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Some Data on the Inheritance of Horns in Sheep

An Ultra Long Horn; Three-Year-Old Dorset Ram, Fitted for Exhibition.

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SOME DATA ON THE INHERITANCE OF HORNS IN SHEEP

By T. R. Arkell

For many years scientists and practical breeders have devoted much time to solving the phenomenon that surrounds the inheritance of horns in sheep. Horns offer a fertile field for experimental breeding investigations, since they represent a patent character that can be readily distinguished in the soma and the degree of potency in which they may appear in different crosses can be accurately ascertained by actual measurement. Horns in sheep, however, do not have the simple manner of inheritance that do horns in cattle. The production of horn in the former is influenced and controlled most strongly by sex, exhibiting a markedly different condition in each sex, whereas in the latter there occurs in both male and female the simple dominance of an inhibitor to horn growth.

Attention was called by Darwin* in 1871 to the fact that, when a cross is made between pure horned and hornless sheep—it matters not which sex bears the horns—the male offspring eventually develops horns of some kind but the females are hornless. Wood † (1905)published a note which, based on actual breeding tests, corroborated Darwin's findings. Wood carried his investigations further, breeding the F_1 generation *inter se* and discovered that of the F_2 males approximately seventy-five per cent. were horned and twenty-five per cent. polled while the opposite condition obtained in the females; namely, twenty-five per cent. horned and seventy-five per cent. polled. This percentage of horned and hornless individuals coincided with Mendelian expectation, showing that the interpretation of this phenomenon according to Mendel's theory, was a just and accurate one. Wood obtained his results from reciprocal crosses between Dorset Horn, a breed having both males and females horned, and Suffolk Down, of which both sexes are hornless. Darwin's data were gotten from sources of a similar nature, except that for the horned breed, Lonk sheep were used and for the hornless, Leicesters and Shropshire Downs.

The data of Darwin and Wood, however, do not cover the entire scope of horns in sheep; for sheep, according to the condition of horns they bear, may be divided into three distinct categories: Breeds with both males and females heavily horned

* Darwin, Charles, "The Descent of Man and Selection in Relation to Sex," New York, Appleton.
† Wood, T. B., "Note on the Inheritance of Horns and Face Color in Sheep," Jour. Agric. Sci., 364, 365, pl. IV.

as the Dorset Horn and Lonk; breeds with the males only horned, (frequently even they are hornless and at times the females may also show some signs of horn growth) as the various sub-breeds that are included in the great Merino class; and breeds with both sexes hornless as the Downs and many coarse-wooled sheep, the most prominent of the latter being the Lincoln, Cotswold and Leicester. The males of the Dorset Horn and Lonk bear immense spirally curved horns, while the female horn, although well-marked and quite long, does not attain such great thickness and length nor is so much curved as that of the male. Little appreciable variation exists, the writer has discovered from actual measurements, in the size of the horns of Dorsets under similar conditions of feed and care. This, however, does not hold true for Merino horns. They are most variable even within the same breed or strain.

There are three types of Merinos in America, recognized by sheep breeders as the American, Delaine and Rambouillet. Plumb * states that the American Merino ram carries heavy, spirally twisted horns but the ewes are hornless. The same authority claims that the rams of the National, Standard or Victor-Beall Delaines may or may not have horns; that the Dickinson Delaine may have small horns but a polled head is preferred, and that the Black Top Merino rams usually have horns. The foregoing represent the most important strains of Delaine Merinos in this country. In all instances the ewes, to comply with the standard, must be hornless. To relate again from Plumb, Rambouillet rams usually have large, spirally turned horns, but there are also polled males, and the females are hornless. From what evidence I have shown, it will be readily conceived that, although the mere mention of a Dorset Horn ram suggests without further explanation long horns, the same does not apply so conclusively to the Merino. In some Merino strains neither rams nor ewes have horns; in others, the rams only bear horns, which may be short and slender, and, again, in some, the rams may possess long, heavy horns. All authorities on sheep concur that Merino ewes are hornless, yet many practical Merino sheep raisers with whom I have conversed on this topic have admitted that a mere scab or very short, loose scur may appear every now and again from the horn pits of some ewes in the flock. I myself have at times noted this in Merino flocks and, besides, another feature which may bear some particular significance in heredity and has been generally overlooked. This feature comprehends a short, hard knob—I have used this word for a lack of a more pertinent one—protruding from the horn pits, which in pure hornless breeds show a slight depression, and covered with the unbroken skin. These excrescences, or knobs,

* Plumb, Charles S., 1906, "Types and Breeds of Farm Animals." Boston: Ginn.

Shrapshire Ram, No. 1.

Hampshire Ram, No. 3.

Dorset Horn Ram, No. 2.

Merino Ewe, No. 43.

Native Ewe, No. 61.

Merino Ram, No. 235.

seem to represent all horn growth the Merino ewe is capable of making, except in instances where the knob has disrupted the skin and a scablike horn or scur has resulted. From an examination of 128 Class A and B American Merino ewes I discovered 53 individuals or 41 per cent. bearing knobs and five of these had besides scabs or short scurs. In our Station flock of Merinos which consists mostly of pure-bred Rambouillets with a few heavily wrinkled Americans there is virtually as great a percentage of females with knobs.

Horns of Merino rams are not always sufficiently developed at birth so that they can be readily perceived or even felt. In fact, several days may elapse before an appreciable growth is made to enable an observer to recognize the presence of a horn. This is not the case with the Dorset Horn or any breed where both sexes bear horns. Horn growth with these sheep can almost invariably be distinguished at birth. The length will vary from a quarter to an inch and a half or even greater. The males have more prominent horns at birth than the opposite sex. I have been assured of these facts by sheep raisers and also by my own practical experience with sheep. Darwin* remarked these conditions, although in the case of the Merinos his evidence is limited. However, he cites one striking instance, which, perhaps, as Merinos are known in this country, represents an exception in prolonged horn development rather than the rule, of a Merino ram in Saxony, observed by Prof. Victor Carus, which was born on Feb. 10 and first showed horns on March 6.

Castration also affords most interesting data and brings forth rather peculiar results in its effect on the development of horns. Here again a divergence occurs between the two types of horns as represented by the Merino and the Dorset Horn. Early castration of a Merino ram lamb leads to a wether, destitute, or almost so, of horns. An emasculated Dorset, even though the testes are removed when but two or three weeks old, always produces horns, although these are reduced in size, and, according to my observation and what I have been told by practical breeders of these sheep, they correspond in length and diameter to about two-thirds of the size of the normal horn. Castle † (1911) has noted the disappearance of horns in castrated Merino rams and draws therefrom the conclusion that "the presence of the male sex-gland in body, or rather probably some substance given off into the blood from the sex-gland, favors the growth of horns." Darwin ‡ (1871) also had considerable evidence, bearing on this subject, which I quote:

"With sheep both sexes properly bear horns; and I am informed that with Welch sheep the horns of the males are consider-

* Darwin, Charles, "The Descent of Man and Selection in Relation to Sex." New York: Appleton.
† Castle, W. E., "Heredity in Relation to Evolution and Animal Breeding." New York: Appleton.
‡ Darwin, Charles, "The Descent of Man and Selection in Relation to Sex." New York, Appleton.

Dorset Horn Ewe, No. 14.

Merino Ewe, No. 42.

Merino Ewe, No. 40.
(Wool clipped from head to show knobs plainly.)

Southdown Ram, No. 4.

H x Mo-F_1, Ewe, No. 113.

Sn x D-F_1, Ram, No. 108.

ably reduced by castration; but the degree depends much on the age at which the operation is performed, as is likewise the case with other animals. Merino rams have large horns, whilst the ewes 'generally speaking are without horns'; and in this breed castration seems to produce a somewhat greater effect, so that if performed at an early age the horns 'remain almost undeveloped.' On the Guinea coast there is a breed in which the females never bear horns, and, as Mr. Winwood Reade informs me, the rams after castration are quite destitute of them."

Darwin's deduction is that castration, so far as horns is concerned at least, leads to a return to the primal condition of the animals, since, as he states, "horns of all kinds, even when they are equally developed in the two sexes, were primarily acquired by the male to conquer other males, and have been transferred more or less completely to the female."

The relation between the potency of horn growth and the presence of the male sex-gland, is not yet altogether determined. Nor can it be until the effects of spaying, or removal of the ovaries, of Dorset Horn and Merino ewes are worked out. No experiments, so far as the writer can discover, have ever been pursued in this regard. At present writing I have just spayed three Dorset Horn and three Rambouillet ewe lambs. The results will be watched with interest and will be recorded and published in a subsequent paper. It is possible that in regard to the Dorset Horn the horn may receive a rigid check in development, in which case it would be apparent that upon the foregoing assumption the female sex-gland also influences or aids growth; or, perhaps, the horn may assume a ram-like appearance in similar fashion as sterilized females of the human family produce a heavy growth of hair on the face. Should the horn remain normal, then it will point strongly to a potent influence of virility.

The interpretation offered by Wood to explain the peculiar inheritance of horns in sheep, in accordance with the data which he obtained by crossing Dorset Horns with Suffolk Downs and which I have previously reviewed, is that the horned character appears dominant in the male but recessive in the female. Bateson,* in examining these facts has drawn the conclusion: "Sex itself acts as a specific interference, stopping or inhibiting the effects of a dominant factor, and it is not a little remarkable that the inhibition occurs always, so far as we know, in the female, never in the male." He admits, however, the difficulty in distinguishing between this probability and the other possibility; namely that the male provides a stimulating factor. But discussing further in this connection he makes this statement: "Since the condition can be developed in males, it is evident that maleness itself is not a necessary complement; and it is not

* Bateson, W., 1909, "Mendel's Principles of Heredity." Cambridge, England, University Press.

H x Mo-F_1, Ewe, No. 85.

Sn x D-F_1, Ram, No. 108.

Merino Ewe, No. 46.
(Wool clipped from head to show scablike ~~seives.)~~ scurs

D x Sn-F_1, Ram, No. 109.

Hampshire Ewe, No. 110.

easy to suppose that there is some other factor regularly coupled with maleness which has this property, though that possibility cannot be absolutely excluded. The suggestion, however, that the female contains something which suppresses the effect of the otherwise dominant factor is consistent with the observation that when these sex-limited conditions, as they are called, do appear in females, they are developed to a somewhat less degree than in males, just as in horned breeds of sheep the ewes have horns smaller than those of the rams."

