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On the Growth of the Gravid Uterus in the Merino.

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In Study 17 (Curson and Malan, 1936), the relationship of (*a*) the gravid uterus and (*b*) the foetus to the body weight of the ewe less the weight of the gravid uterus, was considered. When the weight of the gravid uterus was expressed as a percentage of the ewe weight less the weight of the gravid uterus a considerable amount of individual variation in the weight of the gravid uterus at a specified age was eliminated.

Having obtained data, not only on the weight of the gravid uterus and foetus, but also on the associated structures *viz.* the foetal sac, foetal membranes and foetal fluids, it is now possible to give a more detailed description of the growth of the gravid uterus and its constituent parts. In the present series of observations the gestation stages were taken at approximately monthly intervals; one pair of the ten ewes at each stage.

The discussion below is a consideration of—

(*a*) the increase in weight with gestation age;

(*b*) the constituents as percentages of the gravid uterus;

(*c*) the foetus, fluids and membranes as percentage of the foetal sac; and

(*d*) the increase in length of the allantoic and amniotic sacs with gestation age.

The data are tabulated thus:—

TABLE I.

Absolute Weights (in gm.).

Ewe.	(1) Wt. of Ewe—Wt. of gravid uterus.	(2) Gestation age (days).	(3) Wt. of the gravid uterus.	(4) Empty uterus.	(5) Foetal sac.	(6) Foetus.	(7) * All. fluid.	(8) * Am. fluid.	(9) All. Chor.	(10) All. Am.
35984	38875	32	135	64	71	·827	46·2	4	17	·1
44803	39789	33	128	46	82	1·25	56	6	13	·223
45082	36320	60	875	301	574	54·2	95	210	98·2	4·5
44849	31971	60	688	280	408	44·5	73	240	44·5	5·5
15337	37268	90	2,195	887	1,308	530	76	520	95	35·5
21665	33918	90	1,690	485	1,205	470	76	500	33	22
44679	34277	121	5,640	960	4,680	2,730	690	930	62	75
38521	33209	121	4,440	740	3,700	2,170	555	760	80	55
44397	30968	145	5,320	622	4,698	3,300	670	520	65	52
30514	27508	146	6,058	708	5,350	3,540	1,140	300	90	49

* These figures refer actually to *c.c.*, but as the specific gravity is so similar to water no adjustment has been made. In any case such adjustment would reduce the error shown in Chart D.

A. THE INCREASE IN WEIGHT WITH GESTATION AGE.

When the *absolute* growth of the gravid uterus is considered, the differences between the weights of the ewes cause a considerable amount of variation in the weight of the gravid uterus. This variation is greatly decreased when the weight of the gravid uterus is expressed as a percentage of the ewe weight. In Table II the data are therefore transformed into percentages of the ewe weight less the weight of the gravid uterus.

TABLE II.

All Weights Expressed as a Percentage of Ewe Weight—Weight of Gravid Uterus.

Ewe.	(1) Gestation age (days).	(2) Wt. of the G. U.	(3) Empty uterus.	(4) Foetal sac.	(5) Foetus.	(6) All. fluid.	(7) Am. fluid.	(8) All. Chor.	(9) All. Am.
35984.....	32	·347	·165	·183	·0021	·119	·010	·044	·003
44803.....	33	·322	·116	·206	·0031	·141	·015	·033	·001
45082.....	60	2·41	·829	1·58	·149	·262	·578	·270	·012
44849.....	60	2·15	·876	1·28	·139	·228	·751	·139	·017
15337.....	90	5·89	2·38	3·51	1·42	·204	1·39	·255	·095
21665.....	90	4·98	1·43	3·55	1·39	·224	1·47	·097	·065
44679.....	121	16·45	2·80	13·65	7·96	2·01	2·71	·181	·219
38521.....	121	13·37	2·23	11·14	6·53	1·67	2·29	·241	·166
44397.....	145	17·18	2·01	15·17	10·66	2·16	1·68	·210	·168
30514.....	146	22·02	2·57	19·45	12·87	4·14	1·09	·327	·178

The weight of the gravid uterus as a percentage of the ewe weight in relation to age was approximated by the following parabolic curve (Curson and Malan, 1936):—

$$W = 0{\cdot}000263t^{2{\cdot}21 \pm 0{\cdot}1033*} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Where W = weight of the gravid uterus as a percentage of the weight of the ewe less the weight of the gravid uterus.

t = gestation age in days.

