three days is always much less rapid than from the fifth day on."

Dr. Helen Dean King * from her work with albino rats finds ^{that} the male rat at birth usually weighs about .8 grams more than does the female.

Bowditch** describes the growth of children as taking place in such a way "That until the age of 11-12 years, boys are both taller and heavier than girls of the same age. At this period of life, girls begin to grow very rapidly and for the next two or three years, surpass the boys in both height and weight. Boys then

* Anatomical Record Vol. 9.

** 8th Annual Rept. of Massachusetts Bd. of Health, 1872.

acquire and retain a size superior to that of girls."

Individuality and Growth: Individuality can not be considered a factor which influences growth but a brief discussion of it at this time is not out of place.

In any group of individuals kept under identical conditions there will be found considerable variation in regard to a character. For example, in studying the growth in a group of animals we will find some individuals growing at a rate above the average and others below the average. No one can account for this other than saying that it is due to individual variation. The fact that under the same conditions one animal will grow faster than another can not be definitely explained. It may be due to a number of factors which we know nothing of. Such cases must be considered under the head of "Individuality."

Individuality is an important factor which must be considered in all investigational work. It is a factor which can only be dealt with by selecting a large enough number of animals to equalize the variation.

Pregnancy and Lactation, and Growth: As these are the main factors to be considered in this investigation, little will be said in regard to them at this point. The discussion and data from this and other investigations will follow in a detailed form.

While little work has been done to determine the effect of these factors on growth, it may be said that enough has been done to indicate that they are very important factors to be considered in the growth process. This will

* 8'th An. Rept. of Mass. Board of Health, 1872.

be shown in the discussion to follow.

Measurement of Growth: The writer has been unable to find any accurate measurement of growth from any of the literature on growth investigations. Perhaps one reason why there is no accurate measurement of growth is because that which constitutes growth has not been determined.

If by growth we mean skeletal growth, the measurement should be a measurement of the skeleton. It would be an exceedingly difficult matter to devise an adequate means of measurement of skeletal growth without destroying the animal. Of course it would be an easy matter to kill the animal and measure the skeleton at a given time, but this would not indicate growth. We could get some idea of growth by starting with a very large number of animals and killing one and taking the measurements at various intervals and comparing them with each other. This form of procedure would be out of the question owing to expense. Aside from this question there would be others entering. One could not get growth of an individual but of a group, and individuality would be a big factor to contend with.

There seems to be no more satisfactory method of determiningⁱⁿ growth, even tho it is not satisfactory, than by taking a large number of measurements of the individual at certain intervals, depending upon conditions, of the end in view.

There were seventeen distinct measurements taken of each individual at each time the animal was measured throughout the experiment from which the data of this investigation have been taken. The measurements were as

follows: weight, width of head, height at withers, height at croup, breadth of shoulders, breadth of shoulder points, breadth of hams, breadth of hip bones, depth of chest, heart girth, flank girth, length of body, circumference of fore shin bones, circumference of rear shin bones, distance from elbow down and distance from shoulder point down.

Body Weight: This is probably the most common and most widely used of all measurements. Some investigators have used this measurement alone as an indication of growth. Minot* says, "To measure the growth the weights were taken of the growing and adult animals, the weight being the only available measure for the whole animal, and the only one permitting comparisons between different species of organisms. In all these weighings there is necessarily an error. A positive error, because the digestive tract contains always considerable quantities of undigested matter; moreover the bladder may hold a greater or less quantity of urine: a negative error because every illness, even a very slight indisposition, or injury, causes a greater or less loss of weight. The quantitative values of these errors is presumably not very great; they probably counter-balance one another to a certain extent in the averages, which may be accepted as approximately accurate."

Weight cannot be considered an accurate measure for growth in the higher animals. Increase in weight does not always imply that growth has taken place. In fact, as has been mentioned, it was found at the Missouri Station that steers grew very much in height while the body weight remained

* Journal of Physiology: Vol. XII. p. date

constant or the animal even lost in weight in some cases.

In discussing weight variation, Burlingham and Gillette* have pointed out that a dairy cow may show a difference of as high as 50 pounds from day to day which cannot be accounted for. "Differences in intestinal and bladder content do not account for it as proved at the Missouri Station where an animal was kept on scales and all feed given and all excrement weighed. Under these conditions daily weighing showed as high as 30-40 pounds unaccounted variation. Regan has suggested as an explanation, a difference in the moisture content of cells.** However, while body weight cannot be used alone as an indication of growth, until someone finds an accurate form of measurement it must be used with other measurements as a partial indication of growth.

Height Measurements: As growth in farm animals signifies increase in height our data must contain measurements of stature. The withers and croup or hooks are the points usually selected for this measurement. In some animals these measurements should be comparatively accurate. The horse and dairy cow should show the least variation due to factors other than growth entering in, as there is comparatively little covering over the skeleton at these points in these animals.

"Differences in condition may prove a factor in influencing height measurements by varying the thickness of the fatty tissues over the withers and hooks.***

*** & * Burlingham and Gillette: Thesis, University of Mo. '14
 ** Regan: Thesis, U. of Mo. 1914.

Trowbridge has proved this to be of but slight significance. He fed a Jersey cow so that her condition at different periods was described as "common", "medium", and "good". During this time height measurements changed but 1.25 centimeters at the withers and .5 centimeter at the hooks. This variation is of even less importance in the study of normal growth since all animals were kept in uniform growing condition."

In ~~swine~~ ~~this~~ variation is much greater, consequently the measurements less accurate, owing to the large amount of fat and muscle which may be formed over these parts. No experiment known to the writer has been performed to determine this accurately, but a study of the records in this investigation show that an animal may decrease 6 or 7 centimeters in height. This can be accounted for only by the loss of the tissue above the points measured. However, there seems to be no more accurate a method of determining height than the measurements of these points.

A study of the records shows that these measurements are comparatively constant as a whole, even tho they show much variation at times, and that they may be considered a fairly accurate indication of increase in stature.

Width of Head and Circumference of Shin Bones:

Width of head and circumference of shin bones show the least variation of any of the measurements taken in this investigation. This is probably due to the fact that less muscle

and fat are formed at these places than at any of the other places measured. The great difficulty found in these measurements is that the increase is so slow *that* it requires a long period of time to show any appreciable change at these points. So small is the increase that accurate measuring is very difficult and the error *in* measuring may be greater than the variation in the size of the parts.

The head of the pig does not seem to grow at the same rate throughout the growing period but grows more rapidly between the ages of twenty and thirty months. In all other measurements taken the increase was gradual, more rapid while young and decreasing until growth ceased.

Length of Body: Another measurement which may be considered as a "growth" measurement is the length of body. This dimension remains comparatively constant and is not subject to so much error due to loss of flesh, etc. However, this is one of the most difficult measurements to make accurately, owing largely to the fact that it is hard to get the animal to stand in the same position each time that it is measured. A slight humping of the back, dropping of the head, or any such condition, is apt to cause considerable error. This is more true with swine than would probably be the case with cattle or horses but it seems probable that the error might be considerable even in these animals.

Girth Measurements: The girth measurements, namely, heart girth, paunch girth, and flank girth, are poor indicators of the growing condition. It is true that normal growth will cause an increase in girth dimensions, but the difficulty arises when we find that a number of other condit-

ions may produce an increase or decrease of these same dimensions, making it impossible to distinguish these conditions from growth. It is easily seen that the contents of the intestinal tract will affect these measurements considerably. A loss of flesh will make a greater change in these dimensions than in any other. It may be said that there is probably less chance of error in measuring in these parts than in most of the measurements. These measurements are valuable as a check and to show the general condition of the individual, and for that reason should not be discarded. A study of the data in this investigation shows that there may be a decrease of from 20 to 30 centimeters in the measurement of these parts.

Breadth measurements: The breadth measurements taken, namely, breadth of shoulder, shoulder points, hip bones, and hams, seem to indicate the condition more than the growth. As has been said of some of the other measurements, growth under normal conditions will cause increase in these parts, but as factors other than growth may cause an increase in growth and breadth, it is difficult to tell when growth occurs. These measurements are easily taken and are of value as a check and as an indication of growth when compared with other measurements.

Depth of Chest: Measurement of depth of chest is probably an indication of health and vigor as much, if not more, than an indication of growth. The increase in

this part remains comparatively constant throught the period of growth and does not show so much fluctuation, due to other factors, as do some of the other measurements.

Distance from Elbow and Shoulder Point Down:

Distance from elbow down and from shoulder point down are quite closely associated as shown by the data in this investigation. A fluctuation of one is usually accompanied by a like change in the other, tho perhaps not to the same degree. The increase is comparatively constant throught and they are not subject to such large variations as are some of the other measurements. At times, however, even these measurements decrease considerably due to ^{the} condition of the individual.

Chance of error in measuring is perhaps greater for these measurements than for most of the others. It is difficult to get hogs to stand while measuring and more difficult to get them to stand in the same position at each time of measuring. An animal may stand well up on its toes at one time and not at another, thus making the error in measuring much greater.

Correlations of Measurements: In this investigation the measurements have been studied separately and in groups to determine, if possible, whether any or all were correlated to any extent. Measurements were used of a few individuals separately, and the percentage gains for consecutive periods were computed to see if they would show any relation. This method proved of little value and showed only in a general way that some of the measurements were

correlated to a certain extent. If the measurements of swine were not subject to such large variations perhaps such a method would show a closer correlation of measurements.

From a careful study of the data, such as was necessary in this investigation, one is able to see that all measurements are correlated to a greater or less degree and that certain of the measurements are very closely related.

In discussing the separate measurements, cases have been mentioned where some of them were closely associated. A brief discussion of the general correlation of the measurements will now be given.

All measurements are associated to a certain extent. For example, when an animal grows rapidly for a time, this is shown by the increase of all measurements. On the other hand, when an individual loses in condition during a lactation period, some measurements show a greater decrease than others. This should be expected since some measurements tend to show condition rather than growth and will consequently show a greater shrinkage.

Some of the measurements, which seem to be indications of growth, are more closely correlated than others. The chief measurements of this kind are height of withers, height of croup, length of body, width of head, and circumference of the shin bones. Excepting the period between twenty and thirty months when the head seems to grow more rapidly, these measurements are closely correlated and do not show a great amount of variation.

The breadth measurements are all closely cor-

related as should be expected since a loss or gain in condition should be about equal in all parts.

The girth measurements are closely associated in a normal condition. In the pregnant condition the flank and paunch girth show a greater increase than does the heart girth.

Burlingham and Gillette* compared five separate measurements of dairy cows to determine the correlation existing between them. The measurements were height at withers, depth of chest, width of hooks, length from withers to hooks, and length from hooks to pin bones. The following table shows the comparison of measurements in light fed Jerseys:

Period	No. of Animals	Height of withers cm.	Depth of chest cm.	Width of Hooks cm.	Length from withers to hook	Length from hooks to pins
1	4	39.89	37.54	33.67	39.20	36.84
2	6	23.63	21.99	21.89	24.14	21.05
3	7	12.85	14.66	18.18	14.70	14.91
4	8	13.42	15.54	12.76	17.15	19.30
5	7	10.21	10.26	13.47	4.46	7.89

"It is interesting to note that the correlations in growth are so close that a variation of one measurement in any period is usually associated with a like variation in the others. These tables point out that growth in the different parts is closely correlated,- that data on the increase in one, measures the increase in another. From these figures it seems that skeletal changes can be indicated

by accurate measurements of the animals."

Regan* has also pointed out that measurements of dairy heifers are so closely correlated that the measurement of the height of withers may be considered a satisfactory measurement of growth in these animals.

While with dairy cows, and perhaps some other animals, two or three measurements are sufficient indications of growth, this number would probably not be sufficient with swine, since they are subject to so much variation.

Growth in swine must be determined by a large number of measurements and a comparison and careful study of ^{these} measurements.

* Regan: Thesis, 1914. U. of Mo.

CHAPTER II.

Gestation.

Definition: Gestation is the act of carrying young in the uterus from the time of conception until birth.

Germ Cells: Conception is produced by the union of the female egg cell (ovum) with the male germ cell (sperm).

According to Robinson the ova are germ cells which have probably descended, in direct line, from the most primitive animal cell.* They have acquired capabilities additional to those possessed by the original cell and contain within their substance the basis of the essential capabilities of their ancestors and the main possibilities of their descendants.

Fertilization:- The ova are discharged from the follicle cells of the ovary at some time closely associated with the heat period.

The act of copulation results in the introduction of seminal fluid through the generative aperture of the female.

The spermatozoa contained in the seminal fluid advance by their own motion as a rule toward the ovaries or Fallopian tubes where they meet the ovum of the female.

Fertilization usually takes place in the Fallopian tubes although it sometimes occurs in the ovaries or uterus. According to Marshall** the ovum goes through a number of changes and lies naked in the Fallopian tubes or uterus for some time before it obtains attachment.

* Journal of Anat. and Phys. Vol. XXVIII

** Marshall: Physiology of Reproduction.

Classification of Mammals: Mammals are classified according to their placental characters as non-deciduates and deciduates. In deciduates the substance of the mucosa undergoes rapid growth and textural modifications and the maternal and foetal parts of the placenta become firmly united. In non-deciduates there is no formation of decidual tissue, and at parturition the foetal tissue and villi are simply drawn out like the fingers from a glove, no vascular substance from the mother being thrown off.

The common farm animals, namely horses, cattle, sheep, and swine, are classed as non-deciduates.

Foetal Nutrition:- In his discussion of foetal nutrition Howell* shows that the new material for growth must be absorbed directly from the maternal blood of the uterus. He says, "Within a short time, however, the chorionic villi begin to burrow into the uterine membrane at the point of attachment, the decidua serotina, and the placenta gradually forms as a definite organ for the control of foetal nutrition."

The foetal blood and maternal blood do not come into actual contact, but an active diffusion relation is set up between them. Nutritive materials pass from the maternal to the foetal blood and the waste products pass from the foetal to the maternal blood.

It has been proven by experiment that materials pass from the maternal blood to the foetus.

* Howell: Text-book of Physiology.

The method of exchange of materials between the foetus and maternal organism is not clear, according to physiologists. The exchange probably takes place thru the chorionic villi by some physical process, depending upon the nature of the substance. According to Howell it is evident that the maternal organism digests and prepares the food for the embryo, excretes its wastes, ^{and} regulates the condition of temperature, as it does for its own substance, but as the foetus approaches term, its tissues and organs begin to assume more of an independent activity in preparation for the change at birth.

Marshall's ideas* are not in accord with those of Howell. He believes that the ovum has the power of metabolism and plays an important part in the manufacture of its own food material. He cites Born's experiment, in which Bohr found that the foetal rabbit absorbs slightly more oxygen and gives off slightly more carbonic acid per kilogram per hour than the mother, as the basis of his belief. Marshall says, "As a large amount of the energy is generated, while at the same time practically none dissipated, as heat evaporated or radiated from the surface or lungs, the unavoidable conclusion is that the foetus itself carries out the work or organization, and utilizes the energy for its fulfillment."

Bonnet* showed that the trophoblast in ruminants absorbed the constituents of the uterine-milk, a

* Marshall. Physiology of Reproduction.

nutritive juice found in the uterus of ruminants. The materials are changed by the trophoblast into forms suitable for the growth of the foetus.

Marshall cites examples to show that individual substances as proteins, carbohydrates, fats., etc., show changes which appear to be the result of trophoblastic activity. He says, "A consideration of these facts leads us to believe that the new organism owes its development in large part to the energy generated in it and by it from the combination of substances supplied by the mother, and to a series of active metabolic changes by means of which these substances are transformed into living protoplasm."

The trophoblast acts as a special organ of foetal nutrition. It possesses both anabolic and katabolic activities. As the period of pregnancy advances the activities of the trophoblast are probably transferred to the specialized organs of the foetus so that in the later stages of pregnancy the metabolic activity is restricted entirely to these specialized organs of the foetus,

As the period of pregnancy advances the trophoblast becomes less active and degenerates. That the trophoblast is functionless as an organ of nutrition, is shown from the fact that the foetus, if prematurely born, ^{often} is able to maintain life without its aid.

It is probable that the trophoblast is more concerned with the quality of material than the quantity. In the first stages of pregnancy the quantity of material

required by the foetus is infinitesimal and the trophoblast is well developed and active but generates as the requirements of the foetus increase.

Protein Metabolism in Pregnancy: A number of experiments have been carried on to determine what changes occur in the metabolism of the maternal organism during pregnancy. Most of these experiments have been limited to the human and some of the lower animals such as the dog, rabbit, etc. No experiments of this nature have been performed with farm animals but the condition in these individuals would probably be very similar to those in which the investigations have been made.

Repriff* found that anabolic processes are increased and katabolic processes diminished in pregnancy in dogs, rabbits, and guinea pigs. Hageman's* investigations with the dog indicated a loss of nitrogen in the mother, and he concluded that the additional nitrogen in the mother, required for the growth of the uterus and the mammae, must have been derived from the maternal tissues. Hageman found a continuous loss of nitrogen in the mother during the first part of pregnancy and a storage of nitrogen during the second part of pregnancy,

Von Ecke* obtained contradictory results in his numerous experiments with pregnant rabbits. In some cases he found a positive balance throughout and in others he found a negative balance.

*Marshall: Phys. of Reproduction.

Jagerroos* found that in the pregnant dog a loss of nitrogen occurred each week throughout the whole course of gestation except the third.

Dar and Dannay * in experiments with pregnant bitches found that there was first a period of loss of nitrogen, then a balance or very slight loss, and then a retention increasing with the progress of gestation. Further, there was over all a gain of nitrogen in two dogs at the conclusion of labor. Hence they conclude that pregnancy in a healthy animal, with a rational and sufficient diet, does not necessitate a drain on her stock of nitrogen to satisfy the needs of the foetus.

It is generally believed by investigators that during the period in which the needs of the embryo are small, the amount of protein katabolized is not counterbalanced by the food protein, and the maternal tissues suffer loss; in the later period the excreted nitrogen is more than counterbalanced by the food nitrogen, and the maternal tissues gain, or at least lose very little.

The negative nitrogen balance in the first part of pregnancy and the positive balance in the later part of the period is probably due in some way, according to Marshall,* to the fact that the trophoblast acts as the organ of nutrition in the early stages while in later stages the cells of the new organism are capable of carrying on their own metabolic functions.

Carbohydrate Metabolism in Pregnancy: Little is known regarding the carbohydrate metabolism in pregnancy.

* Marshall: Physiology of Reproduction.

Diets rich in carbohydrates have been known to cause abortion at times.

Lactose may appear in the blood in pregnancy. Laevulose is present in the allantois fluid of some mammals. The store of glycogen in the liver is said to be increased in pregnancy in some mammals. It is present in the placenta in many mammals.

Glycogen is almost universally distributed throughout the developing tissues of the foetus. It has been shown by Boht* that the energy in the mammalian foetus is supplied by the combustion of carbohydrates. He gives figures to show that the foetal rabbit requires a definite daily supply of glycogen.

Metabolism of Fats in Pregnancy: Marshall* says, "The absorption of fats from the intestine is increased during pregnancy, the fats contained in the feces being all decreased toward the end of the gestation period. This is the time when the subcutaneous tissues of the foetus receive an abundant supply. There is a corresponding increase of fat in the maternal blood in the dog and guinea-pig and the excess disappears after parturition."

Investigations have shown that increased fat formation takes place during pregnancy. In the placenta there is evidence of transmission of fat to the product of conception. Marshall concludes that there is no reason to doubt that there is an active transference of fat from the mother, or to assume that a transformation from

* Marshall: Physiology of Reproduction.

carbohydrates or proteins is necessary.

Investigators differ as to the origin of foetal fat.

Metabolism of Metals and Salts in Pregnancy:

Little is known regarding the metabolism of individual metals and salts. The fixation of minerals is slight at the beginning but becomes active toward the end of pregnancy. With a few exceptions the mineral salts are approximately in the same proportion throughout pregnancy; the exceptions are sodium, potassium, and calcium, of which sodium decreases and calcium increases with the replacement of cartilage by bone and potassium increases with the increased manufacture of red blood corpuscles.

Part, at least, of the iron for the foetus is derived from the haemoglobin of the maternal organism. Nearly all investigations have shown iron containing granules in the trophoblast.

When present in sufficient quantities, calcium is probably derived from the maternal blood. The maternal tissues are probably drawn upon in case of an insufficient supply in the blood.

Investigators have found that the excretions of phosphoric acid and the sulfates are parallel to that of nitrogen during pregnancy.

There is probably little change in chloride metabolism during pregnancy.

Respiratory Exchange during Pregnancy: "Modifications in the respiratory exchange arise from the alterations in the maternal organism, and from the requirements

of the product of conception. To a certain extent diffusion of oxygen takes place from mother to foetus, as it has been proved, by experiments in asphyxia of the mother, that the direction in which oxygen goes across the placenta depends on the tension. Whether there is also a gas secretion by the trophoblast is unknown." (Marshall)

Marshall states that Bohr has shown by convincing experiments that in the later stages of pregnancy the foetal guinea pig consumes at least as much oxygen as the mother. His results indicate that carbohydrates are the source of energy.

"The high consumption^{of} energy in the foetus, which differs from the adult in losing little heat by radiation from the skin surface and lungs, must be due to the intensive growth of the embryo." (Marshall).

From the figures of some German investigators on metabolism in human pregnancy, Marshall concludes that the early stages of pregnancy have had a favorable influence on the growth of the mother animal, and at the same time have led to a more energetic metabolism.

CHAPTER III.

Effect of Pregnancy on Growth.

Practical live-stock men are quite generally of the opinion that too early breeding of the domestic animals is detrimental. One of the most common opinions among the men of practical experience is that early breeding "stunts" growth. This is also the conclusion reached by the few investigators who have carried on experiments for the purpose of determining the effect of early breeding on growth. A more detailed discussion of this point will be given in the later pages of this paper. Data, representing work at this station will be presented to show the effect of early breeding on growth of swine.

If, as practical men and scientific investigators believe, early breeding stunts growth, it must be due to the fact that growth is checked during pregnancy or lactation, or during both periods. A study of growth during these separate periods should give some information as to the cause of the stunted condition of animals following continuous early breeding.

Little work has been done to show the effect of pregnancy on growth. Possibly the most common belief among those who have made no study of the matter, would be that pregnancy checks growth because of the fact that the maternal organism must furnish materials for the growth of the foetus, consequently reducing the materials available for the growth of the young mother.

As has been previously shown, the maternal

duties probably do not extend to the formation of the foetal tissue components, but are limited to the provision of food and oxygen for the fertilized ovum, the removal of waste products, and the preparation of an organ of nutrition for the new-born young.

It is probable that the foetus receives nutriment both from the unorganized substances of the food and from the maternal tissues.

Some investigators believe that only the surplus nutriment is passed on to the foetus and that better nourishment of the maternal tissues results in growth of the foetus. Paton* claims that the size of the offspring of the human female may be diminished by restricting the diet of the mother.

This does not seem to hold true in the case of cattle in the western range country. The cows are "roughed" through the winters on the least feed possible yet produce large, vigorous, normal calves in the spring. There is a tendency for show cows in high condition to produce small calves.

If the maternal body is deprived of protein, fat and carbohydrates during the pregnant period, we should expect a check in growth of a young animal during the gestation period. If, on the other hand, metabolism is increased, or in some other way the animal makes better use of the food consumed, so that a gain results in the maternal organism, or there is at least no loss, we might expect growth to continue or to increase during the pregnant

* Lancet: 1905. vol. 1, p. 11

period.

Effect of Pregnancy on Body-weight of Women:

Some observations of the human female during the pregnant period have been made. Gassner* observed a progressive increase in weight, greater than the increase in weight of the foetus and generative organs together. This is due to the increase in other parts of the maternal organism as a "result of the inactivity and good dietic conditions during pregnancy, and the frequency with which the tissue fluids are increased."

Baumm found that a diet necessary to maintain the body-weight in a woman of the same size gave an increase in weight of a pregnant woman amounting to an average of 1.777 kilo in the last month, of which .650 kilo represented increase outside the foetus and generative organs.

The observations mentioned were not taken during the growing period. However, if there is gain in weight^{of} the maternal organism during a pregnant period in adult life, it is reasonable to expect a like tendency to increase in the growing individual. It would at least seem that there should be no check in growth, judging from the observations mentioned.

Effect of Pregnancy on Growth in Guinea Pigs:

Minot** has made a very careful study of growth in the guinea pig. Among his observations was that of determining

* Marshall: Physiology of Reproduction.

** Journal of Physiology, Vol. XII.

the effect of gestation on growth. It will be noted that Minot has used body-weight as the only measurement of growth. Of this he says, "To measure the growth the weights were taken of the growing and adult individuals, the weight being the only available measure for the whole animal, and the only one permitting comparisons between different species of organisms."

In his article "Senescence and Rejuvenation", Minot* says:- "Let us consider next the effect of gestation on growth. It has been asserted by Carpenter, Spencer and others that the functions of nutrition and reproduction are in principle opposed to one another, because reproduction makes such a demand upon the parent for material that the supply for nutritive material is lessened. The reproductive process causes, according to these authors, the impairment of nutrition and growth. Unfortunately they have both overlooked that they have made a preliminary assumption without adequate justification, namely, that before reproduction, the organism must be already growing nearly or quite up to the maximum of its assimilative power, - if this were not the case, then the surplus or reserve capacity for assimilation would be called in to meet the reproductive demand, and the parent organism would meanwhile keep on growing as before. Now Edelfsen and Heusen have shown experimentally that female guinea pigs grow about the same whether they have young or not during

their own growing period. In other words, these animals have precisely that surplus power of nutrition, which Carpenter tacitly assumed not to exist. My own observations fully confirm the conclusion of Edelfson and Hensen. To utilize my own data, I have proceeded in the following manner:- there are 66 litters of whose mothers' weights at various times within 70 days before delivery I have records. These data have been tabulated so as to give the following:

XXIV

Average Changes in Weights of 66 Mothers before Delivery.

Days before delivery	Total weight	No. of lbs.	Average	Increase	Average	Daily per
					da. incr.	cent incr.
70-66	16200	40	405.0			
65-61	25792	60	429.9	24.9	5.0	1.2
60-56	17168	40	429.2	-.7	-.1	-.0
55-51	17270	38	454.5	25.3	5.1	1.2
50-46	18287	38	481.2	26.7	5.3	1.2
45-41	22925	42	545.8	64.6	12.9	2.7
40-36	18410	34	541.5	-4.3	-.9	-.1
35-31	17554	31	566.3	24.8	4.9	.9
30-25	22104	36	614.0	47.7	9.5	1.7
25-21	21227	33	643.2	29.2	5.8	0.9
20-15	21362	31	689.1	45.9	9.2	1.4
15-11	35241	46	766.1	77.0	15.4	2.2
10-5	34976	42	832.8	66.7	13.3	1.7
5-1	53137	63	843.4	10.6	2.1	0.3
3-0	29999	35	857.1	13.7	4.6	0.5

"As the results of this table are irregular, I have sought to better them by a system of interpolation. The original records from which this table is calculated contain many observations giving the weights of the mother at intervals of five days or less. For all such intervals the weights have been calculated by dividing the difference between the two weights by the number of days, to ascertain the average daily increase, by which the weight for each day was then calculated. The following table gives the results of the corrected tabulation; comparison with the previous table will show the extent of the alterations resulting from the interpolations.

XXV

Average Changes in the Weights of Mothers during Gestation based upon Observed Weights plus Weights Calculated and Interpolated.

Days before delivery	Total weight	No. of lbs	Average Increase	Average da. incr.	Daily Per cent incr.
70-66	37891	89	425.7		
65-61	60302	147	410.2	-15.5	-3.1
60-56	51459	131	392.8	-17.4	-3.5
55-51	63506	143	444.1	51.3	10.3
50-45	68193	147	463.9	19.8	4.0
45-41	79725	155	514.4	50.5	10.1
40-36	73419	140	524.4	10.0	2.0
35-31	68324	127	538.0	13.6	2.7
30-26	76281	132	577.9	39.9	8.0
25-21	76654	124	618.2	40.3	8.1
20-16	86738	131	662.1	43.9	8.8
15-11	101412	143	709.2	47.1	9.4
10-6	92000	123	748.0	38.8	7.8
5-1	85969	108	796.0	48.0	9.6
3-0	33207	4	830.2	34.2	11.4

"The results from the corrected table are somewhat more regular than those from the observations merely. There is certainly a greater percentage increase of weight in the mother during the latter than during the first half of the period of gestation.

"According to the corrected table there is a loss of weight at the beginning of gestation but as the averages are very irregular this may be an accidental result of the data being so few in number, but it is quite possible that such loss in weight at the beginning of gestation is a normal consequence of the physiological disturbance ensuing on conception.

"Table XXIV shows that about 67-68 days before delivery the average weight of the mothers was 405 grams, 67-68 days is the usual length of the gestation period. Now Table XV (a table showing normal growth) shows that this weight corresponds to an age of 90 days, hence we may assume that the age of the 66 mothers of Table XXIV was about 90 days. Table XV also shows that 70 days later the weight is 532.1 grams instead of 830.2 the highest value of Table XXV, this value being the average weight just before gestation ends. Accordingly, gestation adds 300 grams or more to the weight of the mother. My weighings of the same 66 mothers within three days after delivery gives for 62 observations a total of 36456 grams or an average weight of 588 grams, three days after delivery. Now the corresponding weight of females not pregnant

is 532.1 grams as nearly as can be determined by my data, hence there is an excess of 55.9 grams in favor of the gestating guinea pigs. This is more noteworthy as immediately after delivery there is a loss of weight, so that the average of 588 is smaller than an average from a sufficient number of weighings at 0 days would be. So far then as we can judge at present gestation does not represent a tax upon the parent but a stimulus - it does not impede growth, but on the contrary favors it."

Minot's data represent a more extensive investigation than that of Edelfson and Hensen whose work Minot discusses. It is very probable that his results are much more accurate and reliable than those of either of the other investigators.

One weakness in Minot's work is that body weight is the only measurement of growth employed. Does increase in weight mean increased growth? It is very probably that this is nearer the truth in an animal such as the guinea pig than would be the case with some farm animals.

Since increase in weight means a greater absorption of nutriment from the food, above that required for maintenance, it seems reasonable to assume that at least part of this increased nutriment will go toward increased growth when an animal is young and growing.

Watson's Observations on Growth of White Rats:

In the Journal of Comparative Neurology and Psychology, Watson* publishes his results of observations on the effect

* Vol. XV, No. 6, 1905. *b*

of the bearing of young on the bodyweight of the white rat.

Females were selected from five litters of rats born at about the same time. Each of these groups were divided into approximately equal sub-groups, one containing the rats which were to be mated, the other, those which were to remain unmated.

The rats received the best of care and feed throughout the experiment.

Watson describes the experiment as follows:-

"At 70 days of age, the rats destined to bear young were mated with the largest males in the laboratory. The males were kept in the cages until the female showed signs of pregnancy, and were then removed. Twenty-one days is the usual length of the period of gestation. In nearly every case large litters were born, - in some cases the litters contained as many as 14 young. At the end of twenty days the young were removed from their mother. She was then allowed to recover completely. This took, usually, from 30 to 50 days. When recovery was complete the males were again introduced, and the same routine followed, until each mated rat had borne three litters. When recovery was complete from the birth of the third and final litter, the experiment, so far as body-weight was concerned, was at an end.

