

Studies in Sex Physiology, No. 10:*

The Situation of the Developing Foetus in the Merino Sheep.

By

H. H. CURSON, F.R.C.V.S., Dr.Med.Vet., Research Officer,
Onderstepoort, and

J. B. QUINLAN, F.R.C.V.S., Dr.Med.Vet., D.V.Sc., Sub-
Director of Veterinary Services and Animal Industry.

INTRODUCTION.

WITH regard to the situation of the foetus *in utero* of any species, there is very little definite information available, excepting, of course, shortly before birth when the dorso-sacral position generally accompanies a longitudinal cephalic presentation. Indeed Williams, W. L. (1931, p. 136) quotes figures indicating "that the probability of dystokia in posterior as compared to anterior presentation is 60 : 14". He adds: "posterior presentation has been common in dystokia in both mares and cows, but usually the foetus has been dead or clearly and definitely diseased. The more the problem is studied, the more evident it seems that the great majority of caudal presentations are pathological".

Obviously the most suitable time to gain this knowledge would be during life; but as facilities existed for examining the gravid uteri taken from Merino ewes killed in experiment by Quinlan, Maré and Roux (1932a)† use was made of the available material. See Table. Although Williams, W. L. (1931) warns one that "the *position* of the foetus in a dead pregnant female *may* be quite unlike that of the living animal . . ." yet it does not appear likely that the *presentation* would be at all altered, i.e. it would be longitudinal and either the cephalic or the caudal end would be directed towards the *canalis cervicis uteri*. With regard to the *position* of the foetus, i.e. the relation between any selected point of the foetal body, e.g. the dorsum and the maternal body, e.g., vertebrae, pubis, right iliac region or left iliac region, and *posture*, i.e. the arrangement of the head, neck, and limbs, it is probable alterations may take place after death.

* For footnote, see next page.

† This experiment, undertaken at Grootfontein School of Agriculture, Cape Province, was to determine the stage during oestrus when "motile sperms in the genitalia of the ewe are capable of fertilising an available ovum".

* For convenience this paper is No. 10 of the *Series of Studies on Sex Physiology* issued from Onderstepoort. Previous numbers are:—

1. QUINLAN, J. (1928). Vasectomy as a Method of Sterilising Ram Lambs. A Comparison with Castration. *Jl. Agric. Sc.*, Vol. 18, 26/7/28, pp. 446-459. Also published in *13th and 14th Reports Dir. Vet. Educ. & Res.*, pp. 583-595.
2. KUPFER, M. (1928). The Sexual Cycle of Female Domesticated Mammals. *13th & 14th Rpts. Dir. Vet. Educ. & Res.*, pp. 1213-1253.
3. QUINLAN, J. (1930). Gland-grafting in Merino Sheep. Preliminary Observations on its Influence (a) on Body Development, Wool Production and Progeny and (b) on Senility. *16th Rept. Dir. Vet. Serv. & Animal Industry*, pp. 367-413.
4. QUINLAN, J., AND MARAIS, I. P. (1931). Gland-grafting in Merino Sheep. Preliminary Observations on its Influence: (c) on Castrated Sheep. *Jl. S.A. Vet. Med. Assn.* II (2), pp. 104-115. Also published in *18th Rpt. Dir. Vet. Serv. & Animal Industry*, pp. 831-879.
5. QUINLAN, J., AND MARÉ, G. S. (1931). The Physiological Changes in the Ovary of the Merino Sheep in South Africa and their Practical Application in Breeding. *17th Rpt. Dir. Vet. Ser. & Animal Industry*, pp. 663-707.
6. QUINLAN, J., AND MARÉ, G. S. (1930). The Hand-serving Method of Mating Merino Sheep. *Farming in South Africa*, Vol. V, No. 52.
7. QUINLAN, J. (1932). The Vitality of the Spermatozoa and the Liberated Ovum in Domestic Animals, with Special Reference to the Relation of the Time of Copulation during Oestrus to Conception. *Jl. S.A. Vet. Med. Assn.*, Vol. 3, No. 1, pp. 1-7.
8. QUINLAN, J., AND MARÉ, G. S., AND ROUX, L. L. (1932). The Vitality of Spermatozoa in the Genital Part of the Merino Ewe, with Special Reference to its Practical Application in Breeding. *18th Rpt. Dir. Vet. Ser. & Animal Industry*, pp. 831-871.
9. QUINLAN, J., MARÉ, G. S., AND ROUX L. L. (1932). A Study of the Duration of Motility of Spermatozoa in the Different Divisions of the Reproductive Tract of the Merino Ewe. *Jl. S.A. Vet. Med. Assn.* Vol. 3, No. 4, pp. 149-162. Also published in the *Onderstepoort Journal of Vet. Sc. and An. Ind.*, Vol. 1, No. 1.