In a similar way the best fitting equation to the date in column (1) and (3) of Table II is obtained and found to be

$$W = 0{\cdot}0000268\ t^{2{\cdot}73 \pm 0{\cdot}0839*} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

and for the two series combined

$$W = 0{\cdot}0000809\ t^{2{\cdot}48 \pm 0{\cdot}1041*} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

[These equations express the weight of the gravid uterus as a percentage of the ewe weight (less the weight of the gravid uterus) in terms of the gestation age.

In order to obtain the weight (W) in grams the right hand side of the equation may be multiplied by ($\frac{1}{100}$ times the average ewe weight). The above equations then become:—

$$W = 0{\cdot}0967\ t^{2{\cdot}21} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)^1,$$

$$W = 0{\cdot}00922\ t^{2{\cdot}73} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)^1,$$

and $W = 0{\cdot}0522\ t^{2{\cdot}48}$ ... ... (3)^1, respectively.]

The above equation (3) for the two series combined is shown on Chart A by a smooth curve. The series of data used in Study 17 (Curson and Malan, 1936) are included in this chart (Chart A) and shown by crosses to differentiate them from the present data which are shown by dots.

The increase in the weight of the foetus with advancing age has been discussed in a previous study (Curson and Malan, 1935), but no endeavour was made to apply any of the empirical or theoretical formulae to the data. The nature of these formulae and their applications are discussed by various authors and a detailed review is given by Needham (Needham, 1931, pp. 383-440). The data under discussion in the present study are inadequate to enlarge on the discussion quoted and further consideration will be postponed to a later date when all the data accumulated during this series of studies will be treated in one systematic whole.

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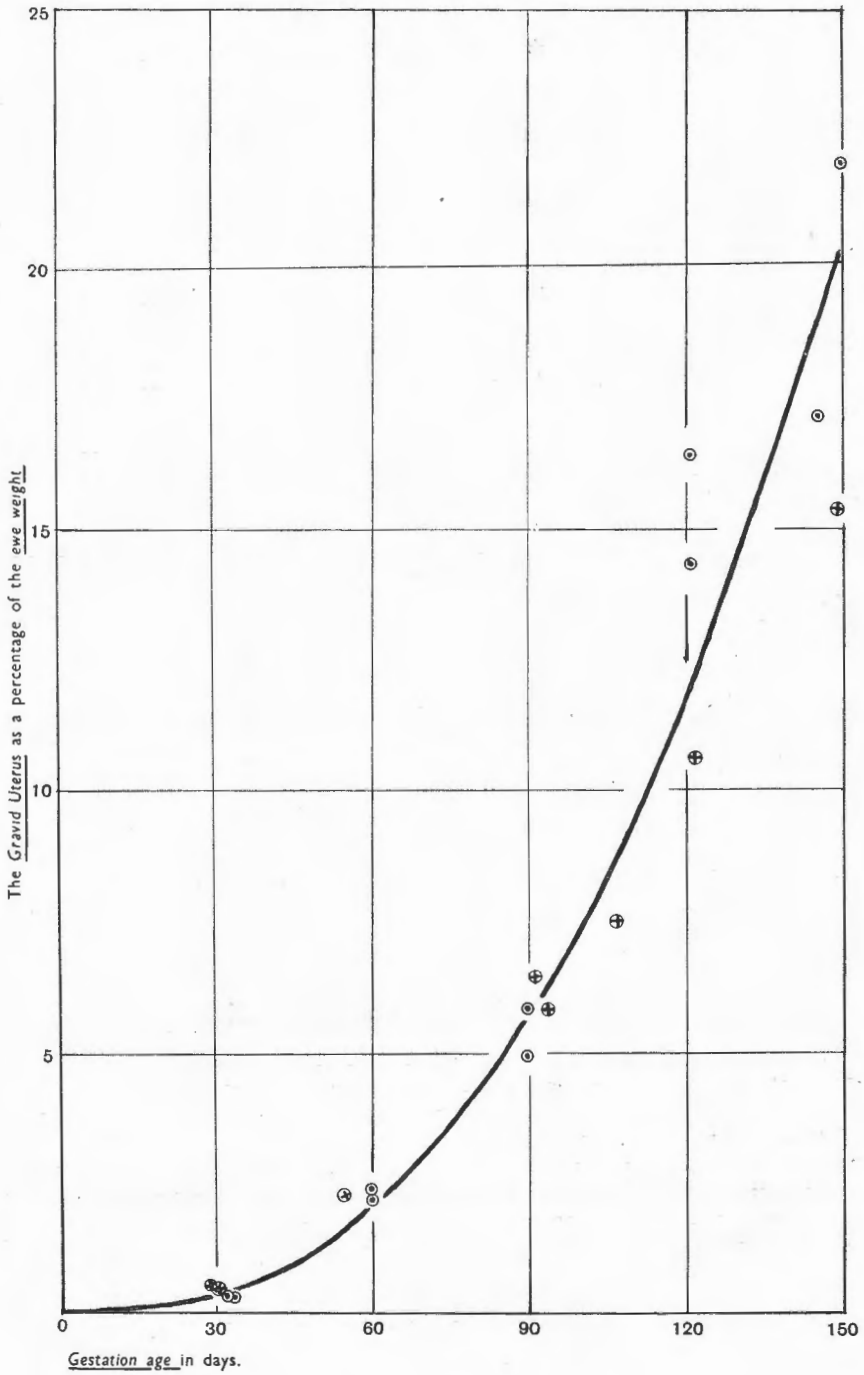
* Attached to the power index is given its standard error.