"The following table presents for comparison the record of the weights at the ages given, of the mated and unmated individuals of Group C. This table gives a good illustration of what occurred in the four other groups.

"A study of this table shows the fluctuations in the body-weight of the mated rats, due to pregnancy, suckling of young, etc. The general features of the table are clear, but one point is worthy of note. Immediately after the birth of the young, the mated rats are much heavier than the unmated. The mated rats during pregnancy, seem to have the power of storing up in some way the products obtained from their food. If one takes into account the great strain of suckling ten or twelve young for the period of twenty days, one can easily understand that some such provision as this is necessary. This surplus in weight is largely lost during the time the mother is suckling her young."

Showing the Average body weight at the ages given, of the two mated and two unmated rats of group C.

	Unmated	Mated	
at 70 days	116.1	120.9	Mated at this age.
81	129.4	129.1	Pregnant
92	143.0	176.4	" (before resp'y.
100	148.1	163.5	Young born 6 & 3 das.
107	150.9	170.6	Young large - removed
114	153.7	162.6	Recovery
121	160.1	174.6	
128	162.5	170.7	
135	162.8	171.6	
142	163.5	169.0	
149	163.1	176.5	Recovery complete.
156	168.1	184.0	Mated 1 day before.
163	168.5	204.2	Pregnant
170	169.3	235.1	"
177	171.3		
184	174.1		(before resp'y.
191	177.4	218.8	Young born 12 & 15 das.
198	177.6	227.6	
205	180.3	225.7	Young removed.
212	187.2	226.3	One rat ill
219	190.1	226.0	One rat ill
233	190.8	222.5	Sick rat killed. (other rat
240	191.7	235.7	Ave. rose after killing
247	193.3	220.2	Slightly ill
254	194.0	226.0	Mated 3rd & last time

	Mated	Unmated	
261 days	198.6	235.8	Pregnant
275	198.1		
282	192.4	239.0	Litter of 14 born 6 days before; exhausted; young removed.
296	190.1	217	Rapid recovery after removal of young.
317	185.1		
345	197.1	219.4	Final Average.

The data here given are not for the pregnant period only. They show that animals which have passed through three gestation and lactation periods are heavier than the unmated animals. Since, as Watson points out and the figures show, lactation causes a serious loss, there must be ^a considerably greater rate of growth during the pregnant period than during a corresponding open period in white rats.

Watson reaches the following conclusions:-

"1. The groups of mated rats grew to be somewhat heavier than the unmated groups. This was found to be true in four out of five groups. The mated individuals were, on the average, 9 percent heavier than the unmated."

Musser's Observations on Dairy Heifers.

Musser * compared the total nutrients, energy values, and average weights of dairy cows during pregnant and farrow periods.

Cow 62.

Table Comparing Nutrients Consumed, Energy Values and Weight of Cow. No. 62 When farrow and Pregnant.

Condition	Protein	Carbohydrates	Fat	Therms	Ave. Weight
Farrow	225.4	1149.62	65.37	1418.67	903.6
Pregnant	161.76	1096.41	37.02	1341.03	999.3

* Musser : Thesis 1914 . U. of Mo.

"It is readily seen that Cow 62 received less digestible nutrients and maintained a higher average weight during gestation than she did while on maintenance. She received .337 therms daily less while pregnant than when farrow and on maintenance. Taking everything into consideration, the data on Cow 62 shows conclusively that it required no extra feed or loss in weight to produce the foetus."

"As stated before, there is no attempt made to prove that changes in the weight of the maternal organism represent the tax upon the mother in a physiological way. Yet these data show that if the maintenance requirement of the mother was accurately determined, and it is believed that such is the case, the growth of the foetus was not made by an extra amount of feed being fed the mother during gestation."

The following Table gives the daily digestible nutrients and energy value during maintenance and gestation of five Factors.

Table 18.

Cow	Period	Protein	Carbohydrates	Fat	Energy Val.
27	Maintenance	.818	5.830	.315	6.385
	Gestation	.811	5.570	.176	6.382
62	Maintenance	.734	5.020	.272	5.487
	Gestation	.707	4.850	.171	5.531
304	Maintenance	.925	5.645	.228	6.266
	Gestation	1.292	6.278	.217	6.948
206	Maintenance	1.217	7.796	.299	8.586
	Gestation	1.518	8.316	.219	8.796
400	Maintenance	.990	6.306	.243	6.926
	Maintenance	1.340	7.068	.222	7.631

Table Showing Weight Changes of the Above Cows.

Table 19.

Cow No.	Ave. Weight on maintenance	Weight when bred	Wt. after calving	Dif, af- ter calv.	Wt. of calf
27	897	896	944	+48	75.0
62	917	917	900	-17	48.5
304	984	962	948	-14	82.5
206	1291	1327	1256	-71	95.0
400	1128	1119	1145	+26	

"In Table 18 a comparison is made of the average daily digestible nutrients and energy value during gestation and while on maintenance. From these data it is seen that both (27 and 62) animals have produced the foeti and maintained normal weights on less feed than they used for maintenance when farrow.

"This does not necessarily mean that the growth of the foetus exerts no tax upon the maternal organism. It might rather indicate that the animal used her feed more economically during pregnancy, or it might indicate that the physiological strain upon the mother cannot be measured by changes in her body weight. Yet it might be that pregnancy causes the animal to function abnormally under these conditions." (Musser)

A second experiment of a like nature was carried on by Musser with cows 206 and 304. The results are given in the table with Factors 27 and 62. (Table 18).

Of these results Musser says, "In Table 18 it is readily seen that when we make allowance for experimental error in weight after calving, Cow 304 has duplicated the results of Experiment I. This fact is more evident when we study the comparison in Table 19, in which we see that Cow 304

has lost but 14 pounds, received but little feed above her maintenance ration and has dropped an 82.5 pound calf.

"Cow 206 does not show quite the same results as do the other three cows. However, Musser notes that the cow was "off-feed" for a time and had other factors entering into her case which were not found in the other cows. He says, "Taking these factors into consideration we probably have in this case similar results as shown in the other three cases."

In a summary of his work Musser states that .215 therms more daily were received by the animals during gestation than on maintenance. He states that had Cow 206 performed normally, the results would probably have been reversed, and the gestating animals would have shown a lower energy requirement than the farrow animals.

Musser concludes that "the nutrients required to develop the foetus in dairy cows and the tax on the maternal organism are too small to be measured by changes in the mother's weight."

Griswold's Observations on Swine.

Griswold * carried on an experiment with swine to determine the effect of pregnancy and lactation on growth. He observed differences in the rate of growth in pregnant and open sows, and also made digestion trials with pregnant and open sows.

Table X shows a comparison of the measurements of pregnant and open gilts as taken from Griswold's work at this Station.

*Griswold: Thesis, U.Of. Mo. 1915.

TABLE X

Factors	PREGNANT FACTORS							DRY FACTORS		
	1	2	3	5	7	8	9	Ave.	6	10 Ave.
Height at withers	8.0	4.0	4.0	8.0	7.0	6.0	10.0	6.8	7.0	9.0 8.0
Height at croup	7.0	4.0	3.0	5.0	4.0	5.0	7.0	5.2	7.0	7.0 7.0
Length of Body	12.0	15.0	15.0	10.0	12.0	11.0	14.0	13.2	17.0	1 7.0 17.0
Distance From Elbow to ground	2.0	1.0	2.0	2.0	0.0	2.0	1.5	1.7	1.0	1.0 1.0
Distance from Shoulder to ground	3.0	0.0	3.0	2.0	1.0	2.0	2.0	2.0	1.0	2.0 1.5
Depth of Chest	7.0	4.0	5.0	7.0	5.0	4.5	5.0	5.6	4.0	5.0 4.5
Cir. of Front Cannon	2.0	1.0	1.0	0.5	2.0	1.0	1.5	1.2	1.5	1.0 1.3
Cir. Rear Cannon	2.0	1.0	0.5	1.0	2.5	2.0	2.0	1.2	2.0	0.0 1.0
Width Of Head	2.5	2.5	2.5	1.5	3.0	1.5	2.5	2.3	3.0	3.5 3.3
Width Sh. Points	3.0	4.0	5.0	6.0	6.0	2.0	5.0	4.6	5.0	7.0 6.0
Width of Shoulders	6.0	7.0	5.0	6.0	6.0	6.0	7.0	6.2	6.0	6.0 6.0
Width of Hams	7.0	7.0	6.0	5.0	6.0	5.5	7.0	6.4	7.0	7.0 7.0
Width of Ham Points	6.0	5.0	3.0	4.0	6.0	4.0	5.0	4.6	4.0	4.0 4.0
Heart Girth	25.0	28.0	23.0	31.0	25.0	22.0	28.0	27.0	23.0	23.0 23.0
Weight	106.0	98.0	106.0	105.0	99.0	99.0	109.0	105.0	93.0	98.0 91.0

Griswold says, "The averages for gain in height at both withers and croup are in favor of the open gilts, but a comparison of the gains by different individuals does not support the idea that the average represents the true situation. In gain in height at withers, one of the pregnant gilts is highest, while two others are higher than one of the open gilts. That is to say, that the average for three of the five pregnant gilts is higher than is the average for the two open gilts. In gain in height at croup two of the pregnant gilts have just exactly equalled the two open ones.

"In length of body there appears to be a uniform gain in favor of the open ones. In width of head the gains appear to be slightly in favor of the open gilts. The above measurements most nearly indicate skeletal growth, except for the measurements of cannons which show very little difference. While the averages indicate that there is possibly greater growth made by the open animals, than by the pregnant, a more careful study points out the fact that the greatest differences are individual differences rather than group differences. In the case of the length of body this is not so apparent, but even here the difference between the greatest gain by a pregnant gilt and the gain by an open one is only two centimeters, while a difference of five centimeters is shown between the gains of two of the pregnant gilts. Therefore we may conclude that the factor of individuality may possibly be strong enough to account for the differences observed."

Griswold carried on digestion trials with open and pregnant gilts. Two animals in each condition were used. He found that each pregnant gilt excreted less dry matter, protein, fat, and nitrogen free extract than did either of the open animals. The average daily excess for an open gilt for the ten days he found to be as follows: dry matter, 35.0 grams, protein 15.62 grams, fat 5.07 grams, and nitrogen free extract 20.93 grams.

He found in the case of crude fiber that the groups were not consistent but the average amount excreted was higher for the pregnant gilts. The same was true of the ash. The daily average excess was : fiber, 3.61 grams; ash, 2.98 grams.

"Since the amount of nutrients^{fed} was the same for all animals, a smaller amount of any nutrient excreted by an animal means a larger amount of that nutrient digested by the animal; that is to say, a higher digestion coefficient."

"If these amounts be taken as average for the whole gestation period and compared with the amounts of constituents found by analysis in the largest litter we have the following;

Weight in Grams		
Excess Digested	Dry matter	Protein
by pregnant Gilt	3994.6	1780.7
Constituents in litter	1257.9	799.8
Excess digested over		
amount in the litter	2736.7	980.9

"This would look as if a pregnant gilt may, because of more efficient digestion, take enough more protein and dry matter from her food for the development of her litter." (Griswold)

Observations on Swine at the Missouri Station.

In 1908 an experiment was begun at this Station, by Dean F.B. Mumford, to determine the effect of early breeding in swine.

Six gilts were selected to begin the experiment. These were divided into three lots. One lot was set aside as Immature Factors, to be bred at the first oestrus period and twice per year thereafter. Another lot was set aside as a Half Mature group, to be bred at about 18 months of age. The third lot to be known as Mature Factors, were to be bred at about thirty months.

It was planned to keep the animals under the same conditions as far as possible as regards care, feed, etc. The animals were given advantage of pasture whenever possible, and with this, three rations were considered enough to meet all requirements. These rations were as follows:

Ration No. 1:- For brood sows with pigs and for breeding pigs up to 150 lbs. and fattening pigs up to 125 lbs. in weight:

Shorts	20 parts
Bran	10 parts
Cornmeal	10 parts
Oil meal	5 parts.

This ration will give a feed of 87 percent dry matter with a nutritive ratio of 1:4.94. It contains about .716 lbs. of digestible nutrients per pound of feed.

Ration No. 2:- For breeding animals of all sorts

over 150 lbs. in weight on dry lot and not suckling pigs,-

Corn	13 parts
Shorts	10 parts.
Bran	5 parts
Alfalfa meal	5 parts

This gives a ration of 87.4 percent of dry matter and a nutritive ratio of 1:6.044. This ration also contains about .716 pounds of digestible matter per pound of feed.

Ration No. 3: for dry sows on grass and fattening hogs over 125 lbs. in weight the following ration was used:-

Corn	6 parts
Oil meal	1 part.

This gives a ration of 87.1 percent of dry matter with a nutritive ratio of 1:67.1. This ration contains about .843 pounds of digestible nutrients per pound of feed.

Three gilts from each generation were to be reserved for breeding purposes. All other pigs were fattened and disposed of as pork. Accurate records were kept of all litters.

The breeding animals were measured once a month from the beginning until one year of age. After one year old, they were measured every three months.

Besides measurements and feed records, records were also kept of length of period of gestation,- regularity with which sows breed, number of pigs born alive and dead, weight of each, percentage raised, sex of pigs, and the weekly weights.

The original sows all have names ending with unit numbers.

No. V and VI are the Immature Factors.

No. III and VII are the Half Mature Factors.

No. IV and VIII are the Mature Factors.

The first generation of Immatures have names from 10-20.

The first generation of Half Mature Factors have names from 10-20 with suffix (A). The first generation of mature Factors have names from 10-20 with the suffix B.

The second generations are named from 20-30, with the suffix A or B if of Half mature or Mature parents.

The third generations are named from 30-40. The fourth generations are named from 40-50; the fifth generations are named from 50-60.

Since the experiment was not planned for the purpose of determining the effect of pregnancy and lactation on growth, the data have not been ideal for such a study. However, the data offer quite an amount of material for comparisons of Factors in such a way as will show the effect of the conditions of pregnancy and lactation on growth.

A comparison of Factors during pregnant periods with Factors which were farrow has been made. For this comparison farrow Factors which had been, as nearly as possible, subject to the same conditions as had the pregnant Factors were chosen. For example only those Factors which were approximately of the same age were compared. Factors whose periods occurred at the same season of the year, and, as often as possible during the same year, were selected for comparison. Those

comparisons in which the feed of the two Factors was very unequal are considered of little value.

The animals have been compared in the following manner: The animals which had been measured at some time during the first part of the pregnant period and again near the end of the period were selected. The differences between these measurements were taken as the gains or losses for the period. From these differences the daily gains or losses were computed. For comparisons an open Factor, which had been measured ^{at} approximately the same age, was selected and similar calculations made. These figures were compared for the two Factors. The daily feed consumed was also noted and the digestible nutrients calculated. These points were considered in the comparisons.

Providing that the feed is nearly equal during the periods compared for the two Factors, a greater daily gain by one animal may indicate an advantage due to that condition. For example if a pregnant animal shows a greater daily gain than does the open animal, this might indicate increased growth due to the pregnant condition, or vice versa.

Of course, individual variation will be an important factor. Animals will vary regardless of condition. This condition has been met, or reduced as much as possible, by making a large number of comparisons.

The first pregnant period of the Immature Factors was found to be better for comparisons because at this age measurements were taken more often. It was also an easy

matter to find open Factors among the Half Mature group at this age for comparisons.

The value of the investigation would have been greatly increased if individual records had been kept. The feed records have been kept of groups of animals and the data on feed consumed are therefore only approximate.

The average was taken and recorded as the amount consumed by each Factor. It is easily seen that should a dry Factor and a pregnant Factor be together, one might eat more than the other and yet be recorded as having consumed an equal amount..

The following group of twenty-five tables shows the same number of comparisons of the growth of pregnant and open Factors. The tables are commented upon individually at the end of each.

Group I.

Table Comparing Immature Factor VI During First Pregnant Period
with Factor VII During Dry Period at the Same Age. Forty-two
Day Period. Age 6 Months 18 Days to 7 Months 29 Days.

Factor	Period Gain		Daily Gain	
	Vip	VII	Vip	VII
Weight	48.0	45.0	1.142	1.071
Height Withers	4.5	5.5	.1071	.1309
Height Croup	3.0	5.5	.10714	.1309
Breadth Shoulders	3.0	2.0	.10714	.0476
Breadth Shoulder Pt.	3.5	.5	.0833	.0119
Breadth Hips	2.0	1.5	.0476	.0357
Breadth Hip Bones	2.0	2.5	.0476	.0595
Heart Girth	10.0	8.0	.238	.1905
Paunch Girth	13.0	5.0	.3095	.1190
Flank Girth	9.0	10.0	.2143	.2380
Depth Chest	4.5	4.5	.1071	.1071
Length Body	2.0	10.0	.0476	.2380
Width Head	.5	.75	.0119	.0178
Cir. Rear Shin Bone	1.0	1.5	.0238	.0357
Cir. Fore Shin Bone	1.0	1.0	.0238	.0238
Dist. Elbow Down	1.0	3.0	.0238	.0714
Dist. Sh. Pt. Down	2.0	2.5	.0476	.0595

Feed Consumed: Individual feeds not recorded, each the same.
From the table it is seen that the VI exceeds in weight and some of the
other measurements but in height, length, width of head, etc. Factor VII
gains more, which might indicate that growth was more rapid in the dry animal.

Table Comparing Immature Factor VI During Third Pregnant Period with Mature Factor VIII During Dry Period at Same Age. Age 21-14 to 23-13. Sixty Days. Shows Also Increased Size of Factor VIII Due Probably to not Having Been Bred.

Factor	First Measurement		Second Measurement		Gain for Period		Gain per Day	
	VI	VIII	VI	VIII	VI	VIII	VI	VIII
Weight Lbs.	200	340	279	361	79	21	1.315	.0335
Height Withers Cm	59.5	66.5	61	65	1.5	-1.5	.025	-.025
Height Croup	65.5	76.0	68	73.5	2.5	-2.5	.0415	-.0415
Breadth Shoulders	31.5	39.	33.5	38.5	2.	-.5	.0333	-.00833
Breadth Sh. Pt.	28.0	35	26.5	35.0	-1.5	0	-.025	0
Breadth Hams.	27.5	36	31	35.0	3.5	-1	.0583	-.0167
Breadth Hip Bones	23.5	32	24.5	31.0	1.0	-1	+.0167	-.0167
Heart Girth	117	142	115	130	+2.0	-12	+.0333	-.2000
Paunch Girth	126	153	130	150	4.0	-3	+.06667	-.05
Flank Girth	116	143	110	130	-6.0	-13	-.1000	-.2167
Depth Chest	34.5	43.5	39.5	43.5	5.0	0	.0833	.00
Length Body	94.0	104	98.	110	4.0	6	.06667	.1000
Width Head	12.5	14.5	12	15.5	-5.0	1	-.00833	.0167
Cir. Rear Sh. Bone	16.0	18.5	16.5	17	.5	-1.5	.00833	-.025
Cir. Fore Sh. Bone	15.5	17.5	16	18	.5	.5	.00833	.00833
Dist. Elbow Down	31.0	32.0	32.0	37	1.0	5	.0167	.00833
Dist. Sh. Pt. Down	33.5	34.5	34.0	39	.5	4.5	.00833	.075
Feed Consumed Lbs.				(3)314.0	(3)	91	b.333	1.516
Digestible Nutrients				264.7		76.8	4.41	1.28

This Table is of little value as Factor VI received so much more feed than did Factor VIII. Factor VI, exceeds in width of head and length of body.

*Vi retained also
Viii should be given 3.9 msk.*

Table Comparing Immature Factor V During First Pregnant Period with
Factor VIII During Dry Period at the Same Age. Age V 6-20 to
7-28; VIII 6-19 to 7-30.

Factor	First Measurement		Second Measurement		Period Gain		Daily Gain	Gain
	V	VIII	V	VIII	V	VIII		
Weight	129	124	171	167	42	43	1.077	1.02
Height	57.5	55.5	160	59.5	3.5	4	.0641	.0952
Height Withers	51.5	48	55.5	54.5	4	6.5	.1025	.1548
Breadth Shoulders	27	26	27	29	0	3	.0000	.0714
Breadth Sh. pt.	24	23.5	26	26	2	3.5	.05125	.0598
Breadth Hams	24.5	24.	26	26	1.5	3	.0384	.0476
Breadth Hip Bones	20	22	24	23	4.	1	.1025	.0238
Heart Girth	91	90	99	97	8	7	.2051	.1666
Paunch Girth	100	106	109	107	9	1	.2307	.0238
Flank Girth	93	90	100	98	7	8	.1795	.1905
Depth Chest	29	28.5	31.5	30.5	2.5	3	.0641	.1476
Length Body	73.5	71	75.	79	1.5	8	.0384	.1905
Length Head	10.5	10.78	11.	11.5	.5	.75	.0128	.0179
Cir. Rear Sh. Bone	13.5	14.	14.5	15	1	1	.0256	.0238
Cir. Fore Sh. Bone	14	14	15.	15	1	1	.0256	.0238
Dist. Elb. Pt. Down	27	25	28	28	1	3	.0256	.0174
Dist. Sh. Point Down	28.5	26	29.5	30	1	4	.0256	.0952
Feed Consumed								
Digestible Nutrients								

Same for the Two Factors.

Factor VIII is somewhat behind in weight but exceeds in the measurements which we should expect to find in a growth animals, namely: Height, length of body, width of head, etc.

Table Comparing Factor V During Second Pregnant Period With
Factor VIII During Dry Period at about the Same Age. V
13-28 to 16-6; VIII 13-30 to 16-15.

Factor	First		Second		Period		Daily	
	Measurement V	VIII	Measurement V	VIII	Gain or Loss V	VIII	Gain or Loss V	VIII
Weight Lbs.	250	251	245	293	-5	42	-.0714	.5454
Height Withers	Cm.	59	60	64.5	1	4.5	-.0143	.0584
Height croup	"	67.5	67	70	-.5	0	-.00714	0
Breadth Shoulders	"	35	35	37	0	3	0	.039
Breadth Sh. Pt.	"	31	31	34	0	3	0	.039
Breadth Hams	"	30	33	34.5	3	1.5	.0438	.0194
Breadth Hip Bones	"	27	29	31	2	2	.0285	.0261
Heart Girth	"	118	120	126	2	6	.0285	.078
Paunch Girth	"	135	135	138	-4	3	-.0571	.039
Flank Girth	"	120	125	123	-1	-3	-.0143	-.039
Depth Chest	"	38.5	38.5	39.5	-.25	1	-.00357	.013
Length of Body	"	94	95	97	-3	2	-.0428	.026
Width of head	"	13.5	13.5	13.5	-.5	0	-.00714	0
Cir. Rear Shin Bone	"	16.5	17.5	18	-.5	.5	-.00714	.0065
Cir. Fore Shin Bone	"	16	17	19	-.5	2	.00714	.026
Dist. Elbow Down	"	28	33	32	2	-1	.0285	-.013
Dist. Sh. Pt. down	"	31	34.5	33.5	2	-1	.0285	-.013
Feed Consumed								
				Ration No. 1-56)				
				3-175)				
Digestible Nutrients					231	3-56)	3.3	3.45
					165.4	2-210)	2.36	2.56

On approximately the same amounts of feed Factor VIII gained more rapidly in nearly all measurements. It will be noticed that Factor VIII received two tenths pounds more per day digestible nutrients than did Factor V which might make some difference but hardly as much as is indicated in the measurements.

Table Comparing Factor V During 3rd Pregnant Period With Factor VIII Dry At Same Age. Age V, 22-14 to 23-11; VIII 21-14 to 23-13.

Factor	First		Second		Period		Daily	
	V	VIII	V	VIII	Gain or Loss V	Gain or Loss VIII	V	VIII
Weight	258	340	328	361	70	21	2.5	.35
Height Withers Cm.	60.5	66.5	60	65	-.5	-1.5	-.018	-.025
Height Croup	69	76.0	68.5	73.5	-.5	-2.5	-.018	-.0416
Breadth Should.	32.5	39	34	38.5	1.5	-.5	.0535	-.00833
Breadth Sh. Pt.	30	35	29	35	-1	0	-.0357	0
Breadth Hams	30	36	31.5	35	1.5	-1	.0535	.0167
Breadth Hip Bones	27	32	26	31	-1	-1	-.0357	-.0167
Heart Girth	115	142	123	130	8	-12	.2857	-.2
Paunch Girth	141	153	149	150	8.	-3	.2857	-.05
Flank Girth	115	143	125	130	9	-13	.3214	-.2167
Depth of Chest	38	43.5	41.5	43.5	3.5	0	.125	0
Length of Body	95	104	97	110	2	6	.0714	.10
Width of Head	12.5	14.5	13.5	15.5	1	1	.0357	.0167
Cir. Rear ShinBon.	16	18.5	17	17	1	-1.5	.0357	.025
Cir. Fore Sh. Bone	16	17.5	17	18	1	-.5	.0357	.00833
Dist. Elb. Down	33.5	32	32	37	-1.5	5.0	-.0535	.0833
Dist. Sh. Pt. Down	37	34.5	34	39	-3.0	4.5	-.1071	.075
Feed Consumed					119	91	4.25	1.52
Digestible Nutrients					100.3	76.7	3.58	1.28

Factor V gains more in nearly every measurement but receives far more feed than does Factor VIII. Therefore gains could not be attributed to the pregnant condition. Both animals on pasture.

Table Comparing Factor XI During first Pregnant Period, age 6-4 to 9-5
with Factor XIA Dry period,, Age 6-1 to 9-0.

Factor		1st. Meas.		2nd. Meas.		Gain or Loss Period		Daily Gain or Loss	
		XI	XIA	XI	XIA	XI	XIA	XI	XIA
Weight	Lbs.	96	120	186	177	90	57	.99	.6263
Height Withers	Cm.	44.5	47	52.5	56	9	9	.0879	.0989
Height Croup	"	50.	57	57.5	63	7.5	6	.0824	.06593
Breadth Shoulders	"	24	26	32.5	30	8.5	4	.0934	.04384
Breadth Sh. Pt.	"	23	20	29	23	7	3	.077	.033
Breadth Hams	"	23	26	28	28	5	2	.05494	.02192
Breadth hip bones	"	20	19	25	21	5	2	.05494	.02192
Heart Girth	"	86	88	109	102	23	14	.2527	.1536
Paunch Girth	"	97	107	123	123	26	15	.2857	.1648
Flank Girth	"	87	98	104	106	17	8	.1868	.08768
Depth Chest	"	35.5	29	34	33	8.5	4	.0934	.04384
Length Body	"	65	79	88	84	23	5	.2527	.05494
Width Head	"	9.75	13.5	11.5	16	1.75	2.5	.0192	.02747
Cir. Rear Sn. Bone	"	13	13	15	14	2	1	.02192	.01096
Cir. Fore Sh. Bone	"	13.5	13.	15.5	14	2	1	.02192	.01096
Dist. Elbow Down	"	23.5	24.0	28	29	4.5	5	.0494	.05494
Dist. Sh. Pt. Down	"	25	27	29	32	4	5	.04384	.05494
Feed Consumed		Ration No. 1		351.75		1-189)		463 3.86	
						2-273)		5.08	
Digestible Nutrients				251.85		330.79		2.76 3.64	

Factor XI on less feed gained more in nearly all measurements. Factor XIA gained more in height at withers, width of head, distance from elbow down, and shoulder point down, but whether this might be due to conditions or feed cannot be said. Measurements taken in different years.

Factor XI Dec. 4 to Mar. 5, 1910; XIA Nov. 18-'11 to Feb. 17-'12.

Table Comparing Factor XI During Second pregnant Period with Factor Xia
Dry at Same age. Age XI 12-15 to 14-13; Xia 12-1 to 15-1.

Factor	First Measurement XI	Second Measurement Xia	Second XI	Second Xia	Period		Daily	
					Loss or gain XI	Loss or gain Xia	Loss or gain XI	Loss or gain Xia
Weight Lbs.	187	262	219	355	33	93	.5424	1.01
Height Withers	52	59	54	66	2	7	.0339	.0761
Height Croup	60.5	68	64	73	3.5	5	.0593	.0545
Breadth Shoulders	30	38	32	43	2	5	.0339	.0545
Breadth sh. Pt.	26.5	28	28	30	1.5	2	.02541	.0218
Breadth Hams	27.5	29	29.5	39	2	0	.0339	.0
Breadth Hip Bones	23	24	24	31	1	7	.01694	.0761
Heart Girth	105	124	115	148	10	24	.1694	.2608
Paunch Girth	130	144	130	158	0	14	0	.1521
Flank Girth	110	121	110	140	0	19	0	.1955
Depth Chest	33.5	39	35	45	1.5	6	.02541	.0652
Length Body	82	89	89	102	7	13	.1186	.1413
Width Head	11.5	18	13.5	20	2	2	.0339	.0218
Cir. Rear Shin Bone	15	15.5	17	17.5	2	2	.0339	.0218
Cir. Fore Shin Bone	15	15.5	16	16.5	1	1	.01694	.0109
Dist. Elbow Down	29	31	30	31	1	0	.01694	.0
Dist. sh. Pt. Down	31.5	34	32	32	.5	-2	.00847	-.0218
Feed Consumed					326.75	496.4	5.54	5.34
Digestible Nutrients					234.68	414.25	3.97	4.5

Factor Xia gained more in weight and about one-half of the other measurements but it will be noticed received more digestible nutrients in feed. Factor Xia gained more in height at croup, width of head, circumference of shin bones, etc. on less nutrients. This may be due to pregnant condition. Measurements were taken about the same season of year but in different years.

XI June 15-'10 - Aug. 13-'10; Xia May 18-'12 Aug. 18-'12.

Table Comparing the Pregnant Period of Factor XIII Age 7-15 to 9-5
With Dry Period of Factor XIIa Age 7-9 to 9-8.

Factor	First		Second		Period		Daily	
	Meas.	XIII	Meas.	XIIa	Gain or Loss	XIII	Gain or Loss	XIIa
Weight Lbs.	120	152	171	186	51	34	1.041	.5573
Weight Withers	45.5	53	53	54	5.5	3	.1326	.0338
Height at Croup	52	58	57.5	62	5.5	4	.1123	.0655
Breadth Shoulder	26	28	31	31	5	3	.102	.0491
Breadth Shoulder Pt.	23	20	27	24	4	4	.0816	.0655
Breadth Hams	25	27	27	29	2	2	.0408	.0328
Breadth Hip Bones	21	19	24	19	3	0	.0612	.0000
Heart Girth	88	96	100	103	12	7	.2448	.1147
Paunch Girth	101	113	120	122	19	9	.3877	.1475
Flank Girth	88	95	100	114	12	19	.2448	.3114
Depth Chest	28	32	31.5	33	3.5	1	.0714	.0164
Length of Body	69	76	87	89	18	13	.3673	.2131
Width Head	9.5	14.5	10.5	16.5	1	2	.0204	.0328
Cir. Rear Shin Bone	13	14	14	14.5	1	.5	.0204	.0082
Cir. Fore Shin Bone	13.5	14	14.5	15	1	1	.0204	.0164
Dist. Elbow Down	27	25	27	29	0	4	.0000	.0655
Dist. Sh. Pt. Down	28	29	29	31	1	2	.0204	.0328
Feed Consumed Lbs.	Ration No. 1				225.75	2-341	4.6	5.6
Digestible Nutrients					161.54	244.16	3.29	4.01

On less feed Factor XIII gained more in nearly all measurements. Factor XIIa gained more in width of head and distance from elbow and shoulder point down. This would indicate a greater growth due to the pregnant condition. Measurements at the same season but different years.