Reviewing the evidence of other investigators in this regard and combining with it our own gotten from actual breeding tests with many different breeds of sheep at this Station and the Station for Experimental Evolution, Davenport and myself * (1912) formulated the hypothesis, that horns in sheep represented a typical sex-limited character. This was based on the assumption that there is an inhibitor to horn formation located on the sex chromosome. The hypothesis further assumes that, as in man so in sheep, the male is heterozygous (simplex) in sex. One sex chromosome is then to be expected in the male, and substantially this condition has been found to hold for man by Guyer † (1910). The female will then be duplex in respect to sex. Consequently, since the inhibitor is sex-linked it will be simplex in the male and duplex in the female. The inhibitor, then (designated in Tables I and II by the letter I, its absence by i) will at all times be double in the female and single in the male, and, in the gametes, will always be associated with the sex chromasome, which is designated throughout by the symbol X; its absence by x. There are, moreover, two classes of horn determiners; namely, the Dorset Horn type (H), and the Rambouillet type (H′). H is a vigorous, sturdy determiner, capable of producing under fertile conditions a heavy somatic growth of horn. H′ is a weaker determiner, more easily controlled and dominated by the reactionary influence of the inhibitor. In the zygote the single inhibitor is incapable of preventing the development of either horn determiner, even when simplex. However, in the simplex condition, since there is only one "dose" of horn in the germ plasm, the somatic growth is greatly reduced and in the case of the weak determiner, H′, potency runs still lower. But the double inhibitor is capable of checking and preventing entirely somatic appearance of the single horn (Hh or H′h) but not the double determiner (H H or H′ H′). Again, H′ H′ does not show equal potency in the soma, but exists in females as knob-like protuberances, scabs or scurs, which I have previously described as possessed by Merino ewes. In Merino males the duplex determiner, since only one inhibitor is reacting against

* Arkell, T. R., and Davenport, C. B., "Horns in Sheep as a Typical Sex-Limited Character." Science, N. S., Vol. xxxv, No. 897, pp. 375-377.

† Guyer, M. F. "Accessory Chromosomes in Man," Biol. Bull. xix, 219, 234, pl. I.

H x Mo-F_1, Ram. No. 114.

D x Sn-F_1, Ewe, 132.

D x Mo-F_1, Ewe, No. 143.
(A long horn but ~~swerved~~ backwards.) curved

D x Mo-F_1, Ram, No. 161.
(Taken at twelve months.)

Se x Mo-F_1, Ewe No. 191.

its development, can, however, produce a large-sized horn. A glance at Tables I and II prepared from data obtained from crossing various classes of horned and hornless sheep at this Station, will show how this hypothesis feasibly explains all of the phenomena of horns in sheep. Of course, the potency of somatic horn production may also be raised in the male by the agency, perhaps, of some material elaborated by the sex-gland, as the effects of castration show; yet probably the female exerts a similar influence although to a much less degree, which as yet cannot be proved until our results of the unsexing of horned females are obtained. However, it must be borne in mind that maleness can only act as a stimulating influence, giving impetus to corporeal horn growth, when the determiner for horn is present. The weak determiner, H′, upon the removal of this impetus may not be able to develop whatever; but H will always produce horn in the soma, although castration will lessen its potency, so that a smaller horn results. It is obvious that the determiner for horn must always be present in the germ plasm before a horn can appear. Where it is absent in both sexes (the recessive condition) the offspring will under all conditions be hornless; for two recessives can produce nothing but the recessive condition.

Morgan,* in a personal communication, after reviewing some data I showed him, suggested that possibly the Merinos possessed a special inhibitor to horn development which was absent in other breeds; the assumption is tenable but unwieldy, and, besides, presents the feature which is difficult to explain of how the Merino alone should have an inhibitor, although virtually analogous conditions as with the Merino obtain when horned sheep are crossed with hornless, yet, under his hypothesis, devoid of the inhibiting factor. It is more reasonable to presume that the horn determiner of the Merino represents a lower or weakened grade of that of the regular long horn as borne by the Dorset. It is apparent, from an examination of the Dorset and Merino crosses † especially the 1912 F_2 generation, that the horn of the Dorset in itself is dominant to the Merino horn. This condition then is very similar to that of human hair color, as worked out by Davenport ‡ (1909). In hair color the more intense or the greater pigmentation is dominant to the less. The Dorset horn clearly represents a more intense condition of horn than that of the Merino, since the male horns are in most cases larger and the females always bear long horns.

The sporadic appearance of horns in Down rams and the loss of horns in Merino rams can be readily explained. Many Down ewes are simplex as to horns, but horns do not appear in the soma owing to the counteracting influence of the double inhibitor.

* Morgan, T. H., Columbia University.
† See Tables IX and XVI.
‡ Davenport, Gertrude C., and C. B. "Heredity of Hair Color in Man." Amer. Nat., xliii, 193-211.

D x R-F_1, Ewe, No. 162.

D x Mo-F_2, Ram, No. 242.

Se x Mo-F_1, Ram, No. 195.
(Taken at twelve months.)

D x N-F_2, Ram, No. 230.

H x Mo-F_2, Ram, No. 240.

H x Mo-F_2, Ram, No. 241.
(Taken at twelve months.)

When a male offspring is born, the proper combination may occur to give him a simplex horn, which will be a short stub or scur. Such a ewe, bred upon a pure hornless ram, would theoretically produce fifty per cent. of her male lambs with scurs and fifty per cent. without horns. These circumstances are occurring constantly in Down flocks. I remember vividly when I was a boy on the farm that one year we used as sire an imported Oxford Down ram on our selected registered Oxford Down ewes. Forty-two males lambs were sired by him. Of these two had large horns, eighteen scurs and the rest hornless. It was discovered subsequently that the ram normally possessed scurs or short horns, but these had been destroyed early in life by caustic potash, so that at the time we purchased him they were not noticeable. The ram was evidently simplex in respect to horns, and the two lambs with large horns were doubtless duplex, or possessed two horn determiners, being the issue from simplex ewes. I also remember, and have received corroboration by my father, that the same year a ewe lamb produced a sturdy growth of horn, which while young (for she was killed early) gave pretensions to become as long as the horn of a Dorset ewe. This, again represents the condition of a duplex horn. The breeders of hornless sheep are never free, except by judicious selection of strains that assuredly never produce horns, from the frequent reappearances of horn growths. In the various families of the Merino the opposite condition obtains. The horn of the males is most variable in size and at times disappears. The reason is obvious: the duplex condition is at times, or in some strains, broken down into the simplex, and, when two simplex horned sheep are bred together, twenty-five per cent. of the rams theoretically may be hornless.

Let us now consider our data and methods of obtaining these. In studying horns we first found it necessary to select some common standard whereby we could describe and compare accurately all sizes and degrees of horns. The ratio of circumference to length was taken for this purpose. This is attained in the following manner: Two measurements of length are made from the poll to the tip of the horn, one on the inside and the other on the outside of the horn. An average of these is taken and the results represent the length of the horn. The circumference is taken as close to the poll as possible. Any horn having a ratio less than 1.00, we have designated a scur and beyond that short, medium or long horn as the ratio justifies.

The first problem that presented itself was the effect or relation of age to the ratio; or, in other words, whether the ratio was constant at all ages. Without definite knowledge in this regard many errors might easily enter that would greatly depreciate the scientific value of the data. To this end measurements of Dorset rams and ewes were made every month from birth until a fairly constant ratio was attained. It was discovered that not until eighteen months of age did the horns reach a stage of virtually perfect maturity beyond which appreciable fluctuations in size no longer occurred in any great degree. The circumference at first expands to a greater extent than does the length, consequently giving a less ratio. So far as we have been able to judge from data at hand there seems to be no definite rate of increase in growth, nor is it in any way comparable to the growth of the body. When work of gathering this data was commenced, we had in mind only the desire to be able to recognize the period when variations in horn growth ceased. Since then a new avenue of research has been opened up; namely, variations in the rate of growth and the possibility of an inheritable tendency in this respect.

At three months of age the rams possessed on an average a ratio (length divided by circumference) of in round figures 2.00, the ewes, 1.60; at six months the rams 2.60, the ewes 2.00; at one year the rams 3.25, the ewes 2.50; and at eighteen months the rams 3.40 and the ewes 2.70. The average ratio of a matured horn, according to our measurements of forty-eight Dorset Horn rams and ewes, was for the ram 3.44 and for the ewe 2.72. This, I admit, does not represent altogether a fair average, since only twenty-four individuals of each sex were included. In order to establish a more exact average, measurements of several hundred sheep should be made. However, in all instances the ratios ran fairly uniformly, the difference between the highest and the lowest in the ewes, which was the greatest, being .49 points. The difference between the ratios of the horns of the rams and the ewes may be represented by a coefficient whereby the ratio of the one may be expressed in terms of the other. In this instance with the data we have at our disposal the coefficient would be 1.265. However, as I have already pointed out, this factor, owing to the comparatively small number of measurements of typical long horns we have been able to make, should not be adjudged as absolute. We have used it only in making rough comparisons.

Where reciprocal crosses were made of a long horned sheep (Dorset Horn) with a hornless sheep (Down), the females were invariably polled and the males always possessed some indications of horn growth, varying all the way from minute scurs to a medium-sized horn. The longest horn from such a cross had a ratio of 2.86 and the shortest consisted of a scur with a ratio of .32. Crosses of horned father and polled mother or vice versa gave horns in the male offspring very similar in character or, at least, no appreciable difference could be discerned. The right and left horns of the Dorset Horn are almost invariably uniform,

(H x Mo) H-F_1 x P, Ram, No. 249.

H x Mo-F_2, Ram, No. 243.

(Sn x D) D-F_1 x P, Ewe, No. 277.

Sn x D-F_2, Ewe, No. 268.

H x Mo-F^2, Ewe, No. 316 (192).

although in six per cent. of cases examined a very slight difference did exist.

Matings between hornless sheep invariably produce hornless females, and males that are either hornless or possess intermediate (simplex) horns. The hornless females may be pure or simplex, which selective breeding alone will show, unless their lineage for several generations is known. The hornless males cannot reproduce a horn.

The experience of practical breeders, as I have stated heretofore, provides proof of this, and in our own breeding operations hornless males bred upon recognizedly pure hornless ewes have never produced in the male offspring the slightest semblance of a horn. The horned males of this cross are clearly simplex.

The knobs of Merino ewes are not mensurable. In general they are most variable as to size. Sometimes they can scarcely be discerned, but can always be felt by a careful observer. They may simply fill the depression which normally exists in hornless ewes at the horn pits or they may protrude as much as an inch and a half beyond the skull. So far as our knowledge extends the knob condition exists only in Merino sheep and will be present in females, without producing a scur or horn, through successive generations. However, in some instances, as I have already mentioned, the knob may disrupt the skin, producing a scab-like horn or a scur.

Our belief that the knob represents the duplex condition of the Merino horn (H′H′) is based on the data contained in Tables VIII and IX. These records show that when crosses with other breeds are made, the knobs disappear, the F_1 female offspring possessing either an entire absence or a long horn according to the nature of the mating. When a ewe bearing the knob character is crossed with a long horned ram other than a Merino, the offspring, both rams and ewes, possess long horns. We have had no exception as yet to this rule; our knowledge, however, comprehends but a few examples. The length of the horns of the F_1 offspring, although the ratio of length to circumference is somewhat less than that for the long horns of the Dorsets, clearly entitles their inclusion in the long horn class. This patently proves that the Merino bearing a knob must possess two horn determiners in her germ plasm; otherwise, we should have some hornless females and males with simplex horns. It further proves that the potent horn determiner of the Dorset is not offset by the weakness of the Merino determiner but rather strengthens it, for the two together are capable of producing a heavy horn, almost as large as the pure Dorset horn. The offspring from matings between a hornless ram and a ewe bearing knobs are in every respect similar to those of a hornless and a long horned sheep; the females show an entire absence of horn growth and the males bear the usual simplex condition of horns.