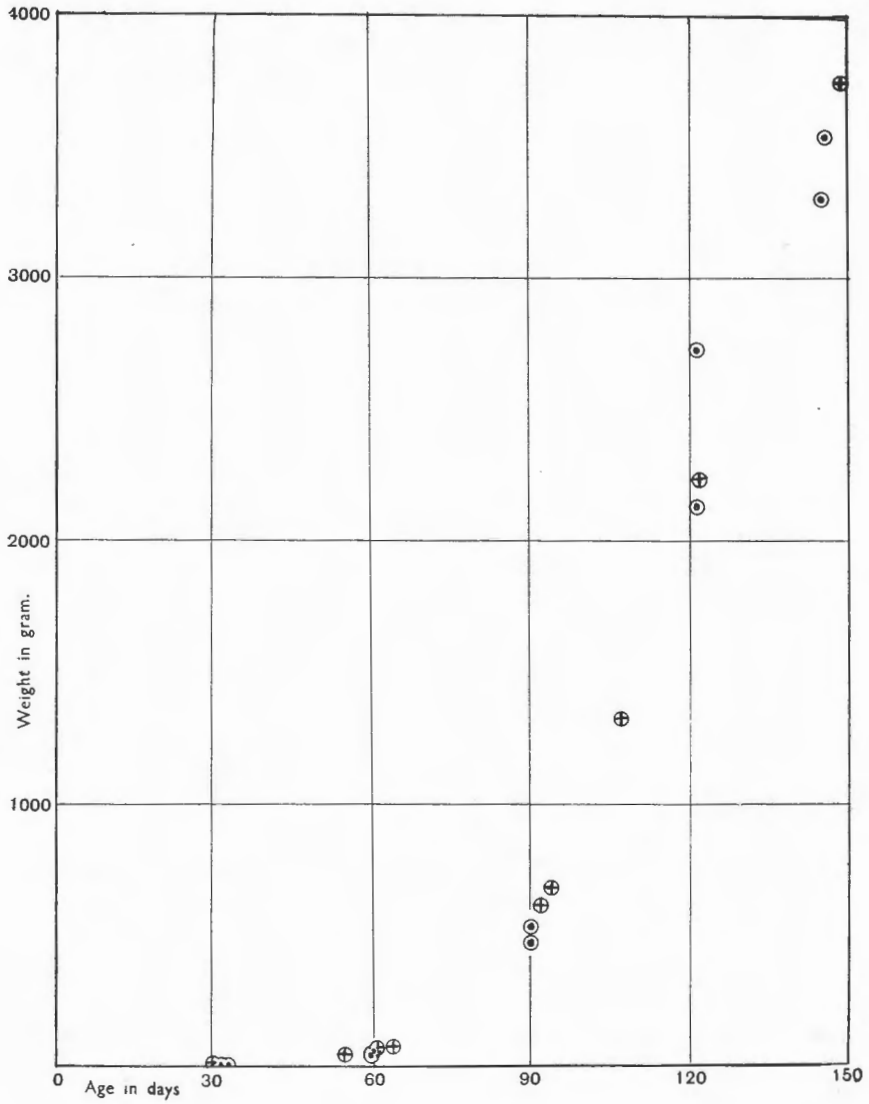
CHART A (18).
The growth of the gravid uterus.



