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THE MOVEMENT OF OVA IN THE GENITAL TRACT OF THE EWE

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SUMMARY

In the ewe, an oestrogen-induced oedema and flexure of the utero-tubal junction gives it a valve-like action which controls the time of passage of ova into the uterus. In two-tooth ewes, perhaps because of the early relaxation of the utero-tubal junction due to a lower oestrogen secretion, ova tend to reach the uterus earlier than in mature sheep. The survival of such ova may be prejudiced, and this may account for some two-tooth infertility.

It is UNCERTAIN whether the female reproductive tract is wholly or only partly responsible for the transport of the motile male gametes, the spermatozoa. No such doubt can exist about the transport of the immotile female gametes, the ova. Their movement along the female genitalia is due entirely to the activity of the female reproductive tract.

While spermatozoa in the tract move towards the ovaries, ova move in the opposite direction. How the female tract contrives at least partial control of the first of these while at the same time wholly controlling the second is not known.

It is of interest to consider what is known of the movement of ova in the genital tract of the ewe, and its significance in problems of fertility.

MOVEMENT OF OVA

Within a few hours after ovulation, the ovum passes to the junction of the ampulla and isthmus of the Fallopian tube, and then spends about 72 hours moving along the isthmus before entering the uterus. This movement of the ovum has been ascribed by Wintenberger-Torres (1961) to tubal peristalsis and anti-peristalsis which are controlled by the balance between oestrogen and progesterone. The cilia at the free surface of cells lining the Fallopian tube probably also play a part in moving the ovum by beating towards the uterus.

Ova are apparently prevented from passing into the uterus at this time by the valve-like action of the utero-tubal junction which operates when the level of oestrogen is relatively high

(Edgar and Asdell, 1960a). This valve-like action was illustrated by ligating the ovarian end of one tube and, shortly after oestrus, observing its subsequent distention with tubal secretions which could not pass into the uterus and which ordinarily escape into the abdominal cavity (Fig. 1). Although fluid under pressure was unable to enter the uterus from the Fallopian tube, spermatozoa were, at the same time, able to pass in the opposite direction (Edgar and Asdell, 1960b); the action of the utero-tubal junction at this stage in the oestrous cycle is truly valve-like. It was ascribed to the oedema of the wall, the flexure of the canal, the narrow lumen and the folding of the tubal lining

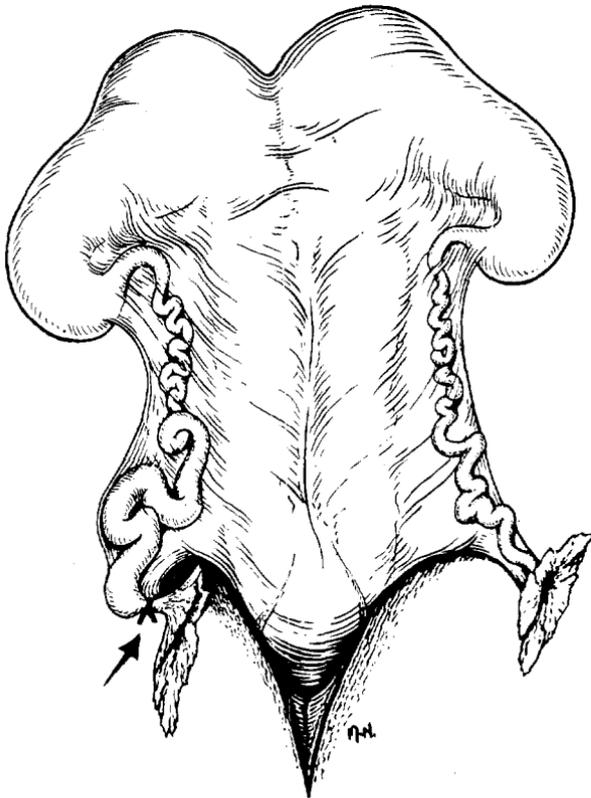


Fig. 1: Ventral aspect of the reproductive tract exposed through a mid-ventral abdominal incision in a ewe. The ovarian end of the right uterine tube was ligated (arrow) on the day of oestrus, and the distended and normal tubes are seen one day later.