XIII 1-15 '10 to 3-5 '10; XIIa 12-7 '12 to 2-6 '13.

Table Comparing First Pregnant Period Growth of Factor XIV with Dry Factor XIIa at about the Same Ages. Age XIV 6-4 to 9-5; Age XIIa 6-5 to 8-10.

Factor		First Measurement		Second Measurement		Period Loss or Gain		Daily Loss or Gain	
		XIV	XIIa	XIV	XIIa	XIV	XIIa	XIV	XIIa
Weight	Lbs.	105	125	187	163	82	37	.901	.5606
Height Withers	Cm.	45	50	51.5	53	6.5	2	.0714	.0303
Height Croup	"	50.5	57	55	60	4.5	3	.0494	.0455
Breadth Shoulders	"	23.5	25	31	30	7.5	5	.0824	.0758
Breadth Sh. Pt.	"	21	19	27	24	6	5	.0659	.0758
Breadth Hams	"	22.5	25	27.5	28	5	3	.0549	.0455
Breadth Hip Bones	"	20.5	19	24	20	3.5	1	.0384	.0153
Heart Girth	"	83	88	105	99	22	11	.2417	.1666
Paunch Girth	"	96	110	128	118	32	8	.3516	.1213
Flank Girth	"	88	90	105	103	17	13	.1868	.197
Depth Chest	"	26	30	31	32	5	2	.0948	.0303
Length body	"	73	77	85	88	12	11	.1318	.1666
Width Head	"	10	15	11.5	15	1.5	0	.0164	.0000
Cir. Rear Sh. Bones	"	13	14	15	14.5	2	.5	.0219	.0076
Cir. Fore Sh. Bones	"	13.5	14.5	15.5	14.5	2	0	.0219	.0000
Dist. Elbow Down	"	25	26	29	28	4	2	.0438	.0303
Dist. Sh. Pt. Down	"	27	28	30.5	31	3.5	3	.0384	.0455
Feed Consumed	Lbs.	Ration No. 1-		369.25		105)			
Digestible Nutrients				2		-224)		4.05	
				284.38		235.56		3.57	
								4.98 lbs.	

On less feed Pregnant Factor shows greater gains in nearly all measurements.. Factor XIIa only exceeds in breadthshoulder points, flank girth, length body, and distance from shoulder point down. Seems to indicate increased growth due to pregnant condition. Measurements taken at same season but different years.

XIIa 11/3/13 to 1/8/13;- XIV 12/4/09 to 3/5/10/.

Table Comparing Second Pregnant Period Growth of Factor XIV with Growth
Of Factor XXa Dry Same Period. Age XIV 12-15 to 14-13; XXa 12-2 to 15-2.

Factor	Lbs.	Cm.	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
			XIV	XXa	XIV	XXa	XIV	XXa	XIV	XXa
Weight			180	285	235	348	55	63	.932	.6847
Height Withers			53	59	58	63	5	4	.0847	.0434
Height Croup			62	67	64.5	70	2.5	3	.0424	.0326
Breadth Shoulders			28.5	36	32	40	3.5	4	.0593	.0434
Breadth Shoulder Pt.			25	27	27	28	2	1	.0339	.0108
Breadth Hams.			25	35	27.5	37	2.5	2	.0424	.0217
Breadth Hip bones			21	27	23.5	29	2.5	2	.0424	.0217
Heart Girth			106	126	115	143	9	17	.1525	.1848
Paunch Girth			120	138	137	150	17	12	.2881	.1304
Flank Girth			100	125	113	133	13	8	.2203	.0868
Depth Chest			32.5	38	39	42	6.5	4	.1101	.0434
Length Body			85	98	90	105	5	7	.0847	.0760
Width Head			12	16	13	17	1	1	.0169	.0108
Cir. Rear ShinBone			16.5	16.5	16	18	-.5	1.5	-.0085	.0163
Cir. Fore Shin Bone			16	16	16	17	0	1	.0000	.0108
Dist. Elbow Down			30	27	32	26	2	-1	.0000	-.0108
Dist. Sh. Pt. Down			32.5	30	34.5	28	2	-2	.0339	-.0217
Feed Consumed Lbs.			Ration No.		1- 8 lbs.)	269 3-420	4.55	4.56		
Digestible Nutrients					51 162 lbs)	205.18 354.06	3.47	3.85		
					3-99 "					

On a somewhat better ration as indicated by the digestible nutrients, dry Factor XXa has not made as rapid gains in hardly any measurements taken as has Pregnant Factor XIV. Factor XXa exceeds only in heart girth and circumference of shin bones. This would seem to indicate more rapid growth due to pregnancy.

XIV 6/15/10 to 8/13/10: XXa 7/6/14 to 10/16/14.

Table Comparing Growth During First Pregnant Period of Factor XXI
Age 6-4 to 9-3 with Dry Factor XX at the Same Age 6-23 to 9-21.

Factor		First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
		XXI	XX	XXI	XX	XXI	XX	XXI	XX
Weight	Lbs.	159	168	209	208	50	40	.5494	.4395
Height Withers	Cm	49	47	53	56	3	9	.0330	.0990
Height Croup	"	57	55.5	62	63	5	7.5	.0549	.0824
Breadth Shoulders	"	30	28.5	35	32	5	3.5	.0549	.0384
Breadth Sh. Points	"	24	22	26	25	2	3	.0219	.0330
Breadth Hams	"	26	27	31	31	5	4	.0549	.0438
Breadth Hip Bones	"	18	17	25	25	7	8	.0770	.0879
Heart Girth	"	93	90	110	112	17	22	.1868	.2417
Paunch Girth	"	116	110	136	132	20	22	.2200	.2417
Flank Girth	"	101	100	122	119	21	19	.2417	.2090
Depth of Chest	"	31	29	34	33	3	4	.0330	.0438
Length of Body	"	80	80	91	90	11	10	.1209	.1096
Width Head	"	13	11	17	17	4	6 (?)	.0438	.0660
Cir. Rear Shin Bone	"	15	16	16	16.5	1	.5	.0110	.0055
Cir. Fore Shin Bone	"	15	16	17	17	2	1	.0219	.0110
Dist. Elbow Down	"	25	25	28	27	3	2	.0330	.0219
Dist. Sh. Pt. Down	"	26	24	30	29	4	5	.0438	.0549
Feed Consumed Lbs.				Ration No. 1		301.5	269.5	4.86	4.84
				2		140.86	142.8		
						442.36	412.3		
						316.73	295.21	3.48	3.47
Digestible Nutrients									

Pregnant Factor gained more in weight and a number of other measurements. Factor XX seemed to gain more in what we might call growth measurements, as height, length of head, width, etc. This may be due to the dry condition. Measurements taken same year, season, etc.

XXI 10/22/10 to 1/21/11: XX 10/22/10 to 1/21/11.

Table Comparing Growth of Pregnant Factor XXII Age 6-23 to 9-21 With that of Dry Factor XX, Age 6-23 to 9-21.

Factor	First Measurement XXII XX	Second Measurement XXII XX	Period Gain or Loss XXII XX	Daily Gain or Loss XXII XX
Weight Lbs.	170	217	47	.5165
Height Withers	47	53	5	.0549
Height Croup	55	59	4	.0438
Breadth Shoulders	29	34	5	.0549
Breadth Sh. Pts.	23	27	4	.0438
Breadth Hams	26	32	6	.0660
Breadth Hip Bones	18	25	7	.077
Heart Girth	93	117	25	.2747
Paunch Girth	117	138	21	.2307
Flank Girth	100	120	20	.2200
Depth Chest	29	35	6	.066
Length Body	85	93	8	.0877
Width Head	11	15.5	5.5	.0604
Cir. Rear Sh. Bones	15	16.5	1.5	.0165
Cir. Fore Sh. Bones	15	17	2	.0219
Dist. Elbow Down	26	26	0	.0000
Dist. Sh. Pt. Down	24	28	4	.0438
Feed Consumed Lbs.				
	Ration No. 1-241.5)		378.3	4.15
	2-136.8)		1.269.5	4.84
			2.142.8	
			412.3	
Digestible Nutrients Lbs.			270.86	2.97
			295.21	3.47

As seen from the Table dry Factor XX gained more for eight measurements but also received more feed. The measurements are the growth measurements, as height, length, width of head, etc. May indicate growth due to dry condition or to excess feed.

XX 10-23-10 to 1-21-11; XXII 10-23-10 to 1-21-11.

Table Comparing Factor XXII Growth During Second Pregnant Period
Age 11-18 to 14-2 With Dry Factor XIII B. Age 11-9 to 15-13.
During Same Period.

Factor	First Measurement XXII XIII B	Second Measurement XXII XIII B	Period Gain or Loss XXII XIII B	Daily Gain or Loss XXII XIII B
Weight Lbs.	193	206	13	.1711
Height Withers	54	55	1	.0132
Height Croup	64	64	0	.0000
Breadth Shoulders	35	33	-2	-.0263
Breadth Sh. Pt.	27	26	-1	-.0132
Breadth Hams	29	28	-1	-.0132
Breadth Hip Bones	23	22	-1	-.0132
Heart Girth	108	105	-3	-.0394
Paunch Girth	118	126	8	.1052
Flank Girth	110	114	4	.0526
Depth Chest	34	33	-1	-.0132
Length Body	94	94	0	.0000
Width Head	16.5	16	-.5	-.0066
Cir. Rear Sh. Bone	16.5	16.5	0	.0000
Cir. Fore Sh. Bone	17	16.5	-.5	-.0658
Dist. Elbow Down	28	30	2	.0263
Dist. Sh. Pt. Down	30	33	3	.0263
Feed Consumed Lbs.			299	3.93
Digestible Nutrients			221.2	2.9
			405.7	3.21

On a slightly heavier ration XIII B gained far more in nearly all measurements. XXII seemed to lose throughout the period. May be due to pregnant conditions or to some other cause. Different seasons of year and different years.
XX II 3-18-11 to 6-2-11.
XIII B 18-3-12 to 12-7-12.

Table Comparing Growth of Pregnant Factor XXX Age 6-11 to 9-7 with
Dry Factor XIIIA age 6-5 to 9-8.

Factor		First Meas. XXX XIIIA	Sec. Meas. XXX XIIIA	Period		Daily	
				Gain or Loss XXX XIIIA	Gain or Loss XXX XIIIA	Gain or Loss XXX XIIIA	Gain or Loss XXX XIIIA
Weight Lbs.		181	263	82	94	.9213	.9890
Height Withers	Cm.	51	56	5	6	.0561	.0631
Height Croup	"	61	63	2	7	.0225	.0736
Breadth Shoulders	"	33	38	6	10	.0674	.1053
Breadth Sh. Points	"	21	28	7	6	.0786	.0631
Breadth Hams	"	28	31	3	8	.0337	.0842
Breadth Hip Bones	"	20	23	3	3	.0337	.0315
Heart Girth	"	100	116	16	24	.1797	.2526
Paunch Girth	"	130	144	24	19	.2696	.2000
Flank Girth	"	104	121	17	25	.1910	.2631
Depth Chest	"	33	35	2	7	.0235	.0736
Length Body	"	81	92	11	17	.1235	.1789
Width Head	"	14	16	2	2.5	.0225	.0263
Cir. Rear Shin Bone	"	14.5	15	.5	1.5	.0056	.0158
Cir. Fore Shin Bone	"	15	15.5	.5	2	.0056	.0211
Dist. Elbow Down	"	27	30	3	2	.0337	.0211
Dist. Sh. Pt. Down	"	30	31	1	2	.0012	.0211
Feed Consumed				392	516	4.4	5.43
Digestible Nutrients				294.9	369.46	3.31	3.89

It will be noticed that Factor XIIIA gained more in nearly all measurements. However she received considerably more feed which is probably more of a factor than condition. Measurements taken at about the same season but in different years.
XXX: Oct. 12-12 to 1-8-13
XIIIA: 11-3-12 to 2-6-13.

Table Comparing Growth During the Second Pregnant Period of Factor XXX
With Growth at same Age of Factor XXIA When Dry. XXX Age 12-4 to
15-13 XXIA 12-2 to 15-2.

Factor	Cm.	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
		XXX	XXIA	XXX	XXIA	XXX	XXIA	XXX	XXIA
Weight		302	295	337	344	35	49	.3888	.5326
Height Withers		58	62	60	63	2	1	.0222	.0109
Height Croup		66	67	69	69	3	2	.0333	.0218
Breadth Shoulders		39	38	38	41	-1	3	-.0111	.0327
Breadth Sh. Points		28	30	27	29	-1	-1	-.0111	-.0109
Breadth Hams		35	36	32	36	-3	0	-.0333	.0000
Breadth Hip Bones		24	26	25	27	1	1	.0111	.0109
Heart Girth		121	122	124	133	3	11	.0333	.1196
Paunch Girth		143	136	152	143	9	7	.1000	.0761
Flank Girth		123	123	133	137	10	14	.1111	.1522
Depth of Chest		37	35	41	40	4	5	.0445	.0544
Length Body		100	98	105	104	5	6	.0556	.0654
Width Head		18	16	18	18	0	0	.0000	.0000
Cir. Rear Sh. Bone		16.5	17	16.5	17	0	0	.0000	.0000
Cir. Fore Sh. Bone		17	17	17	17.5	0	.5	.0000	.0055
Dist. Elbow Down		30	27	31	28	1	1	.0111	.0109
Dist. Sh. Pt. Down		32	30	33	30	1	0	.0111	.0000
Feed Consumed Lbs.						290.5	420	3.28	4.56
Digestible Nutrients						225.78	354.06	2.5	3.84

Factor XXIA gained more in weight but not quite so much in height. Animals are very close in growth measurements. Factor XXIA received more feed which might account for more rapid gains.

XXX: 4-5-13. to 7-4-13

XXIA: 7-6-14 to 10-6-14.

Table Comparing Growth of Factor XXXI During First Pregnant Period
Age 7-3 to 11-0 with Dry Factor XXIA At Same Period Age 6-2 to 11-2.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XXXI	XXIA	XXXI	XXIA	XXXI	XXIA	XXXI	XXIA
Weight	180	180	290	289	100	129	.8547	.8543
Height Withers	53	48	58	60	5	13	.0427	.0860
Height Croup	60	52	65	64	5	13	.0427	.0795
Breadth Shoulders	33	30	38	38	5	8	.0427	.0530
Breadth Sh. Pts.	23	22	28	29	6	7	.0512	.0463
Breadth Hams	30	27	33	37	3	10	.0256	.0662
Breadth Hip Bones	21	21	26	25	5	4	.0427	.0281
Heart Girth	112	103	129	125	17	22	.1453	.1456
Baunch Girth	120	120	145	132	25	12	.2136	.0795
Flank Girth	107	105	120	122	13	18	.1111	.1125
Depth Chest	34	30	37	36	3	6	.0256	.0397
Length Body	82	78	94	98	12	20	.1024	.1324
Cir. Rear Sh. Bone	17	14	17	17	0	3	.0000	.0199
Width Head	16.5	14.5	17.	16	.5	15	.0042	.0099
Cir. Fore Shin Bone	16.5	14	17	17	.5	3	.0042	.0199
Dist. Elbow Down	28	25	30	28	2	3	.0171	.0199
Dist. Sh. Pt. Down	31	28	32	30	1	2	.0085	.0141
Feed Consumed					523	922.5	4.46	6.11
Digestible Nutrients					378	702.17	3.23	4.65

More Past.

Even on less feed Factor XXXI gained slightly ^{more} in weight and breadth measurements but Factor XXIA surpassed in growth measurements. This may be due to feed or condition. Period for XXIA was during Spring of 1914 while that for XXXI was in the Winter of 1913. This might be an important factor to consider.
XXXIA: 1-6-14 to 6-6-14.
XXXI: 11-4-12 to 3-1-13.

Table Comparing Growth During Pregnant Period of Factor XL Age 8-19
to 11-19 with Dry Factor VII, Age 9-9 to 11-19.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XL	VII	XL	VII	XL	VII	XL	VII
Weight	210	172.5	286	190	76	17.5	.8240	.2464
Height Withers	53	54.15	58	55	5	.5	.0543	.0070
Height Croup	60	62.5	64	67	4	4.5	.0434	.0633
Breadth Shoulders	31	29.5	36	32	5	2.5	.0543	.0352
Breadth Sh. Pts.	23	27	26	28	3	1	.0327	.0140
Breadth Hams	30	27	35	27	5	0	.0543	.0000
Breadth Hip Bones	24	24.5	28	24	4	-.5	.0434	-.0070
Heart Girth	108	105	125	106	17	1	.1848	.0140
Paunch Girth	134	115	145	120	11	5	.1196	.0704
Flank Girth	113	109	133	115	20	6	.2170	.0845
Depth Chest	33	35.5	36	34	3	-1.5	.0327	-.0211
Length Body	87	80	88	85	9	5	.0978	.0704
Width Head	16	13.5	17	12.5	1	1	.0109	.0140
Cir. Rear Shin Bone	15	14	16	14.5	1	.5	.0109	.0070
Cir. Fore Sh. Bone	15	14	15.5	14.5	.5	.5	.0055	.0070
Dist. Elbow Down	26	29	29	27	3	-2	.0327	-.0280
Dist. Sh. Pt. Down	28	30	30	29	2	-1	.0218	-.0140
Feed Consumed					588	105	6.4	1.48
Digestible Nutrients					421	88.5	4.58	1.25

It is difficult to draw any conclusions from Table; XL gained more in nearly every measurement but received nearly four times the amount of feed. Factor was not on pasture as was Factor VII.
XL: 11-27-13 to 2-27-14.
VII: 6-10-9 to 8-20-09.

Table Comparing the Growth of Factor III During Second Pregnancy with that of Factor VII dry at Same age. Age III 21-14 to 23-14; age VII 20-13 to 23-14.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	III	VII	III	VII	III	VII	III	VII
Weight	297	353	316	355	19	2	.6129	.0328
Height Withers	66	66.5	67	65	1	-1.5	.0322	-.0246
Height Croup	74.5	73	73.5	73	-1	0	-.0322	.0000
Breadth Shoulders	36	41.5	38	41	2	-.5	.0644	-.0082
Breadth Sh. Pts.	33.5	39.0	33.5	35	0	0	.0000	-.0656
Breadth Hams	34	37.5	34	37	0	-.5	.0000	-.0082
Breadth Hip Bones	30	34.5	30	32.5	0	0	.0000	-.0328
Heart Girth	125	142	127	145	2	3	.0644	.0492
Paunch Girth	138	152	145	162	7	10	.2260	.1640
Flank Girth	128	142	131	146	3	4	.0968	.0656
Depth of Chest	39	44	41	42.5	2	-1.5	.0644	-.0246
Length of Body	105	105	105	106	0	1	.0000	.0164
Width Head	13	13.5	13.5	13.5	.5	0	.0161	.0000
Cir. Rear Shin Bone	17	16	16.5	16.5	-.5	.5	-.0161	.0082
Cir. Fore Shin Bone	17	16	17.5	16.5	.5	.5	.0161	.0082
Dist. Elbow Down	33	31.5	33.5	31.5	.5	0	.0161	.0000
Dist. Sh. Pt. Down	36.5	34	36	34	-.5	0	-.0161	.0000
Feed Consumed					7 lbs.	7 lbs.	.22	.11
Digestible Nutrients							.19	pasture

On hardly any feed other than pasture with VII having advantage of age and showing higher rate of growth in previous dry period, still in pregnant condition, III shows more growth, as seen in Table. Growth measurements are closer with height at croup and circumference of rear shin bone in favor of VII.

VII: 5-14-10 to 7-15-10.

III: 3-14-10 to 7-15-10.

Table Comparing the Growth of Factor 51 During First Pregnancy
With Dry Factor XXA at the Same age 10-2 to 11-2.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	LI	XXA	LI	XXA	LI	XXA	LI	XXA
Weight	184	251	223	263	38	12	1.2350	.4000
Height at Withers	53	57	54	57	1	0	.0323	.0000
Height At Croup	59	65	61	66	2	1	.0645	.0333
Breadth Shoulders	31	35	32	36	1	1	.0322	.0333
Breadth Sh. Pt.	23	26	22	26	-1	0	-.0322	.0000
Breadth Hams	29	32	31	33	2	1	.0645	.0333
Breadth Hip Bones	23	26	23	26	0	0	.0000	.0000
Heart Girth	103	120	111	123	8	3	.2580	.1000
Paunch Girth	110	132	128	130	18	-2	.5806	-.0667
Flank Girth	99	121	116	120	17	-1	.5484	-.0333
Depth Chest	32	36	35	38	3	2	.0968	.0667
Length of Body	87	94	90	98	3	4	.0968	.1334
Width Head	14.5	15	14.5	15	0	0	.0000	.0000
Cir. Rear. Sh. Bone	15	16	15	16	0	0	.0000	.0000
Cir. Fore Sh. Bone	15	16	15	16	0	0	.0000	.0000
Dist. Elbow Down	25	27	27	28	2	1	.0645	.0333
Dist. Sh. Pt. Down	28	29	30	30	2	1	.0645	.0333
Feed Consumed					186	210	6.0	7.0
Digestible Nutrients					133.18	177	4.3	5.9
							Pasture	

On less feed and no pasture Factor LI has gained more in nearly all measurements. Measurements taken in different years. Factors XXA also had an advantage of pasture, May indicate growth due to a pregnant condition. XXA greater length.
LI: 1-20-15 to 2-20-15.
XXA: 5-6-14 to 6-6-14.

Table Comparing the Growth of Factor XXA During First Pregnancy with Dry Factor XIIIB at the Same Age 18-3 to 31-3; XIIIB 18-7 to 31-13.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XXA	XIIIB	XXA	XIIIB	XXA	XIIIB	XXA	XIIIB
Weight Lbs.	355	287	415	346	60	59	.6667	.6020
Height Withers	63	63	65	64	2	1	.0222	.0102
Height Croup	68	71	69	71	1	0	.0111	.0000
Breadth Shoulders	41	38	44	41	3	3	.0333	.0306
Breadth Sh. Pts.	29	28	28	29	-1	1	-.0111	.0102
Breadth Hams	37	34	40	34	3	0	.0333	.0000
Breadth Hip Bones	28	26	30	26	2	0	.0222	.0000
Heart Girth	145	122	146	137	1	15	.0111	.1530
Paunch Girth	151	135	160	150	9	15	.1000	.1530
Flank Girth	143	123	145	139	2	16	.0222	.1632
Depth Chest	43	40	46	44	3	4	.0333	.0408
Length Body	109	103	110	112	1	9	.0111	.0918
Width Head	17.5	19	19	18	1.5	-1	.0167	-.0102
C. Rear Ch. Bone	18	16.5	18	17.5	0	1	.0000	.0102
Cir. Fore Sh. Bone	16.5	17	17.5	17	1	0	.0111	.0000
Dist. Elbow Down	28	32	27	32	-1	0	-.0111	.0000
Dist. Sh. Pt. Down	30	34	30	35	0	1	.0000	.0102
Feed Consumed					539	413.5	6.0	4.21
Digestible Nutrients					390.37	306.8	4.33	3.13
								More Past.

Factor XXA gained more in most measurements but on more feed. Factor XIIIB gained in girth measurements and length more rapidly. Result may be due to feed or condition. Measurements now in same year.

XXA Jan. 1-6-15 to 4-6-15.

XIIIB 3-1-13 to 6-7-13.

Comparing Growth of Factor XIIIA During First Pregnancy with
Dry Factor XIIIB at About Same Age XIIA 18-5 to 21-5; XIII B
18-7 to 21-13

Factor	Cm.	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
		XIIA XIIIB	XIIA XIIIB	XIIA XIIIB	XIIA XIIIB	XIIA XIIIB	XIIA XIIIB	XIIA XIIIB	XIIIB
Weight		305	287	340	346	35	59	.3763	.6020
Height Withers		62	63	64	64	2	1	.0215	.0102
Height Croup		77	71	70	71	-7	0	-.0753	.0000
Breadth Shoulders		35	38	36	41	1	3	.0108	.0306
Breadth Sh. Pt.		27	28	28	29	1	1	.0108	.0102
Breadth Hams		32	34	33	34	1	0	.0108	.0000
Breadth Hip Bones		25	26	27	26	2	0	.0215	.0000
Heart Girth		125	122	126	137	1	15	.0108	.1530
Paunch Girth		138	135	153	150	15	15	.1615	.153
Flank Girth		126	123	130	139	4	16	.043	.1632
Depth Chest		40	40	41	44	1	4	.0108	.0408
Length Body		101	103	106	112	5	9	.0538	.0918
Width head		19	19	19	19	-1	-1	-.0108	-.0102
Cir. Rear. Sh. Bone		17	16.5	18	17.5	1	1	.0108	.0102
Cir. Fore Sh. Bone		17	17	17.5	17	.5	0	.0054	.0000
Dist. From Elbow Down		32	32	30	32	-2	0	-.0215	.0000
Dist. Sh. pt. Down	W	34	34	32	35	-2	1	-.0215	.0102
Feed Consumed						441	413.0	4.7	4.21
						315.76	306.8	3.39	3.13

Factor XIIIB shows more gain in most cases than does XIIA and is also on slightly less feed the pasture would probably make up for this. May indicate more growth due to dry condition.

XIII B 3-1-13 to 6-7-13.

XIIA 11-3-13 to 2-3-14.

Table Comparing Growth of Factor XIIA during second Pregnancy with that of Dry Factor XIIIB; age XIIA 24-5 to 27-5; XIIIB 24-13 to 27-13

Factor	First Measurement XIIA XIIIB	Second Measurement XIIA XIIIB	Period		Daily Gain or Loss	
			XIIA	XIIIB	XIIA	XIIIB
Weight	313	366	55	30	.6044	.3333
Height Withers	65	66	1	0	.0110	.0000
Height Croup	71	73	0	1	.0000	.0111
Breadth Shoulders	36	39	4	3	.0438	.0333
Breadth Sh. Pts.	26	28	0	0	.0000	.0000
Breadth Hams	33	33	3	3	.0219	.0333
Breadth Hip Bones	26	26	3	3	.0329	.0323
Geart Girth	127	135	8	5	.0879	.0556
Paunch Girth	144	151	8	3	.0879	.0223
Flank Girth	126	133	14	2	.154	.0223
Depth Chest	41	43	1	1	.011	.0111
Length Body	106	117	3	-3	.0329	-.0333
Width head	18	19	0	1	.0000	.0111
Cir. Rear Sh. Bone	17	17.5	0	.5	.0000	.0056
Cir. Fore Sh. Bone	17	18	0	.5	.0000	.0056
Dist. Elbow Down	32	32	0	-2	.0000	-.0223
Dist. Sh. Pt. Down	33	34	1	-1	.0110	-.0111
Feed Consumed			490	311	6.38	3.45
Digestible Nutrients			413.07	233.3	4.54	2.59

Factor XIIA showed more gain in most cases but received more feed. Regardless of feed XIIIB gained more in some of the least variable measurements as head, shin bones, height croup. Gains could hardly be said to be due to pregnant condition. XIIIB 9-7-13 to 13-6-13. XIIA 5-3-14 to 8-3-14.

Table Showing Growth of Factor XIA During Pregnancy with that of Factor XIII_A Dry at Time but Had raised two Litters. Age XIA 30-1 to 33-1; XIII_A 30-5 to 32-4.

Factor		First		Second		Period		Daily	
		Measurement XIA	XIII _A	Measurement XIA	XIII _A	Gain or Loss XIA	XIII _A	Gain or Loss XIA	XIII _A
Weight		340	283	431	398	91	115	.989	1.91
Height Withers	Cm.	63	67	64	68	1	1	.0109	.0167
Height Croup	"	73	73	72	74	-1	1	.0109	.0167
Breadth Shoulders	"	35	35	39	38	4	3	.0436	.0499
Breadth Sh. Pts.	"	27	25	28	28	1	3	.0109	.0499
Breadth Hams	"	32	31	37	32	5	1	.0544	.0167
Breadth Hip Bones	"	25	22	30	25	5	3	.0544	.0499
Heart Girth	"	120	122	135	132	15	10	.1630	.1667
Paunch Girth	"	142	136	160	134	18	-2	.1956	-.0333
Flank Girth	"	126	123	149	129	23	6	.2608	.1000
Depth of Chest	"	41	41	43	43	2	2	.0218	.0333
Length of Body	"	112	109	110	106	-2	-2	-.0218	-.0499
Width of Head	"	18.5	19	19	19	.5	0	.0054	.0000
Cir. Rear Shin Bone	"	17	18.	17.5	17	.5	-1	.0054	-.0167
Cir. Fore Shin Bone	"	16.5	18	17	17.5	.5	-.5	.0054	.0083
Dist. Elbow Down	"	31	33	32	32	1	-1	.0109	-.0167
Dist Sh. Pt. Down	"	33	36	35	34	2	-2	.0218	-.0333
Feed Consumed						553	427	6.0	7.11
Digestible Nutrients						395.5	305.7	4.3	5.1

Regardless of much less feed XIA gained more in several measurements. XIII_A gained more in height but less in length, width of head, etc. May be due to pregnant condition. XIA 11-18-13 to 2-18-14. XIII_A 11-3-14 to 1-2-15.

Table Comparing Growth of Factor VII During Pregnant Period with
Factor XIIIB During Dry Period Age VII 23-13 to 26-11; Age XIIIB
XIIIB 24-13 to 27-13.

Factor	Cm.	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
		VII	XIIIB	VII	XIIIB	VII	XIIIB	VII	XIIIB
Weight		364	366	415	396	51	30	.5600	.3333
Height Withers		66.5	66	69	66	3.5	0	.0274	.0000
Height Croup		75	73	76	74	1	1	.011	.0111
Breadth Shoulders		40.5	39	42	42	1.5	3	.0164	.0333
Breadth Sh. Pt.		35.5	28	33	28	-2.5	0	-.0274	.0000
Breadth Hams		36.5	33	40	36	3.5	3	.0384	.0333
Breadth Hip Bones		34	26	28	28	-6	2	-.0670	.0222
Heart Girth		148	135	141	140	-7	5	-.0770	.0556
Paunch Girth		152	151	159	153	7	2	.0770	.0222
Flank Girth		146	133	151	135	5	2	.0549	.0222
Depth Chest		43.5	43.	44	44	.5	1	.0055	.0111
Length Body		108	117	110	114	2	-3	.0219	-.0333
Width Head		14	19	19	20	4	1	.0438	.0111
Cir. Rear Shin Bone		17	17.5	19	18	2	.5	.0219	.0056
Cir. Fore Shin Bone		17	18	19	18.5	2	.5	.0219	.0056
Dist. Elbow Down		32	32	33	30	1	-2	.0110	-.0222
Dist. Sh. Pt. Down		34	34	36	33	2	-1	.0219	-.0111
Feed Consumed						252	311	2.77	3.45
Digestible Nutrients						209.77	233.34	2.3	3.45

Factor VII gained more in nearly all measurements on less feed. However, the feed is probably equalized by pasture as VII had more pasture. May indicate growth due to pregnancy. Different years about same season.
VII 8-13-10 to 11-13-10.
XIIIB 9-7-13 to 12-6-13.