A chart, Chart B, has, however, been prepared, which illustrates the nature of the prenatal growth of the foetus. The data given in Table I are again denoted by dots and the series used in Study 17 is shown by crosses.

CHART B (18).

The growth of the foetus.

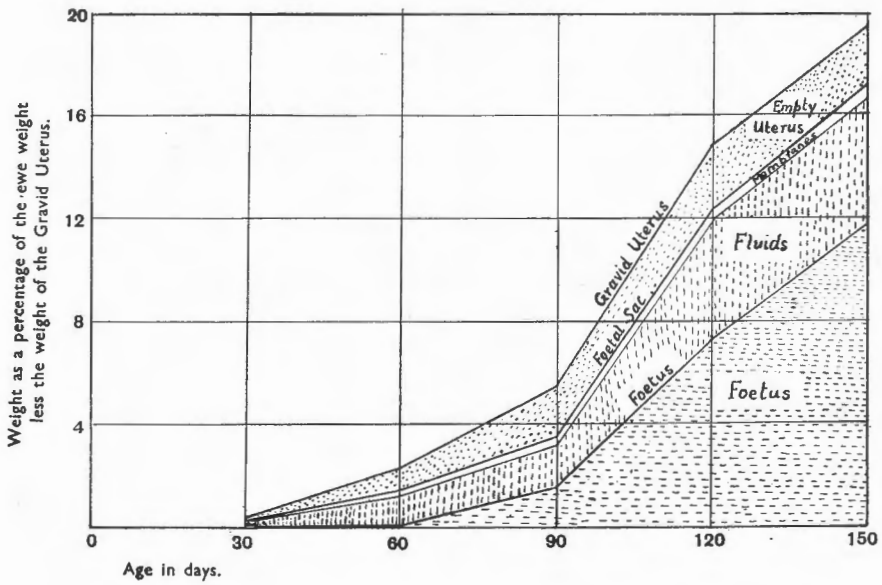


The most striking feature of the prenatal growth of the foetus is the exceedingly little increase in weight during the first half and the rapid and almost constant rate of growth during the second half of the gestation period.

Considering the increase in absolute or percentage weight of the other constituents of the foetal sac, several features in their growth are suggested. See Tables I and II. The fluids, Allantoic and Amniotic, differ in the sense that the first, the Allantoic, shows little increase during the first three months while the increase in the amount of Amniotic fluid occurs largely during this period. In the case of the Amniotic fluid a decrease in weight during the 5th or last month is suggested by the data in Tables I or II. Taken together the fluids are gradually increasing in weight with advancing age. (See Chart C.)

CHART C (18).

The gravid uterus and its constituents as a percentage of the ewe weight less the weight of the gravid uterus.



The membranes also differ in their increases in weight during the gestation period. After the second month very little increase in the weight of the Allanto-Chorion is shown by the above data. The Allanto-Amnion, on the other hand, steadily increases during the first four months and then appears to remain constant, or very nearly so. The total weight of the membranes gradually increases during the whole of the gestation period. (See Chart C.)

The general nature of the growth of the separate constituents considered is therefore to some extent similar for the empty uterus, Amniotic fluid and the Allanto-amnion and then again for the Allantoic fluid and Allanto-chorion.

B. The Constituents as Percentages of the Gravid Uterus.

Below, in Table III, the weights of the different constituents are expressed as percentages of the weight of the gravid uterus.

Table III.

Contents of the Gravid Uterus Expressed as Percentages of the Gravid Uterus.