A peculiar feature of the simplex horn, it will be remarked by examining data in the different tables, in the offspring arising from Merino crosses comprehends a striking irregularity in size betwixt the right and left horns of many individuals. I understand from trustworthy information that this lack of similarity also exists to some extent in pure-bred Merino strains. I regret that I have no precise data to offer upon this, since I have been unable to get measurements of a large number of Merino horns. All simplex horns are more or less subject to variation; but of those derived from the Dorset Horn it is by no means so apparent. This erratic variation, which does not occur in the duplex horn of the Dorset, is, perhaps, due to the low potency of the Merino horn determiner; or, in other words, the impetus to somatic growth from the determiner is not always sufficiently great to repel completely some local agency, as, for instance, unequal thickness of skin over the budding horns, counteracting development. Neither horn possesses an advantage in size; an average of all cases at this Station shows approximately an even division.

Little comment need be made on the matings of Dorset Horns, (See Table V). There may be a heritable tendency anent size of horn, but, owing to limited data, no inferences can be drawn at present. However, I am making measurements this year of the horns of about two hundred Dorsets of both sexes, composing a flock in Vermont. Several sires have been used, and knowing the sizes of the horns of both parents and offspring, I may be able to recognize a mode of inheritance.

Only a few representative examples have been shown of matings of hornless breeds. (See Tables VI and X). Altogether 113 individuals have been used in these crosses, being carried along to study characters other than horns. Where a Native * has entered a cross, the F_2 generation is given to show that these sheep belong to pure hornless strains. In fact, our Native ewes were selected with care and all were given breeding tests before being introduced into the experiment.

More offspring from the Southdown-Dorset crosses (See Table VII) were expected. The fertility of our first Southdown ram used proved most uncertain, only one lamb being born from him. It, moreover, was stillborn and deformed, and a description of it, consequently, could not be included satisfactorily in the data. The wide variation of the simplex horns in the different males is worthy of notice. Apparently the horn determiners and inhibitors do not always exist in equal degrees of strength. The

* Native is the term applied to the ordinary grade sheep which exist all too prevalently in New Hampshire, their origin being most difficult to trace.

H x Mo-F_2, Ram, No. 331 (1912).

(D x N) D-F_2, Ram, No. 307 (1912).

H x Mo-F_2, Ram, No. 333 (1912).

Sn x D-F_2, Ewe, No. 336 (1912).

D x Mo-F_2, Ewe, No. 354 (1912).

inhibitor at times may so predominate over the single determiner as to reduce somatic appearance of horn growth to a considerable extent. In the offspring of the F_2 generation, however, there is, with those possessing the double determiner, a complete return to the long horned condition. Referring to Table XI, F_2 ram, 269, is without doubt duplex horned, since length, circumference and ratio correspond closely with those of the long horns of the Dorsets. The other F_2 horned males shown in this table, from the condition of their horns, must be simplex. F_2 female, 229, is also long horned. It is not a little remarkable to note that, with the exception of the Merino crosses, no extracted females possess the slightest vestige of horn other than a perfect long one, which goes to show how completely the single horn determiner in held in abeyance by the double inhibitor. In fact, the inheritance of long horns in sheep (Dorset Horn) is very similar to that of colour blindness in the human family, where the female will transmit the colour blind character to her male offspring without being herself colour blind. For it requires two "doses" of the colour blind determiner to produce this disease in the female. In like fashion are horns in sheep transmitted in heredity; the female will be either entirely destitute of horns or possess a normal long horn according to the number of horn determiners she holds in her germ plasm.

The matings of hornless breeds with Merinos (See Table VIII), so far as the F_1 generation is involved, are of especial interest in proving the assertion heretofore made that the knobs of Merino ewes depend for their development upon two horn determiners (H'H') in their germ plasm. Therefore, the knob or scur represents the acme of complete horn production in the Merino female. An examination of Table VIII shows that every male offspring, derived from a cross between hornless father and Merino mother with knobs or scablike growths, produced scurs or horns of a simplex nature. Now, were the mothers simplex in regard to horns, some hornless F_1 males would inevitably appear. The F_1 females from the foregoing mating, of course, were hornless but bearing one horn (H'h) determiner, as subsequent matings to bring the F_2 generation prove. I strongly suspect that most, if not all, of our hornless Merino ewes are simplex in respect to horns, but, owing to the fact that most of the ewes in this class bore females, we have not at the present time any accurate means of ascertaining their condition in this regard. Merino ewe, 45, however, we know must be simplex since she produced a male offspring, 213, bearing scurs.

Misfortune has attended our Merino rams for two years. One died of derangement of the urinary organs during the mating season, and another accidentally met his death. In both instances it was found impossible to replace them opportunely at breeding time. Consequently, our offspring from matings of Merino ram with hornless breeds (See Table VIII) are few in number, and do not permit of extensive comparisons. I had hoped from this cross to find some F_2 females having knobs. However, this feature has been clearly shown in the female F_2 offspring from matings of hornless breeds with Merinos (See Tables XII and XV), where six females bear the knob character.

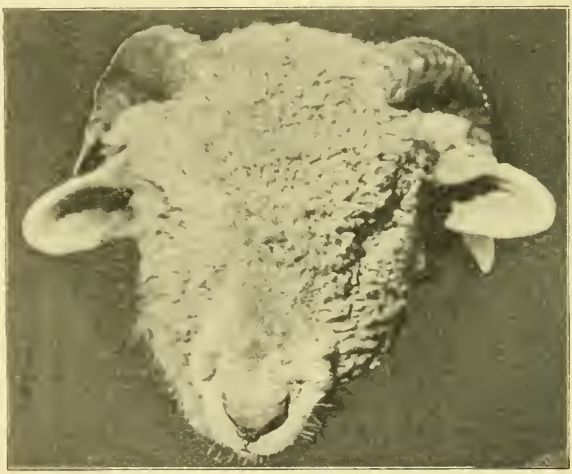
In the F_2 individuals obtained from Merino crosses with hornless sheep (See Tables XII and XV) a reappearance of long horns in the rams occurs, although the ratios of these horns are somewhat less than the average for the horns of Dorsets. The ewes either bear knobs, scabs, or are hornless. The striking dissimilarity between the lengths of the right and left horns of Merinos, especially simplex, is also shown. This variation is sometimes very slight and cannot be distinguished without actual measurement. Since we have used a tape marked in millimeters, we have been able to discover fine differences.

Matings of Dorset Horns with Merinos (See Tables IX and XVI) add corroboration to my former statement that the knob of the Merino female is represented in the germ plasm by the double determiner. If only one horn allelomorph were present, we should expect some shorthorned male offspring. The horns of the F_1 rams are all sufficiently large to permit them being included satisfactorily in the long horn category. The ratios, it is true, are less than those of the horns of Dorsets. However, this can be explained by reason of the fact that the horn determiner (H′) of the Merino is less potent than that of the Dorset. The females, 143, 145 and 162, (See Table IX), likewise bear long horns. Some doubt exists, perhaps, as to the nature of the horn of 162. The horn curved forward in a curious fashion, and, had it not been sawed off, would have pierced the head below the eye. Consequently, its length is not as great as it normally would be. The circumference, however, is a direct indication that it is a long horn, being even greater in that regard than 143, which plainly bears a long horn.

The 1912 F_2 generation (See Table XVI) adds further evidence in support of these facts. A word or two more is necessary to explain the gametic condition of D x Mo ram, 167, (Table IX and XVI). His mother, 31, is most probably simplex horned, and since his horn is comparatively short in relation to the horns of 161, 163 and 164, the belief that it also is simplex is strongly sustained. Consequently, it must bear the long horn determiner (H), since the gametes produced by his father are h
XHI and XHi and by his mother XH′I and X~~H~~I. In some instances hornless Merino ewes have been indicated as possessing a simplex horn. In all cases of this nature I am assured that such is the condition, for I have based my assumption on the

Sn x D-F_2, Ewe, No. 335 (1912).

H x MoF_1-, ~~Ewe~~, No. 114.
ram



D x Mc-F_2, Ram, No. 356 (1912).

Sn x D-F_2, Ram, No. 269.

Sn x D-F_2, Ram, No. 337 (1912).

evidence that at some time in her life she has produced, mated with a hornless ram, a simplex horned male offspring. Where doubt in the least exists I have given both the simplex and pure hornless formulæ.

The data, derived from the 1912 lambs, may, perhaps, not be considered pertinent or of sufficient importance to be included in this paper. However, another twelve months will have to pass before the horns are large enough to make accurate measurements. I think I have determined the condition of their horns correctly, although I am free to admit that I may find myself mistaken in some cases. I have designated what I thought was a simplex horn as "scur" and duplex as "horn."

This bulletin is written merely to review and present what data have already been obtained on horns in sheep in our breeding investigations with these animals at this Station. It is not intended as an ultimate effort in this regard, for we must verify our results by making still further crosses. Our 1912 crop of lambs will provide much valuable evidence. I include in this paper a preliminary estimate of the condition of their horns. However, since the oldest is five months and the youngest only two months, I cannot accurately draw conclusions as to what sort of horns they may eventually produce. I think, nevertheless, that, from the experience I have necessarily gained in guaging the size of horns, my approximation in most cases will prove correct. Bulletins on the inheritance of other characters in sheep will be shortly published. The work progresses slowly as is the case with breeding investigations with all large animals, since it is greatly retarded by the inability to breed ewe lambs and obtain strong, vigorous offspring.

In conclusion I wish to pay tribute to the kindly advice and aid Dr. C. B. Davenport, Director of the Station for Experimental Evolution, Carnegie Institution of Washington, Cold Spring Harbor, L. I., has extended to me in this work at all times.