Table Comparing Growth of Pregnant Factor IV Age 23-14 to 26-11 with
Factor VIII, age 21-14 to 29-11.

Factor	Cm.	First Measurement		Second Measurement		Period		Daily	
		IV	VIII	IV	VIII	IV	VIII	Gain or Loss	Gain or Loss
Weight		322	340	350	428	28	88	.3076	.3636
Height Withers		65	66.5	69	70	4	3.5	.0440	.0145
Height Croup		75	76	76	78	1	2	.011	.0083
Breadth Shoulders		39	39	43	44	4	5	.0440	.0206
Breadth Shoulder Pt.		34	35	30	34	-4	-1	-.0440	-.0041
Breadth Hams		34	36	37	40	3	4	.033	.0164
Breadth Hip Bones		31	32	29	34	-3	3	-.023	.0083
Heart Girth		136	142	140	146	4	4	.044	.0164
Paunch Girth		159	153	151	167	-8	14	-.088	.058
Flank Girth		140	143	142	147	2	4	.022	.0164
Depth Chest		45	43.5	46	48	1	4.5	.0110	.0186
Length Body		114	104	117	110	3	6	.033	.0248
Width Head		13.5	14.5	19	22	5.5	7.5	.0604	.0309
Wir. Rear Sh. Bone		17.5	18.5	17.5	20.5	0	3	.0000	.0082
Cir. Fore Sh. Bone		18	17.5	18	21	0	3.5	.0000	.0145
Dist. Elbow Down		30	32	31	35	1	3	.011	.0123
Dist. Sh. Pt. Down		32	34.5	35	36	3	1.5	.033	.0061
Feed Consumed						252	746	.2.78	3.08
Digestible Nutrients						212.44	592.8	2.32	2.95

Factor IV Shows a little less gain in weight and a few other measurements but more gain in growth measurements. Receives a little less feed.

A summary of the foregoing tables or comparisons is shown in the following table.

Discarded be- cause of Une- qual Feeds	More Growth and Weight in Pregnant Animals	More Weight but Less Growth in Pregnant Animals	Less Growth and Weight in Pregnant Animals	Less Weight But More Growth in Pregnant Animals	TOTAL
7	7	5	3	3	25

From the twenty-five comparisons, seven were discarded because of the unequal amounts of feed received. Seven pregnant animals showed a greater gain in nearly all measurements. Five pregnant animals showed increased weight but a smaller gain in height and length measurements than did the open sows.

Only three pregnant animals showed smaller gains than did the open Factors.

Twelve of the eighteen pregnant Factors show an increase in weight over that of the open Factors.

Three pregnant Factors gained less in weight but made more growth than the open animals.

The tables indicate rather conclusively that pregnancy in sows causes an increase in weight.

They indicate further, but not so conclusively, that growth is increased during gestation.

Effect of Early Pregnant Period on Growth
Rate During a Later Dry Period.

It would be interesting to observe what effect an early pregnant and lactation period would produce on growth rate during a later dry period. The writer has found no data on this point from the literature reviewed.

The data gathered in this experiment offer very little from which information on this point can be obtained. It was only in cases where the sows failed to breed for some time following the lactation period that dry periods, long enough to be considered, could be found. Such cases proved to be very few in number.

A few cases were found in which a comparison of the growth rate of two Factors, one of which had previously raised one or two litters, could be made,

Three cases in which the animal either aborted toward the end of the first pregnant period, or lost her pigs at birth, were found. These Factors have been compared in growth rate with open Factors which had never been bred to see if there was any difference which might be attributed to the early pregnant period. These comparisons are presented in Group II.

GROUP II TABLE I

Table Comparing Immature Factor VI During a Period of 31 Days
in Which She is Dry 20 Days and Pregnant 11 Days with Mature
Factor VIII During Dry Period at Same Age. Age 20-13 to 21-13.

Factor	Period Gains		Daily Gains	
	VI	VIII	VI	VIII
Weight Lbs.	20	12	.645	.3871
Height Withers	2.5	1	.0806	.03236
Height Croup	1.5	3	.0484	.0968
Breadth Shoulder	2.5	-1	.0806	-.03236
Breadth Shoulder Point	1	0	.0323	.0000
Breadth Hams	0	-1	.0000	-.03236
Breadth Hip Bones	-1.5	0	-.0484	.0000
Heart Girth	15	1	.484	.03236
Paunch Girth	6	5	.1935	.1613
Flank Girth	10	3	.322	.0968
Depth of Chest	0	1.5	.000	.0484
Length of Body	5	-1	.1612	-.03236
Width Head	0	1	.0000	.03236
Cir. Rear Sh. Bone	.5	.5	.01612	.01613
Cir. Fore Sh. Bone	-.5	0	.01612	.0000
Dist. Elbow Down	1	-1	.0323	-.03236
Dist. Sh. Pt. Down	1.5	-.5	.0484	-.01613
Feed Consumed	108	3.48	105	3.39
Digestible Nutrients	91.04	2.9	82.2	2.64

Factor VI Seems to grow as fast even tho she has raised two litters. Same of increase may be due to short time pregnant.

GROUP II TABLE II
Table comparing Growth of Factor XIII after an early Pregnant Period with Growth of Factor VIII before Pregnancy to See if Pregnancy When Young Affects Growth Later. Age XIII 13-16 to 20-12: VIII, 13-20 to 20-14.

Factor	First		Second		Period		Daily	
	Measurement XIII VIII	Measurement XIII VIII	Measurement XIII VIII	Measurement XIII VIII	Gain or Loss XIII VIII	Gain or Loss XIII VIII	Gain or Loss XIII VIII	Loss VIII
Weight	164	251	240	328	76	77	.3619	.3928
Height	55	60	60	65.5	5	5.5	.0238	.0280
Height Group	61.5	70	63	73.	1.5	3	.0071	.0153
Breadth Shoulders	28	34	33	40	5	6	.0238	.0306
Breadth Sh. Pt.	24	31	26	35	2	4	.0095	.0204
Breadth Hams	25	33	30	37	5	4	.0238	.0204
Breadth Hip Bones	21	29	24	32	3	3	.0143	.0153
Heart Girth	100	120	112	141	12	21	.0571	.1071
Paunch Girth	117	135	129	148	11	13	.0523	.0663
Flank Girth	110	125	111	140	1	15	.0048	.0765
Depth Chest	32	38.5	40	42	8	3.5	.0381	.0178
Length Body	82	95	82	105	0	10	.0000	.0510
Width Head	11.5	13.5	17	13.5	5.5	0	.0261	.000
Cir. Rear Shin Bone	14.5	17.5	17	18	2.5	.5	.0119	.0026
Cir. Fore Shin Bone	15	17	17	17.5	2	.5	.0095	.0026
Dist. Elbow Down	30	33	28	33	-2	0	-.0095	.0000
Dist. Sh. Pt. Down	32	34.5	31	35	-1	.5	-.0048	.0026
Feed Consumed					849	756	4.04	3.85
Digestible Nutrients					677.35	555.4	3.23	2.8

The two factors are very close in rate of growth. VIII received less feed and made a little better gain. May indicate that pregnancy and lactation check growth in a later dry period. Tho about the same age XIII was much smaller due probably to check while lactating.

XIII 7-16-10 to 2-11-11.

VIII 10-30-09 to 5-14-10.

GROUP II TABLE III

Table Comparing Growth of Factor XXX During Dry Period following Two Pregnancies, with Growth of Factor VIII at Same Age but never pregnant. To See if Rate of Growth is Decreased by Early Breeding. Age XXX 21-0 to 27-0; VIII 21-14 to 29-11.

Factor	First		Second		Period		Daily	
	XXX	Measurement VIII	XXX	Measurement VIII	Gain or Loss XXX	Period VIII	Gain or Loss XXX	Loss VIII
Weight	300	340	385	428	85	88	.47	.3636
Height Withers	60	66.5	63	70	3	3.5	.016	.0145
Height Croup	70	76	71	78	1	2	.0055	.0082
Breadth Shoulders	37	39	42	44	5	5	.0276	.0206
Breadth Sh. Pts.	29	35	28	34	-1	-1	-.0055	-.0041
Breadth Hams	31	36	35	40	4	4	.0221	.0164
Breadth Hip Bones	25	32	26	34	1	2	.0055	.0082
Heart Girth	130	142	140	146	10	4	.0552	.0164
Paunch Girth	142	153	148	167	6	14	.0331	.0580
Flank Girth	128	143	127	147	-1	4	-.0055	.0164
Depth Chest	37	43.5	42	48	5	4.5	.0276	.0186
Length Body	104	104	104	110	0	6	.0000	.0248
Width Head	18	14.5	19	22	1	7.5	.0055	.0309
Cir. Rear Sh. Bone	17	18.5	17	20.5	0	3	.0000	.0082
Cir. Fore Sh. Bone	17.5	17.5	17	21	-.5	3.5	-.0028	.0145
Dist. Elbow Down	30	32	30	35	0	3	.0000	.0123
Dist. Sh. Pt. Down	32	34.5	30	36	-2	1.5	.0110	.0061
Feed Consumed					1190	746	6.6	3.08
Digestible Nutrients					875.16	628.9	4.83	2.6

Owing to difference in feed it is hard to draw any conclusion from table. It would seem that early breeding has checked growth somewhat.

VIII 6-14-10 to 2-11-11
XXX 1-1-14 to 7-1-14.

GROUP II TABLE 4

Table Comparing Growth of Factor III, Dry Following Abortion, with Dry Factor VII Same Age. Age 14-0 to 19-2. To See Effect of pregnant Period on Growth Where There Has been no Lactation Period.

Factor	Cm.	First		second		Period		Daily	
		Measurement III VII	Measurement III VII	Measurement III VII	Measurement III VII	Loss III VII	or Gain VII III	Gain or Loss III VII	
Weight		215	244	282	356	67	112	.435	.732
Height Withers		60.5	61.5	63.5	67.5	3	6	.0194	.0392
Height Croup		69	69.5	73	75.5	4	6	.026	.0392
Breadth Shoulders		31	35	35	41	4	6	.026	.0392
Breadth Sh. Pts.		38	30.5	31.5	38	3.5	3.5	.0227	.049
Breadth Hams		27	31	34	38	7	7	.0454	.0457
Breadth Hip Bones		25	28	29.5	34	4.5	6	.0292	.0392
Heart Girth		105	128	128	142	23	14	.15	.0914
Paunch Girth		117	130	138	154	21	24	.1363	.1570
Flank Girth		107	126	124	146	17	20	.1104	.1307
Depth Chest		36	37.5	39	44.5	3	7	.0194	.0457
Length Body		97	94	103	106	6	12	.0388	.0784
Width Head		13	12.5	14	13.5	1	1	.0064	.0065
Cir. Rear Sh. Bone		16	15	16	16	0	1	.0000	.0065
Cir. Fore Sh. Bone		16	15.5	16.5	16	.5	.5	.0032	.0033
Dist. Elbow Down		31.5	30	32	31	.5	1	.0032	.0065
Dist. Sh. Pt. Down		33	33	35	33.5	2	.5	.0128	.0033
Feed Consumed						660.5	660.5	4.31	4.31
Digestible Nutrients						472.92	472.92	3.09	3.09

Factor III seemed to have less growth following pregnancy. May indicate that preg.
period checked growth. Date 10-30-09 to 4-3-10

GROUP II TABLE 5

Table Comparing Growth of Factor XXI After Pregnancy And Death of Pigs, With Factor XX at Same Period, Never Pregnant. Shows Effect of Pregnancy on Growth following A Time When there is No Lactation Period. Age XXI 9-3 to 12; XX 9-31 to 12-17.

Factor	First		Second		Period		Daily	
	XXI	XX	XXI	XX	Gain or Loss	XXI	Gain or Loss	XX
Weight	209	208	210	224	1	16	.0116	.1860
Height Withers	52	56	55	58	3	3	.0348	.0332
Height Croup	62	63	64	64	3	1	.0333	.0116
Breadth Shoulders	35	32	35	34	0	3	.0000	.0332
Breadth Sh. Pt.	26	25	27	27	1	3	.0116	.0332
Breadth Hams	31	31	31	31	0	0	.0000	.0000
Breadth Hip Bones	25	25	23	24	-2	-1	-.0233	-.0116
Heart Girth	110	112	112	112	2	0	.0233	.0000
Paunch Girth	136	132	132	127	-4	-5	-.0465	-.0581
Flank Girth	122	119	113	119	-9	-1	-.1046	-.0116
Depth Chest	34	33	36	35	2	3	.0232	.0332
Length Body	91	90	94	93	3	3	.0348	.0348
Width Head	17	17	17	17.5	0	.5	.0000	.0058
Cir. Rear Sh. Bone	16	16.5	16.5	16.5	0.5	0	.0058	.0000
Cir. Fore Sh. Bone	17	17	16.5	17	-.5	0	-.0058	.0000
Dist. Elbow Down	28	27	28	30	0	3.0	.0000	.0348
Dist. Sh. Pt. Down	30	29	31	33	1	4	.0016	.0467
Feed Consumed					306	336	3.56	3.9
Digestible Nutrients					219.1	240.58	2.55	2.79

There is hardly enough difference in rate of growth to be noted. XX grows a little faster but gets a little more feed. May be a slight check in growth due to early pregnancy.

XXI 1-21-11 to 4-17-11

XX 1-21-11 to 4-17-11

GROUP II TABLE 6.

Table Comparing Growth of Factor XXII Following Death of Litter Age 10-18 to 11-18 With Dry Factor XX Same Age. Show effect on Growth Where there is no or only Short, Lactation Period. Table Little Value as there were 6 lactation Days.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XXII	XX	XXII	XX	XXII	XX	XXII	XX
Weight	195	216	193	230	-3	14	-.0714	.5000
Height Withers	53	55.5	54	57	1	1.5	.0354	.0535
Height Croup	63	64	64	65	1	1	.0354	.0354
Breadth Shoulders	33	33	35	34	2	1	.0714	.0354
Breadth Sh. Pts	28	26	27	27	-1	1	-.0354	.0354
Breadth Hams	29	31	29	31	0	0	.0000	.0000
Breadth Hip Bones	24	24.5	23	23	-1	-1.5	-.0354	-.0535
Heart Girth	110	112	108	111	-3	-1	-.0714	-.0354
Paunch Girth	123	129	118	126	-5	-3	-.1785	.1070
Flank Girth	111	120	110	115	-1	-5	-.0354	-.1785
Depth Chest	33	36	34	35	1	-1	.0354	-.0354
Length Body	90	90	94	93	4	2	.1428	.0714
Width Head	16.5	17.5	16.5	17	0	-.5	.0000	-.0179
Cir. Rear Shin Bone	16	16.5	16.5	17.5	.5	1	.0178	.0354
Cir. Fore Shin Bone	16	17	17	18	1	1	.0354	.0354
Dist. Elbow Down	27	29	28	30	1	1	.0354	.0354
Dist. Sh. Pt. Down	29	30	30	33	1	3	.0354	.1070
Feed Consumed					109	112	3.9	4.0
Digestible Nutrients					178.04	80.2	2.79	2.86

Owing to short period and 6 lactation days, table is of little value. There is no great difference in measurements of Factor, weight excepted. May indicate that pregnancy does not check growth later. Date 3-18-11 to 3-18-11.

Table I indicates that growth rate is not affected by a previous gestation and lactation period.

Table 2 indicates that gestation and lactation may slightly decrease the growth rate in a following^{dry} period.

Table 3 seems to indicate a check in growth due to a previous gestation and lactation period.

Table 4 indicates that an early pregnancy may cause a decreased rate of growth in a following period.

Table 5 shows a little difference in the rate of growth. Possibly the pregnant condition has caused a slight check in growth.

Table 6 is of no value since the sow was suckled for six days.

The tables are too few in number to warrant any conclusions.

Feed Consumed Per 1000 Pounds Live Weight.

Several cases have been cited where investigators have found that no additional feed was required to produce the foetus. Some investigators have found that less feed was required by a pregnant animal than is the case for an open animal.

In studying the growth of a pregnant animal it is very important that the feed factor should be considered. If an animal shows a greater growth rate during the pregnant condition, it is important that we know whether this is due to an extra consumption of food, to the better use made of the food, or to some other cause. If an animal grows less while pregnant, it is important that we know the reason.

Individual feed records in the investigation under discussion have not been kept. Consequently it is questionable whether the data on this point as presented can be considered of much value.

Feed per 1000 Pounds Live Weight When Pregnant and When Open: Table III gives a comparison of the digestible nutrients consumed per thousand pounds live weight by pregnant Factors and open Factors. In working up this table the average weight of the Factors for the period has been computed from the weekly weight records. The feed consumed during the period was reduced to digestible nutrients because of the fact that the rations did not contain the same amounts, or the same percentage, of digestible nutrients.

The amount of digestible nutrients consumed per 1000 pounds live weight, and the period gain or loss for a pregnant

Table III

P R E G N A N T								D				R Y				
Fac- tor	D a t e	Per- iod	Wt.	Feed	Dig. Nut.	Dig. Nut per 1000#	Per'd Gain	Fac- tor	Per- iod	Weight	Feed	Dig. Nut.	Dig. Nut per 1000#	Period Gain		
VI	11/3/09 to 2/24/10	2nd	226	462	336	1485.1	75	IV	11/13/09 to 2/24/10	Dry	262.8	467	338.7	1290.5	77	
VI	6/2/10 to 9/25/10	3rd	255.5	411	346.5	1354.8	90	IV	6/2/10 to 9/25/10	Dry	327	222	187.2	572.7	10	
V	11/24/09 to 3/18/10	2nd	265.2	535	383.1	1444.2	60	VIII	11/24/09 to 3/18/10	Dry	288	535	383.06	1329	48	
V	6/1/10 to 9/10/10	3rd	293.4	219.	184.8	627.7	60	VIII	6/1/10 to 9/10/10	Dry	365	177	149.2	404.3	65	
V	12/9/10 to 4/3/11	4th	321	477.3	345.3	1074	45	VIII	12/9/10 to 4/3/11	Dry	431.7	489.1	352.1	813.4	24	
XIII	1/22/10 to 5/14/10	1st	176	480	344	1958	87	XIIIA	12/20/12 to 4/12/12	Dry	242	651	466	1925	93	
XI	12/26/09 to 4/18/10	1st	173.3	478.3	342.4	1976	68	XIA	12/17/11 to 4/8/12	Dry	175.6	585	420	2392	70	
XIV	12/7/09 to 3/31/10	1st	158.5	500	358	2254	107	XIIA	11/4/12 to 2/26/13	Dry	165.3	602	431	2607	75	
XIV	6/22/10 to 10/12/10	2nd	231.7	463	371	1598	97	XIIA	5/20/13 to 9/9/13	Dry	255.3	314.5	265.1	1037	20	
XXII	10/11/10 to 2/3/11	1st	183	502.3	360	1963	60	XXA	1/15/14 to 5/10/14	Dry	195	738	554	2841	120	
XXII	3/17/11 to 7/6/11	2nd	203	317	249	1225	6	XXA	6/21/14 to 10/10/14	Dry	310.5	507	423	1362	88	
XXX	10/1/12 to 1/25/13	1st	231	486	348	1503	119	XXIA	1/4/14 to 4/29/14	Dry	226	733	544	2404.5	127	
XXX	4/21/13 to 8/9/13	2nd	335	307	247	937.3	72	XXIA	6/25/14 to 10/13/14	Dry	315	496	418	1325	71	
XXXI	11/16/12 to 3/10/13	1st	248	509	364.4	1468.5	97	XIIB	3/26/12 to 7/18/12	Dry	193	565	447	2315.5	100	
XXXI	5/15/13 to 9/7/13	2nd	252	499	415	1646	60	XIIB	9/23/12 to 1/16/13	Dry	264	404	317	1197	11	
XXXI	2/16/14 to 6/10/14	3rd	351	791	587	1673	68	XIIB	6/26/13 to 10/18/13	Dry	352	304	256	728	-9	
XL	11/22/13 to 3/18/14	1st	250	752	538.4	2153	102	XIIIB	5/9/12 to 9/2/12	Dry	225	536	443.4	1969	82	
XL	11/2/14 to 2/25/15	2nd	349	605	446.4	1277	-26	XIIIB	4/19/13 to 8/12/13	Dry	349	351	275	787	51	
Total							1247	Total							27300	1123
Feed per 1000 Lbs. Live Weight							22.3	Feed per 1000 Lbs. Live Weight							24.3	
Per Lb. Gain								Per Lb. Gain								

animal was computed. These were compared with like figures for an open animal during an equal period in which the conditions were as nearly as possible like those found with the pregnant animal.

A general study of the table shows that, regardless of condition, in most cases the larger gains are made by the Factor receiving the larger amount of feed.

A consideration of each pair separately will lead to no definite conclusions, since in one case a pregnant Factor is found to consume more feed and make less gain than a farrow Factor and in the next pair considered we find just the opposite.

If the maintenance requirement for each individual were known it would probably be an easy matter to make comparisons. As it is, we can not tell how much of the ration is required for maintenance and how much goes to produce gains.

The animals were compared by groups but this method proved unsatisfactory as contradictory results were obtained just as is the case with pairs.

The only method which has been found to compare the pregnant and open Factors is to do so with the whole group.

Comparing the total digestible nutrients consumed per 1000 pounds live weight by pregnant and open Factors, the Table shows that 27413 pounds were consumed by pregnant Factors and 27300 pounds were consumed by open Factors. The pregnant animals gained 1347 pounds, against 1123 pounds for the farrow animals. The feed consumed per 1000 pounds live weight per pound of gain by the pregnant animals was

22 pounds against 24.3 pounds in the farrow individuals. This does not mean that 22 pounds and 24.3 pounds are required to produce one pound of gain, but rather that for each pound of gain these amounts are necessary for maintenance, gain etc.

The difference of 2.3 pounds in favor of the pregnant individuals may be due to the better use to which the food is put in the pregnant animals.

CHAPTER IV.

Lactation.Physiology and Structure of Mammary Glands:

All mammals possess mammary glands, the function of which is to provide nourishment for the newly born young. The number and position of these glands vary considerably in different species. The number in any species usually bears a relation to the normal size of the litter, or to the requirements of the newly born offspring.

In the Ungulates the mammae are contained within a definite milk bag, or udder, suspended below the abdomen. The udder is provided with milk-cisterns into which the milk is conveyed from the secretory glands. Each sinus communicates with the exterior by a teat. The number of teats varies in different animals.

The mammary glands are composed of lobes which are divisible into lobules. Each lobule contains a number of glands which arise from the secretory alveoli. They unite together to form the lactiferous ducts which open to the exterior by minute apertures through the teat.

The alveoli secrete milk during lactation, not merely while suckling is going on but also at other times, so that milk tends to collect in the ducts and reservoirs.

Theories of Secretion:

Three hypotheses have been advanced regarding the manner in which secretion takes place. According to one view the cells themselves break loose and become disintegrated, setting free their contents in the alveoli. Another theory

is that the cells simply excrete the substances without being destroyed themselves. According to the third hypothesis the nuclei of some of the cells separate and become disintegrated, leaving the basal portion still in position.

Each of the theories receives considerable support from various investigators. Perhaps the most widely accepted theory is the second of the above mentioned because of the fact that it has the analogy of the great majority of secretory glands, and that milk formation is believed to be a purely secretory process.

Composition of Milk:

The principal constituents of milk are water, proteins, fats and carbohydrates, and the salts calcium, potassium, magnesium and sodium. The composition of milk varies considerably in different mammals but this is largely in the proportion of the constituents present rather than in a change of constituents present.

Lusk* says, "The milk of one race is specifically adapted to growth of the offspring of that particular race. For example the ash of dog's milk has the same composition as the ash of the newly born pup. The percentage or quantity of constituents in milk is dependent upon the rapidity of growth of the organism."

Studies of the factors which influence the composition and yield of milk have been carried on largely with the dairy cow.

* Lusk: Science of Nutrition.

Marshall* gives the following as factors which influence the composition and yield of cow's milk:- breed of animal, period of lactation, season of year, interval between milking, sexual excitement, situation and climate, and character of food.

Duration of Secretion: the duration of lactation, according to Marshall, is governed by the needs of the young. It also depends on diet, treatment, and individual variation. Castration of an animal during the lactation period may cause her to yield for years.

Formation of Organic Constituents of Milk:-

The principal organic constituents of milk are peculiar to the secretion, a fact which shows that they are elaborated in the mammary glands themselves and not elsewhere in the body. Little is known regarding the origin of the caseinogen of milk. Those who accept the third theory of milk secretion mentioned previously, suggested that the degenerate nuclei of the gland cells furnish the caseinogen. Followers of the other theories must look to some other source for the protein.

Likewise little is known regarding the formation of milk fat. It may be changed in the glands from protein material or is possibly derived from fat formed elsewhere in the body. There is no reason for supposing that the cells of the glands do not possess, in common with most other tissues, the power to elaborate fat. The special composition

* Marshall: Phys. of Reproduction.

of milk fat seems to be by itself conclusive evidence that it is constructed within the mammary glands.

The opinions of investigators differ widely as to the origin of milk sugar. Marshall concludes from his study of investigations by different individuals, that there is little evidence that lactose is elaborated in the mammary glands from any closely related carbohydrate precursor carried thither from elsewhere in the body. It is of course obvious that this sugar must be derived ultimately from compounds contained in the food, and it would seem not improbable that it is manufactured partly from protein substances, and not merely from other carbohydrates.

Growth of Mammary Glands: Growth of the mammary tissue in most mammals is very limited until the beginning of the first pregnancy. In the human there is said to be growth at the time of puberty and ~~that~~ a slight hypertrophy generally takes place in connection with each period of pro-oestrus and oestrus. Marshall attributes these changes to ovarian influence which, he says, is probably responsible for the changes which occur at such times, in the other generative organs.

After the first conception a marked change takes place in the mammary tissue. Marshall discusses the work of Miss Lane-Claypan and Starling on the pregnant rabbit. These investigators found that growth began shortly after conception and continued to within a short time before parturition. This is quite noticeable in all forms of farm animals toward the end of the pregnant period. No doubt

growth takes place in all mammals from the beginning of the pregnant period.

It appears, from Marshall's discussion, that the stimulus to mammary growth arises originally in the ovary and afterwards from the embryo. The inference is that the stimulus is chemical in nature and has its origin either in the foetus or placenta. It has been shown by experiment that there is no nervous connection between the mammary glands and the embryo of the uterus.

To determine the origin of the stimulus a number of investigations have been carried on with rabbits. Injected extracts of pregnant rabbits' ovaries have been found to produce no effect on the mammary tissue of the non-pregnant rabbit. Foetal extract injected into the non-pregnant rabbit produced a development of the mammary glands.

Commencement of Mammary Secretion: A number of theories have been given to explain the beginning of the secretory process. One theory is that the secretory process which marks the cessation of growth of the mammary tissue was caused by the removal of this stimulus, in other words, by the expulsion of the foetus. Abortion or premature labour is often followed by the appearance of milk in the breasts. Another view states that the embryo inhibits the secretion, and upon the removal of the embryo secretion begins.

Miss Lane-Claypan and Starling have reached the following conclusions: "The anabolic changes associated with the

growth of the mammary glands are due to the assimilatory effects of a hormone elaborated in the foetus and carried thence through the placenta by the foetal and maternal circulation. The removal of this stimulus produces those katabolic changes which are involved in the breaking down of the built-up tissues and the consequent formation of milk."

The objections raised to the above theories are as follows:- they do not account for secretions of an indefinitely long period as in castrated cows; they do not account for secretions in animals which have not been pregnant, as young calves, mule mares, etc.; the theories do not account for secretions which sometimes occur in the male.

Factors Influencing Secretion:-

*Voit fed rations consisting of meat alone, meat and starch, meat and fat,^{and} fat alone, to a lactating bitch, and found^{the} influence upon the milk secretion comparatively small.

Dr. Foster ** states, "The quantity of fat present in milk is largely and directly increased by proteid but not increased, on the contrary diminished by the fatty food."

The results of the New York *** Agricultural Experiment Station show no increase of_{fat} for the protein of the food or any decrease in fat for a decrease of fat in^{the} food.

- * Lusk: Science of Nutrition.
- ** Dr. Foster: Text-book of Physiology.
- *** New York Report 1891.

During the first part of lactation there is an excess of fat in milk ^{that} over_^ of the food; later they even up, and at the end of the period there is an excess in the food. The animal stores up an excess of fat before birth of the young which is used up during the first part of the lactation^{period}, according to observations.

Fat shows a greater variation in milk than any other constituent. Casein follows second, then sugar, with the ash showing the least variation.

At the Indiana Station * it was found that feeding cottonseed meal to cows increased the percent of stearin in the fat of the milk.

At this station age was found to influence the fat content of milk. The young cow was found to produce less fat than the middle-aged cow.

At the New York Station** it was shown that the fat of milk must come from the carbohydrates of the food in some manner.

At the Wisconsin Experiment station exclusive wheat, corn, and oat rations of the same composition, as regards the principal nutrients, were compared as rations for dairy cows. There was a great difference noted in production, health and vigor, and the effect on the offspring.

German investigators **** have reached the conclusion that milk secretion is only indirectly affected by food and that feeding large amounts of fat do not change the content of milk fat.

* Indiana Rept. 1891

** Bul. 132 N.Y. State

*** Wis. Bulletin 17.

**** Exp. sta. Records V p. 968.

CHAPTER V.

Effect of Lactation on Growth.

There are several ways of determining the effect of lactation on growth. Direct observation of the individual during the lactation period will often show that the condition is a great drain on the maternal organism. Such a drain is indicated by a great loss of weight. Anyone familiar with swine raising knows that it is almost impossible to prevent a great loss in condition of a sow while suckling an average litter of pigs.

The method of observation can not be used solely as the means of determining the effect of lactation on growth. Observation can not tell us that loss of condition means a check in growth. It is very indefinite and varies in the eyes of different individuals.

As has been previously stated, breeders and investigators believe that too early breeding will stunt the growth of an animal. If this check in growth is due to the conditions gestation and lactation, and it is possible to show that gestation causes no check in growth, it would be necessary to go no further to show that lactation is a check to the growing condition.

A third method of showing the effect of lactation on growth, and the most accurate and definite of the three, is a direct comparison of lactating animals with dry individuals, which have been kept under the same conditions. This method, together with some conclusions drawn by the second method, is used in this investigation.