Ewe.	(1) Gestation age.	G.U.	(2) Empty uterus.	(3) Foetal.	(4) Foetus.	(5) All. fluid.	(6) Am. fluid.	(7) All. Chor.	(8) All. Am.
35984.....	32	100%	47·4	52·6	·61	34·2	2·96	12·6	0·74
44803.....	33	—	35·9	64·1	·98	43·8	4·69	10·2	0·17
45082.....	60	—	34·4	65·6	6·19	10·9	24·0	11·2	·51
44849.....	60	—	40·7	59·3	6·47	10·6	34·9	6·5	·80
15337.....	90	—	40·4	59·6	24·1	3·46	23·7	4·33	1·62
21665.....	90	—	28·7	71·3	27·8	4·50	29·6	1·95	1·30
44679.....	121	—	17·0	83·0	48·4	12·2	16·5	1·10	1·33
38521.....	121	—	16·7	83·3	48·9	12·5	17·1	1·80	1·24
44397.....	145	—	11·7	88·3	62·0	12·6	9·8	1·22	·98
30514.....	146	—	11·7	88·3	58·4	18·8	5·0	1·49	·81

When the growth of the gravid uterus is further analysed it is shown that its increase in weight is largely due to the increase in weight of the foetal sac. The increase in the weight of the foetal sac again is largely the result of the growth of the foetus (see Chart C). During the early stages of pregnancy the weight of the foetus is only a very small percentage of the foetal sac or of the gravid uterus, but towards the later stages it becomes of increasing importance and at birth constitutes more than half the weight of the gravid uterus, while the weight of the foetal sac is then less than $1\frac{1}{2}$ times the weight of the foetus.

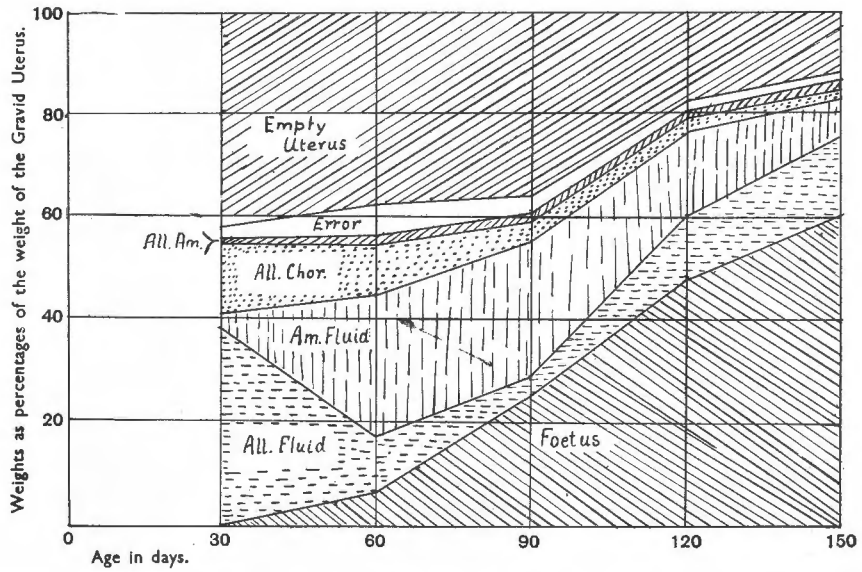
The increasing importance of the weight of the foetus as a percentage of the weight of the gravid uterus with advancing age, is clearly shown. The foetus is the only constituent which shows an increase in percentage with advancing age. At the age of one month the foetus is less than 1 per cent. of the weight of the gravid uterus while at birth the foetus is over 60 per cent. of the weight of the gravid uterus.

The empty uterus as a percentage of the gravid uterus becomes less as the foetal sac becomes more, while the increase in the foetal sac as a percentage of the gravid uterus is entirely due to the increase of the foetus. (See Chart D.)

The Allantoic fluid first decreases and then increases as a percentage of the gravid uterus while the behaviour of the Amniotic fluid is just the reverse, showing first an increase and then a decrease. The sum of the two fluids, however, gradually decreases. This is also true for the sum of the membranes.

CHART D (18).

The constituent parts of the gravid uterus as percentages of the gravid uterus.



In Chart D there is an unshaded strip marked "Error" to denote the discrepancy between the weight of the foetal sac and the sum total of its constituents. This discrepancy is mainly due to loss during separation of the constituents because of evaporation and otherwise.