TABLE I.—SUMMARY OF ALL POSSIBLE MATINGS OF LONG HORNED (DORSET HORN) AND HORNLESS SHEEP.*

Determiners in Germ Plasm of			Number of horned and Hornless Offsprnig.						Reference.
	Males.	Females.	Male.			Female.			
			Horned.	Horned, simplex.	Hornless.	Horned.	Hornless simplex.	Hornless.	
Soma Gametes	XxhhIi (hornless) XhI xhi	XXhhII (hornless) XhI							Tables VI, X
Zygotes	XxhhIi (hornless)	XXhhII (hornless)	0	0	61	0	0	52	
Soma Gametes	XxhhIi (hornless) XhI xhi	XXHhII (hornless, simplex) XHI XhI	(2) 2		(2) 2	0		(2) 2	
Zygotes	XxHhIi (horned, simplex) XxhhIi (hornless)	XXHhII (hornless, simplex) XXhhII (hornless)	(0)	(1)	(1)	0	(1)	(1)	
Soma Gametes	XxhhIi (hornless) XhI xhi	XXHHII (horned) XHI	15					24	Table VII
Zygotes	XxHhIi (horned, simplex)	XXHhII (hornless, simplex)	0	3	0	0	1	0	
Soma Gametes	XxHhIi (horned, simplex) XHI XhI xHi xhi	XXhhII (hornless) XhI	(.5) 0		(.5) 1	(0) 0		(3) 8	Table XI
Zygotes	XxHhIi (horned, simplex) XxhhIi (hornless)	XXHhII (hornless, simplex) XXhhII (hornless)	(0) 0	(2) 2	(2) 2	(0) 0		(1) 1?	
Soma Gametes	XxHhIi (horned, simplex) XHI XhI xHi xhi	XXHhII (hornless, simplex) XHI XhI	(7.5) 6		(2.5) 4	(2) 1			Tables XI, XIV
Zygotes	XxHHIi (horned) XxHhIi } (horned, simplex) XxHhIi } XxhhIi (hornless)	XXHHII (horned) XXHhII } (hornless. simplex) XXHhII } XXhhII (hornless)	(1.5) 1	(3) 3	(1.5) 2	(1.25) 2		(3.75) 3?	

Soma XxHhIi (horned, simplex) Gametes XHI XhI xHi xhi	XXHHII (horned) XHI	(10) 10		(0) 0	(4) 4		(4) 4	Tables XI, XIV
Zygotes XxHHIi (horned) XxHhIi (horned, simplex)	XXHHII (horned) XXHhII (hornless, simplex)	(3) 3	(3) 3	(0) 0	(2) 2	(2) ?	(0) 0	
Soma XxHHIi (horned) Gametes XHI xHi	XXhhII (hornless) XhI	5		c	c		5	Table VII
Zygotes XxHhIi (horned, simplex)	XXHhII (hornless, simplex)	0	1	0	0	5	0	
Soma XxHHIi (horned) Gametes XHI xHi	XXHhII (hornless, simplex) XHI XhI	6		0	14		c	
Zygotes XxHHIi (horned) XxHhIi (horned, simplex)	XXHHII (horned) XXHhII (hornless, simplex)	(1)	(1)	(0)	(1)	(1)	(0)	
Soma XxHHIi (horned) Gametes XHI xHi	XXHHII (horned) XHI							Table V
Zygotes XxHHIi (horned)	XXHHII (horned)	1	0	0	9	0	0	

*The above table gives a summary of the various matings that can be made, their hypothetical somatic and gametic composition as to horns, and the proportion of each sort of zygote that can be formed in each sex. The actual frequency of the different kinds of horned offspring derived from each mating is given on the left of the table, the expected proportions in the more complex cases being given in parenthesis above the actual findings. It is impossible to recognize a pure hornless from a simplex hornless female from simplex parents without a subsequent breeding test. Where doubt exists, such cases have been placed in the pure hornless column followed by an interrogation mark.

TABLE II.—SUMMARY OF MATINGS OF LONG HORNED (DORSET HORN) AND HORNLESS SHEEP WITH MERINOS.*

Determiners in Germ Plasm of		Number of Horned and Hornless Offspring.						Reference.
Male.	Female.	Male.			Female.			
		Horned.	Horned, simplex.	Horn-less.	Horned. (Knobs or scurs).	Hornless simplex.	Horn-less.	
Soma XxhhIi (hornless)	XXH'hII (Hornless, simplex)							Tables VIII, XII, XV
Gametes XhI	XHI							
xhi	XhI							
Zygotes XxH'hIi (horned, simplex)	XXH'hII (hornless, simplex)	(0)	(3)	(3)	(0)		(11)	
XxhhIi (hornless)	XXhhII (hornless)	0	3	3	0		14?	
Soma XxhhIi (hornless)	XXH'H'II (horned)							Table VIII
Gametes XhI	XH'I							
xhi								
Zygotes XxH'hIi (horned, simplex)	XXH'hII (hornless, simplex)	0	10	0	0	23	0	
Soma XxH'hIi (horned, simplex)	XXhhII (hornless)							Table XIII
Gametes XH'I	XhI							
XhI								
XH'I								
xhi								
Zygotes XxH'hIi (horned, simplex)	XXH'hII (hornless, simplex)	(0))	(2)	(2)	(0)		(3)	
XxhhIi (hornless)	XXhhII (hornless)	0	1	3	0		3?	
Soma XxH'hIi (horned, simplex)	XXH'hII (hornless, simplex)							Tables XII, XV
Gametes XH'I	XH'I							
XhI								
xH'i								
xhi								
Zygotes XxH'H'Ii (horned)	XXH'H'II (horned)							
XxH'hIi } XxHhIi } (horned, simplex)	XXH'hII } XXH'hII } (hornless, simplex)	(4)	(6)	(4)	(4)		(12)	
XxhhIi (hornless)	XXhhII (hornless)	3	7	4	5		11?	
Soma XxHhIi (horned, simplex)	XXH'hII (hornless, simplex)							Table XVI
Gametes XHI	XH'I							
XhI	XhI							
xHi								
xhi								

Zygotes	XxHH'Ii (horned)	XXHH'II (horned)							
	XxHhIi, XxH'hIi (horned, simplex)	XXHhII, XXH'hII (hornless, simplex)	(0.5)	(1.5)	(0.5)	(1)		(2)	
	XxhhIi (hornless)	XXhhII (hornless)	2	0	0	2		1?	
Soma	XxH'hIi (horned, simplex)	XXH'H'II (horned)							
Gametes	XH'I, XhI, xH'i, xhi	XH'I							Table XIII
Zygotes	XxH'H'Ii (horned)	XXH'H'II (horned)	(1.5)	(1.5)	(0)	(1)	(1)	(0)	
	XxH'hIi (horned, simplex)	XXH'hII (hornless, simplex)	1	2	0	0	0	0	
Sama	XxH'H'Ii (horned)	XXhhII (hornless)							
Gametes	XH'I, xH'i	XhI							Table IX
Zygotes	XxH'hIi (horned, simplex)	XXH'hII (hornless, simplex)	0	2	0	0	0	0	
Soma	XxHHIi (horned)	XXH'hII (hornless, simplex)							
Gametes	XHI, xHi	XH'I, XhI							Table VIII
Zygotes	XxHH'Ii (horned)	XXHH'II (horned)	(0.5)	(0.5)	(0)	(1)	(1)	(0)	
	XxHhIi (horned, simplex)	XXHhII (hornless, simplex)	0	1	0	0	2	0	
Soma	XxHHIi (horned)	XXH'H'II (horned)							
Gametes	XHI, xHi	XH'I							Table IX
Zygotes	XxHH'Ii (horned)	XXHH'II (horned)	(0.5) 2	(1.5) 0	(0.5) 0	(1) 2		(?) 1?	

* See footnote below Table I. I have indicated the Merino horn throughout as H', so as to show patently the nature of the mating.

TABLE III.—MEASUREMENTS OF MATURE HORNS OF DORSET FIELD* SHEEP.

Males.			Females.		
Length, mm.	Circum., mm.	Ratio Length. / Circum.	Length, mm.	Circum. mm.	Ratio Length. / Circum.
799	220	3.63	350	120	2.92
799	222	3.60	349	120	2.91
753	211	3.57	324	118	2.75
739	207	3.57	373	130	2.87
780	219	3.56	344	122	2.82
741	209	3.54	342	122	2.80
813	231	3.52	336	120	2.80
822	235	3 50	R 325	R 117	R 2.78
772	221	3.49	L 314	L 117	L 2.68
748	214	3.49	318	115	2.77
730	210	3.48	349	126	2.77
R 750	R 216	R 3.47	323	117	2.76
L 736	L 216	L 3.41	332	121	2.74
729	212	3.44	338	124	2.73
750	218	3.44	340	125	2.72
722	210	3.43	R 321	R 121	R 2.65
739	217	3.41	L 328	L 121	L 2.71
765	225	3.40	349	130	2.69
753	223	3.38	330	123	2.69
731	219	3.34	321	120	2.68
791	237	3.34	326	123	2.65
796	242	3.29	331	125	2.65
731	223	3.27	332	126	2.64
726	225	3.23	340	130	2.62
726	227	3.20	316	127	2.49
			340	140	2.43
Aver. 757	220	3.44	Aver. 334	123	2.72

TABLE IV.—RATE OF GROWTH OF HORNS OF DORSETS.

Males.
(Average of 14 Individuals.)

Length, mm.	Circum., mm.	Ratio Length / Circum.	Age.
42	53	.79	1 week
120	108	1 12	1 month
332	166	2 00	3 months
447	172	2.60	6 "
585	189	3.09	9 "
667	203	3.28	12 "
713	211	3.37	15 "
736	215	3.42	18 "
741	216	3.43	24 "
749	216	3.46	30 "

Females.
(Average of 12 Individuals.)

32	49	.65	1 week
78	74	1 05	1 month
148	91	1.62	3 months
211	106	1.99	6 "
264	115	2.29	9 "
302	120	2 51	12 "
319	122	2 61	15 "
330	123	2 68	18 "
337	123	2 73	24 "
339	123	2.75	30 "

* Maintained under ordinary farm conditions; not highly fitted for exhibition.

TABLE V.—MATINGS OF DORSET HORNS.

(For explanation of symbols see footnote.†)

Father.							Mother.									F1.							
No.	Breed.	Horns. Somatic Condition.	Horns. Zygotic Condition.	Horns. Length mm.	Horns. Circum. mm.	Horns. Ratio Length. / Circum.	No.	Breed.	Horns. Somatic Condition.	Horns. Zygotic Condition.	Horns. Length mm.	Horns. Circum. mm.	Horns. Ratio Length. / Circum.	Horns. Ratio F in Terms of m.	Nature of Mating.	No.	Sex.	Horns. Somatic Condition.	Horns. Zygotic Condition.	Horns. Length mm.	Horns. Circum. mm.	Horns. Ratio Length. / Circum.	Horns. Ratio F1 in Terms of m.
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	9	D	Pres.	XXHHII	R-L 340	R-L 125	R-L 2.72	3.44	D x D	157	M	Pres.	XxHHIi	R-L 666	R-L 200	R-L 3.33	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	5	D	Pres.	XXHHII	R-L 324	R-L 118	R-L 2.75	R-L 3.47	D x D	160	F	Pres.	XXHHII	R-L 357	R-L 120	R L-2.98	R-L 3.77
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	5	D	Pres.	XXHHII	R-L 324	R-L 118	R-L 2.75	R-L 3.47	D x D	139	F	Pres.	XXHHII	R-L 321	R-L 110	R-L 2.92	R-L 3.69
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	8	D	Pres.	XXHHII	R-L 318	R-L 115	R-L 2.77	R-L 3.50	D x D	159	F	Pres.	XXHHII	R-L 373	R-L 130	R-L 2.87	R-L 3.63
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	8	D	Pres.	XXHHII	R-L 318	R-L 115	R-L 2.77	R-L 3.50	D x D	158	F	Pres.	XXHHII	R-L 344	R-L 122	R-L 2.82	R-L 3.57
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	10	D	Pres.	XXHHII	R-L 312	R-L 121	R-L 2.58	R-L 3.26	D x D	173	F	Pres.	XXHHII	R-L 319	R-L 117	R-L 2.73	R-L 3.45
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	9	D	Pres.	XXHHII	R-L 340	R-L 125	R-L 2.72	R-L 3.44	D x D	138	F	Pres.	XXHHII	R-L 308	R-L 117	R-L 2.64	R-L 3.34
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	7	D	Pres.	XXHHII	R-L 319	R-L 120	R-L 2.66	R-L 3.36	D x D	137	F	Pres.	XXHHII	R-L 302	R-L 115	R-L 2.63	R-L 3.33
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	11	D	Pres.	XXHHII	R 167 L 180	R 122 L 120	R 1.37* L 1.50*	R 1.73 L 1.89	D x D	172	F	Pres.	XXHHII	R-L 327	R-L 125	R-L 2.62	R-L 3.31
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	6	D	Pres.	XXHHII	R-L 349	R-L 130	R-L 2.69	R-L 3.40	D x D	121	F	Pres.	XXHHII	R-L 310	R-L 125	R-L 2.48	R-L 3.14

* Portion of horn cut off to prevent it entering head. Consequently length is shorter than it normally should be.