There can be no question that an animal producing milk requires an extra quantity of feed. This is recognized in all feeding standards and by all feeders. The question seems to be whether an individual can take enough nutriment to produce milk for the young and to produce growth at the same time. If this can not be done, then it must be determined whether milk production or growth is sacrificed.

W.M. Regan* in his thesis reports the results of an investigation carried on with dairy cows at this Station. He shows that lactation and growth have a marked effect on each other. He found that the rate of growth decreased markedly during the lactation period. He found further that the young growing animal produces less because of the growing condition.

Regan used height at withers and body weight as measurements of growth.

The following table shows the effect of lactation on height at withers as reported in his thesis.

* Regan, W.M. : Thesis U. of Mo. 1914.

Light Fed Late Calving Compared to Light Fed

Early Calving.

Table II.

Age in months	Height at Withers in Centimeters		Difference
	Late Calving	Early Calving	
18	115.2	114.1	1.1
19	116.0	114.7	1.3
20	117.5	115.4	2.1
21	118.6	116.2	2.4
22	119.3	117.2	2.1
23	120.1	117.7*	2.4
Gain in cm.	4.9	3.6	
Gain in percent	4.2	3.1	
24	121.0	118.1	2.9
25	121.9	118.3	3.6
26	122.4	118.5	3.9
27	123.5	119.0	4.5
28	124.2	119.5	4.7
29	125.1	121.0	5.0
30	125.5	120.6	4.9
31	126.2	121.1	5.1
32	126.6	121.9	4.7
33	127.0	122.6	4.4
34	127.3 *	123.0	4.3
35	127.5	123.7*	3.8
Gain in cm.	7.4	6.0	
Gain in percent	6.1	4.8	
36	127.7	123.6	4.1
37	127.0	123.7	3.3
38	127.2	123.4	3.8
39	127.3	123.1	4.2
40	127.1	123.0	4.1
41	127.5	123.2	4.3
42	127.7	123.2	4.5
43	127.3	123.3	4.0
44	127.9	123.4	4.5
45	128.1	123.5	4.6
Gain in Cm.	.7%	0	
Gain in percent	.5	0	

* Measurement before calving.

" The average height at withers for the animals of each of these groups are shown in Table III. A reference to Table II shows that at 18 months of age the late calving group were 115.2 cm. high and the average of the heights of the early calving group was 114.1 cm. This was six months before cows of the early calving group freshened. From this time on the early calving group gained in height at an increasingly slower rate than did the late calving group, until, a year later, or six months after they had calved the early calving group was 5 cm. less in height than the late calving group. Thereafter until the calving of the late calving group, the early calving cows gained at a slightly faster rate as compared to the late calving group. At the time of calving of the late calving group the early calving group was 123.7 cm. high while the late calving group measured 127.5 cm.

" For the first 23 months the management of both groups was in every way identical with the exception that the early calving group were pregnant from the 14th month to the 23rd month. After the early calving group calved, its ration was changed but the change was in the direction of being more favorable to growth as they got more feed and better care than they had had previously. In view of the fact I think that we are safe in concluding that the difference in growth between the two groups as above noted is due to the factor of milk production and our answer to the first question is an affirmative one, lactation does affect growth." (Regan)

The following Table shows a comparison of the late and early calving groups in body weight. It will be noted that the table shows the same general results as does the comparison of height measurements.

Light Fed Late Calving Compared with Light Fed Early Calving.

Age in Months	BODY WEIGHTS IN POUNDS		Difference
	Late Calving	Early Calving	
18	565	576	-11
19	601	604	- 3
20	612	625	-13
21	623	650	-27
22	647	672	-25
23	667	686*	-19
<hr/>			
	Gain in Lbs. 102	110	
	" " Percent 18.2	19	
24	690	610	80
25	689	636	63
26	736	657	79
27	771	677	94
28	795	693	102
29	813	705	108
30	832	709	123
31	867	735	132
32	894	769	125
33	932	790	142
34	944	800	144
35*	976*	850*	126
<hr/>			
	Gain in Lbs. 309	164	
	" " Percent 46.3	23.9	
36	823	750	73
37	840	761	79
38	855	784	71
39	863	771	92
40	883	803	80
41	886	821	65
42	900	831	69
43	907	866	41
44	937	892	45
45	970	916	54
46	976*	939	38
<hr/>			
	Gain in Lbs. 8	89	
	" " % 1	10.4	

* Weight at Calving

A comparison of weights shows that there is a sudden loss of weight at the time of calving, as would be expected, and from that time on, there is an increasingly greater loss until near the end of the lactation period.

Regan reaches the following conclusions:

1. Lactation does affect growth.
2. Growth does affect lactation.
3. The relative amount of the effect of each depends upon the length of time that has elapsed since the beginning of each.
4. The more immature the animal at the time of lactation, the greater is the check on growth, and the more tendency there is for the check to be a permanent one.

Minot* made a careful study of growth during the lactation period in guinea pigs. An extract from his "Senescence and Rejuvenation" shows the results of his investigation.

He says, "The complexity of the relations of the total weight to physiological conditions is illustrated by the fact that ^{altho} gestation does not hinder growth lactation causes a great loss of weight. I have utilized my records of the weights of the same 66 mothers tabulated in Tables XXIV and XXV and thus obtained the following:

* Journal of Physiology: Vol. XII.

TABLE XXVII

Average alterations of Weight of 66 Female Guinea pigs
Past Partum

Days after Delivery	Total Weight	No. of Obs.	Average	Increase	Ave. da. increase	Da. % Incr.
0	14726	24	613.6			
1-5	31657	55	575.6	-38.0	-7.6	-1.2
6-10	28367	51	556.2	-19.4	-3.9	-0.7
11-15	20933	36	581.5	-25.3	5.1	0.9
16-20	20595	36	572.1	-9.4	-1.9	-0.3
21-25	15394	28	549.8	-22.3	-4.5	-0.8
26-30	11603	20	580.1	-30.3	-6.1	1.1
31-35	11909	21	567.1	-13.0	-2.6	-0.4

By the system of interpolations I have obtained
from the above table the following:

TABLE XXVIII

Average Changes in Weights of Mothers During Lactation,
Based upon Observed Weights plus Weights Calculated and
Interpolated.

Days After Delivery	Total Weight	No. of Obs.	Average	Increase	Ave, Da. Incr.	Da % Incr.
0	14726	24	613.6			
1-5	60974	110	554.3	-59.3	-11.9	-1.9
6-10	57256	104	550.5	-3.8	-0.8	-0.1
11-15	49134	87	564.8	-14.3	2.9	0.5
16-20	55832	99	564.0	-0.8	-0.2	-0.03
21-25	46864	85	551.3	-12.7	-2.5	-0.4
26-30	39993	71	563.3	12.0	2.4	0.4
31-35	24543	43	570.8	7.5	1.5	0.3

"These tables show that there is a great and rapid loss of weight immediately after delivery and continuing several days, and that subsequently there is a continued loss of weight going on at a somewhat slower rate for about three weeks, after which the recovery of weight begins. Unfortunately the available data are insufficient to give a regular series of averages. The change is often so conspicuous in an individual that the eye notes it in looking at the mother from day to day.

"It is probable that during gestation there is an accumulation of material in the mother's body which afterwards is exhausted for the production of milk. In this manner we may account for the over gain in weight before delivery and the loss of weight after." (Minot)

Watson's Observations on White Rats.

The results of Watson's Observations with white rats has already been referred to.

His results show that unmated rats are lighter in weight than rats which have produced and raised three litters. His data show that there is a check in growth during the lactating period. Watson's investigation differed from that of other investigators of this subject in that he allowed the rats to recover fully after each lactation period before mating them again.

Griswold's Observations in Swine.

The following table is offered by Griswold as

a comparison of growth in dry and lactating factors.

The table shows very plainly that growth has been retarded in the lactating Factors. Factor number 5 shows a loss in nearly every measurement.

Griswold concludes that lactation greatly retards growth.

Growth in Centimeters During the Lactation Period
as Shown by Measurements. Feb. 28-May 11.

Factor	No. 6 check	No. 9 no.lact. period	No. 2 suckled on limi- ted rat- ion	No. 5 suckled on full ration
Height at Withers	7.0	4.0	3.0	-5.0
Height at Croup	6.0	4.0	0.0	-2.0
Length of Body	6.0	7.0	1.0	-3.0
Distance from Elbow to ground	4.0	3.0	0.0	0.5
Distance from Sh. Points to ground	5.0	2.0	1.0	-1.0
Depth of Chest	5.0	3.0	2.0	-4.0
Circumference front cannon	1.0	0.0	0.5	0.5
Circumference rear cannon	1.0	0.0	0.5	-0.5
Width of Head	1.0	1.0	-1.0	-0.5
Width of Sh. Points	2.0	1.0	0.0	-1.0
Width of Shoulders	5.0	0.0	-2.0	-5.0
Width of Hams	2.0	0.0	0.0	-4.0
Width of Ham Points	3.0	1.0	-1.0	-4.0
Heart Girth	9.0	2.0	-9.0	-22.0
Gain in Weight	3.0	-5.0	-4.0	-18.0

Results of the Swine Breeding Investigation
at this Station.

The records of the swine breeding experiment being carried on at this Station do not offer very much material for comparison of growth rate during dry and lactating periods. This is because of the fact that too great intervals elapse between the time of measurements after the first year. On account of the shortness of the periods it is seldom that two measurements occur during a single lactation period.

Fortunately, the few comparisons which have been made show the same general results. A larger number seems unnecessary to warrant the drawing of conclusions.

The comparisons in this group have been made in the same way as was explained for the pregnant Factors; namely, the daily gain or loss was computed for a certain interval during which the factor was suckling a litter, and was compared with the daily loss or gain of a dry Factor during the same period.

These comparisons are presented in the seven tables of Group IV which follow. Each table represents one comparison of a dry and lactating Factor. Each is commented upon at the end of the table.

Group IV Table I

Table Comparing Immature Factor VI During First Lactation Period with
Factor VII During Dry Period at Same Age; 70 and 71 Days. Age VI
9-9 to 11-18; VII 9-9 to 11-19.

Factor	Period Gain or Loss		Daily Gain or Loss	
	VI	VII	VI	VII
Weight	-30.5	17.5	-4435	.2464
Height Withers	-3.0	.5	-.0438	.00704
Height Group	-3.0	4.5	-.0285	.0633
Breadth Shoulders	-3.5	2.5	-.050	.0352
Breadth Sh. Pts.	-3.0	1.0	-.0285	.0140
Breadth Hams	-3.0	0.0	-.043	.000
Breadth Hip Bones	-1.5	-.5	-.0214	-.00704
Heart Girth	-16.0	1	-.2285	.0140
Paunch Girth	-10	5	-.1428	.0704
Flank Girth	-12	6	-.1714	.0845
Depth Chest	-2.5	-1.5	-.0357	-.03112
Length Body	-4	5.0	-.0571	.0704
Width of Head	-.5	1	-.0071	.0140
Cir. Rear Sh. Bone	0	.5	.0000	.00704
Cir. Fore Sh. Bone	-.5	.5	-.0071	.00704
Distance, El. Down	0	-2	10000	.03804
Dist Sh. Pt. Down	-.5	-1	-.0071	-.0140
Feed Consumed		Approximately Same		

Growth is checked by lactation as shown by nearly all measurements.

GROUP IV TABLE II

Table Comparing the Immature Factor V During Second Lactation Period With Factor VIII Day. At Same Age. Age V 19-4 to 20-21; VIII 19-2 to 20-14

Factor	Cm.	First		Second		Period		Daily	
		Measurement V	Measurement VIII	Measurement V	Measurement VIII	Gain or Loss V	Gain or Loss VIII	Gain or Loss V	Gain or Loss VIII
Weight		259	320	248	328	-11	8	-.2444	.1905
Height Withers		60.5	66.5	60	65.5	-.5	-1	-.0111	-.0238
Height Group		67.5	74.5	66.5	73	-1	-1.5	-.0322	-.0357
Breadth Shoulders		36.5	40	31	40	-5.5	0	-.1322	.000
Breadth Sh. Pt.		32.5	36	29	35	-3.5	-1	-.0778	-.0238
Breadth Hams		31	36	29.5	37	-1.5	1	-.0333	.0328
Hip Bones		27.5	32	25	32	-2.5	0	-.0556	.000
Heart Girth		118	135	111	141	-7	6	-.1556	.1428
Flank Girth		123	132	110	140	-13	8	-.2900	.1905
Paunch Girth		139	143	140	148	1	5	.0222	.1190
Depth Chest		39	42	38	42	-1	0	-.0222	.0000
Length Body		93	102	95	105	2	3	.0444	.0714
Width Head		12.5	13.5	12.5	13.5	0	0	.0000	.0000
Cir. Rear Sh. Bone		17	17.5	16.5	18	.5	.5	.0111	.0119
Cir. Fore Shin Bone		16.5	17.5	17.	17.5	.5	0	.0111	.0000
Dist. Elbow Down		30	33	31	33	1	0	.0322	.0000
Dist. Sn. Pt. Down		33	35	34	35	1	0	.0322	.0000
Feed Consumed						347	105	3.71	2.5
Digestible Nutrients						238.45	82.17	5.52	1.95

Altho receiving three times the amount of feed, Factor V grows less than VII, as shown by nearly all measurements.

Group IV Table 3

Table Comparing Factor XI During First Lactation Period with Dry Factor
XIA At the Same Age. Age XI 11-31 to 12-15; XIA 11-3 to 12-1.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XI	XIA	XI	XIA	XI	XIA	XI	XIA
Weight	188	237	187	262	-1	25	-.04	.9000
Height Withers	51	61	52	59	1	-2	.04	-.0714
Height Croup	59	69	60.5	68	1.5	-1	.0600	-.0357
Breadth Shoulders	30	34	30	36	0	4	.0000	.1428
Breadth Sh. Pt.	27.5	25	26.5	28	-1	3	-.04	.1071
Breadth Hams	29	34	27.5	39	-1.5	5	-.0600	.18
Breadth Hip Bones	25	23	23	24	-2	1	-.08	.0357
Heart Girth	107	124	105	124	-2	0	-.08	.0000
Paunch Girth	135	140	130	144	-5	4	-.2000	.1428
Flank Girth	108	120	110	121	2	1	.09	.0325
Depth Chest	33	38	33.5	39	.5	1	.02	.0325
Length Body	90	90	88	89	-2	-1	-.320	-.0325
Width Head.	11.5	17	11.5	18	0	1	.000	.0325
Cir. Rear Sh. Bone	15	15	15	15.5	0	.5	.000	.0179
Cir. Fore Sh. Bone	15	15	15	15.5	0	.5	.000	.0179
Dist. Elbow Down	28	31	29	31	1	0	.04	.0000
Dist. Sh. Pt. Down	29	33	31.5	34	2.5	1	.100	.0325
Feed Consumed			133		133	140	5.32	5.21
Digestible Nutrients			95.23	105.1	95.23	105.1	3.81	3.8

Factor XI Gains more in height and distance from elbow and shoulder point down. Measurements indicate check in growth due to lactation.

XI 5-2-10 to 6-15-10

XIA 4-20-12 to 5-18-12

Group IV Table 4

Table Comparing Lactation Period of Factor XIII with Dry Period of Factor XIIA. At About the Same Age. Age XIII 11-21 to 13-16 XIIA 11-5 to 13-5

Factor	First Measurements		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XIII	XIIA	XIII	XIIA	XIII	XIIA	XIII	XIIA
Weight	182	220	164	231	-18	11	-.3214	.3667
Height Withers	54.5	56	55	57	15	1	.00803	.0333
Height Croup	61.5	64	61.5	66	0	2	.0000	.0666
Breadth Shoulders	30.5	33	28	25	-2.5	3	-.0446	.10
Breadth Sh. Pt.	27.5	24	24	25	-3.5	1	-.0625	.0333
Breadth Hams	28	29	25	32	-3	3	-.0556	.10
Breadth Hip Bones	24.5	21	21	22	-3.5	1	-.0625	.0333
Heart Girth	105	112	100	116	-5	4	-.0803	.1333
Paunch Girth	123	124	117	128	-6	4	-.01113	.1333
Flank Girth	108	112	110	115	2	3	.03571	.1000
Depth Chest	33.5	35	32	37	-1.5	2	-.0268	.0666
Length Body	96	94	82	94	-14	0	-.25	.0000
Width Head	11	17	11.5	16.5	.5	-.5	.00803-	.01666
Cir. Rear S. B.	15	15.5	14.5	16	-.5	.5	-.00803	.0166
Cir. Fore S. B.	15	16	15	16	0	0	.0000	.0000
Dist. Elbow Down	30	29	30	30	0	1	.0000	.0333
Dist. Sh.Pt. Down	32.5	31	32	32	-.5	1	-.00803	.0333
Feed Consumed					352	126	6.28	4.2
Digestible Nutrients					252.3	90.22	4.5	3.01

Dry Factor XIIA gains more in all measurements but width of head. Received much less feed. Indicates check in growth due to lactation.

XIII 5-21-10 to 7-16-10

XIIA 4-3-13 to 5-3-13.

TABLE 5 GROUP IV

Table Comparing Growth of Factor XXXI During first Lactation Period with Dry Factor XXIA at Same Age. Age XXXI 11-0 to 12-4 (9 days pregnant 26 days suckling) XXIA 11-2 to 12-3

Factor	Cm.	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
		XXXI	XXIA	XXXI	XXIA	XXXI	XXIA	XXXI	XXIA
Weight		290	289	250	295	-40	6	-1.143	.2000
Height Withers		58	60	59	62	1	2	.0285	.0667
Height Croup		55	64	65	67	0	3	.0000	.1000
Breadth Shoulders		38	38	35	38	-3	0	-.0857	.0000
Breadth Sh. Points		28	29	26	30	-2	1	-.0571	.0333
Breadth Hams		33	37	31	36	-2	-1	-.0571	-.0333
Breadth Hip Bones		26	25	23	26	-3	1	-.0857	.0333
Heart Girth		129	125	117	122	-12	-3	-.3426	-.10
Paunch Girth		145	132	142	136	-3	4	.0857	-.1333
Flank Girth		120	122	129	123	9	1	.2571	.0333
Depth Chest		37	36	37	35	0	-1	.0000	-.0333
Length Body		94	98	95	98	1	0	.0285	.0000
Width Head		17	16	17	16	0	0	.0000	.0000
Cir. near Sh. Bone		17	17	17	17	0	0	.0000	.0000
Cir. Fore Sh. Bones		17	17	16.5	17	-.5	.0	-.0143	.0000
Dist. Elb. Down		30	26	29	27	-1	-1	-.0285	-.0333
Dist. Sh. Pt. Down		32	30	31	30	-1	0	-.0285	.0000
Feed Consumed						231	134	6.6	4.45 lbs.
Digestible Nut. Lbs.						165.4	113.0	4.73	3.76 pas.

Lactating Factor shows a loss or no gain in nearly all measurements. Indicates check due to lactation. XXIA shows little gain but surpasses XXXI in most measurements.

XXXI 3-11-13 to 4-5-13
XXIA 6-6-14 to 7-6-14

GROUP IV TABLE 7

Table Comparing Growth of Factor XIIA During Lactation Period with
Factor XIIB Dry. Preg. 20 Days. Age. XIIA 27-5 to 30-5; Age XII B
27-5 to 30-5.

Factor	Cm.	First		Second		Period		Daily	
		XIIA XIIB	Measurement	XIIA XIIB	Measurement	Gain or Loss XIIA XIIB	Gain or Loss XIIA XIIB	Gain or Loss XIIA XIIB	Loss XIIIB
Weight		368	314	243	331	-125	17	-1.395	.1867
Height at Withers		66	62	62	65	-4	3	-.0436	.0333
Height at Croup		71	69	67	70	-4	1	-.0436	.0110
Breadth at Shoulders		40	36	31	39	-9	3	-.0978	.0330
Breadth S. Pts.		26	26	23	28	-3	2	-.0326	.0220
Breadth Hams		35	33	30	36	-5	3	-.0545	.0330
Breadth Hip Bones		29	26	21	28	-8	2	-.0872	.0220
Heart Girth		135	127	109	134	-26	7	-.2286	.0769
Paunch Girth		152	138	126	145	-26	7	-.2286	.0769
Flank Girth		140	135	109	131	-31	6	-.3369	.0659
Depth Chest		42	41	47	43	5	1	.0545	.0110
Length Body		109	110	104	110	-5	0	-.0545	.0000
Width Head		18	18.5	18	19	0	.5	.0000	.0055
Cir. Rear Sh. Bone		17	17.5	16.5	17.5	-.5	0	-.0055	.0000
Cir. Fore Sh. Bone		17	17.5	17	17.5	.000	0	.0000	.0000
Dist. Elbows Down		31	29	32	31	1	2	.0109	.0220
Dist. Sh. Pt. Down		34	31	33	33	-1	2	-.0109	.0220
Feed Consumed						762	581	8.38	6.38
Digestible Nutrients						551.8	416	6	5.38

Lactating Factor shows loss in nearly every measurement the receiving more feed than dry factor. Indicates check due to lactation.

XIIA 8-3-14 to 11-3-14

XIIB 12-6-13 to 2-7-14

GROUP IV TABLE 8

Table Comparing Growth of Factor XIIA During Lactation with that of Factor XIIB Dry. Age XIIA 21-5 to 24-5; XIIB 21-27 to 24-28

Factor	First Measurement XIIA XIIB	Second Measurement XIIA XIIB	Period		Daily	
			Gain or Loss XIIA XIIB	Gain or Loss XIIA XIIB	Gain or Loss XIIA XIIB	Gain or Loss XIIA XIIB
Weight	340	334	-27	21	-.3034	.2260
Height Withers	64	63	1	3	.0112	.0322
Height Croup	70	69	1	2	.0112	.0215
Breadth Shoulders	36	42	0	-4	.0000	-.0430
Breadth Sh. Pts.	28	27	-2	1	-.0235	.0107
Breadth Hams	33	34	0	-1	.0000	-.0107
Breadth Hip Bones	27	24	-1	2	-.0112	.0215
Heart Girth	126	138	1	-2	.0112	-.0215
Paunch Girth	153	153	-9	-5	-.1111	-.0535
Flank Girth	130	133	-4	-8	-.0449	-.086
Depth of Chest	41	42	0	1	.0000	.0107
Length of Body	106	112	0	2	.0000	.0215
Width of Head	18	17.5	0.5	-5	.0000	-.0053
Cir. Rear Sh. Bone	18	17	-1	0	-.0112	.0000
Cir. Fore Shin Bone	17.5	17	-.5	0	-.0056	.0000
Dist. Elbow Down	30	31	1	0	.0112	.0000
Dist. Sh. Pt. Down	32	33	1	0	.0012	.0000
Feed Consumed			866	256	10.85	3.22
Digestible Nutrients			702.7	215.81	7.9	2.71

Lactating Factor does not show so much loss in this case, in fact shows some gain, probably due to large quantity of feed received. However the dry Factor shows more gain. Factor only suckled 3 pigs.

XIIB 6-6-13 to 9-7-12
XIIA 2-3-14 to 5-3-14

A study of the tables shows that not only do the lactating Factors grow slower than do the dry individuals, but they show a loss in nearly all measurements during the period .

The decrease in measurements must of course be due chiefly to loss of fat and muscle. It is unlikely that the skeleton shows any decrease. If there is any growth during the lactation period, the methods of measurement now used are not accurate enough to detect it.

From this study it seems safe to conclude that lactation causes a marked check on growth rate in young sows.

CHAPTER VI.

Feed Consumed During Pregnancy and Lactation.

Comparisons of feed consumed per 1000 pounds live weight during a lactating period and a corresponding dry period have been made. The data have been taken from the weekly weight and feed records, and have been computed in the same manner as was explained for pregnant animals.

Table I, Group V, offers an interesting study not only for comparing dry and lactating Factors but also for comparing different lactating Factors, and the same Factor during different periods.

A glance is all that is necessary to see that the lactating animals consume far more feed per 1000 pounds live weight than do the dry Factors. The lactating animals have lost in weight in eleven cases out of thirteen considered. In the other two cases, very small gains were made. The loss in weight varies from 11 to 140 pounds for the period in different individuals.

Feed Consumed Per 1000 Lbs.

Table I

Live Weight During Lactation and Dry Periods.

Group V

									L A C T A T I N G										Pig
Fac- Tor	D a t e		D Per- iod	R Wt	Y Feed	Dig. Nut.	Per 1000#	Gain	Fac- tor	D a t e		Per- iod	Wt.	Feed	Dig. Nut.	per 1000#	Gain or Loss	Raised ✓	
IV	2/24/10	to 5/4/10	Dry	318	269	199	626	29	VI	2/24/10	to 5/4/10	2nd	213.9	471	337.24	1575	-45	8	
VIII	3/18/10	to 5/25/10	Dry	328.4	137	106	332	11	V	3/18/10	to 5/25/10	2nd	258	396	283.5	1089	-63	5	
VIII	9/10/10	to 11/16/10	Dry	410	201	169.4	413.4	0	V	9/10/10	to 11/16/10	3rd	290.5	473	339	1165	+ 5	3	
XIA	4/8/12	to 6/5/12	Dry	266	290	224	840.4	79	XI	4/18/10	to 6/15/10	1st	186.6	236	169	904	-11	3	
XIIIA	4/12/13	to 6/18/13	Dry	293.4	236	184.3	634	22	XIII	5/14/10	to 7/20/10	1st	162	362	259	1599	-50	5	
XIIA	2/26/13	to 5/6/13	Dry	217.2	345	247	1136	27	XIV	3/31/10	to 6/8/10	1st	163	366	262	1609	-26	5	
XIIA	9/9/13	to 10/28/13	Dry	281	244	183.3	651	47	XIV	10/12/10	to 12/1/10	2nd	221.5	326	233.4	1053	-40	7	
XIIB	7/18/12	to 9/18/12	Dry	245	283	239	974	15	XXXI	3/10/13	to 5/10/13	1st	254	567	406	1596	-39	7	
XIIB	1/16/13	to 3/17/13	Dry	274	319	228	834	16	XXXI	9/7/13	to 11/8/13	2nd	264	447	320	1216	-61	3	
XIIB	10/18/13	to 12/23/14	Dry	312	225	164	526	-35	XXXI	6/10/14	to 8/15/14	3rd	336.4	476	341	1012	-44	6	
XIIIB	9/2/12	to 11/5/12	Dry	265	256	218	820	33	XL	3/18/14	to 5/21/14	1st	282.5	616	441	1561	-42	6	
XIIIB	8/12/13	to 10/12/13	Dry	375.5	292	157	417	28	XL	2/25/15	to 4/25/15	2nd	322.4	363	273.3	847.3	+ 5	4	
XXIA	10/13/14	to 1/12/15	Dry	330	391	302	915	-17	XXE	8/9/13	to 11/8/13	2nd	286	659	472	1652	-140	8	

N.B. Measurements in Pounds.

On the other hand the dry Factors have gained in most cases and have consumed far less feed. The gain has varied from 11 up to 79 pounds.

It is of interest to note the variation in the amount of feed consumed by different Factors during the lactation period and also the amount consumed by the same Factors during different periods.

As a general rule, the quantity of feed consumed depends somewhat on the size of the litter, as would be expected. However, this does not seem to be the only factor determining the amount of feed consumed.

One interesting comparison in the Table is that of Factors XIV and XXXI. Each suckled 7 pigs and lost the same in weight, but Factor XXXI received practically 50 percent more feed during the period. Factor XXXI was raising her first litter while XIV was raising the second, but this factor does not seem sufficient to account for the difference.

Another interesting case is a comparison of Factors VI and XXX. Each raised eight pigs during their second lactation periods. Factor XXX received 77 pounds more of feed and lost 140 pounds in weight against 45 pounds for Factor VI.

Factors XIII and XIV have received practically the same amounts of feed and raised the same size litters. Factor XIV has lost twice as much in weight.

Again, Factor XXXI during the third lactation period has raised six pigs, consumed 1012 pounds of nutrients per

1000 pounds live weight and lost 44 pounds in weight. Factor XL during the first lactation period has raised six pigs, lost 42 pounds in weight, but consumed 50 percent more feed per 1000 pounds live weight.

It seems that the feed consumed is determined largely by the needs of the individual and that other factors are only secondary.

The following conclusions seem to be warranted:

Lactating sows consume more feed than do Dry Factors.

Sows suckling large litters require more feed as a rule than do those suckling small litters.

These conclusions are in accord with the opinions of practical hog raisers.

Feed Consumed During Successive Pregnant and Lactating Periods: Tables (Group VI) showing the digestible nutrients consumed per 1000 pounds live weight and the total gain or loss in weight during successive pregnancies and lactations have been worked out for nearly all Factors. This table has been worked out in the same way as were those in which the comparison was made with dry and open Factors and should require no further explanation.

The purpose of the table is to compare the nutrients consumed during successive pregnant and lactating periods, to compare the amounts consumed by successive generations of Immature Factors, and to compare the amounts consumed by Immature Factors with that consumed by Mature and Half Mature Factors.

Owing to the large number of conditions entering in, it is difficult to make a satisfactory comparison.

A study of the table is necessary

to compare the digestible nutrients consumed during successive pregnancies and lactation periods. It is readily seen that there is no regular increase or decrease during successive pregnancies but this varies with conditions. The records of Factors VI and V show some indication of a decrease in nutrients consumed during successive pregnancies, i.e., a smaller amount of feed will produce just as much or more gain in the second or third pregnancies as it did in the first, etc. However, an examination of the records shows that Factors XI and XXXI, in particular, show the opposite, or, in other words, show an increased amount of nutrients producing less gain in later periods than was the case in the first period.

The data are not complete enough to allow any conclusion to be drawn. It would seem that the digestible nutrients consumed vary with conditions rather than with the period of pregnancy. The condition of the animal at the beginning of the period is an important thing to consider in this connection. If an animal has suckled a large litter, and consequently is in very poor condition at the beginning of pregnancy, she seems to make better use of her feed and shows a more rapid gain during the next pregnant period than is the case when she is in good condition at the start. Individual variation is no doubt an important point to consider.

Feeds Consumed by Successive Generations of Immature Factors.