C. THE FOETUS, FLUIDS AND MEMBRANES AS PERCENTAGES OF THE FOETAL SAC.

To further analyse the data the weights of the foetus, the fluids and the membranes are expressed as percentages of the weight of the foetal sac and given in Table IV below.

TABLE IV.

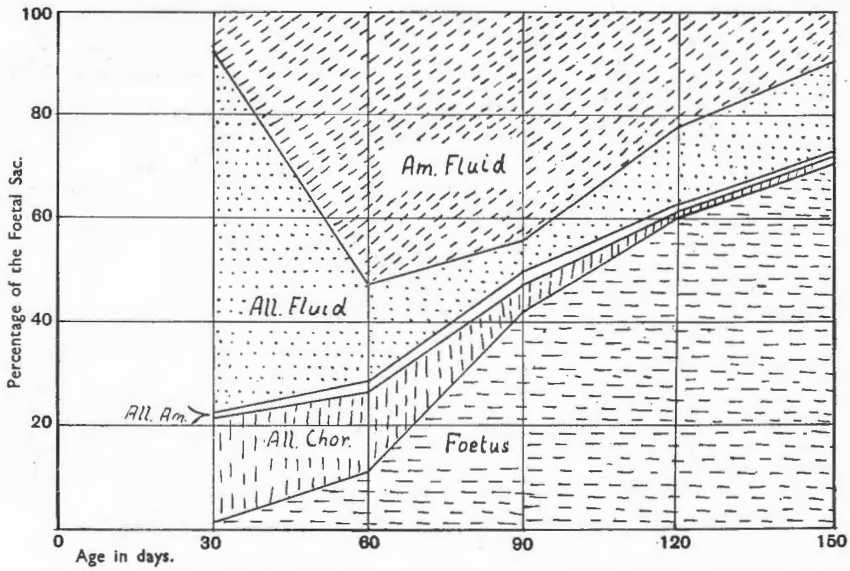
Contents of the Foetal Sac Expressed as Percentages of the Foetal Sac.

Ewe.	Gestation age.	Foetal sac.	Foetus.	All. fluid.	Am. fluid.	All. Chor.	All. Am.
35984.....	32	100%	1·16	65·1	5·6	23·9	1·41
44803.....	33	—	1·52	68·3	7·3	15·9	0·27
45082.....	60	—	9·44	16·6	36·6	17·1	0·78
44849.....	60	—	10·91	17·9	58·8	10·91	1·35
15337.....	90	—	40·52	5·81	39·8	7·26	2·71
21665.....	90	—	39·00	6·31	41·5	2·74	1·83
44679.....	121	—	58·33	14·74	19·87	1·32	1·60
38521.....	121	—	58·65	15·00	20·54	2·16	1·49
44397.....	145	—	70·24	14·26	11·1	1·38	1·11
30514.....	146	—	66·17	21·31	5·61	1·68	0·92

The data in Table IV are graphically presented in Chart E.

CHART E (18).

The constituents of the foetal sac expressed as percentages of the foetal sac.



The chart clearly illustrates the increase of the foetus as a percentage of the foetal sac. The Allanto-Amnion appears to remain a constant percentage of the foetal sac. The behaviour of the other constituents are clearly shown by the chart and requires no further comment.

D. THE INCREASE IN LENGTH OF THE ALLANTOIC AND AMNIOTIC SACS WITH GESTATION AGE.

The effect of age on the C. R. length of the Merino foetus was discussed in Study 13 (Curson and Malan, 1935). We propose now to investigate the relationship between gestation age and the lengths of the Allanto-chorionic (Allantoic) and Allanto-amniotic (Amniotic) sacs. The data bearing on this subject are given in Table V below:—