† Under the captions "Breed" and "Nature of Mating," D represents Dorset Horn; Sn., Southdown; H., Hampshire Down; Se., Shropshire Down; Mo., Merino; Lr., Leicester; N., Native. In the "Sex" columns M refers to the male; F, to the female. R and L are used as symbols for right and left horns respectively.

TABLE VI.—MATINGS OF HORNLESS BREEDS.

Father.							Mother.									F1.							
		Horns.							Horns.									Horns.					
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length. / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length. mm.	Circum. mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.
4	Sn	Abs.	XxhhIi				24	Sn	Abs.	XXhhII					Sn x Sn	93	M	Abs.	XxhhIi				
1	Se	Abs.	XxhhIi				77	Se	Abs.	XXhhII					Se x Se	118	M	Abs.	XxhhIi				
3	H	Abs.	XxhhIi				73	H	Abs.	XXhhII					H x H	111	M	Abs.	XxhhIi				
1	Sn	Abs.	XxhhIi				61	N	Abs.	XXhhII					Sn x Sn	187	M	Abs.	XxhhIi				
1	Se	Abs.	XxhhIi				66	N	Abs.	XXhhII					Se x N	104	M	Abs.	XxhhIi				
3	H	Abs.	XxhhIi				72	N	Abs.	XXhhII					H x N	129	M	Abs.	XxhhIi				
4	Sn	Abs.	XxhhIi				18	Sn	Abs.	XXhhII					Sn x Sn	94	F	Abs.	XXhhII				
1	Se	Abs.	XxhhIi				79	Se	Abs.	XXhhII					Se x Se	149	F	Abs.	XXhhII				
3	H	Abs.	XxhhIi				75	H	Abs.	XXhhII					H x H	110	F	Abs.	XXhhII				
4	Sn	Abs.	XxhhIi				61	N	Abs.	XXhhII					Sn x N	103	F	Abs.	XXhhII				
1	Se	Abs.	XxhhIi				61	N	Abs.	XXhhII					Se x N	200	F	Abs.	XXhhII				
3	H	Abs.	XxhhIi				67	N	Abs.	XXhhII					H x N	126	F	Abs.	XXhhII				

TABLE VII.—MATINGS OF DORSET HORNS WITH HORNLESS BREEDS—F_1.

Father.							Mother.									F_1.							
		Horns.							Horns.									Horns.					
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length. Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length. Circum.	Ratio F. in Terms of m.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length. Circum.	Ratio F. im Terms of m.
										Horned Father; Hornless Mother.													
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	20	Sn	Abs.	XXhhII					D x Sn	233	M	Pres.	XxHhIi	R-L 484	R-L 180	R-L 2.69	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	59	Sn	Abs.	XXhhII					D x Sn	134	M	Pres.	XxHhIi	R 280 L 300	R 116 L 116	R 2.42 L 2.59	
	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	58	Sn	Abs.	XXhhII					D x Sn	168	M	Pres.	XxHhIi	R-L 99	R-L 95	R-L 1.05	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	17	Sn	Abs.	XXhhII					D x Sn	169	M	Pres.	XxHhIi	R-L 140	R-L 313	R-L .45	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	17	Sn	Abs.	XXhhII					D x Sn	132	F	Abs.	XXHhII				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	16	Sn	Abs.	XXhhII					D x Sn	133	F	Abs.	XXHhII				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	16	Sn	Abs.	XXhhII					D x Sn	170	F	Abs.	XXHhII				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47		N	Abs.	XXhhII					D x N	81	F	Abs.	XXHhII				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47		N	Abs.	XXhhII					D x N	82	F	Abs.	XXHhII				
										Hornless Father; Horned Mother.													
4	Sn	Abs.	XxhhIi				13	D	Pres.	XXHHII	R-L 310	R-L 115	R-L 2.70	R-L 3.42	Sn x D	109	M	Pres.	XxHhIi	R-L 352	R-L 123	R-L 2.86	
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.55	Sn x D	175	M	Pres.	XxHhIi	R-L 146	R-L 114	R-L 1.28	
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.55	Sn x D	108	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32	
4	Sn	Abs.	XxhhIi				15	D	Pres.	XXHHII	R-L 317	R-L 115	R-L 2.76	R-L 3.49	Sn x D	176	F	Abs.	XXHhII				

TABLE VIII.—MATINGS OF HORNLESS BREEDS WITH MERINOS.—F_1.

Hornless Father; Merino Mother.

Father. No.	Father. Breed.	Father. Horns. Somatic Condition.	Father. Horns. Zygotic Condition.	Father. Horns. Length, mm.	Father. Horns. Circum., mm.	Father. Horns. Ratio Length. / Circum.	Mother. No.	Mother. Breed.	Mother. Horns. Somatic Condition.	Mother. Horns. Zygotic Condition.	Mother. Horns. Length, mm.	Mother. Horns. Circum., mm.	Mother. Horns. Ratio Length. / Circum.	Mother. Horns. Ratio F in Terms of m.	Nature of Matings.	F_1. No.	F_1. Sex.	F_1. Horns. Somatic Condition.	F_1. Horns. Zygotic Condition.	F_1. Horns. Length, mm.	F_1. Horns. Circum., mm.	F_1. Horns. Ratio Length. / mm.	F_1. Horns. Ratio F in Terms of m.
3	H	Abs.	XxhhIi				41	Mo	Pres.	XXH'H'II	R-L 24	R-L 58	R-L .42	R-L .53	H x Mo	212	M	Pres.	XxH'hIi	R 64 L 22	R 68 L 69	R .95 L .33	
1	Se	Abs.	XxhhIi				57	Mo	Pres.	XXH'H'II	R-L 7	R-L 35	R-L .20	R-L .25	Se x Mo	196	M	Pres.	XxH'hIi	R 101 L 111	R 105 L 113	R .97 L .99	
4	Sn	Abs.	XxhhIi				34	Mo	Mere Scabs	XXH'H'II					Sn x Mo	183	M	Pres.	XxH'hIi	R-L 151	R-L 151	R-L 1.00	
	Sn	Abs.	XxhhIi				34	Mo	Mere Scabs	XXH'H'II					Sn x Mo	88	M	Scurs*	XxH hIi				
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					H x Mo	114	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83	
4	Sn	Abs.	XxhhIi				35	Mo	Knobs	XXH'H'II					Sn x Mo	184	M	Pres.	XxH'hIi	R 25 L 13	R 71 L 63	R .36 L .22	
4	Sn	Abs.	XxhhIi				45	Mo	Knobs	XXH'H'II					Sn x Mo	186	M	Pres.	XxH'hIi	R 17 L 19	R 59 L 54	R .29 L .36	
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					H x Mo	209	M	Pres.	XxH'hIi	R 13 L 11	R 43 L 45	R .31 L .25	
4	Sn	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					H x Mo	210	M	Pres.	XxH'hIi	R 19 L 9	R 64 L 40	R .30 L .23	
	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II					H x Mo	87	M	Scurs †	XxH'hIi				
3	H	Abs.	XxhhIi				45	Mo	Abs.	XXH'hII					H x Mo	213	M	Pres.	XxH'hIi	R-L 10	R-L 38	R-L .27	
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII XXhhII					Se x Mo	195	M	Abs.	XxHHIi				
3	H	Abs.	XxhhIi				42	Mo	Pres.	XXH'H'II	R 31 L 10	R 65 L 42	R .48 L .24	R .60 L .30	H x Mo	208	F	Abs.	XXH'hII				
3	H	Abs.	XxhhIi				41	Mo	Pres.	XXH'H'II	R-L 24	R-L 58	R-L .42	R-L .53	H x Mo	113	F	Abs.	XXH'hII				
3	H	Abs.	XxhhIi				48	Mo	Pres.	XXH'H'II	R-L 11	R-L 28	R-L .40	R-L .50	H x Mo	216	F	Abs.	XXH'hII				
3	H	Abs.	XxhhIi				48	Mo	Pres.	XXH'H'II	R-L 11	R-L 28	R-L .40	R-L .50	H x Mo	217	F	Abs.	XXH'hII				
4	Sn	Abs.	XxhhIi				38	Mo	Pres.	XXH'H'II	R-L 19	R-L 60	R-L .32	R-L .41	Sn x Mo	185	F	Abs.	XXH'hII				

3	H	Abs.	XxhhIi				46	Mo	Mere Scabs	XXH'H'II				H x Mo	214	F	Abs.	XxH'hII			
1	Se	Abs.	XxhhIi				55	Mo	Mere Scabs	XXH'H'II				Se x Mo	193	F	Abs.	XXH'hII			
	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II				H x Mo	83	F	Abs.	XxH'hII			
	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II				H x Mo	84	F	Abs.	XXH'hII			
	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II				H x Mo	85	F	Abs.	XXH'hII			
3	H	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II				H x Mo	122	F	Abs.	XXH'hII			
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II				H x Mo	124	F	Abs.	XXH'hII			
3	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II				H x Mo	211	F	Abs.	XXH'hII			
3	H	Abs.	XxhhIi				47	Mo	Knobs	XXH'H'II				H x Mo	215	F	Abs.	XXH'hII			
3	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II				H x Mo	218	F	Abs.	XXH'hII			
1	Se	Abs.	XxhhIi				54	Mo	Knobs	XXH'H'II				Se x Mo	147	F	Abs.	XXH'hII			
1	Se	Abs.	XxhhIi				53	Mo	Knobs	XXH'H'II				Se x Mo	190	F	Abs.	XXH'hII			
1	Se	Abs.	XxhhIi				53	Mo	Knobs	XXH'H'II				Se x Mo	191	F	Abs.	XXH'hII			
1	Se	Abs.	XxhhIi				54	Mo	Knobs	XXH'H'II				Se x Mo	192	F	Abs.	XXH'hII			
	Lr	Abs.	XxhhIi				27	Mo	Knobs	XXH'H'II				Lr x Mo	80	F	Abs.	XXH'hII			
179	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II				Sn x Mo	284	F	Abs.	XXH'hII			
179	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II				Sn x Mo	285	F	Abs.	XXH'hII			
4	Sn	Abs.	XxhhIi				35	Mo	Knobs	XXH'H'II				Sn x Mo	89	F	Abs.	XXH'hII			
3	H	Abs.	XxhhIi				50	Mo	Abs.	{ XXH'hII { XXhhII				H x Mo	219	F	Abs.	{ XXH'hII? { XXhhII?			
3	H	Abs.	XxhhIi				15	Mo	Abs.	{ XXH'hII { XXhhII				H x Mo	115	F	Abs.	{ XXH'hII? { XXhhII?			
3	H	Abs.	XxhhIi				37	Mo	Abs.	{ XXH'hII { XXhhII				Se x Mo	123	F	Abs.	{ XXH'hII? { XXhhII?			
1	Se	Abs.	XxhhIi				56	Mo	Abs.	{ XXH'hII { XXhhII				Se x Mo	146	F	Abs.	{ XXH'hII? { XXhhII?			
1	Se	Abs.	XxhhIi				52	Mo	Abs.	{ XXH'hII { XXhhII				Se x Mo	189	F	Abs.	{ XXH'hII? { XXhhII?			
1	Se	Abs.	XxhhIi				56	Mo	Abs.	{ XXH'hII { XXhhII				Se x Mo	194	F	Abs.	{ XXH'hII? { XXhhII?			