It is likewise very difficult to make a satisfactory

GROUP VI

Feed per 1000 Lbs. Weight

Table I

Successive Pregnant Periods

P R E G N A N T									L A C T A T I N G									
Fac- tor			Per- iod	Wt.	Feed	Dig. Nut.	Per 1000#	Gain	Fac- Tors	D a t e		Per- iods	Wt.	Feed	Dig. Nut.	Per 1000#	Gain lbs.	No. Pg.
VI	11/3/09	to 2/24/10	2nd	226	462	336	1485	75	VI	2/24/10	to 5/4/10	2nd	214	471	337.24	1575	-45	8
VI	6/2/10	to 9/25/10	3rd	255.5	411	346.5	1355	90	VI	9/25/10	to 11/23/10	3rd	290.5	411	294.3	1012.4	-6	4
VI	12/12/10	to 4/3/11	4th	315.6	457.3	327.4	1034.4	45	VI	4/3/11	to 6/3/11	4th	262.3	294	210.5	802	-120	7
VI	6/6/11	to 9/26/11	5th	253	475	371.6	1467.8	121	VI	9/26/11	to 12/2/11	5th	298.3	482	345	1155.75	-29	4
VI	12/23/11	to 4/2/12	6th	307.4	601	430.3	1398.5	57	VI	4/2/12	to 6/8/12	6th	330	527	377.3	1143	+ 20	3
VI	6/13/12	to 10/5/12	7th	359	422	356	997	66	VI	10/5/12	to 12/7/12	7th	376	355	254.2	678.2	-60	7
V	11/24/09	to 3/18/10	2nd	265.2	535	383.06	1444.14	60	V	3/18/10	to 5/25/10	2nd	258	396	283.5	1088.8	-63	5
V	6/1/10	to 9/10/10	3rd	293.4	219	184.6	629.09	60	V	9/10/10	to 11/16/10	3rd	290.5	473	338.7	1165.	+ 5	3
V	12/9/10	to 4/3/11	4th	321	477.3	345.3	1073.88	45	V	4/3/11	to 6/3/11	4th	270	320	229.1	848	-97	5
V	6/7/11	to 9/27/11	5th	276	501	390.20	1412	110	V	9/27/11	to 12/2/11	5th	323	469	335.8	1037.6	-33	3
V	1/10/12	to 5/3/12	6th	330	606	434	1315	66	V	5/3/12	to 6/29/12	6th	353	530.5	380	1079	-12	7
V	1/26/13	to 5/21/13	7th	391	644.5	415	1062	49	V	5/21/13	to 7/27/13	7th	380	289	207	544.4	-64	4
XI	12/26/09	to 4/18/10	1st	173.3	478.25	342.4	1975.8	68	XI	4/18/10	to 6/15/10	1st	186.6	236	169	904.15	-11	3
XI	6/23/10	to 10/15/10	2nd	224	469	375	1672.5	72	XI	10/15/10	to 12/14/10	2nd	239	414	296.4	1227	- 5	5
XI	12/14/10	to 2/22/11	3rd	240	415.3	297.4	1240	-10	XI	3/22/11	to 5/6/11	3rd	217	90	66	304	-26	0
XI	6/6/11	to 9/28/11	4th	246	473	396.4	1609	97	XI	9/28/11	to 12/2/11	4th	233.5	484	346.5	1483	-77	6
XI	12/13/11	to 4/5/12	5th	257	619	443	1727	45	XI	4/5/12	to 6/8/12	5th	238	567	406	1705	- 7	7
XI	6/14/12	to 10/7/12	6th	253.4	451	348.2	1372	41	XI	10/7/12	to 12/7/12	6th	261.4	582	416.7	1591	-22	6
XIII	1/22/10	to 5/14/10	1st	175.7	497.75	343.5	1958	87	XIII	5/14/10	to 7/20/10	1st	162	362	259.2	1599	-50	5
XIV	12/7/09	to 3/31/10	1st	158.5	499.75	357.8	2254	107	XIV	3/31/10	to 6/8/10	1st	163	368	262	1608	-26	5
XIV	6/22/10	to 10/12/10	2nd	231.7	463	370.75	1598	97	XIV	10/12/10	to 12/1/10	2nd	223.5	326	233.4	1052.6	-40	7
XIV	1/22/11	to 4/26/11	3rd	244	560	401	1644	17										
XXII	10/11/10	to 2/3/11	1st	183	502.3	359.6	1963.4	60										

TABLE I GROUP VI

P R E G N A N T								
Fac- tor	D a t e	Per- iod	Wt.	Feed	Dig. Nut.	Per 1000#	Gain	
XXII	3/17/11 to 7/6/11	2nd	203	317	249	1225	6	
XIII	12/12/11 to 4/1/12	3rd	304	552	395	1296	16	
XXII	6/12/12 to 10/1/12	4th	312.5	440	361	1155	5	
XXII	12/15/12 to 4/6/13	5th	312	691	495	1584	101	
XXII	6/15/13 to 10/7/13	6th	321	540	447	1390	56	
XXX	10/1/13 to 1/25/13	1st	231	486	348	1503.4	119	
XXX	4/21/13 to 8/9/13	2nd	334.7	307	247	737	72	
XXX	9/13/14 to 1/3/15	3rd	443	544	437	983	37	
XXX	8/7/15 to 10/23/15	4th	406	558.5	453	1114	14	
XXXI	11/16/12 to 3/10/13	1st	248	509	36.4	1468.5	97	
XXXI	5/15/13 to 9/7/13	2nd	252	499	414.6	1645.8	60	
XXXI	2/16/14 to 6/10/14	3rd	350.6	791.	586.8	1672.4	68	
XXXI	12/9/14 to 3/31/15	4th	375	609	436	1164	15	
XXXI	6/22/15 to 10/12/15	5th	358	462	390	1092	56	
XL	11/22/13 to 3/18/14	1st	250	752	538.4	2153	102	
XL	11/2/14 to 2/25/15	2nd	349	605	446.4	1277	-26	
XL	6/18/15 to 10/10/15	3rd	328	469	395	1205	10	
L	10/20/14 to 2/13/15	1st	223.5	808.5	626	2798	115	
L	5/10/15 to 8/31/15	2nd	331	651	549	1658	22	
L	10/1/15 to 1/22/16	3rd	377	624.5	461	1222	119	
LI	1/13/15 to 5/6/15	1st	240	755	541	2250	111	

CONCLUDED

L A C T A T I N G											
Fac- tor	D a t e	per- iod	Wt.	Feed	Dig. Nut	Per 1000#	Gain	No. Pigs			
XXII	4/1/12 to 6/8/12	3rd	289	546	391	1353	-31	4			
XXII	10/1/12 to 12/7/12	4th	292	644	461	1576	-49	9			
XXII	4/6/13 to 6/7/13	5th	317.5	724	518.4	1633	-70	8			
XXII	10/7/13 to 12/6/13	6th	290	697	499	1717	-79	7			
XXX	8/9/13 to 11/8/13	2nd	286	659	472	1652	-140	8			
XXXI	3/10/13 to 5/10/13	1st	254	567	406	1595.6	-39	7			
XXXI	9/7/13 to 11/8/13	2nd	264	447	320	1216	-61	3			
XXXI	6/10/14 to 8/15/14	3rd	336.4	476	341	1012	-44	6			
XXXI	3/31/15 to 6/5/15	4th	361	334	239	662	-50	1			
XXXI	10/12/15 to 12/7/15	5th	304	481	344.4	1133	-113	7			
XL	3/18/14 to 5/21/14	1st	282.5	616	441	1561	-42	6			
XL	2/25/15 to 4/25/15	2nd	322.4	363	273.3	847.3	+ 5	4			
XL	10/10/15 to 12/7/15	3rd	322	510	349	1054	+12				
L	2/13/15 to 5/8/15	1st	293	518	377	1286	+25	2			
LI	5/6/15 to 7/24/15	1st	260	468.5	335.4	1288	-33				

All measurements in Pounds.

GROUP VI

Feed Per 1000 Pounds Weight

TABLE II

Successive Pregnancy and Lactation, Mature and Half Mature

P R E G N A N C Y									L A C T A T I O N								
Fac- tor	D a t e	Per- iod	Wt.	Feed	Dig. Nut.	Per 1000	Gain		Fac- tor	D a t e	Per- iod	Weight	Feed	Dig. Nut	Per 1000#	Gain or Loss	Pigs Rsd.
IV	9/25/10 to 1/14/11	1st	365.5	369	298	814	62		IV	1/14/11 to 3/18/11	1st	325	239	171	525	-100	1
IV	4/18/11 to 8/11/11	2nd	314	362	267	849	73		IV	8/11/11 to 10/14/11	2nd	298	469	336	1126	- 88	8
IV	1/11/12 to 5/4/12	3rd	325	589	422	1300	55		IV	5/4/12 to 6/29/12	3rd	347	396	284	818	-13	3
IV	7/ 5/12 to 10/30/12	4th	340	478	397.3	1168	69		IV	10/30/12 to 12/21/12	4th	319	443	317	992	-77	5
IV	2/5/13 to 6/1/13	5th	347	706	505.5	1456	122		IV	6/1/13 to 7/26/13	5th	374	538	385	1028	-60	3
VIII	5/2/11 to 8/25/11	1st	460	392	323	701	46		VIII	8/25/11 to 10/28/11	1st	458	420	301	656	-26	3
VIII	1/17/12 to 5/10/12	2nd	469	641	459	978	61		VIII	5/10/12 to 6/29/12	2nd	458	238	170.5	372	-64	3
VIII	7/2/12 to 10/27/12	3rd	452	436	347	767	71		VIII	10/27/12 to 12/21/12	3rd	395	457	327	827	-124	7
VIII	12/25/12 to 4/9/13	4th	403	674	483	1198	138		VIII	4/9/13 to 6/14/13	4th	407	186	157	385	-86	4
VIII	7/17/13 to 11/7/13	5th	440	500	395	897	65		VIII								
VIII	11/22/13 to 3/17/14	6th	506	583	418	823	111		VIII	3/17/14 to 5/18/14	6th	522	325	253	483	-20	-
III	5/27/10 to 9/19/10	1st	330	291	169	512	40		III	9/19/10 to 11/16/10	1st	304	393	281.4	925	-45	6
III	2/21/11 to 6/13/11	2nd	317	360	270	851	34		III								
III	1/7/12 to 4/28/12	3rd	428	603	432	1007	93		III	4/28/12 to 6/29/12	3rd	399	405	290	725	-119	5
III	7/3/12 to 10/24/12	4th	389	445	369	948	60		III	10/24/12 to 12/21/12	4th	365	462	331	897	-60	7
III	12/21/12 to 4/15/13	5th	373	726	520	1394	21		III	4/15/13 to 6/15/13	5th	364	671	480	1315	-85	8
III	6/21/13 to 10/13/13	6th	377	555	453.4	1202	115		III	10/13/13 to 12/6/13	6th	405	488	349	862	-10	3
VII	7/23/10 to 11/15/10	1st	456	291	325	712	40		VII	11/15/10 to 1/14/11	1st	385	297	213	553	-46	2
VII	1/23/11 to 5/7/11	2nd	369	420	305	827	30		VII	5/17/11 to 7/19/11	2nd	298	410	294	1000	-60	7
XIA	9/17/12 to 1/8/13	1st	400	245	184	460	0		XIA	1/8/13 to 3/8/13	1st	372	222	159	426	-37	1
XIA	3/13/13 to 7/4/13	2nd	379	446	331	871	21		XIA	7/4/13 to 9/13/13	2nd	358	593	425	1190	-50	4
XIA	11/6/13 to 2/28/14	3rd	392	645	462	1178	97		XIA	2/28/14 to 5/2/14	3rd	325	609	489	1501	-130	9

GROUP VI

P R E G N A N C Y							
Fac- tors	D a t e	Per- iod	Weight	Feed	Dig. Nut.	Per 1000	Gain
XIA	5/2/14 to 8/24/14	4th	365	597	490	1343	145
XIIA	10/28/13 to 2/28/14	1st	327	685	491	1486	20
XIIA	4/28/14 to 8/22/14	2nd	346	615	440	1272	47
XIIA	12/6/14 to 4/1/14	3rd	314	693	496	1577	-13
XIIIA	10/28/13 to 2/20/14	1st	379	609	436	1151	53
XIIIA	4/28/14 to 8/20/14	2nd	361	607	501	1388	61
XXA	1/14/15 to 5/6/15	1st	396	594	438	1104	45
XIIIB	2/19/14 to 6/13/14	1st	464	760	565	1215	39
XIIB	2/13/14 to 6/6/14	1st	340	799	593	1693	46

TABLE II CONCLUDED

Lactating											
Fac- tor	D a t e	Per- iod	Weight	Feed	Dig. Nut.	Per 1000	Gain #or Loss	Pgs. Rsd.			
XIA	8/24/14 to 10/24/14	4th	341	616	441	1292	-137	8			
XIIA	2/28/14 to 4/22/14	1st	326	686	491	1503	-15	3			
XIIA	8/22/14 to 10/24/14	2nd	284	710	508	1788	-116	8			
XIIA	4/1/14 to 5/29/15	3rd	306	567	406	1324	-50	10			
XIIIA	2/20/14 to 4/26/14	1st	370	682	488	1318	-66	8			
XIIIA	8/20/14 to 10/24/14	2nd	336	638	457	1357	-106	8			
XXA	5/6/15 to 7/10/15	1st	380	400	286.4	753	-60	6			

comparison of the nutrients consumed by successive generations of Immature Factors.

For this purpose, tables of Group VII are presented showing the total and average amounts of digestible nutrients consumed during a number of gestation and lactation periods, the total and average gains or losses for the periods, and the number of pounds of digestible nutrients, per 1000 pounds of live weight, consumed per pound of gain.

These tables, tho not entirely satisfactory, offer the best means of comparison which can be made from the data at hand.

GROUP VII TABLE 1

Comparison of Feed per 1000 Lbs. Weight per Pound
Gain by Successive Generations of Immature Factors
During Gestation Periods.

Factor	Lbs. Dig. nutri. per 1000 Lbs. period	No. of periods	Total gain in weight Pounds.	Aver. Feed Lbs.	Aver. Gain Lbs.	Feed per 1000 lbs. live wt. per lb. gain
VI	7738	6	454	1289	75	17.2
V	6945	6	290	1157	48	24.1
XI	9596	6	313	1599	52	30.6
XXII	8613	6	244	1435	41	35.0
XXXI	7043	5	296	1409	59	24.0
XL	4635	3	86	1545	29	53.2
L	5678	3	256	1893	85	22.2

GROUP VII TABLE 2

Same as Above for First Three Gestation Periods.

Factor	Lbs. Dig. Nutri. per 1000 lbs. period	No. of periods	Total gain in Weight Pounds	Aver. Feed Lbs.	Aver. Gain Lbs.	Feed per 1000 lbs. live wt. per lb. gain
VI	3874	3	210	1291	70	18.4
V	3157	3	165	1052	55	19.1
XI	4888	3	140	1629	47	34.6
XIV	5496	3	221	1832	73	28.1
XXII	4484	3	82	1494	27	55.3
XXXI	4787	3	225	1595	75	21.2
XL	4635	3	86	1545	29	53.0
L	5678	3	256	1893	85	22.2

GROUP VII TABLE 3

Table Comparing Feed Consumed, Loss in Weight; and Pigs Raised by Generations of Immature Factors.

Factor	No. of Periods	Feed per 1000 lbs. live weight consumed lbs.	Ave. Feed per 1000#	Total Loss in Weight Lbs.	Aver. Loss in Weight Lbs.	Ave. No. Pigs raised per period
VI	6	6682	1114	231	38	5.5
V	6	10663	1777	264	44	4.5
XI	6	7759	1293	184	24	4.5
XIV	2	2661	1330	66	33	6
XXII	4	6279	1569	229	57	4
XXXI	5	5619	1124	307	61	4.8
XL	3	3462	1154	25	8	3.3(?)

GROUP VII TABLE 4

Digestible Nutrients per 1000 Pounds Weight per pound Gain, During Pregnant Period of Mature and Half Mature Factors

Factor	Dig. Nut. per 1000 pounds weight total Lbs.	Average dig. nut. per 1000 lbs.	Total Gain	Aver. Gain	No. Periods	Feed per 1000 lbs. weight per Lb. gain
IV	5587	1117	381	76	5	14.7
VIII	4711	942	381	76	5	12.5
XIA	3852	963	263	66	4	14.6
XIIA	4335	1445	54	18	3	80
III	4712	942	248	49	5	19.2

GROUP VII TABLE 5

Feed Consumed, Pigs Raised and Loss in Weight of Mature and Half Mature Factors During Lactation Periods.

Factor	Total Dig. Nutrients per 1000 Lbs. Live Wt.	Aver. Dig. Nutrients per 1000 Lbs. Wt. for Period	Total Loss	Aver. Per'd Loss	No. Periods	Ave. No. Pigs Raised
IV	4489	898	248	49	5	4.0
VIII	2723	544	320	64	5	3.4
XIA	4419	1105	354	88	4	5.5
XIIA	4615	1538	181	60	3	7.0
III	4724	945	319	64	5	6.0

These data are presented in Tables 1 and 2 Group VII. In Table I the number of gestation periods considered is not the same for all Factors. Table 2 is offered as a means of comparing Factors during the same number of pregnant periods.

Altho there is some variation, in general, the results are not unlike, as shown in the two Tables. All generations are shown to have consumed more feed per pound of gain than did the two original sows, as shown by computing the average for the two. The second, third, and fifth generation sows consumed more nutrients per pound of gain than did the preceding generation sows. However, the fourth and sixth generation sows have consumed less digestible nutrients per pound of gain than did one

of the original Factors and far less than did some of the ^{the} sows in generation preceding them.

It should be mentioned that Factor L raised but two pigs. . On this account she was probably in better condition in the following pregnant periods and possibly did not require so much feed during these periods as did the other Factors.

Factor XXXI was farrowed in the third litter of Factor XXII. The other Immature Factors were farrowed in the first litters of their respective mothers. Possibly this will make some difference in the feed record of Factor XXXI.

The data show some indication that the successive generations of Immature Factors consume more digestible nutrients per 1000 pounds weight per pound of gain. However, the Factors considered are too few in number and the results too indefinite to warrant drawing conclusions.

In Table III, Group VII, is given the digestible nutrients consumed during lactation periods ~~by~~ successive generations of Immature Factors. The Table also shows the average number of pigs raised, and the average loss of weight per period. Here there are too many conditions entering in to make any form of comparison.

Feed Consumed by Mature and Half Mature
Factors.
During Pregnancy and Lactation.

The quantity of digestible nutrients consumed by Mature and Half Mature Factors during the pregnant periods is given in Table IV, Group VII, and that consumed during lactation periods in Table V.

In Table IV it is seen that in nearly every case the Mature and Half Mature Factors have required less digestible nutrients per 1000 pounds weight per pound of gain than did the Immature Factors as shown in Tables I and II. The one exception is that of Factor XIIIA which required an abnormal amount, apparently. This is probably due to the small gains made. The records show no reason for the small gains made by this Factor.

From Table V, Group VII, it is seen that Mature and Half Mature Factors consume less digestible nutrients during lactating periods than do the Immature Factors, considered in Table III. The one exception is Factor XIIIA.

The following conclusions seem justifiable.

Mature Factors or Half mature Factors require less feed during pregnant and lactating periods than do Immature Factors.

Mature and Half Mature Factors require less feed per 1000 pounds weight per pound of gain than do Immature Factors, during gestation periods.

CHAPTER VII

The Effect of Pregnancy and Lactation
Combined on Growth.

Previous figures show that gestation probably does not check growth. In fact there is rather conclusive evidence that during the pregnant period there is an increased rate of growth. The data further show that lactation causes a serious check on growth.

For practical purposes it is necessary to determine the effect of gestation and lactation acting together on growth. In other words, the practical man is more concerned with the effect of "Early Breeding" on an animal and the offspring than he is with the effect during the pregnant or lactation period.

Does Early Breeding Stunt Growth?: The first question which comes to our minds is, what will be the final effect on the animal which was bred at a very early age?

Practical men and a good many investigators claim that an animal which was bred at too early an age will never reach normal size, in other words, will be stunted.

Professor Eckles'* work with dairy cows at this Station shows that animals bred at an early age never attain full size as indicated by height at withers and body

weight.

He says, "It will be recalled that one-half of our experimental animals were bred to calve at an early age, and the others about one year later, or at an age that would be called rather old for the breed.

"Our results for the groups are given in Tables 7, 8, and 9. It will be noted from Table 7 that with both breeds the late calving group was of greater height, which indicates a larger framed animal when mature. The height measurements were continued with each animal until it ceased to grow and the measurements given therefore represent the final height of the animal. It will be noted in the heavy fed Jersey group, that at 18 months both groups were of practically the same height. At 24 months the late calving group was the larger and remained so from this time on. Practically the same results are to be observed for the light fed Jerseys and Holsteins.

Influence of Age at First Calving upon Growth of Heifers

Age	Heavy Fed				Light Fed			
	Early calving		Late Calv.		Early calv.		Late Calving	
	No.		No.		No.		No.	
	Ani-	Height	Ani-	Height	Ani-	Height	Ani-	Height
	mals	inches	mals	inches	mals	Inches	mals	Inches
Jerseys								
1 mo.	2	28.7	1	26.1	2	27.0	2	27.8
3	2	32.9	1	27.8	2	30.5	2	31.6
6	2	38.6	1	34.4	3	35.2	2	36.2
12	2	44.7	1	41.3	3	40.0	2	41.2
18	4	46.6	5	46.4	4	43.0	3	44.5
24	4	47.5	5	48.1	6	45.1	4	46.3
30	4	48.5	5	49.1	6	45.9	4	47.9
36	3	48.7	5	49.8	6	47.1	4	48.7
48	2	49.0	5	49.8	6	47.7	4	49.0
60	2	49.0	5	49.9	6	47.8	4	49.1

Holsteins

1 mo.	2	29.9	1	31.6
3	2	35.6	2	34.7
6	3	41.6	4	40.8
12	3	46.3	4	47.4
18	5	49.6	4	49.6
24	5	50.9	4	51.5
30	5	51.8	4	52.7
36	5	51.9	4	53.0
48	5	52.8	4	54.0
60	5	53.1	4	54.0

Influence of Age at First Calving Upon Weight of Cows.

Jerseys.

Age	Heavy		Fed		Light		Fed	
	Early Calv.		Late Calv.		Early Calv.		Late Calv.	
	No.		No.		No.		No.	
	Ani-	Weight	Ani-	Weight	ani-	Weight	Ani-	Weight
	mals		mals		mals		mals	
Birth	3	54	5	47	6	54	4	53
3 mos.	3	166	5	151	6	141	4	172
6 mos.	4	315	5	285	5	241	4	271
12 mos.	4	515	5	479	6	362	4	397
18 mos.	4	756	5	695	6	484	4	514
24 mos.			5	827			4	644
30 mos.			5	942			4	798
36 mos.								
After	4	758	4	1001	6	556	4	806
1st. calv.								
6 mos.	4	726	5	911	6	614	4	800
later								
After	3	740	5	937	6	687	3	830
2nd calv								
6 mos.	3	839	5	924	6	706	4	882
later								
After	3	835	3	1021	4	772	3	886
3rd calv								
6 mos.	2	864	-----		3	762	1	956
later								
After	1	867	2	978	3	904	1	967
4th calv								
6 mos.								
later	1	923	-----		1	810	-----	
After								
5th calv			2	1010	2	885	1	1021
6 mos.								
later			2	986	-----		1	942

Influence of Age at First Calving Upon Weight of Cows.
Holsteins.

Table 9.

Age	Heavy Fed				Light Fed			
	Early Calv.		Late Calv.		Early Cal.		Late Calv.	
	No. Ani- mals	Weight	No. Ani- mals	Weight	No. Ani- mals	Weight	No. Ani- mals	Weight
Birth	4	83	4	82	2	103	6	92
3 mos.	4	240	4	209	1	227	6	184
6 mos.	4	428	4	415	2	395	6	296
12 mos.	4	664	4	664	2	504	6	409
18 mos.	4	900	4	925	2	675	6	574
24 mos.			4	1111			6	734
30 mos.	4	883	4	1232	2	820	6	849
36 mos.	4	888	-----		2	879	-----	
After first calving	4	963	4	1225	2	932	6	866
6 mos. later	4	1011	4	1129	2	1101	6	883
After 2nd cal.	3	1105	4	1139	2	1117	5	946
6 mos. later	3	1118	4	1121	1	1116	5	968
After third calving	-----		2	1197	1	1240	4	1063
6 mos. later	-----		3	1211	-----		3	1081
After fourth calving	-----		1	1299	1	1275	3	1119
6 mos. later	-----		1	1239	-----		-----	

"Tables 8 and 9 give the weights of the animals of the two groups both before the first calving and later. These weight figures also show clearly that the groups which calved at the more advanced age were the larger animals when mature. This difference was sufficient to make it possible to classify the cows of either the light fed, or the heavy fed groups, into early calving and late calving divisions, by their appearance."

Observations on Size of Early Bred Gilts at
the Missouri Station.

Tables I, II and III, Group VIII, showing the measurements of Immature, Mature, and Half Mature Factors at approximately the same ages are here presented.

Table I shows the measurements at approximately 30 months of age. It is further seen from the table that the Immature Factors have raised three or four litters each, while the Half Mature Factors have raised about two each, and the Mature Factors are just reaching the breeding age.

The condition of the animal at the time of measurement would make considerable difference in the measurements. For example an animal measured at the end of the lactation period would not be comparable with one measured just previous to ^{the} lactation period. One cannot

TABLE I

Table Comparing Immature, Half Mature, and Mature Factors in Size as Shown
by the Measurements, at a Given Age, Approximately Equal.

Factor	VI	V	XI	XXII	XXX	XXXI	III	VII	XIA	XIIA	XIIIA	IV	VIII	XIIB	XIIIB
Age	29-10	29-9	29-18	31-16	30-0	30-0	29-11	29-10	30-1	30-5	30-5	29-10	29-11	30-28	30-13
Weight	332	324	233	300	430	340	310	345	340	243	283	330	428	331	430
Height Withers Cm.	66	64	56	59	66	64	66	67	63	62	67	67	70	65	70
Height Croup	72	72	64	69	73	74	77	76	73	67	73	76	78	70	74
Breadth Should.	40	33	30	35	47	39	36	38	35	31	35	39	44	39	45
Breadth Sh. Pts.	30	32	25	24	27	28	29	32	27	23	25	30	34	28	30
Breadth Hams	37	35	30	32	39	35	31	35	32	30	31	34	40	36	44
Breadth Hip Bones	28	29	22	23	30	26	27	28	25	21	22	27	34	26	30
Heart Girth	132	130	105	115	150	132	124	132	120	109	122	132	146	134	145
Paunch Girth	150	149	139	150	158	140	134	145	142	126	136	142	167	145	160
Flank Girth	131	134	107	125	133	125	127	136	126	109	123	135	147	131	147
Depth Chest	44	44	35	40	43	41	42	44	41	47	41	45	48	42	45
Length Body	105	98	99	102	113	108	107	105	112	104	109	105	110	110	114
Width Head	19	17	17.5	18	19.5	18	20	19	18.5	18	19	20	22	19	20
Cir. rear Sh. B.	19	18	17.5	18	16	17.5	19	18.5	17	16.5	18	19	20.5	17.5	19
Cir. fore Sh. B.	19	18	17	18	17.5	18	20	19	16.5	17	18	19	21	17.5	18.5
Dist. EL. Down	33	32	31	33	31	31	32	29	31	32	33	34	35	31	32
Dist. Sh. Pt. D'n	33	35	33	35	34	33	35	32	33	33	36	37	36	33	33
Condition prev's to measurement	P	P	D	D	P	D	D	P	P	D	D	S	D	D	P
No. litters raised	3	4	4	4	2	3	2	1	2	2	2	1	0	0	0

GROUP VIII TABLE II

Table Comparing Immature, Half Mature, and Mature Sows in Size, as Shown by Measurements, at a Given Age, Approximately the Same.

Factor	V	VI	XI	XXII	XXX	XXXI	XIA	III	VIII	IV
Age	41-15	41-16	41-16	43-18	42-1	42-1	42-1	41-17	41-17	41-16
Weight	315	311	275	274	402	284	330	420	454	323
Height Withers	64	65	58	60	66	66	64	70	71	68
Height Croup	71	71	64	71	73	74	74	80	77	77
Bread. Should.	39	38	34	30	43	39	38	44	46	36
Bread. Sh. Pts.	30	28	27	27	30	31	29	33	31	30
Bread. Hams	36	36	30	28	39	34	33	38	41	36
Bread. Hip Bones	23	23	22	23	29	26	26	27	28	26
Heart Girth	130	125	110	106	152	130	124	142	152	133
Paunch Girth	149	138	150	132	140	140	144	155	162	140
Flank Girth	135	134	112	106	135	130	123	144	160	125
Depth Chest	41	41	37	36	48	42	41	47	49	43
Length Body	106	106	97	107	116	110	112	124	116	108
Width Head	19	19	17.5	17.5	20	19	19	21	23	19
Cir. Rear Sh. B.	17	17	17	17	17	18	16.5	18	21	16.5
Cir. Fore Sh. B.	17.5	17	17	17.5	17.5	18.5	17	19	21	17
Dist. Elb. Down	32	32	32	32	32	33	32	35	35	35
Dist. Sh. Pt. D.	35	35	35	34	34	35	35	36	37	36
Condition Previous to Measuring	P	P	S	S	D	S	P	P	P	P
No litters raised	5	5	6	6	4	5	4	3	1	2

GROUP VIII TABLE III

Table Comparing Immature, Half Mature, and Mature Factors in Size as Shown by Measurements at Same Ages. To show The Effect of Early Breeding on Final Size. Age 62-16. XI 59-18; XXII 68-37

Factor	V	VI	III	VII	VIII	IV	XI	XXII
Weight lbs.	356	355	406		400	378	299	410
Height Withers	66	66	67		71	66	68	65
Height Croup	73	73	77		78	76	68	73
Breadth Sh.	39	40	36		42	40	34	43
Breadth Sh. Pt. 30	26	26	28		29	28	26	30.5
Breadth Hams	32	32	34		37	34	31	36
Breadth H. Bon. 26	24	24	26		29	26	25	28
Heart Girth	130	123	127		143	133	121	134
Paunch Girth	140	147	151		158	150	145	152
Flank Girth	125	134	137		146	130	123	120
Depth Chest	42	40	44		48	44	38	43
Length Body	110	108	120		118	114	105	110
Width Head	20	19	21		22	19	18	20
Cir. R. Sh. B. 17.5		17.5	18		19.5	17	18	18
Cir. F. Sh. B. 17		17.5	18		20	17	17	19
Dist. El. Down 31		29	31		32	34	31	32
Dist. Sh. Pt. 33		32	33		34	36	33	33
Condition Previous to Meas.	D	S	S		farrow.	D	S	S
Number of Litters raised	7	9	7*		5 dead at birth	5	8	10
								<u>Immature</u>

*Accidentally bred when young

N.B. All measurements in centimeters.