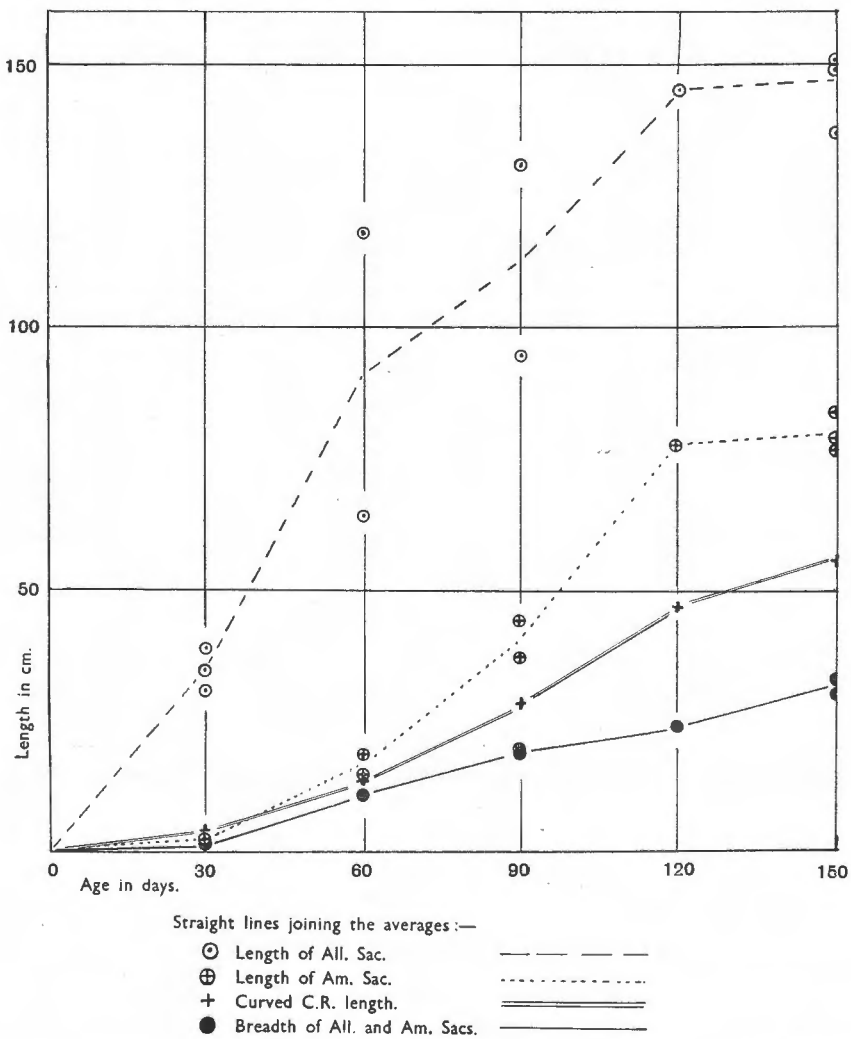
TABLE V.

Ewe.	Gestation (days).	C.R. (Straight) Length Foetus (cm.).	Length Allantoic sac (cm.).	Length Amniotic sac (cm.).	Breadth of both sacs. (cm.).
35984.....	32	2·2	—	2·5	2
44803.....	33	2·4	—	2·5	2
45082.....	60	11·5	118	15	11
44849.....	60	10·5	64	19	11
15337.....	90	24	131	37	20
21665.....	90	22·5	95	44	19
44679.....	121	32·5	—	—	—
38521.....	121	36	145	78	24
44397.....	145	37	137	79	30
30514.....	146	40	—	—	33

It will be observed that no measurements were taken for the allantoic sac at the end of the first month. Three records of approximately one-month-old pregnancies taken at the Pretoria Abattoirs give an average of 35·5 cm., the individual lengths being 31 cm., 35 cm. and 39·5 cm. Only the record given above is available for the end of the fourth month, but for the full term allantoic sac two additional figures were obtained at the Pretoria Abattoirs, *viz.* 149 cm. and 151 cm.

CHART F (18).

Length and breadth of the All. and Am. sacs in cm.



As Table V only shows one reading for the length of the Amniotic sac at full term, the lengths were taken of the two full-term pregnancies obtained at the Pretoria Abattoir. These were 77 cm. and 83·5 cm. respectively.

The data given above is featured diagramatically in Chart E herewith, along with the position relating to the *breadth* of the two sacs at their maximum width.

From the above it will be observed that there is an increase in *length* of the two sacs up to the end of the fourth month, being more marked in the Allantoic sac, which is approximately double that of the Amniotic sac. In the case of the *breadth* there is a steady increase from the end of the first month right up to full term.

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