Merino Father; Hornless Mother.

235	Mo	Pres.	XxHHIi	{ R 604 { L 581	{ R 194 { L 194	{ R 311 { L 299	110	H	Abs.	XXhhII				Mo x H	296	M	Pres.	XxH'hIi	{ R 39 { L 35	{ R 60 { L 57	{ R .65 { L .62
235	Mo	Pres.	XxHHIi	{ R 604 { L 581	{ R 194 { L 194	{ R 311 { L 296	110	H	Abs.	XXhhII				Mo x H	295	M	Pres.	XxH'hIi	{ R 27 { L 25	{ R 62 { L 46	{ R .44 { L .55
235	Mo	Pres.	XxHHIi	{ R 604 { L 581	{ R 194 { L 194	R 311	120	H (H xMo)	Abs.	{ XXH'hII { XXhhII?				Mo(Hx H-Mo)	297	M	Scurs ‡	{ XxH'H'Ii? { XxH'hIi			

* Died when three weeks old.
† Died when four weeks old. Obvious indications of horns in all three instances.

TABLE IX.—MATINGS OF DORSET HORNS WITH MERINOS.—F_1.

Horned Father: Merino Mother.

Father.							Mother.									F_1.							
		Horns.							Horns.									Horns.					
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length. mm.	Circum. mm.	Ratio Length / Circum.	Ratio F in Terms of M.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length / Circum.	Ratio F in terms of M.
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	28	Mo	Knobs	XXH'H'Il					D x Mo	161	M	Pres.	XxHH'Ii	R-L 699	R-L 211	R-L 3.31	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	27	Mo	Knobs	XXH'H'Il					D x Mo	164	M	Pres.	XxHH'Ii	R-L 653	R-L 207	R-L 3.16	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	33	Mo	Knobs	XXH'H'Il					D x Mo	163	M	Pres.	XxHH'Ii	R-L 633	R-L 208	R-L 3.04	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	27	Mo	Knobs	XXH'H'Il					D x Mo	165	M	Pres.	XxHH'Ii	R-L 155	R-L 138	R-L 1.13*	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	31	Mo	Abs.	XXH'hII? XXh hII?					D x Mo	167	M	Pres.	XxHhIi	R-L 383	R-L 190	R-L 2.02	
2	D	Pres.	XxXXIi	R-L 750	R-L 216	R-L 3.47	30	Mo	Mere scabs	XXH'H'II					D x Mo	143	F	Pres.	XXHH'II	R 293 L 267	R 110 L 110	R 2.67 L 2.43	R 3.38 L 3.07
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	26	Mo	Knobs	XXH'H'Il					D x Mo	145	F	Pres.	XXHH'II	R-L 292	R-L 120	R-L 2.43	R-L 3.07
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	32	Mo	Knobs	XXH'H'II					D x Mo	162	F	Pres.	XXHH'II	R 218 L 241	R 117 L 117	R 1.87† L 2.06	R 2.37 L 2.61
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	31	Mo	Abs.	XXH'hII? XXhhII?					D x Mo	144	F	Abs.	XxHhII				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	29	Mo	Abs.	XXH'hII? XXhhII?					D x Mo	166	F	Abs.	XxHhII				

* Died at twelve weeks of age.

† Portion of horn cut off to prevent it entering head; consequently, length is shorter than it normally should be.

TABLE X.—MATINGS OF HORNLESS BREEDS.—F_2.

Father							Mother								F_1										F_2							
		Horns.							Horns.									Horns.									Horns.					
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length / Circum.	Ratio F. in Terms of M.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length / Circum.	Ratio F. in Terms of M.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length mm.	Circum. mm.	Ratio Length / Circum.	Ratio F. in Terms of M.
1	Se	Abs.	XxhhIi				64	N	Abs.	XXhhII					*199	Se x N	M	Abs.	XxhhIi					Se x N	292	M	Abs.	XxhhIi				
1	Se	Abs.	XxhhIi				63	N	Abs.	XXhhII					105	Se x N	F	Abs.	XXhhII													
															3	H	M	Abs.	XxhhIi					H (HxN)	257	M	Abs.	XxhhIi				
3	H	Abs.	XxhhIi				67	N	Abs.	XXhhII					126	H x N	F	Abs.	XXhhII													
															3	H	M	Abs.	XxhhIi					H (HxN)	255	M	Abs.	XxhhIi				
3	H	Abs.	XxhhIi				69	N	Abs.	XXhhII					127	H x N	F	Abs.	XXhhII													
4	Sn	Abs.	XxhhIi				61	N	Abs.	XXhhII					187	Sn x N	M	Abs.	XxhhIi					Sn x N	271	F	Abs.	XXhhII				
4	Sn	Abs.	XxhhIi				61	N	Abs.	XXhhII					103	Sn x N	F	Abs.	XXhhII													
1	Sn	Abs.	XxhhIi				64	N	Abs.	XXhhII					199	Se x N	M	Abs.	XxhhIi					Se x N	293	F	Abs.	XXhhII				
1	Sn	Abs.	XxhhIi				64	N	Abs.	XXhhII					106	Se x N	F	Abs.	XXhhII													
4	Sn	Abs.	XxhhIi				21	N	Abs.	XXhhII					179	Sn	M	Abs.	XxhhIi					Sn	283	F	Abs.	XXhhII				
4	Sn	Abs.	XxhhIi				20	N	Abs.	XXhhII					95	Sn	F	Abs.	XXhhII													
															3	H	M	Abs.	XxhhIi					Sn	283	F	Abs.	XXhhII				
3	H	Abs.	XxhhIi				69		Abs.	XXhhII					127	H x N	F	Abs.	XXhhII													

*Adjacent male (M) and female (F) individuals in F_1 are the parents of the F_2 individual that is placed in the same line with its father.

TABLE XI.—MATINGS OF DORSET HORNS WITH HORNLESS BREEDS.—F_2.

Father.							Mother.								F_1.										F_2.							
		Horns.							Horns.									Horns.									Horns.					
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length / Circum.	Ratio F. in Terms of M.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum. mm.	Ratio Length / Circum.	Ratio F. in Terms of M.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length / Circum.	Ratio F. in Terms of M.
Simplex horned (Hh) father; simplex hornless (Hh) mother.																																
4	Sn	Abs.	XxhhIi				13	D	Pres.	XXHHII	R-L 310	R-L 116	R-L 2.70	R-L 3 42	109*	Sn x D	M	Pres.	XxHhIi	R-L 352	R-L 123	R-L 2 86										
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	17	Sn	Abs.	XXhhII					132	D x Sn	F	Abs.	XXHHII					(SnxD) (DxSn)	269	M	Pres	XxHHIi	R-L 753	R-L 222	R-L 3 39	
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	59	N	Abs.	XXhhII					134	D x N	M	Pres.	XxHhIi	{R 280 L 300}	R-L 116	{R 2.43 L 2 59}										
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	—	N	Abs.	XXhhII					83	D x N	F	Abs.	XXHhII					D x N	231	M	Pres.	XxHhIi	R-L 17	R-L 41	R-L 42	
2	D	Pres.	XxHHIi	R-L 759	R-L 216	R-L 3.47	59	N	Abs.	XXhhII					134	D x N	M	Pres.	XxHhIi	{R 280 L 309}	R-L 115	{R 2 42 L 2.59}										
2	D	Pres.	XxHHIi	R-L 750	R-L 316	R-L 3.47	—	N	Abs.	XXhhII					82	D x N	F	Abs.	XXHhII					D x N	230	M	Abs.	XxhhIi				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	59	N	Abs.	XXhhII					134	D x N	M	Pres.	XxHhIi	{R 280 L 300}	R-L 116	{R 2.42 L 2 59}										
2	D	Pres.	XxHHIi	R-L 750	R-L 316	R-L 3 47	—	N	Abs.	XXhhII					81	D x N	F	Abs.	XXHhII					D x N	229	F	Pres.	XXHHII	R-L 344	R-L 131	R-L 2 63	R-L 3 33
4	Sn	Abs.	XxhhIi				13	D	Pres.	XXHHII	R-L 310	R-L 113	R-L 2 70	R-L 3 42	109	Sn x D	M	Pres.	XxHhIi	R-L 352	R-L 123	R-L 2.86										
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	17	Sn	Abs.	XXhhII					132	D x Sn	F	Abs.	XXHhII					(SnxD) (DxSn)	268	F	Abs.	XXHhII XXhhII				
4	Sn	Abs.	XxhhIi				13	D	Pres.	XXHHII	R-L 310	R-L 116	R-L 2 70	R-L 3 42	109	Sn x D	M	Pres.	XxHhIi	R-L 352	R-L 123	R-L 2.86										
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	15	Sn	Abs.	XXhhII					133	D x Sn	F	Abs.	XXHhII					(SnxD) (DxSn)	270	F	Abs.	XXHhII XXhhII				
Simplex horned (Hh) father; duplex hornless (hh) mother—F_1 x P.																																
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 3.81	R-L 3.55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32										
—							—								21	Sn	F	Abs.	XXhhII					(SnxD) Sn	280	M	Pres.	XxHhIi	{R- 146 L 88}	{R 115 L 115}	{R 1 27 L ..77†}	
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .39										
—							—								24	Sn	F	Abs.	XXhhII					(SnxD) Sn	274	M	Scurs‡	XxHhIi				
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.53	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .33										
—							—								17	Sn	F	Abs.	XXhhII					(SnxD) Sn	273	M	Abs.	XxhhIi				
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32										
4	Sn	Abs.	XxhhIi				21	Sn	Abs.	XXhhII					98	Sn	F	Abs.	XXhhII					(SnxD) Sn	281	M	Abs.	XxhhIi				
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2 61	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32										
—							—								92	Sn	F	Abs.	XXhhII					(SnxD) Sn	276	F	Abs.	{XXHhD? XXhhII?}				
Simplex horned (Hh) father; horned (HH) mother—F_1 x P.																																
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2 81	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32										
2	D	Pres.	XxHHIi	R-L 750	R-L 215	R-L 3.47	9	D	Pres.	XXHHII	R-L 340	R-L 125	R-L 2.72	R-L 3.44	138	D	F	Pres.	XXHHII	R-L 308	R-L 117	R-L 2.64	R-L 3 34	(SnxD) D	275	M	Pres.	XxHHIi	R-L 728	R-L 316	R-L 3 34	
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32										
—							—								14	D	F	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.55	(SnxD) D	272	M	Pres.	XxHhIi	R-L 31	R-L 57	R-L 46	
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3.55	105	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L 32										
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	9	D	Pres.	XXHHII	R-L 340	R-L 125	R-L 2.72	R-L 3.44	12	D	F	Pres.	XXHHII			R-L 2.70	R-L 3 42	(SnxD) D	277	F	Pres.	XXHHII	R-L 327	R-L 126	R-L 2.61	R-L 3.28
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32										
—							—								10	D	F	Pres.	XXHHII	R-L 312	R-L 121	R-L 2.58	R-L 3 26	(SnxD) D	278	F	Horns‡	XXHHII				
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	31	Mo	Abs.	{XXHhII? XXhhII?}					167	D x Mo	M	Pres.	XxHhIi	R-L 383	R-L 190	R-L 3.02			289	F	Pres.	XXHHII	R-L 307	R-L 124	R-L 2 47	R-L 3 12
—							—								9	D	F	Pres.	XXHhII	R-L 340	R-L 125	R-L 2.72	R-L 3 44	(DxMo) D								