LITERATURE.

In regard to the position of the foetus *in utero* Craig (1930), merely states that this . . . “is very nearly constant in the same species, and this relation it retains . . . until near parturition, when it is changed . . .”. In regard to the *horse*, he quotes Colin, who states that “towards the termination of pregnancy the foetus of the mare lies with the belly upwards, the hind limb in the largest of the uterine cornua, and the anterior limbs and head directed towards the cervix”. Concerning the *ox*, again quoting Colin, he adds: “The belly of the foetus of ruminants is directed downwards . . . and the head is directed *backwards*”. Nothing definite is stated with regard to the *sheep*.

A significant statement is the following: "The position of the foetus towards the termination of gestation may vary occasionally, and even frequently, owing to the active reflex movements which it performs, and to those energetic movements, it cannot be doubted, are due the difficult presentations which the foetus offers so frequently at birth".

Smith (1921); while repeating, for the *horse*, the above description given by Colin, adds (quoting from Ellenberger's "Physiologie"—after Franck—) that "preparatory to birth the foetus changes position and turns on its side, so as to assume, first a lateral position, and lastly an upright one, by which the foetal and maternal spines are brought nearer together. To assume this position the foetus has had to make a complete (half) revolution". Regarding the *cow* Smith states that "the foetus lies on its back . . . as in the mare, but somewhat crooked—viz. the head inclining towards one side and the hind extremities towards the other: in all other respects its position resembles that of the foetus of the mare".

In regard to the active movements of the foetus in late pregnancy, Smith adds: "the alteration in the position of the foetus does not occur through its own movement, but by the contraction of the uterus; on the other hand, the stretching of the limbs is the result of foetal movement".

Williams, W. L. (1931), after explaining that "the foetus of unipara constitutes an arc of a circle" to correspond with the lesser curvature of the uterus, strongly contests the view expressed above, especially in regard to the dorso-pubic position alleged to be assumed by the equine foetus. He adds: "If the . . . position is physiological, it would be of great interest to discover the forces which bring about the rotation at birth"! Concerning the bovine foetus, he considers that as both foetus and uterus are so distinctly arciform, "it is very doubtful that the harmony of the two arcs should become seriously disturbed during the later stages of gestation".

From the above references, it is clear that no precise knowledge is available concerning not only the sheep, but also the horse and cow.

MATERIAL STUDIED.

When fertility had been established by Quinlan and co-workers (1932a) in the ewes referred to above (loc. cit. footnote), the sheep were of no further use to the investigators. It was, therefore, decided to kill them at varying intervals and to preserve the internal genitalia intact for further study. Notes were kept regarding the date and hour of copulation and again concerning the hour of slaughter. The gravid uteri were removed immediately after death, sealed in tins containing 10 per cent. formalin and then despatched by rail to Onderstepoort, where, as opportunity offered, they were examined by the writers. In some instances the material had been tightly packed in the various receptacles, but in only a few cases was it difficult to arrange each specimen in the dorso-ventral position (with the *pars indivisa* of the uterus directed caudally) for photographing. It will be observed (see Plate) that the specimens have been arranged according to the age of the foetuses, concerning which details can be seen in the accompanying Table.

TABLE AND COMMENTS.