Summary Table I

Showing Averages for Groups

	Immature	H. Mature	Mature
Weight	326.5	355.2	376.7
Height Withers	62.5	65	68
Height Croup	70.6	73.2	74.5
Breadth Shoulders	38.1	35	41.7
Breadth Sh. Points	27.7	27.2	30.5
Breadth Hams	34.7	31.8	38.5
Breadth Hip Bones	26.3	24.6	29.7
Heart Girth	127.3	121.4	139.2
Paunch Girth	147.7	136.6	153.5
Flank Girth	126	124.5	140
Depth Chest	41.1	43	45
Length Body	104	107.4	109.7
Width Head	18.1	18.9	20.2
Cir. Rear Shin Bone	17.7	17.8	19
Cir. Fore Shin Bone	17.9	18.1	19
Dist. Elbow Down	31.8	31.4	33.
Dist. Sh. Pt. "	33.8	33.8	34.7
Average Litters Raised	3.3	1.8	.25

Summary Table II

Weight	327	375	388
Height Withers	63.1	67	69.5
Height Croup	71.6	77	77
Breadth Shoulders	37.1	41	41
Breadth Sh. Pts.	28.8	31	30.5
Breadth Hams	33.8	35.5	38.5
Breadth Hip Bones	24.3	26.5	27
Heart Girth	122.1	133	142.5
Paunch Girth	141.5	149.5	151
Flank Girth	125.3	133.5	142.5
Depth Chest	40.8	44	46
Length Body	107	118	112
Width Head	18.6	19.5	21
Cir. Rear Sh. Bone	17.1	17.2	18.7
Cir. Fore Sh. Bone	17.5	17.5	19
Dist. Elbow Down	34.7	35.5	36.5
Average Number of Litters	5 plus	3 plus	1 plus
Distance Sh. Pt. Down	34.7	35.5	36.5

Summary Table III

Showing Averages of Groups.

	Immature	H, Mature	Mature
Weight	355	406	389
Height Withers Cm	64.5	67	68.5
Height Croup	71.4	77	77
Breadth Shoulders	39	36	41
Breadth Should. Pts.	28.1	28	28.5
Breadth Hams	32.7	34	35.5
Breadth Hip Bones	25.7	26	27.5
Heart Girth	127	127	137.5
Paunch Girth	146	151	154
Flank Girth	125	137	138
Depth Chest	40.7	44	46
Length Body	108.2	120	116
Width Head	19.2	21	20.5
Cir. Rear Shin Bone	17.7	18	18.2
Cir. Fore Shin Bone	17.6	18	18.5
Distance Sh. Pt. Down	32.7	33	35
Distance Elbow Down	31.7	31	33
Ave. Number litters Produced	8.5	7	5

overcome this chance of error as the animals are few in number and very few could be found when ⁱⁿ exactly in the same condition. By taking averages for each group the chance of error is probably lessened.

A summary of Table I is presented showing the average measurements for each group. From the table it is seen that the Mature Factors exceed in all measurements and the Half Mature Factors exceed the Immature group in weight and the growth measurements, tho in some of the breadth measurements and girth measurements the Immatures exceed.

In Table II are presented similar data for the Factors which had reached approximately 42 months. A summary of this table is likewise presented. This summary shows that the Immature Factors are behind in all measurements and that the Half Matures have made less growth than have the Mature Factors.

In Table III figures to show the size of Factors at a little over five years of age are presented. It seems reasonable to assume that animals will grow no more after this age. A study of the measurements of Factors bears out this assumption. A study of the summary of this table will show that animals bred at an early age never attain the size as do those Factors which were not bred so early. As only one Factor known as Half Mature, reached this age, the chance of error is probably greater due to individuality.

However, none of the factors known as Immatures reached the size, as did this Factor III. There is, therefore, rather conclusive evidence that early breeding stunts growth in swine.

Tho the Immature Factors are apparently stunted the difference is very small.

On Plate I is a curve showing diagrammatically the difference in size of Immature Factors, Half Mature Factors, and Mature Factors at 30 months of age. The curve has been plotted from the Summary of Table I, Group VIII.

On Plate II is a curve plotted from the Summary of Table II, Group VIII. It shows the difference in size of the Factors at 42 months of age.

Plate III shows the difference in size of the Factors at about 60 months of age.

Plate IV shows a curve comparing the five original Factors in body-weight throughout a five year period.

Curves comparing the five original Factors in height at withers and the width of head during a five year period, are presented in Plates V and VI.

The curves show that the Mature and Half Mature Factors grow more rapidly during the first two or three years and mature at an earlier age than do the Immature Factors. The Immatures finally attain a size nearly equal to that of the Half Matures and Matures. At about five years of age, the difference in size, as shown by these

measurements, is small.

Since pregnancy apparently produces little, if any, check in growth, and lactation produces a serious check, it seems safe to conclude that lactation is the principal cause of the stunted condition. It is probable that in an animal having several lactation periods during the growing period, growth is checked to such an extent that the animal fails to reach normal size before the "growth impulse" is lost or runs out.

Effect of Early Breeding on Maturity.

A study of Tables I, II, and III, Group VIII, shows that as the animals have become older, there is less difference in size between the Immatures and the other Factors. In other words, late bred Factors seem to mature at an earlier date than do the early bred Factors.

The following table, (Table I, Group IX,) is an attempt to show the ages at which the sows of separate groups seem to reach approximate maturity and complete maturity. The table is probably of little value since it is very difficult to know when an animal has matured, or growth has ceased. There is considerable variation in the individuals of the separate groups making it impossible to say from these data when a given group reaches maturity. There are not enough animals considered to justify drawing any conclusions from the figures.

Table showing ages at which Factors appear to reach approximate maturity and maturity.

Table I Group IX

Ractor	Age of Approximate Maturity	Apparent Mat.
V*	30 months	48 months
VI*	30 months	48 months
XI*	35 months	49 months
XXII*	30 months	49 months
XXX*	30 months	?
XXXI*	36 months	?
III**	29 months	39 months
XIA**	21 months	?
VII**	20 months	?
IV***	26 months	30 months
VIII***	29 months	42 months
* Immature		
** Half Mature		
*** Mature		

The figures indicate that maturity is reached at an earlier age in Half Mature and Mature Factors than is the case with Immature Factors but, as has been mentioned, the figures are too indefinite to warrant drawing conclusions.

Effect of Early Breeding on the Offspring.

Having shown the effect of early breeding on the sow, the effect on the offspring will now be considered.

Two or three litters from each sow have been kept and "fed out" until they reached 250 pounds in weight. Accurate records have been kept of the weights and feed consumed.

Table I, Group X, showing the age at which the offspring attain to a weight of 100 pounds and 250 pounds, follows. The table also shows the total and average feed consumed in attaining these weights. (Table II Group X)

In a summary of this Table the time and feed required by the offspring of Immature, Half Mature, and Mature Factors have ^{each} been averaged. From this summary it is seen that the offspring of the Immature Factors have required slightly more feed, and a little more time to attain to a weight of 100 and 250 pounds, than have the offspring of Half-Mature parents. However, the offspring of Mature sows have required a longer time and more feed than have those of the Immature sows. This would seem to indicate that the age of the parents has little effect on the growth of the offspring. The difference as noted is probably due to other conditions, ^{such} as the time of the year, the year fed, etc.

In passing it might be noted that the spring farrowed litters appear to require less time to attain to a certain weight than do fall farrowed litters. This may account for some of the differences shown in the table, since about one-half of the offspring of the Mature Factors were fall farrowed while in the other groups the majority of the litters were spring farrowed.

To compare the growth of breeding animals, whose parents were immature, with that of ~~the~~ animals from

GROUP X TABLE 1

Table Showing Age At which Offspring Reach 100 Lbs. and 250 Lbs. in Immature, and Mature, and Half Mature Factors. Shows Feed Required to Reach 100 and 250 Lbs.

Fact- or	No. Pig in Lit.	Date of Farrowing	Age at which Pigs reach 100 lbs.	Litter Ave	Age at which pigs reach 250 Lbs. Average	Total Feed 100 Lb. Period	Average Feed 100 Pound Period	Total feed 250 lb. Period	Ave.
VI	7	2-24-10	169 das.	2nd	310. days	1726(1)	245.5	(1) 3218 (3) 3617	(1) 459 (3) 515.5
VI	4	9-29-11	188.5	5th	276.5	1273.5(1)	318.4	(1) 390 (3) 2186	(1) 97.5 (3) 546.5
V	5	3-18-10	174	2nd	310	1306(1)	361	(1) 538 (2) 3211.4	(1) 105 (3) 642.3
V	3	9-29-11	183	5th	267	820(1)	273	(1) 280 (2) 1524	(1) 93 (2) 508
IX	3	4-18-10	158	1st	306	842(1)	281	(1) 344 (3) 1457	(1) 115 (3) 729
IX	6	9-28-11	195.5	4th	292 Not acc.	1878(1)	313	(1) 460 (3) 3690.5	(1) 77 (3) 615
XXII	4	4-1-12	128.5	3rd	247	588(1)	147	(1) 776 (3) 981	(1) 194 (3) 490
XXII	9	10-1-12	172	4th	279	2411(1)	268	(1) 928 (3) 5429	(1) 103 (3) 603.2
XXX	8	8-9-13	190	2nd	322	2393(1)	299	(1) 871 (3) 6126	(1) 109 (3) 770
XXX	4	5-30-15	158	4th		1033(1)	258		
XXyI	7	3-10-13	187	1st	320	1929(1)	275	(1) 872.5 (3) 1941	(1) 178.5 (3) 608
XXXI	3	9-7-13	174	2nd	307	1052(1)	351	(1) 285 (3) 2380	(1) 95 (3) 793
XXXI	6	6-10-14	149	3rd	261	1473(1)	245.5	(1) 790 (3) 3619	(1) 131.5 (3) 60.3

TABLE I

Fact- or	No. pig in Lit	Litter	Date of Farrowing	Age at which pigs reach		Total Feed 100 lb. period	Ave. feed 100 lb. period	Total feed 250 lb. period	Ave. lb period
				100lbs. Ave.	250 lbs. Ave.				
XL	6	1st	3-18-14	160 da.	276 da.	(1)1455 (3)63 (1)867 (1)932.75	(1)242.6 (3)10 (1)217 (1)311.75	(1)505.5 (3)2807	(1)126.2 (3)702
XL	4	2nd	2-25-15	142					
VIII	3	1st	8-25-11	215	348				
VIII	3	2nd	5-10-12	143	257	(1)787	(1)262		
VIII	5	3rd	10-27-12	157	288	(1)1281	(1)256		
IV	7	2nd	8-10-11	211	326	(1)1811.5	(1)258.8		
IV	3	3rd	5-4-12	126	250	(1)531	(1)177		
VII	6	2nd	5-17-11	171	311	(1)1292	(1)215		
III	5	3rd	4-28-12	146	265	(1)1140	(1)228		
XIIB	4	1st	6-13-14	158	266	(1)932	(1)233		
XIIB	3	1st	6-6-14	188	336	(1)1029	(1)343		
XIIIA	8	1st	2-20-14	139	246	(1)1652	(1)209		
XIIIA	8	2nd	8-20-14	150	252	(1)1842	(1)230		

TABLE I CON.

Fact- or	No. pg. in litter	Litter	Date of Farrowing	Age at		Total feed 100 Lb. Period	Ave. Feed 100 Lb. Period	Total Feed 250 lb. period	Ave. 250 lbs. period
				which pigs reach 100 Lbs. Ave	which pigs reach 250 Lbs. Ave.				
XIIA	3	1st	2-19-14	151 das.	266 da.	(1)761.5	(1)254	(1)414 (3)1897	(1)138 (3)632
XIIA	8	2nd	8-22-14	162	271	(1)2395	(1)299	(1)1012 (3)4674	(1)127 (3)584
XIA	8	3rd	2-28-14	150	259	(1)1932.5	(1)241.5	(1)1148 (3)5094	(1)143.5 (3)637
XIA	8	4th	8-24-14	160	272	(1)2386	(1)298	(1)1021 (3)5554.5	(1)127 (3)694

TABLE II GROUP X
Table Comparing Age at which Pigs of Immature Factors Reach 100 lbs.
250 Lbs. in weight with age at which pigs of Half Mature and Mature
Factors reach same Weight.

Factor	Ave. No. Days pigs Reach 100 lbs.	Ave. no days required to reach 250 lbs.	Ave. Feed required to produce 100 lbs.	Ave. Feed Required to produce 250 lbs.	Digestible Nutrients Consumed 250 lb. Per.	Difference
Immature	168.5	290	(1) 266 lbs.	(1) 145 lbs. (3) 625	630 lbs.	
Half Mature	153	268	(1) 247	(1) 150 (3) 624	633 lbs.	3
Mature	171	294	(1) 263	(1) 155 (2) 694	686	56
Half Mature & Mature Combined	162	281	(1) 254	(1) 152 (3) 654	660	30

mature parents the following tables are offered, (Group XI). Some of the comparisons are made with Factors whose parents were immature for several generations back.

From this group of tables there appears to be no noticeable decrease in growth rate due to the fact that the parents were immature.

There are seven comparisons considered, one being left out because of the unequal rations received. Of the remaining seven comparisons, two show approximately equal growth for both Factors, three show slightly increased growth for the offspring of Immature Parents, and two show increased growth by the offspring of mature parents.

There is no indication of a decreased or increased rate of growth due to the age of the parents at farrowing.

TABLE I GROUP XI
Table Comparing Growth of Factors XL, age 6-19 to 7-19
And Factor VII Dry, Age 6-18 to 7-29

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XL	VII	XL	VII	XL	VII	XL	VII
Weight	134	133	161	177	37	45	.9000	1.071
Height Withers	47	50	53	55.5	5	5.5	.1667	.1309
Height Croup	53	55	59	60.5	6	5.5	.2000	.1309
Breadth Shoulders	28	27	28	29	0	2	.0000	.0476
Breadth Sh. Points	30	25.5	31	26.1	1.5	.5	.0333	.0119
Breadth Hams	24	24.5	27	26	3	1.5	.1000	.0337
Breadth Hip Bones	19	21.5	21	24	2	2.5	.0667	.0595
Heart Girth	86	93	96	100	10	8	.3333	.1905
Paunch Girth	106	105	117	110	11	5	.3666	.1199
Flank Girth	96	93	106	103	10	10	.3333	.2380
Depth Chest	27	29	31	33.5	4	4.5	.1333	.1071
Length Body	78	73	85	83	7	10	.2333	.238
Width Head	14	10.5	14	11.25	0.	.75	.0000	.0179
Cir. Rear Sh. Bone	14	13	14.5	14.5	.5	1.5	.0167	.0357
Cir. Fore Sh. Bone	13.5	13.5	15	14.5	1.5	1	.05	.0338
Dist. Elbow Down	24	25	26	28	2	3	.0667	.0714
Dist. Sh. Pt. Down	25	26.5	27	29	2	2.5	.0667	.0595
Feed Consumed							4.2	4.0
Digestible Nutrients							3.0	2.86

Table compares growth of 5th generation Immature with Original Factor. Fifth Generation sow seems to grow about as fast as the original.

XL 9-27-13 to 10-27-23

VII 3-19-09 to 4-30-09

GROUP XI TABLE 2

Table Comparing Growth of Factor XL Age 14-19 to 17-19 with that of Factor VII Age 14-10 to 16-14 both Dry. XL Raised Litter, VII Never Produced. To see if Previous Pregnancy Lessens Growth or if Immature Parents Cause Decreased Growth of Offspring.

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XL	VII	XL	VII	XL	VII	XL	VII
Weight	253	244	320	309	68	65	.7472	.8667
Height Withers	58	61.5	61	63.5	3	2	.0329	.0267
Height Croup	64	69.5	67	70	3	.5	.0329	.0067
Breadth Shoulders	32	35	38	37	6	2	.0658	.0267
Breadth Sh. Pts.	24	30.5	26	33	2	2.5	.0219	.0333
Breadth Hams	31	31	36	34	5	3	.0548	.0400
Breadth Hip Bones	24	28	28	30	4	2	.0438	.0267
Heart Girth	112	128	128	130	16	2	.1754	.0267
Paunch Girth	131	130	140	144	9	14	.0986	.16000
Flank Girth	117	126	132	125	15	-1	.1644	-.0133
Depth Chest	36	37.5	39	39.5	3	2	.0329	.0267
Depth Body	100	94	113	100	13	6	.1428	.0800
Width Head	16	12.5	17.5	13	1.5	.5	.0164	.0067
Cir. Rear Sh. Bone	16.5	15.	18	15.5	1.5	.5	.0164	.0067
Cir. Fore Sh. Bone	17	15.5	17	16	0	.5	.0000	.0067
Dist. Elbow Down	29	30	28	30	-1	0	-.01096	.0000
Dist. Sh. Pt. Down	31	33	31	32.5	0	-.5	.0000	-.0067
Feed Consumed					448	266	4.9	3.54
					377.66	197.57	4.13	3.04

Fifth Generation pig which had been pregnant and suckled litter grew faster in most cases than did VII. Received more feed, however, which may account for it.
 XL 5-27-14 to 8-27-14
 VII 11-1-09 to 1-15-10

GROUP XI TABLE 3

Table Comparing Dry Period Growth of Factor L Age 5-25 to 7-6 with
Dry Period of Factor III Age 6-19 to 8-0.

Factor		First		Second		Period		Daily	
		Measurement L	III	Measurement L	III	Gain or Loss L	III	Gain or Loss L	III
Weight		125	116	175	148	50	32	1.143	.7619
Height Withers	Cm.	49	48	52	52.5	3	4.5	.0714	.1071
Height Croup	"	53	55	59	59	6	4	.1428	.0952
Breadth Shoulders	"	24	25	30	26	6	1	.1428	.0338
Breadth Sh. Pt.	"	18	23.5	20	24.5	2	1	.0476	.0238
Breadth Hams	"	22	24	27	24	5	0	.119	.0000
Breadth Hip Bones	"	18	20	22	22	4	2	.0952	.0476
Heart Girth	"	85	86	106	90	21	4	.5000	.0952
Paunch Girth	"	103	100	123	100	20	0	.4761	.0000
Flank Girth	"	84	86	110	91	26	5	.679	.119
Depth Chest	"	26	27	32	29.5	6	2.5	.1428	.0595
Length Body	"	79	72	86	77	7	5	.1666	.1190
Width Head	"	13	10	14.5	11.5	1.5	1.5	.0357	.0357
Cir. Rear Sh. Bone	"	13	1.5	14	14	1	1.5	.0238	.0357
Cir. Fore Sh. Bone	"	13	13	13.5	14.5	.5	1.5	.0119	.0357
Dist. Elbow Down	"	25	25	27	28	2	3	.0476	.0714
Dist. Sh. Pt. Down	"	27	27	29	30	2	3	.0476	.0714
Feed Consumed						274.5	6.5		5.0 (estimate)
Digestible nutrients						Feed an estimate			

Here Factor L grows faster but on more feed. Seems to show that 6 generations of early breeding does not affect growth of offspring. L is some younger.

L 9-12-14 to 10-24-14

III 3-19-09 to 4-30-09

GROUP IV TABLE 4

Table Comparing Growth of Factors 51 and 20A Dry-Age (20A) 6-2 to 8-2
Compare 5th generation Immature with 2nd Half Mature.

Factor	First		Second		Period		Daily	
	LI	XXA	LI	XXA	LI	XXA	LI	XXA
Weight	123	130	166	172	42	42	.7818	.7118
Height Withers	47	48	50	52	4	4	.0545	.0678
Height Croup	53	54	57	61	7	7	.0727	.1186
Breadth Shoulders	24	25	30	30	5	5	.1090	.0847
Breadth Sh. Pt.	18	20	21	22	3	3	.0545	.0339
Breadth Hams	24	24	27	28	4	4	.0545	.0678
Breadth Hip Bones	18	18	21	22	4	4	.0545	.0678
Heart Girth	84	94	97	107	13	13	.3095	.2203
Paunch Girth	105	105	115	119	10	14	.1818	.2372
Flank Girth	92	94	98	112	6	18	.1090	.305
Depth Chest	26	28	31	32	5	4	.0909	.0678
Length Body	76	75	83	88	7	13	.1272	.0203
Width Head	13	14	13.5	14.5	1.5	.5	.0273	.0085
Cir. Rear Sh. Bone	13	13.5	14	15	1	1.5	.0182	.0254
Cir. Fore Sh. Bone	13	13.5	13.5	15.5	.5	2.	.0091	.0339
Dist. Elbow Down	25	24	25	25	0	1	.0000	.0169
Dist. Sh Pt. Down	28	26	28	28	0	3	.0000	.0339
Feed Consumed					302	381.5	5.5	6.46
Digestible Nutrients					235.9	285.6	4.5	4.84

Factor XXA gained more in growth measurements but received more feed. May indicate that there is no very noticeable decrease in growth due to immature parents.

LI 9-26-14 to 11-20-14
XXIA 1-6-14 to 3-6-14

GROUP XI TABLE 5

Table Comparing Growth During pregnancy of Factor L Age 8-3 to 11-3
with Growth During Pregnancy of Factor III, accidentally bred. 9-9 to 11-20

Factor	First		Second		Period		Daily	
	Measurement L	III"	Measurement L	III	Gain or Loss L	III	Gain or Loss L	ILL
Weight	192	161	254	195	62	34	1.016	.4722
Height Croup	61	60	64	65	3	5	.0492	.0694
Height Withers	53	53	59	56.5	6	3.5	.0883	.0486
Breadth Shoulders	32	28.5	36	29	4	.5	.0654	.0069
Breadth Sh. Pt.	22	24.5	25	27	3	3.5	.0492	.0347
Breadth Hams	30	26	33	28	3	3	.0492	.0278
Breadth Hip Bones	23	23	25	24	2	1	.0327	.0139
Heart Girth	106	100	122	105	16	5	.2623	.0694
Paunch Girth	119	110	134	126	15	16	.246	.2222
Flank Girth	106	100	125	110	19	10	.3114	.1388
Depth Chest	33	31	35	33.5	2	2.5	.0327	.0347
Length Body	91	85	92	84	1	-1	.0164	-.0139
Width Head	15.5	13	16.5	11.5	1	.5	.0164	-.0069
Cir. Rear Shin Bone	14.5	14.5	15.5	14.5	1	0	.0164	.0000
Cir. Fore Sh. Bone	14.5	14.5	15	14.5	.5	0	.0082	.0099
Dist. Elbow Down	25	29	26	29	1	-1	.0164	-.0139
Dist. Sh. pt. Down	27	32	29	30	-2	-1	.0327	-.0139
Feed Consumed					345	105	5.67	1.46
Digestible Nutrients					253.1	88.52	4.21	1.23 Past.

Factor III little older and received less feed. Owing to difference in feed, could hardly draw any conclusions. Would ~~see~~^{one} that immature parents had little effect on growth.
L 11-20-14 to 1-20-15
III 6-9-09 to 8-20-09

GROUP XI TABLE 6

Table Comparing Growth of Factors XX and IV During Dry Period to See Effect of Immature Parents on Growth of offspring. Age XX 6-22 to 11-18; 6-18 to 11-19

Factor	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
	XX	IV	XX	IV	XX	IV	XX	IV
Weight	168	123	230	179	62	56	.4217	.3636
Height Withers	47	51	57	58	10	7	.068	.0454
Height Group	55.5	55.5	65	67	9.5	11.5	.0646	.0746
Breadth Shoulders	28.5	26	34	31	5.5	5	.0374	.0325
Breadth Sh. Pt.	23	24	27	27	5	3	.034	.0196
Breadth Hams	27	25	31	25.5	4	.5	.0272	.0033
Breadth Hip Bones	17	22	23	24	6	2	.0408	.013
Heart Girth	90	90	111	106	21	16	.1428	.1039
Paunch Girth	110	103	126	111	16	8	.1088	.0519
Flank Girth	100	91	115	105	15	14	.102	.0908
Depth Chest	29	28.5	35	36	6	7.5	.0408	.0487
Length Body	80	73	92	87	12	14	.0816	.0908
Width Head	11	11	17	13	6	1	.0408	.0065
Cir. Rear Sh. Bone	16	14	17.5	15	1.5	1	.0102	.0065
Cir. Fore Shin Bone	16	15	18	16	2	1	.0136	.0065
Dist. Elbow Down	25	25	30	29	5	4	.034	.026
Dist. Sh. Pt. Down	24	28	33	31	9	3	.0612	.0196
Feed Consumed					636.3	294	4.32	1.9 Past.
Digestible Nutrients					455.6	223.8	3.1	145

Factor XX shows more gain in nearly every way. However, she received twice as much feed as IV but had no pasture. It would seem to indicate that if feed is plentiful, parents have little effect on growth of offspring.

XX 10-22-10 to 3-18-4
IV 3-19-09 to 8-20-09

GROUP XI TABLE 7

Table Comparing Growth of Dry Factors XXXI and XIIA to See Effect of Immature Parents on Offspring. Age XXXI 6-13 to 7-3; Age XIIA 6-5 to 7-9

Factor	Cm	First Measurement		Second Measurement		Period		Daily	
		XXXI	XIIA	XXXI	XIIA	Gain or Loss XXXI	Loss XIIA	Gain or Loss XXXI	Loss XIIA
Weight		182	125	190	152	8	27	.348	.7941
Height Withers		53	50	53	52	0	2	.0000	.0588
Height Croup		60	57	60	58	0	1	.0000	.0294
Breadth Shoulders		32	25	33	28	1	3	.0434	.0882
Breadth Sh. Pt.		23	19	22	20	-1	1	-.0434	.0294
Breadth Hams		30	25	30	27	0	2	.0000	.0588
Breadth Hip Bones		18	19	21	19	3	0	.1304	.0000
Heart Girth		108	88	112	96	4	8	.1739	.2352
Paunch Girth		128	110	120	113	-8	3	-.3481	.0882
Flank Girth		108	90	107	95	-1	5	-.0434	.1470
Depth Chest		34	30	34	32	0	2	.0000	.0588
Length Body		79	77	82	76	3	-1	.1304	-.0294
Width Head		16	15	16.5	14.5	.5	-.5	.0217	-.0147
Cir. Rear Sh. Bone		15.5	14	17	14	1.5	0	.0651	.0000
Cir. Fore Sh. Bone		16	14.5	16.5	14	.5	-.5	.0217	-.0147
Dist. Elbow Down		28	26	28	25	0	-1	.0000	-.0294
Dist. Sh. Pt. Down		30	28	31	29	1	1	.0434	.0294
Feed Consumed						84	175	3.65	5.14
Digestible Nutrients						70.8	125.3	3.08	3.7

XIIa Shows more gains but also received more feed which may have caused the extra gain.

XXXI gained more in width of head, shin bones, etc.

XXXI 10-12-13 to 11-4-13

XIIA 11-3-13 to 12-7-13

GROUP XI TABLE VIII

Table Comparing Dry Factors XIII and III. Growth When Young to See
the Effect Immature Parents Have on Growth of Offspring.
Age XIII 6-4 to 7-15; III 6-19 to 8-0.

Factor	Cm.	First Measurement		Second Measurement		Period Gain or Loss		Daily Gain or Loss	
		XIII III	XIII III	XIII III	XIII III	XIII III	XIII III	XIII III	III
Weight		94	116	120	148	26	32	.619	.7619
Height Withers	Cm.	45	48	46.5	52.5	1.5	4.5	.0357	.1071
Height Croup	"	51	55	52	59	1	4	.0238	.0952
Breadth Shoulders	"	23	25	26	26	4	1	.0952	.0238
Breadth Sh. Pts.	"	20	23.5	23	24.5	3	1	.0714	.0238
Breadth Hams	"	21	24	25	24	4	0	.0952	.0000
Breadth Hip Bones	"	19	20	21	22	2	2	.0476	.0476
Heart Girth	"	82	86	88	90	6	4	.1428	.0952
Paunch Girth	"	95	100	101	100	6	0	.1428	.0000
Flank Girth	"	82	86	88	91	6	5	.1428	.1190
Depth Chest	"	25.5	27	28	29.5	2.5	2.5	.0595	.0595
Length Body	"	67	72	69	77	2	5	.0476	.1190
Width Head	"	9.5	10	9.5	11.5	0	1.5	.0000	.0357
Cir. Rear Sh. Bone	"	12.5	12.5	13	14	.5	1.5	.0119	.0357
Cir. fore Sh. Bone	"	13	13	13.5	14.5	.5	1.5	.0119	.0357
Dist. Elbow Down	"	24	25	27	28	3	3	.0714	.0714
Dist. Sh. Pt. Down	"	26	27	28	30	2	3	.0476	.0714
Feed Consumed						191	210	4.55	5.0 Est.
Digestible Nutrients						136.76	150.36	3.36	3.56

The feed record of Factor III was not definite but she probably received a little more feed. III shows more growth. May indicate more growth from mature parents.
XIII 12-14-09 to 1-13-10
III 3-19-09 to 4-30-09

Early Breeding for the Commercial Hog Raiser:-

The commercial hog raiser is interested only to a limited extent in the various conditions which have been discussed so far. He is interested in them in so far as they affect the profit which he receives from his business. If it is more profitable for him to breed his sows young than when mature or half mature, he will breed them while young. If the young age is not the profitable age to breed, he will not breed while young.

It has been difficult from the data on hand to make comparable records of the profit realized from the three groups over a period of years.

Table I, Group XIV, is an attempt to show, in a general way, the profit received from Immature, Half Mature, and Mature Factors which have been kept through a period of five years.

This table does not contain accurate records of the cost of producing pork for each group, but is merely an estimate of the main factors.

The total amount of feed consumed by the sow, the total number of pigs raised, the total feed consumed by these pigs in reaching 250 pounds, the cost of the feed, the feed consumed per 100 pounds of pork produced, the value of the pork produced, and the profit realized are the points considered in this table.

To make the comparisons accurate records should be shown for the cost of care, marketing, pasture, and other less important features.

TABLE I GROUP XIV

Table Comparing the Profit Realized from Immature, Half Mature and Mature Sows during Five year Period.

Fact- or	Total Feed		Total No. pigs raised	Lbs. Grain per 100 lbs. pork Produced	Cost of feed for sow pigs	Cost of feed for pigs	Value pork at 8 cents	Profit
	Total Feed Consumed lbs.	consumed by pigs to 250 lbs.						
V	(1) 2779.5	(1) 12,330	30	526	\$86.08	\$318	\$600	\$196
	(2) 2435	(3) 18,750						
	(3) 1839							
	(1307)*							
.VI	(1) 3936.5	(1) 22,605	55	471	94.58	582.90	1100	423.50
	(2) 2230	(3) 34375						
	(3) 1596							
	(1307)*							
IVM	(1) 2774	(1) 18360	20	601	80.73	227	400	92.27
	(2) 2747	(3) 113880						
	(3) 1457							
	(837)*							
III H.M.	(1) 2764	(1) 11513	29	518	82.51	303.20	580	194.30
	(2) 2704	(3) 18096						
	(3) 1691							
	(837)*							
VIII M	(1) 2059	(1) 7106	17	622	77.20	192.87	340	70
	(2) 2765	(3) 11798						
	(3) 1899							
	(837)*							

*Amount of feed received before definite rations were given

177

Table I Group XIV

Table Comparing Profit Realized from Immature, Half Mature, and Mature Sows During a Five year Period.

Fact- of	Total Feed Consumed	Total Feed consumed by pigs to 250 lbs.	Total No. pigs raised	Lb. grain per 100 lbs. pork produced	Cost of feed for sow.	Cost of feed for pigs	Value of pork at 8 cents	Profit
XI	(1) 3883 (2) 309255 (3) 1920	(1) 16440 (3) 25000	40	505	\$93.88	\$423.83	\$800	\$283.30
	(123)							
XXII	(1) 6099 (2) 2907 (3) 1781	(1) 15207 (3) 23125	37	531	114.08	392.22	740	233.70
Average Profit for Immatures \$283.80								
Average Profit for Half Matures \$194.30								
Average Profit for Matures 81.14								
Average pounds of grain per 100 pounds pork								
"	"	"	"	"	"	"	"	Immatures 508
"	"	"	"	"	"	"	"	Half Matures 518
"	"	"	"	"	"	"	"	Matures 612

Such records have not been kept and no attempt is made here to estimate such expenses.