* Adjacent male (M) and female (F) individuals in F_1 are the parents of the F_2 individual that is placed in the same line with the mother.
† Portion of horn broken off.
‡ Died in infancy. Obvious signs of horns which in the case of 278 were well marked.

TABLE XII.—MATINGS OF HORNLESS BREEDS WITH MERINOS.—F_2.

Simplex Horned (H'h) Father; Simplex Hornless (H'h) Mother.

Father.							Mother.								F_1.										F_2.							
No.	Breed.	Horns.					No.	Breed.	Horns.						No.	Breed.	Sex.	Horns.						Nature of Mating.	No.	Sex.	Horns.					
		Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.			Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of M.				Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of M.				Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F in Terms of M.
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114*	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	241	M	Pres.	XxH'H'Ii	R 523 L 480	169 166	R 3 09 L 2 59	
3	H	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					122	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	246	M	Pres.	XxH'hIi	R 275 L 222	155 155	R 1 77 L 1 43	
—	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II					84	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	243	M	Pres.	XxH'hIi	R 67 L 28	85 64	R 79 L 44	
—	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II					85	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	242	M	Pres.	XxH'hIi	R 79 L 40	126 125	R .63 L .32	
—	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II					85	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	245	M	Abs.	XxhhIi				
—							49	Mo	Knobs	XXH'H'II					83	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	240	M	Abs.	XxhhIi				
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					124	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	238	F	Mere scabs	XXH'H'II				
3	H	Abs.	XxhhIi				41	Mo	Pres.	XXH'H'II	R-L 24	R-L 58	R-L 42	R-L .53	113	H x Mo	F	Abs.	XXH'hII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83		H x Mo	244	F	Knobs	XXH'H'II				
—	H	Abs	XxhhIi				49	Mo	Knobs	XXH'H'II					83	H x Mo	F	Abs.	XXH'hII													
3	H	Abs	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83		H x Mo	239	F	Abs.	XXH'hII? XXhhII?				
3	H	Abs	XxhhIi				45	Mo	Abs.	XXH'H'II					116	H x Mo	F	Abs.	XXH'hII													

Hornless Father; Simplex Hornless (H'h) Mother.

Father.							Mother.								F_1.										F_2.							
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of M.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of M.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F in Terms of M.
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi					Se x Mo	266	M	Abs.	XxhhIi				
1	Se	Abs.	XxhhIi				64	Mo	Knobs	XXH'H'II					147	Se x Mo	F	Abs.	XXH'hII													
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi					Se x Mo	265	M	Abs.	XxhhIi				
1	Se	Abs.	XxhhIi				64	Mo	Knobs	XXH'H'II					147	Se x Mo	F	Abs.	XXH'hII													
—							—								1	Se	M	Abs.	XxhhIi					Se (Lr x Mo)	206	M	Pres.	XxH'hIi	R-L 38	R-L 76	R-L .60	
—	Lr	Abs.	XxhhIi				27	Mo	Knobs	XXH'H'II					80	Lr x Mo	F	Abs.	XXH'hII													
—							—								1	Se	M	Abs.	XxhhIi					Se (Lr x Mo)	207	M	Pres.	XxH'hIi	R 30 L 26	R 65 L 65	R 46 L 40	
—	Lr	Abs.	XxhhIi				27	Mo	Knobs	XXH'H'II					80	Lr x Mo	F	Abs.	XXH'hII													
—	H	Abs.	XxhhIi				45	Mo	Abs.	XXH'hII? XXhhII?					60	H x Mo	M	Abs.	XxhhIi					H x Mo	232	F	Abs.	XXH'hII? XXhhII?				
—	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II					84	H x Mo	F	Abs.	XXH'hII													
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi					Se x Mo	264	F	Abs.	XXH'hII? XXhhII?				
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					146	Se x Mo	F	Abs.	XXH'hII? XXhhII?													
—															3	H	M	Abs.	XxhhIi					H(HxMo)	120	F	Abs.	XXH'hII? XXhhII?				
	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II																						
—															84	H x Mo	F	Abs.	XXH'hII													

*Adjacent male (M) and female (F) individuals in F_1 are the parents of the F_2 individual that is placed in the same line with the father.

TABLE XVI.—MATINGS OF DORSET HORNS WITH MERINOS—F_2 (1912).

Simplex Horned (Hh) Father; Simplex Hornless (H'h) Mother.

Father.							Mother.								F_1.										F_2.			
		Horns.							Horns.									Horns.									Horns.	
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	31	Mo	Abs.	XXH'hII? XXhhII?					167	D x Mo	M	Pres.	XxHhIi	R-L 383	R-L 190	R-L 2.02						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	30	Mo	Mere scabs	XXH'H'Ii					143	D x Mo	F	Pres.	XXHH'Ii	R 293 L 267	R 110 L 110	R 2.67 L 2 43		D x Mo	352	M	Horns	XxHHIi? XxHH'Ii?
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	31	Mo	Abs.	XXH'hII? XXhhII?					167	D x Mo	M	Pres.	XxHhIi	R-L 353	R-L 190	R-L 2.02						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	29	Mo	Abs.	XXH'hII? XXhhII?					166	D x Mo	F	Abs.	XXHhII					D x Mo	356	M	Horns	XxHHIi? XxHH'Ii?
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	31	Mo	Abs.	XXH'hII? XXhhII?					167	D x Mo	M	Pres.	XxHhIi	R-L 383	R-L 190	R-L 2.02						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	31	Mo	Abs.	XXH'hII? XXhhII?					144	D x Mo	F	Abs.	XXHhII					D x Mo	354	F	Horns	XXHHII
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	31	Mo	Abs.	XXH'hII? XXhhII?					167	D x Mo	M	Pres.	XxHhIi	R-L 383	R-L 190	R-L 2 02						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	32	Mo	Knobs	XXH'H'II					162	D x Mo	F	Pres.	XXHH'II	R 218 L 241	R 117 L 117	R 1 67 L 2 06		D x Mo	356	F	Horns	XXHHII? XXHH'II?
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	31	Mo	Abs.	XXH'hII? XXhhII?					167	D x Mo	M	Pres.	XxHhIi	R-L 383	R-L 190	R-L 2.02						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	30	Mo	Mere scabs	XXH'H'II					143	D x Mo	F	Pres.	XXHH'II	R 293 L 267	R 110 L 110	R 2 67 L 2 43		D x Mo	353	F	Abs.	XXHhII? XXH'hII?

TABLE XV.—MATINGS OF HORNLESS BREEDS WITH MERINOS—F_2 (1913).

Simplex Horned (H'h) Father; Simplex Hornless (H'h) Mother.

Father							Mother								F_1										F_2			
		Horns.							Horns.									Horns.									Horns.	
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of m.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of M.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II					218	H x Mo	F	Abs.	XXH'hII					H x Mo	333	M	Horns	XxH'H'Ii
4	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					185	Sn x Mo	M	Pres.	XxH'hIi	R 17 L 19	R 59 L 54	R .29 L .36						
4	Sn	Abs.	XxhhIi				38	Mo	Pres.	XXH'H'II	R-L 19	R-L 60	R-L .32	R-L .41	185	Sn x Mo	F	Abs.	XXH'hII					Sn x Mo	339	M	Horns	XxH'H'Ii
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				46	Mo	Mere scabs	XXH'H'II					214	H x Mo	F	Abs.	XXH'hII					H x Mo	328	M	Scurs	XxH'hIi
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				47	Mo	Knobs	XXH'H'II					215	H x Mo	F	Abs.	XXH'hII					H x Mo	330	M	Scurs	XxH'hIi
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				48	Mo	Pres.	XXH'H'II	R-L 11	R-L 28	R-L .40	R-L .60	217	H x Mo	F	Abs.	XXH'hII					H x Mo	332	M	Scurs	XxH'hIi
5	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1 83						
3	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II					211	H x Mo	F	Abs.	XXH'hII					H x Mo	327	M	Abs.	XxhhIi
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				47	Mo	Knobs	XXH'H'II					215	H x Mo	F	Abs.	XXH'hII					H x Mo	331	M	Abs.	XxhhIi
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hII	R-L 311	R-L 170	R-L 1.83			320	F	Scurs	XXH'H'II
—	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II					85	H x Mo	F	Abs.	XXH'hII					H x Mo	321	F	Mere scabs	XXH'H'II
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83						
—	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II					83	H x Mo	F	Abs.	XXH'hII					H x Mo	316	F	Knobs	XXH'H'II
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83						
—	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II					84	H x Mo	F	Abs.	XXH'hII					H x Mo	319	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1 83						
—	H	Abs.	XxhhIi				49	Mo	Knobs	XXH'H'II					83	H x Mo	F	Abs.	XXH'hII					H x Mo	317	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83						
—	H	Abs.	XxhhIi				44	Mo	Knobs	XXH'H'II					84	H x Mo	F	Abs.	XXH'hII					H x Mo	318	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				41	Mo	Pres.	XXH'H'II	R-L 24	R-L 58	R-L .42	R-L .53	113	H x Mo	F	Abs.	XXH'hII					H x Mo	322 323	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				45	Mo	Abs.	XXH'hII					115	H x Mo	F	Abs.	XXH'hII? XXhhII?					H x Mo	324	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxHb'Ii	R-L 311	R-L 170	R-L 1 83						
3	H	Abs.	XxhhIi				84	H x Mo	Abs.	XXH'hII					120	H x Mo	F	Abs.	XXH'hII? XXhhII?					H x Mo	325	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 312	R-L 170	R-L 1 83						
3	H	Abs.	XxhhIi				46	Mo	Mere scabs	XXH'H'II					214	H x Mo	F	Abs.	XXH'hII					H x Mo	329	F	Abs.	XXH'hII? XXhhII?
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83						
3	H	Abs.	XxhhIi				50	Mo	Abs.	XXH'hII? XXhhII?					219	H x Mo	F	Abs.	XXH'hII? XXhhII?					H x Mo	334	F	Abs.	XXH'hII? XXhhII?
4	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					186	Sn x Mo	M	Pres.	XxH'hIi	R 17 L 19	R 59 L 54	R .29 L .36						
4	Sn	Abs.	XxhhIi				38	Mo	Pres.	XXH'H'II	R-L 19	R-L 60	R-L .32	R-L .41	166	Sn x Mo	F	Abs.	XXH'hII					Sn x Mo	340	F	Abs.	XXH'hII? XXhhII?
4	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					185	Sn x Mo	M	Pres.	XxH'hIi	R 17 L 19	R 59 L 54	R .29 L .36						
179	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					284	Sn x Mo	F	Abs.	XXH'hII					Sn x Mo	341	F	Abs.	XXH'hII? XXhhII?