I.	II.	III.	IV.	V.	VI.	VII.
Serial No. of foetus.	Official No. of ewe.	No. of Table, in Experiment 2B—Quinlan, Maré, and Roux (1932a).	Age of foetus.	Approx. total weight of un-opened uterus.	Approx. weight of foetus.	Approx. size C.R. length.
			Days. Hrs.	Gm.	Gm.	Cm.
1	O. 125	8 i.e. served at 18th hour of oestrus	33 4	120	1.132	2.1
2	O. 66	14 " " 36th " "	33 20	180	1.561	2.3
3	O. 136	10 " " 24th " "	35 1	120	1.926	2.4
4	O. 70	12 " " 30th " "	36 23	100	1.825	2.5
5	O. 91	2 " " onset " "	37 23	140	—	Twins 2.6 2.6
6	O. 163	4 " " 6th " "	39 1	300	4.080	3.5
7	O. 137	6 " " 12th " "	40 8	160	4.125	3.2
8	O. 64	12 " " 30th " "	42 16	120	2.771	3.3
9	O. 138	10 " " 24th " "	43 22	440	8.062	4.1
10	O. 76	4 " " 6th " "	44 21	260	7.811	3.9
11	O. 114	8 " " 18th " "	46 6	420	13.32	5.1
12	O. 140	12 " " 30th " "	46 22	280	7.866	4.8
13	O. 67	6 " " 12th " "	48 8	280	15.06	5.3
14	O. 126	2 " " onset " "	49 1	600	17.58	5.7
15	O. 108	10 " " 24th " "	49 23	500	24.15	6.7
16	O. 75	8 " " 18th " "	51 1	600	23.85	6.7
17	O. 101	8 " " 18th " "	52 1	560	25.551	7.2
18	O. 161	2 " " onset " "	53	460	27.77	7.3
19	O. 87	10 " " 24th " "	55 4	660	36.535	7.9
20	O. 72	6 " " 12th " "	55 18	1000	—	Twins 7.5 7.3
21	E. 88	15 " " 39th " "	56 5	1320	—	Twins 8.4 8.0
22	180	13 " " 33rd " "	64 16	1000	88.48	10.5
23	O. 207	5 " " 9th " "	65 21	840	102.97	11.5
24	O. 82	5 " " 9th " "	66 18	1400	120.0	11.9
25	O. 164	5 " " 9th " "	68 15	1280	151.8	12.6
26	O. 186	11 " " 27th " "	70 17	1500	177.92	13.4
27	O. 190	5 " " 9th " "	72 13½	1400	187.2	14.1
28	O. 168	10 " " 24th " "	80 22	1740	319.8	20.0
29	G. 115	8 " " 18th " "	82 3	2040	400.0	17.3
30	G. 118	8 " " 18th " "	82 23	1640	415.0	17.4
31	O. 152	8 " " 18th " "	83 21	3860	—	Twins 18.5 18.5
32	O. 179	12 " " 30th " "	84 17	1800	457.5	19.3
33	O. 104	11 " " 27th " "	84 19	1440	414.0	18.7
34	2397	12 " " 30th " "	86 20½	3000	355.0	16.5
35	O. 189	9 " " 21st " "	87 22	3720	—	Twins 18.5 19.8
36	175	5 " " 9th " "	96 18	2200	959.0	23.5
37	O. 94	5 " " 9th " "	100 16	2480	988.5	23.5
38	4675	5 " " 9th " "	101 15	1920	942.7	22.9
39	2398	13 " " 33rd " "	102 18	2320	1010.5	21.6
40	G. 127	9 " " 21st " "	105 2	3360	1576.0	25.5
41	G. 130	3 " " 3rd " "	108 16	2580	1216.9	23.0

The following comments must be made on the above:—

(a) *Time during oestrus when ewe was served (column III).*—This information while of the greatest importance to Quinlan and co-workers (1932a), being in fact, the object of their investigations, (inasmuch as it was desired to ascertain at which stage copulation would be most successful), is only of interest in this study in connection with the ageing of the foetus.

(b) *Age of foetus (column IV).*—In his notes regarding the foetuses, kindly furnished by Mr. G. S. Maré of Grootfontein School of Agriculture, the age has been given as from the time of copulation until slaughter. While for practical purposes this is convenient, it must be borne in mind that the precise prenatal age should be dated from fertilization. Factors which accordingly should be considered are:—(a) time of ovulation, (b) time taken for ovum to reach Fallopian tube, and (c) fertilizable period of ovum. The male factors are (i) time of service, (ii) time taken for spermatozoa to meet the ovum, and (iii) longevity of spermatozoa.

Quinlan and Maré (1931) have indicated that the time of ovulation “rarely takes place before the 36th to the 40th hour of oestrus”, but nothing definite is known concerning the period taken for the ovum to reach the oviduct. In connection with this, Quinlan and co-workers (1932a) assume “a period of a few hours to enter the Fallopian tube”. Regarding the fertilizable period of the ovum, Quinlan puts this down as not even “6-12 hours after follicular rupture” in “at least 50 per cent. of cases” (Quinlan 1932b).

Regarding the sperm cell, Quinlan and co-workers (1932a) are of the opinion that “the spermatozoa . . . are capable of . . . impregnating an available ovum from the onset of oestrus until 30 hours afterwards”. Further, that “spermatozoa may reach the abdominal extremity of the Fallopian tubes within 6 hours following coitus”; and finally, that the longevity of sperms depends on the division of the genital tract in which they are present, e.g. about 12 hours in the vagina “and up to the 48th hour after coitus” in the cervix. See No. 9 of the Series of Studies on Sex Physiology.

It is, therefore, obvious from the above considerations that the prenatal age depends on many factors, and although it may be, for practical purposes, calculated from copulation, yet strictly speaking, other factors should be borne in mind.

(c) *Weight of uterus and foetus (columns V and VI).*—Obviously this can only be approximate owing to the specimens having been placed in preservative.