For determining the cost of feeds the following prices were used : corn, 50 cents per bushel, wheat bran \$1.00 per 100 pounds, oil meal, \$35.00 per ton, shorts \$1.15 per hundred, alfalfa \$1.30 per hundred. These prices are an estimate of the values during the five year period. Since the same prices are considered for all Factors, it makes little difference what these prices are. Pork was valued at 8 cents per pound.

Four Immature Factors were considered, two Mature Factors, and one Half Mature. The small number of Factors considered is another point which makes the comparison less valuable.

In spite of all these conditions, the table seems to offer valuable points for ^{the} commercial hog raisers to consider. The main point to consider is, of course, the profit. ~~expenditure~~. It is seen that far more profit is realized from the Immature Factors through a period of five years than from either of the other groups. The least profit is realized from the Mature group. The average profit for each group is presented at the end of the table.

The difference in the profits is so great that, even though the other expenses were considered, the Immatures would have much the advantage of the other groups.

For commercial pork production, it seems safe to conclude that a man cannot afford to delay breeding his

gilts until they are eighteen or more months of age. There would probably be no great advantage in breeding as early as six months. Those farmers who practice breeding so as to have the sows farrow at twelve months, are probably making no great mistake, and it is unlikely that any serious results will follow from such practices.

The average number of pounds of grain per 100 pounds of pork produced will of course be closely associated with the profits realized. From the table we see that it required over 100 pounds more of grain to produce 100 pounds of pork in the Mature group than in the Immature group. This does not mean that the pig from a Mature Factor requires more feed to produce a given amount of pork than does the one from an Immature. This point has been previously discussed. The extra feed is consumed by the sow before her productive period and must be charged to pork produced, thus making the average feed consumed, per pound of pork, much greater,

A man in the pure-bred hog business would probably do well to delay breeding his gilts until they are about 8 months^{old}. Tho there appears to be no great difference in the final size of an animal bred early and one bred at a later period, there is perhaps enough for the breeder of pure breeds to take into consideration. Even in such a case it would hardly seem advisable to delay breeding as late as eighteen months.

Effect of Early Breeding on Farrowing Records:

Very little work has been done to determine the effect of early breeding on the breeding records of animals. Some observations have been made at the Wisconsin Station upon ewes to determine the part played by age upon the breeding records of the animals. Some interesting results are said to have been obtained.

Tables have been prepared to show the farrowing records of the sows under observation in this breeding experiment. Table I, Group XII, gives the length of the gestation period, size of litter, sex of the pigs, birth weight of the pigs, number of pigs raised, and, where records were at hand, the weight of the litter at weaning of all the Factors considered in the investigation. The table also gives the average for each sow.

In the summary of Table I, the average record for each Factor is presented, and from these the average records for the Immature, Half Mature, and Mature groups have been computed.

From these figures the length of the gestation period appears to be slightly less for the Immature group, followed by the Half Matures, with the Mature Factors having the longest period. Because of the few Mature and Half Mature Factors considered, one is hardly justified in saying that early breeding shortens the gestation period, though this may be the case, as the figures indicate.

TABLE I GROUP XII

Tables Showing Farrowing Records of Sows.

Fact- or	No. of litter	Gestation period -days	Size of litter	Birth		No. pigs raised	Pigs born		Weight of litter at weaning	Age first breeding
				Boars	Sows		Boars	Sows		
VI	1st	113	8	1.5	2.19	8	2	6	271	4-21
	2nd	113	9	2.33	2.125	8	3	6	320	
	3rd	116	10	1.86	1.5	4	6	4	175	
	4th	113	8	2.6	2.0	7	5	3	191	conceived
	5th	112	4	3.31		4	4		120	5-6
	6th	111	4	2.81		3	4			
	7th	113	11	1.66	1.7	7	5	6		
	8th	114	11	2.3	2.2	8	4	7		
	9th	114	6	3.25	3.0	6	4	2		
	Average	113.2	8	2.38	2.10	6.1	37 tot.	34 tot.	34.7 per pig	
V	1st	115	3	2.75	2.50	3	1	2	103	6-1
	2nd	114	7	1.7	1.875	5	5	3	193	
	3rd	113	10	1.8	1.916	3	7	3		
	4th	112	9	2.25	2.0	5	4	5	89	conceived
	5th	114	9	2.0	2.25	3	8	1		6-12
	6th	112	11	2.0	1.75	7	9	3		
	7th	115	9	2.25	1.8	4	4	5		
	Average	113.5	8	2.11	2.01	4.3	38 total	20 ave. pig	35	

Table 1 Group XII Con.

Factor	No. of litter	Gestation period days	Size of litter	Birth Weight Boars	Sows	No. pigs raised	Pigs born Boars	Sows	Weight of litter at breed- ing	Age 1st weaning
XI	1st	113	3	3.75	2.5	3	3	1	110	
	2nd	114	6	3.25	2.125	5	3	4	150(?)	
	3rd	113	4	3.0	3.0	0	3	1	145	
	4th	114	7	3.25	2.2	6	3	5		6-26
	5th	114	9	3.5	2.0	7	5	4		
	6th	115	6	3.5	2.66	6	3	3		
	7th	112	7	3.66	2.4	7	3	4		
Average		113.5	6	3.56	2.41	4.8	20	22	per pig 39	
XXII	1st	114	6	3.4	2.25	0	4	2		
	2nd	111	3	3.25		0	3	3	185	
	3rd	112	5	3.63	3.66	4	3	6	292	6-11
	4th	111	9	3.66	3.5	9	3	4		
	5th	111	9	3.6	1.75	8	5	7		
	6th	114	10	3.16	3.65	7	3	4		
	7th	111	4		3.50	4		4		
	8th	112	10	3.00	1.75	1	6	4		
	9th	113	12	3.0	1.6	4	6	6		
XIV	1st	114	6	2.5	2.125	5	3	4	170	
	2nd	112	7	2.625	2.7	7	3	5	196	6-8
	3rd	112	9	2.66	2.66	0	6	3	0	
Ave. XXII		112.1	7.5	2.455	2.21	4.1	32total	36	36.5 ave.	pig
XXIV		112.7	7.3	2.595	2.495	4.0	10	12	30.5	

Table 1 Group XII Con.

Factor	No. of litter	Gestation period days	Size of litter	Birth weight Boars	No. pigs raised	Pigs born Boars Sows	Weight of litter at weaning	Age 1st breed- ing
XXI	1st	114	9	2.0	7	2	202	
	2nd	115	3	2.33	3	0	84	6-0
	3rd	114	7	2.16	6	4		conceived
	4th	113	6	2.16	1	3		7-16
	5th	113	11	2.2	7	5		
						total		
Average		113.4	7.2	2.17	4.8	16	28.6(?)	ave. pig

Table 1 Group 12 Con.

Factor	No. of litter	Gestation period days	Size of litter	Birth weight		No. pigs raised	Pigs born		Weight of litter at weaning	Age 1st breed- ing
				Boars	Sows		Boars	Sows		
XXX	1st	116	9	1.56	1.45	0	4	5		
	2nd	115	12	1.80	1.66	8	6	6	294	6-0
	3rd	112	12	1.50	1.50	0	6	6		
	4th	110	4	1.75	1.50	4	1	3		
Average		113.2	9.2	1.65	1.53	3	17 total		36.7(?)	ave. pig
XL	1st	116	8	2.0	1.95	6	3	5		8-14
	2nd	114	6	2.0	1.66	4	3	3		
	3rd	114	10	2.0	2.0		8	2		
Average		114.6	8	2.0	1.87	3.3	14 total		10	
L	1st	116	5	1.83	1.50	2	3	2		6-10
	2nd	113	4	1.75	1.50	0	2	2		conceived 7-2
Average		114.5	4.5	1.79	1.50	1	5 total		4	
LI	1st	113	6	3.0	2.35	2	4	3		9-26
III	1st	115	9	3.38	3.13	6	7	3		
	2nd	112	7				2	5		
	3rd	111	9	2.8	2.35	5	5	4	198	
	4th	113	9	2.6	2.5	7	4	5	207	
	5th	113	9	2.22	2.5	8	4	5		
	6th	112	4	2.5	4.0	3	2	2		
Average		112.7	7.8	2.676	2.85	5	24 total		33	33.7(?) ave. pig

Table 1 Group 12

Factor	No. of litter	Gestation period days.	Size of Litter		Birth wt.		No. pigs raised	Pigs born		Weight of Age litter at 1st. weaning breeding
			Boars	Sows	Boars	Sows		Boars	Sows	
VII	1st 2nd	115 114	7 7				3 7	4 3	3	
XIa	1st 2nd 3rd 4th 5th	113 113 113 114 113	3 8 10 9 5		3.0 3.0 2.43 2.79 3.0	3.25 3.7 1.83 2.75 2.83	1 4 9 8 5	1 3 7 6 2	3 5 3 3 3	25 180 249 234 ---
Average		113	7		2.84	2.67	5.4	19 total	16	31.3 Av. per pig
XIIIA	1st 2nd	115 114	11 8		2.5 2.625	2.125 2.75	8 8	3 3	8 5	300 313
Average		114.5	9.5		2.562	2.437	8	6 tot.	13	38.2 Av. per pig.
XIIa	1st 2nd 3rd	114 116 116	11 9 12		2.4 2.5 2.0	1.83 2.16 1.66	3 8 10	5 3 6	6 6 6	108 248 ---
Average		114.7	10.7		2.3	1.88	7	14 tot.	19	32.3
XXA	1st	112	6		2.5	2.5	6	3	3	288

Table 1 Group 12 Con.

Factor	No. of Gestation litter Period days.	Size of litter	Birth wt.		No. of pigs raised	Pigs born		Weight of litter at weaning
			Boars	Sows		Boars	Sows	
VIII	1st	115	8	1.7	1.9	3	5	3
	2nd	114	6	4.0	4.0	3	1	5
	3rd	116	9	2.125	2.285	7	4	5
	4th	115	6	2.5	3.4	4	2	4
	5th	114	3	2.75	3.0	0	2	1
Average		114.8	6.4	2.615	2.917	3.4	14 tot'l	18
								31.2 av. per pig
IV	1st	113	5	2.7	2.7	1	3	2
	2nd	114	8	3.7	3.7	8	2	6
	3rd	113	3	3.37	3.35	3	2	1
	4th	118	5	3.33	4.0	5	4	1
	5th	115	3	3.25	4.125	3	1	2
Average		114.4	4.8	3.162	3.52	4	12 tot'l	12
								32 av. per pig
XIIB	1st	113	6	2.2	2.5		5	1
XIIIB	1st	114	7	2.5	2.1		2	5

Table II Group XII
Summary of Farrowing Records from Table I

Group	Gestation Period days	Size of litter	Birth wt. Boars	Sows	No. pigs raised ave per litter	Pigs born Boars	Sows	Ave. Weight pigs at weaning
VI	113.2	8	2.38	2.10	6.1	37	34	34.7
V	113.5	8	2.11	2.01	4.3	38	30	35
XI	113.5	6	2.56	2.41	4.8	20	23	29
XIV	113.7	7.3	2.595	2.495	4.0	10	12	30.5
XXII	113.1	7.5	2.455	2.21	4.1	32	36	36.5
XXXI	113.4	7.2	2.17	1.91	4.8	16	20	38.6
XXX	113.3	9.2	1.65	1.53	3	17	20	36.7
XL	114.6	8	2.0	1.87	3.3	14	10	
L	114.5	4.5	1.79	1.5	1	5	4	
Total	1020.7	65.7	19.71	18.035	35.4	189	178	231.0
Average	113.4	7.3	2.19	2.004	3.93 54%	52%	48%	33.0
III	112.7	7.8	2.676	2.85	5	24	23	31.3
XIa	113	7	2.84	2.67	5.4	19	16	38.2
XIIa	114.5	9.5	2.562	2.437	8	6	13	32.3
XIIa	114.7	10.7	2.3	1.88	7	14	18	
Total	454.9	35.	10.378	9.837	25.4	63	70	101.8
Average	113.7	8.7	2.594	2.459	6.35 73%	48%	52%	33.6
VIII	114.8	6.4	2.615	2.917	3.4	14	18	31.2
IV	114.4	4.8	3.162	3.52	4	12	12	32
Total	229.2	11.2	5.777	6.439	7.4	26	30	63.2
Average	114.6	5.6	2.888	3.218	3.7 66%	46.5%	53.5%	31.6

The Immature group has averaged a greater number of pigs per litter than have the Mature Factors, but a lesser number than the Half Mature Factors. Here the figures are not consistent. They indicate that the size of the litter is probably determined by the individual rather than by the age of breeding.

The birth weight of the pigs is apparently affected by the age at which the sow is bred, according to these data. The pigs of the Mature group average the largest birth weight and those of the Immature group average the smallest birth weight. The boar pigs are heavier at birth than are the sow pigs in nearly all cases. The sow pigs of the Mature Factors considered were heavier at birth than were the boars. Whether the age of breeding has any effect on this point, would be hard to say. These data are not sufficient to determine this point.

The average number of pigs raised per litter is probably affected by environment more than ^{by any} of the other conditions considered. From these data it is seen that the Immature group raised about four pigs per litter, the Half Mature, six, and the Matures slightly less than the Immatures. Possibly the young sows do not make as good mothers since only 54 percent of the pigs are raised in the Immature group against 73 percent for the Half Matures and 66 percent for the Mature ^{group}. The small number of Factors considered as Matures and Half Matures again does not warrant the drawing of definite conclusions.

The percentage of boar and sow pigs is very nearly equal throughout. Considering all Factors together, there were produced equal numbers of boar and sow pigs, 278 of each. Considering the groups separately, the Immatures have produced a slightly less number of sows than boars. The Half Matures have produced a higher percentage of sows. The Matures have produced a little greater percentage of sows than have the Half Matures. This may indicate that old sows produce a greater percentage of sow pigs than boar pigs. A study of the individual Factors does not show this to be true, however. It seems to vary with the individual sows. In most cases the percentage of males and females is very close.

Weight records of the litter at weaning time have not been kept for all litters produced. The records at hand have been observed, and the average weight of the pig at weaning computed for each of the groups. There is apparently little difference due to the age of breeding the animals.

Each Immature Factor was set aside to be bred at the earliest time possible. In some cases it was necessary to breed the sow several times before she conceived. In Table I, Group XII, is shown the age at which each Immature Factor was bred and the age at which she conceived, if it was necessary to breed more than once.

It appears that the age at which the first oestrus period occurs is in the neighborhood of six months, It

occurred as early as 4 months and 21 days in Factor VI and not until 9 months and 26 days with Factor LI. There is some little indication of the oestrus period occurring at a later age in the consecutive generations of the Immature Factors. This is not at all regular, however, as it is seen that both Factors of the fourth generation and one from the sixth were in heat at six months. It is possible that early breeding has some effect on the appearance of the first oestrus period, but the data at hand are not sufficient to show much in regard to this point.

There is no apparent effect on the length of the gestation period due to the sex of the pigs farrowed.

Effect of the Number of Pigs Raised per Litter on the Farrowing Records:

A comparison is now given of the farrowing records of sows, made according to the number of pigs born per litter, disregarding the age of the animal. These figures are presented in Table I, Group XIII.

The smallest number of pigs born per litter was three and the largest number twelve. There is a total of 81 litters considered. Of these, 17 litters, or 21 percent were of 3 pigs; thirteen, or 16 percent were of six pigs; and 9, or 11 percent were of 7 pigs each. Litters of other sizes occurred approximately the same number of times, with the exception of the litter of twelve, which occurred but three times.

Table I Group XIII

Tables Showing the Effect of the Number of Pigs
Raised per litter on the Farrowing Records of Sows.

	Gestation period days	Birth wt. lbs.		No. born		No. raised	Avg. wt. at weaning
		Boars	Sows	Boars	Sows		
3 Pigs	V	115	2.75	2.50	1	2	34.3
	XI	113	2.75	2.5	2	1	36.6
	XXII	111	3.25		3	0	
	XXXI	115	2.33		3	3	28.0
	XIa	113	3.0	3.25	1	2	25.
	VIII	114	2.75	3.0	2	1	
	IV	113	3.37	3.25	2	1	37.3
	IV	115	3.25	4.125	1	2	
Average		113.6	2.931	3.104	1.87	1.12	32.24
4 Pigs	VI	112	3.31		4	0	30
	VI	111	2.81		4	0	
	XI	113	3.0	3.0	3	1	
	XXII	111		2.5	0	4	
	XXX	110	1.75	1.5	1	3	
	L	113	1.75	1.5	2	0	
	III	112	2.5	4.0	2	2	
Average		111.7	2.52	2.5	2.3	1.7	30

Table 1 Group XIII Con.

Factor	Gestation period days	Birth wt. lbs.		No. Born		No. Raised	Avg. wt. at weaning
		Boars	Sows	Boars	Sows		
5 Pigs							
XXII	112	2.62	2.66	2	3	4	46.2
L	116	1.83	1.50	3	2	2	
XIa	113	3.0	2.83	2	3	5	
IV	118	3.33	4.0	4	1	5	26.6
IV	112	2.7	2.7	3	2	1	43.
Average	114.2	2.696	2.74	2.8	2.2	3.4	38.6
6 Pigs							
VI	114	3.25	3.0	4	2	6	
XI	114	2.25	2.125	2	4	5	30
XI	115	2.5	2.66	3	3	6	
XXII	114	2.4	2.25	4	2	0	
IV	114	2.5	2.125	2	4	5	36.6
XIII	112	2.8	3.0	5	1	5	21
XXXI	112	2.16	2.0	3	3	1	
XL	114	2.0	1.66	3	3	4	
LI	113	2.0	2.25	4	2	2	48.
XXa	112	2.5	2.5	3	3	6	
VIII	114	4.0	4.0	1	5	3	31
VIII	115	2.5	3.4	2	4	3	33.2
XIIb	113	2.2	2.5	5	1	4	
Average	113.5	2.54	2.57	3.1	2.8	4	33.3

Table 1 Group XIII Con.

Factor	Gestation period days	Birth wt. lbs.		No. born		No. raised	Avg. wt. at weaning
		Boars	Sows	Boars	Sows		
7 Pigs							
V	114	1.7	1.875	5.	2	5	38.6
XI	114	2.25	2.2	2	5	6	24.1
XI	112	2.66	2.4	3	4	7	
XIV	112	2.625	2.7	2	5	7	28.
XXXI	114	2.16	2.0	3	4	6	
III	112			2	5		
XIIIb	114	2.5	2.1	2	5		
VII	115					2	
VII	114			4	3	7	
Average	113.4	2.316	2.212	3	4	5.7	30.2
8 Pigs							
VI	113	1.5	2.19	2	6	8	34
VI	113	2.6	2.0	5	3	7	27.3
XL	116	3.0	1.95	3	5	6	
XIa	113	3.0	2.7	3	5	4	45
Group XIII. XIIIa	114	2.625	2.75	3	5	8	39
VIII	115	1.7	1.9	5	3	3	33
IV	114			2	6	8	
Average	114	2.238	2.248	3.3	4.7	6.3	35.66

Table 1 Group XIII Con.

Factor	Gestation period days	Birth wt. lbs.		No. born		No. raised	Avg. wt at weaning
		Boars	Sows	Boars	Sows		
9 Pigs							
VI	113	2.33	2.125	3	6	8	40
V	113	2.25	2.0	4	5	5	
V	114	2.0	2.25	8	1	3	30
V	115	2.25	1.8	4	5	4	
XI	114	2.5	2.0	5	4	7	
XXII	111	2.66	2.5	3	6	9	32.4
XXII	111	2.6	1.75	5	4	8	
XXII	112	2.66	2.66	6	3	0	
XIV	114	2.0	1.64	2	7	7	29
XXXI	114	1.56	1.45	4	5	0	
III	115	3.28	3.12	7	3	6	
III	111	2.8	2.25	5	4	5	39.6
III	113	2.6	2.5	4	5	7	29.6
III	113	2.2	2.5	4	5	8	
XIa	114	2.79	2.75	6	3	8	29.2
XIIa	116	2.5	2.16	3	6	8	31
VIII	116	2.125	2.285	4	5	7	29.4
Average	113.5	2.418	2.22	4.5	4.47	5.9	32.24

Table 1 Group XII Con.

Factor	Gestation period days	Birth wt. lbs.		No. born		No. raised	Avg. wt. at weaning
		Boars	Sows	Boars	Sows		
10 Pigs	VI	1.66	1.50	6	4	4	44
	V	1.8	1.916	7	3	3	
Table 1	XXII	2.16	2.65	3	7	7	
Group	XIII	2.00	1.75	6	4	1	
	XL	2.0	2.0	8	2		
	XIIa	2.43	1.83	7	3	9	37.7
Average		2.01	1.941	6.1	3.8	4.8	35.8
11 Pigs	VI	1.66	1.7	5	6	7	
	VI	2.3	2.2	4	7	8	
	V	2.0	1.75	9	2	7	
	XXI	2.2	2.0	5	6	7	
	XIIa	2.5	2.125	3	8	8	37.5
	XIIa	2.4	1.83	5	6	3	36
Average		2.176	1.934	5.1	5.8	6.67	36.75
12 Pigs	XXII	2.0	1.6	6	6	4	
	XXX	1.5	1.5	6	6	0	
	XIIa	2.0	1.66	6	6	10	
Average		1.83	1.59	6	6	4.7	

Summary of Table
Table II Group XIII.

No. in litter	Period of Gestation	Wt. Boars	Wt. Sows	Avg. No. Born		Avg. No. raised	Raised	Avg. wt. at weaning
				Boars	Sows			
3	113.6	2.931	3.104	1.87	1.12	3	66%	32.24
4	111.7	2.52	2.5	2.3	1.7	2.6	65%	30.
5	114.2	2.696	2.74	2.8	2.2	3.4	68%	38.6
6	113.5	2.54	2.57	3.1	2.8	4	66%	33.3
7	113.4	2.316	2.212	3	4	5.7	81%	30.2
8	114	2.238	2.247	3.3	4.7	6.3	78%	35.66
9	113.5	2.414	2.22	4.5	4.47	5.9	65%	32.24
10	113.7	2.01	1.931	6.1	3.83	4.8	48%	35.8
11	113.3	2.176	1.934	5.1	5.8	6.67	61%	36.75
12	113.7	1.83	1.59	6	6	4.7	40%	

Table II, Group XIII, a summary of Table I, shows the averages for each group. The groups are considered according to the number of pigs per litter.

The length of the period of gestation is apparently not affected by the number of pigs farrowed per litter. The length of the period varies from 110 to 116 days. The average length of the period is 113.5 days.

The weight of the pigs at birth decreases as the number of pigs increases. This does not occur in regular order, however.

The numbers of boars and sows farrowed are very nearly equal. The percentage of each does not vary with the size of the litter.

It might seem that the percentage of pigs raised would be greater when small litters are farrowed. From the summary it can be seen that this is not the case. The percentage of pigs raised is close to 65 for all groups. The percentage raised is highest for the sows farrowing seven and eight pigs, according to these figures, and lowest where ten and twelve pigs are farrowed. It is not likely that the percentage of pigs raised is changed by the number of pigs farrowed. This is probably dependent on care and environment more than on other conditions.

The weight of the pigs at weaning time does not seem to change with the number of pigs born or raised. It would be reasonable to think that a sow suckling two or three pigs should be able to supply them with more

nourishment than when a large litter was suckled. Evidently the milk flow is governed by the number of pigs suckled and the pigs of small litters receive no more than those from large litters. At least the data do not show any difference in the weight at weaning due to the number of pigs raised per litter. The data on this point has been limited, consequently no definite conclusions can be drawn.

SUMMARY.

Investigations with women^{have} led to the belief that no more nutrients are required during pregnancy than during non-pregnancy. Some investigations have shown an increase in body-weight of the pregnant woman, over that of the foetus and generative organs, on the same amount of nutrients required for the maintenance when not pregnant.

Minot, using body weight as a measurement of growth, found that pregnancy in guinea-pigs caused no check in growth rate. He found evidence of an increased rate of growth due to the pregnant condition. Although Minot claims that body-weight is the only satisfactory measurement of growth which can be used with the guinea-pig, it seems questionable whether an increase in weight is always an indication of growth.

Watson found from his investigations with white rats, that mated rats grew to a larger size, as indicated by body-weight, than did the unmated rats. He allowed the rats to fully recover after each lactation period. He found some indication of an increased growth rate during the pregnant period.

From his observations on dairy heifers during pregnancy, Musser found, apparently, that very little, if any extra nutrients were required to develop the foetus. If no extra nutrients are required to develop the foetus, there should be no serious check on growth during the pregnant period.

Tables presented by Regan show some evidence of a slight check in growth during the pregnant period of the dairy heifers. There may have been other conditions which caused this apparent check.

Eckles found that there is no very noticeable check in growth during the pregnant period of the dairy heifers.

Griswold found some indication of a check in the growth of pregnant sows. He found that the individual sows varied widely. Some of the open animals showed less growth than the pregnant individuals. In a digestion trial with swine, Griswold found higher coefficients of digestibility for dry matter, protein, fat, and nitrogen free extract, with pregnant animals than with open animals.

In the present investigation twenty-five comparisons have been made of Growth of Factors during pregnant periods with the growth of other Factors during open periods. Seven of the comparisons were discarded because of unequal feed received by the Factors. Of the remaining eighteen comparisons, seven show increased weight and growth by the pregnant animals. Five show increased weight but less growth by the pregnant individuals. Three show increased growth but less weight with the pregnant Factors. Three show more weight and growth by open animals.

A few comparisons have been made to determine the effect of an early pregnant period, or pregnant and lactation period, on the growth during the later open period. The comparisons are too few to give definite results. There is some indication

of a check in growth due to an early pregnant or pregnant and lactation period. Some comparisons show no check due to the early pregnant or pregnant and lactation periods.

Since individual records were not kept, the comparison of feed consumed by pregnant and open Factors is probably of little value. The amount of feed consumed seems to be determined largely by the individual rather than by the condition. As a rule, the animal which receives the largest amount of feed made the greatest gain during the period, regardless of condition. By figuring the amount of digestible nutrients consumed per 1000 pounds live weight, per pound of gain for the pregnant and open group, it was found that the pregnant group consumed slightly less feed per pound of gain than did the open group.

In this investigation it was found that there was no consistent increase or decrease of digestible nutrients consumed per 1000 pounds live weight by animals during successive pregnant periods. This seems to be governed by the needs of the individual at different times.

There is some indication of a greater amount of nutrients being consumed by successive generations of Immature Factors. The results are not consistent.

Observations show that there is a great loss in condition of an animal which is suckling young.

Minot found, from his investigations with guinea-pigs, that lactation was a great drain on the mother. He found a serious check in growth during the lactation period.

From his observations on the white rat, Watson found a check in growth during the lactation period. By allowing sufficient time for recovery, following the lactation period, Watson found that rats which had raised three litters attained a greater size than did unmated rats.

Regan found a very serious check in growth of dairy heifers during the lactation period.

Griswold found a serious check in growth of lactating sows.

In the writer's investigation of the growth of lactating swine, several comparisons of the growth of lactating Factors and open Factors have been made. It was found that lactation produced a serious check in growth.

Lactating Factors consumed more nutrients per 1000 pounds live weight and made less gains than did the dry Factors.

The feed consumed by lactating Factors seemed to be governed by conditions other than previous lactation periods which the animal had had.

There was no apparent increase or decrease of nutrients consumed by successive generations of Immature Factors.

Mature and Half Mature Factors showed a smaller consumption, per 1000 pounds weight, of nutrients during pregnancy and lactation, than did the Immature Factors.

Mature and Half Mature Factors consumed less nutrients per 1000 pounds weight per pound of gain than did Immature Factors during gestation. It is very probably that the difference in age and condition of the Mature, Half Mature, and Immature Factors is largely responsible for the difference in the amount

of nutrients consumed per 1000 pounds weight.

Eckles states that dairy heifers bred at an early age do not reach normal size.

The animals known as Immature Factors in this investigation were apparently stunted to a small degree. They matured more slowly, requiring about four years to reach maturity.

The offspring of Immature Factors grew as rapidly, and required little, if any, more feed per pound of gain than the offspring of Half Mature and Mature Factors.

On account of the greater number of pigs raised during a five year period by the Immature Factors, and, consequently the greater amount of pork produced per 100 pounds of feed, it is probably far more economical for the commercial hog raiser to breed gilts when at an immature age. It would probably not be advisable to breed gilts under eight months of age.

The period of gestation was found to be slightly less for the Immature Factors than for the Half Mature or Mature Factors. The Mature Factors showed the longest period of gestation. There was a difference of 1.2 days in the gestation periods of the Immature and Mature groups.

The Half Mature group produced, on an average, the greatest number of pigs per litter and the Mature group produced the smallest number.

The Immature Factors farrowed smaller pigs than the Mature or Half Mature Factors. Mature Factors produced pigs of the largest birth weight. Boar pigs are heavier at birth

than sow pigs.

The records indicate that the Mature group tended to produce slightly more female pigs per litter, and the Immatures slightly more boar pigs.

The records show a total of 556 pigs farrowed by all groups. Of these there were 278 boar pigs and 278 sow pigs.

The Half Mature Factors raised a greater percent of pigs born than did the Immature or Mature Factors. The Mature Factors raised a smaller percent of pigs born than did the Immature Factors.

The weight of the pigs at weaning time was about the same for each group.

There is some evidence of the oestrus period occurring at a later age in successive generations of Immature Factors.

The period of gestation showed no increase or decrease due to the number of pigs farrowed per litter.

The weight of the pigs at birth is less in large litters than in small litters.

The percentage of pigs raised showed no regular increase or decrease due to the number of pigs born per litter.

The weight of the pigs at weaning time was not affected by the number of pigs in the litter.

CONCLUSIONS.

There is quite conclusive evidence that pregnancy does not check the growth of an animal.

There is rather conclusive evidence to show that pregnancy causes an animal to increase in weight above the weight of the foetus and generative organs.

There is some indication that pregnancy acts as a stimulant causing growth to be increased during the period.

There is probably little difference in the quantity of nutrients required per pound of gain by pregnant and open animals.

Lactation causes a serious check in the growth of an animal. More nutrients are required by lactating animals than by dry animals.

There is evidence to show that immature sows require more nutrients per 1000 pounds weight during pregnancy and lactation than do half mature or mature sows.

There is evidence to show that animals bred at an early age never attain to normal size. Not enough animals were considered in this investigation to warrant conclusions on this point.

There is probably little if any difference in growth rate of pigs due to the age of the parents.

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Plate I.

at about 30 months of age

Plate II.

at about 42 months of age

Plate III.

at about 60 months of age.

Plate IV.

Body Weight of five Original Factors During a five-year period

Plate V

Height at Withers of Five Original Factors During Five year Period.

Plate VI.

Width of Head of Five Original Factors During Five Year Period.

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