Hornless Father; Simplex (H'h) Hornless Mother.

No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of m.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length/Circum.	Ratio F. in Terms of M.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				55	Mo	Abs.	XXH'hII? XXhhII?					149	Se x Mo	F	Abs.	XXH'hII? XXhhII?					Se x Mo	371	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					193	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				54	Mo	Abs.	XXH'H'II					147	Se x Mo	F	Abs.	XXH'hII					Se x Mo	372	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				55	Mo	[illegible]	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				52	Mo	—	XXH'hII? XXhhII?					189	Se x Mo	F	Abs.	XXH'hII? XXhhII?					Se x Mo	373	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				56	Mo	A[illegible]	XXH'hII? XXhhII?					193	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				63	Mo	Knobs	XXH'H'II					190	Se x Mo	F	Abs.	XXH'hII					Se x Mo	374	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				66	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				54	Mo	Knobs	XXH'H'II					191	Se x Mo	F	Abs.	XXH'hII					Se x Mo	375	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				66	Mo	Abs.	XXH'hII? XXhhII?					193	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				54	Mo	Knobs	XXH'H'II					192	Se x Mo	F	Abs.	XXH'hII					Se x Mo	376	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				55	Mo	Knobs	XXH'hII					193	Se x Mo	F	Abs.	XXH'hII					Se x Mo	377	F	Abs.	XXH'hII? XXhhII?
1	Se	Abs.	XxhhIi				55	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi									
1	Se	Abs.	XxhhIi				54	Mo	Abs.	XXH'hII? XXhhII?					194	Se x Mo	F	Abs.	XXH'hII? XXhhII?					Se x Mo	378	F	Abs.	XXH'hII? XXhhII?

TABLE XIV.—MATINGS OF DORSET HORNS WITH HORNLESS BREEDS.—F_2 (1912).

Simplex Horned (Hh) Father; Simplex Hornless (Hh) Mother.

Father.							Mother.								F_1.										F_2.			
		Horns.							Horns.									Horns.									Horns.	
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	59	N	Abs.	XXhhII					134†	D x N	M	Pres.	XxHhIi	R 280 L 300	R-L 116	R 2.42 L 2.59						
3	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	—	N	Abs.	XXhhII					82	D x N	F	Abs.	XXHhII					D x N	303	M	Scurs	XxHhIi
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 116	R-L 2.81	R-L 3.55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 90	R-L .32						
4	Sn	Abs.	XxhhIi				15	D	Pres.	XXHHII	R-L 317	R-L 115	R-L 2.76	R-L 3 49	176	Sn x D	F	Abs.	XXHhII					Sn x D	337	M	Scurs	XxhhIi
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 116	R-L 2.81	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32						
4	Sn	Abs.	XxhhIi				15	D	Pres.	XXHHII	R-L 317	R-L 115	R-L 2.76	R-L 3.49	176	Sn x D	P	Abs.	XXHhII					Sn x D	338	M	Abs.	XxhhIi
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 116	R-L 2.81	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	17	Sn	Abs.	XXhhII					132	D x Sn	P	Abs.	XXHhII					Sn x D	336	F	Horns	XXHHII
4	Sn	Abs.	XxhhIi				14	D	Pres.	XXHHII	R-L 309	R-L 110	R-L 2.81	R-L 3 55	108	Sn x D	M	Pres.	XxHhIi	R-L 31	R-L 99	R-L .32						
3	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	17	Sn	Abs.	XXhhII					132	D x Sn	P	Abs.	XXHhII					(Sn x D) (D x Sn)	335	F	Abs.	XXhhII
Crosses of P_1 x P: Simplex Horned (Hh) Father; (Hh) Dorset Horn Mother.																												
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	59	N	Abe	XXhhII					134	D x N	M	Pres.	XxHhIi	R 280 L 300	R-L 116	R 2 42 L 2.59						
3	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	5	D	Pres.	XXHHII	R-L 824	R-L 118	R-L 2.75	R-L 8.47	150	D	F	Pres.	XXHHII	R-L 357	R-L 120	R-L 2 98	R-L 3.77	(D x N) D	307	M	Horns	XxHHIi
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	59	N	Abs.	XXhhII					139	D x N	M	Pres.	XxHhIi	R-L 321	R-L 110	R-L 2 93						
3	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	11	D	Pres.	XXHHII	R 167 L 180	R 122 L 120	R 1.37* L 1.50	R 1.73 L 1.89	172	D	F	Pres.	XXHHII	R-L 327	R-L 125	R-L 2 62	R-L 3 31	(D x N) D	308	M	Horns	XxHHIi
3	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	59	N	Abs.	XXhhII					134	D x N	M	Pres.	XxHhIi	R 280 L 300	R-L 116	R 2 42 L 2.59						
—							—								8	D	P	Pres.	XXHHII	R-L 340	R-L 125	R-L 2.72	R-L 3.44	(D x N) D	304	M	Scurs	XxHhIi
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	59	N	Abs.	XXhhII					134	D x N	M	Pres.	XxHhIi	R 280 L 300	R-L 116	R 2.42 L 2.59						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	8	D	Pres.	XXHHII	R-L 318	R-L 115	R-L 2.77	R-L 3.50	159	D	P	Pres.	XXHHII	R-L 373	R-L 130	R-L 2.87	R-L 3 63	(D x N) D	305	M	Scurs	XxHhIi
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3.47	58	N	Abs.	XXHHII					134	D x N	M	Pres.	XxHhIi	R 280 L 300	R-L 110	R 2 42 L 2.59						
2	D	Pres.	XxHHIi	R-L 750	R-L 216	R-L 3 47	8	D	Pres.	XXHHII	R-L 318	R-L 115	R-L 2.77	R-L 3.50	159	D	F	Pres.	XXHHII	R-L 373	R-L 130	R-L 2.87	R-L 3.63	(D x N) D	306	F	Abs.	XXHhII

* Portion of both horns cut off to prevent them entering head; consequently, lengths are shorter than they normally would be.
† Adjacent male (M) and female (F) individuals in F_1 are the parents of the F_2 individual that is placed in the same line with the mother.

TABLE XIII.—MATINGS OF HORNLESS BREEDS WITH MERINOS, CROSSES OF F_1 AND F.

Simplex Horned (H'h) Father; Hornless (hh) Mother.

Father.							Mother.								F_1.										F_2.							
		Horns.							Horns.									Horns.									Horns.					
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F in Terms of m.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F in Terms of m.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'R'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83		(H x Mo) H	249	M	Pres.	XxH'hIi	R 44 L 50	R 83 L 85	R .53 L .69	
—							—								75	H	F	Abs.	XXhhII													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83		(H x R) H	250	M	Abs.	XxhhIi				
—							—								73	H	F	Abs.	XXhhII													
4	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					186	Sn x Mo	M	Pres.	XxH'hIi	R 17 L 19	R 59 L 54	R .29 L .36		(Sn x Mo) Sn	287	M	Abs.	XxhhIi				
—							—								25	Sn	F	Abs.	XXhhII													
1	Se	Abs.	XxhhIi				59	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi					(Se x Mo) Se	292	M	Abs.	XxhhIi				
—							—								79	Se	F	Abs.	XXhhII													
1	Se	Abs.	XxhhIi				56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi					(Se x Mo) Se	260	F	Abs.	XXhhII				
—							—								77	Se	F	Abs.	XXhhII													
1							56	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhhIi					(Se x Mo) Se	261	F	Abs.	XXhhII				
—							—								77	Se	F	Abs.	XXhhII													
1							66	Mo	Abs.	XXH'hII? XXhhII?					195	Se x Mo	M	Abs.	XxhbIi					(Se x Mo) Se	263	F	Abs.	XXhhII				
—							—								79	Se	F	Abs.	XXhhII													

Simplex Horned (H'h) Father; Horned (H'H') Mother.

Father.							Mother.								F_1.										F_2.							
No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	No.	Breed.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F in Terms of m.	No.	Breed.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F in Terms of m.	Nature of Mating.	No.	Sex.	Somatic Condition.	Zygotic Condition.	Length, mm.	Circum., mm.	Ratio Length. / Circum.	Ratio F. in Terms of m.
4	Sn	Abs.	XxhhIi				40	Mo	Knobs	XXH'H'II					188	Sn x Mo	M	Pres.	XxH'hIi	R 17 L 19	R 59 L 64	R .29 L .36		(Sn x Mo) Mo	286	M	Pres.	XxH'H'Ii	R-L 715	R-L 211	R-L 3.39	
—							—								34	Mo	F	Mere scabs	XXH'H'II	R 101 L 111	R 105 L 113	R .97 L .99										
1	Se	Abs.	XxhhIi				37	Mo	Pres.	XXH'H'II	R-L 7	R-L 35	R-L .22	R-L 28	196	Mo	M	Pres.	XxH'hIi					(Se x Mo) Mo	267	M	Pres.	XxH'H'Ii? XxH'hIi?	R 319 L 304	R 120 L 109	R 2.66 L 2.79	
—							—								32	Mo	F	Knobs	XXH'H'II													
3	H	Abs.	XxhhIi				43	Mo	Knobs	XXH'H'II					114	H x Mo	M	Pres.	XxH'hIi	R-L 311	R-L 170	R-L 1.83		(H x Mo) Mo	248	M	Pres.	XxH'hIi	R 29 L 37	R 87 L 64	R .43 L .58	
—							—								46	Mo	F	Mere scabs	XXH'H'II													

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