(d) *Size of foetus (column VII).*—Here again only the approximate size can be given, for apart from the action of the preservative, some degree of distortion had taken place through tight packing in despatch.

It is emphasized that far more accurate observations could be made with fresh material.

DISCUSSION ON PLATE.

As the situation of the foetuses is clearly shown in the Plate, it is only necessary to state as follows:—

(a) *Twin Pregnancies.*—Of 41 pregnancies 5 were double, but of these in one case a foetus had been disturbed (No. 5). Those to receive consideration will therefore be Nos. 20, 21, 31 and 35.

(b) *Single Pregnancies.*—Of 41 pregnancies, 36 were single. Three, however (Nos. 8, 12, and 13), had been disturbed, leaving 33 for further study.

(a) TWIN PREGNANCIES.

In regard to *presentation*, all were longitudinal, the direction being one cranial (No. 31), one caudal (No. 20), and two having one foetus cranial (right horn in both instances), and the second foetus caudal (Nos. 21 and 35). As to *position*, the dorso-iliac predominated, 6 foetuses of the 7 being arranged dorsum laterally, and only one (No. 31) dorsum medially. The eighth foetus (No. 35) was dorso-sacral in position. In connection with *posture* this was normal in all cases, except for the foetus occupying the left horn of No. 35. Here the head was turned backwards and it is possible that tight packing was responsible.

(b) SINGLE PREGNANCIES.

In connection with *presentation*, of 33 specimens all were longitudinal, 20 being cranial and 13 caudal. According to Williams, W. L. (1931) "in uniparous animals in *advanced* pregnancy the physiological rule is that the cephalic end of the foetus be directed towards the cervix". The figures quoted are 99 per cent. (Schmaltz citing Kehrer) for the mare, and 95-96 per cent. for the cow.

In this series of uteri, the majority of pregnancies are not advanced. Assuming, therefore, Williams is correct, then it would appear, if the Merino sheep resembles the horse and cow, that during intra-uterine development many of the presentations now caudal would become cranial.

In regard to *position*, the following were the relations.—12 dorso-sacral, this being the case especially towards the end of the series; and 20 dorso-iliac, 10 being directed towards the right and a like number towards the left. As would be expected this series characterized the first half of pregnancy. Only one foetus was found in the dorso-pubic position.

Regarding *posture*, the general flexed condition of the head and limbs was maintained. In a few cases there were departures from the normal, brought about no doubt to some extent by tight packing.

CONCLUSIONS.

An investigation into the situation of the lamb during intra-uterine life, admittedly based on *dead* material, brings to light the following facts:—

(a) That not only in the ewe but also in the mare and cow the situation of the developing foetus is not known with any certainty.

(b) That examination of gravid uteri of the dead sheep indicates (i) longitudinal presentation apparently remains the same, whereas (ii) position and posture are likely to be changed, the former especially in early pregnancy and the latter in late pregnancy. And

(c) That of 36 single pregnancies (see Plate) 21 foetuses were placed in right uterine horn and 15 foetuses were on the left side.

The next study will deal with the relationship between the pregnant horn and the corresponding corpus luteum verum, which followed the ovulation preceding the pregnancy in question.

ACKNOWLEDGMENT.

Our thanks are due to Messrs. T. Meyer and C. G. Walker, who are responsible for the Plate.

REFERENCES.

- CRAIG, J. F. (1930). *Fleming's Veterinary Obstetrics*, 4th Edit., p. 106. Bailliere, Tindall & Cox, London.
- QUINLAN, J., AND MARE, G. S. (1931). The Physiological Changes in the Ovary of the Merino Sheep in South Africa and their Practical Application in Breeding. *17th Rept. Dir. Vet. Serv. and Anim. Indust.*, p. 679. The Govt. Printer, Pretoria.
- QUINLAN, J., MARE, G. S., AND ROUX, L. L. (1932a). The Vitality of the Spermatozoon in the Genital Tract of the Merino Ewe, with Special Reference to its Practical Application in Breeding. *18th Rpt. Dir. Vet. Serv.*, Part II, p. 851-866. The Govt. Printer, Pretoria.
- QUINLAN, J. (1932b). The Vitality of the Spermatozoon and the Liberated Ovum in Domestic Animals, with Special Reference to the Relation of the Time of Copulation during Oestrus to Conception. *Jl. S.A. Vet. Med. Assn.*, Vol. 3, No. 1, p. 6.
- SMITH, F. (1920). *A Manual of Veterinary Physiology*, p. 784. Bailliere, Tindall & Cox, London.
- WILLIAMS, W. L. (1931). *Veterinary Obstetrics*, pp. 136-138. Published by the Author, Ithaca, N.Y.