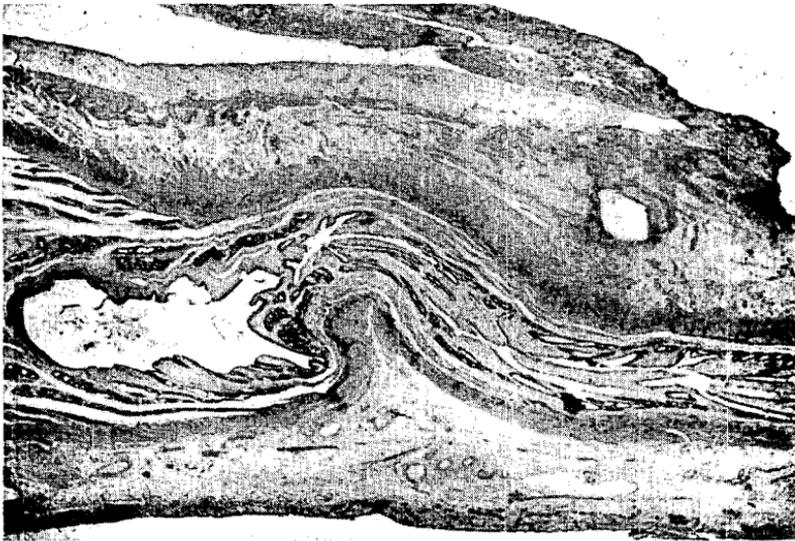


Fig. 2: Longitudinal section through the utero-tubal junction of a ewe one day after oestrus. Note the oedema of the wall, and the marked flexure where the utero-tubal junction turns back on itself.

(Fig. 2). The oedema and increased flexure were shown to be caused by oestrogen and to be absent at other stages of the reproductive cycle.

Tubal fluid and ova can pass through the utero-tubal junction into the uterus on about the fourth day after oestrus, when the endometrium is entering the progestational phase and the progesterone concentration is rising in the ovarian vein (Edgar and Ronaldson, 1958).

INFLUENCE OF OVUM TRANSPORT ON EWE FERTILITY

The timing of the changes in the utero-tubal junction and of the entry of the ovum into the uterus affect its chances of survival and consequently directly influence fertility. Both oestrogen and progesterone have been shown to affect the rate of passage of ova from the Fallopian tube into the uterus. The former is used to prevent pregnancy following misalliance in the bitch by holding the ova too long in the Fallopian tube.

Edgar and Asdell (1960a) noted that the utero-tubal block was inadequate in three of five ewes in which oestrus and ovulation were induced artificially during the non-breeding sea-

son. In these ewes the ova could pass into the uterus at an earlier-than-normal time, which might account for some of the lowered fertility of ewes bred during the non-breeding season.

When comparing the reproductive performance of two-tooth and mature ewes, Edgar (1962) found that 30% of the young sheep returned to first service compared with 16% of older ewes (Table 1). When other such ewes were slaughtered 2 to 4 days after tupping, it was found that the proportion of ewes with ova not dividing was about the same in the two age groups (Table 2), and in the case of the mature sheep this proportion was sufficient to account for their returns to service. This suggested that the difference in fertility between the two-tooths and five-year-old ewes might be at least partly accounted for by the subsequent death of a greater proportion of dividing ova in the young ewes.

The position of all ova and the stage of development of dividing ova in the reproductive tract of these experimental ewes were examined on the third and fourth days after tupping.

In 22% of the young ewes, ova had reached the uterus by the third day after tupping, compared with 5% of mature sheep (Table 3), this difference being statistically significant ($P < 0.05$). Of the dividing ova among those in the uterus, most were at an earlier stage of development in the young ewes (Table 4). Most ova in the mature ewes reached the uterus on the fourth day after the onset of oestrus and all except one of those dividing had developed beyond the eight-cell stage (Tables 4 and 5). In each of three mature ewes killed on the fourth day after oestrus, one ovum was found in a Fallopian tube and another in the uterus, further indicating that ova normally enter the uterus about four days after tupping.

The difficulty in interpreting these results is the inability to determine the time of ovulation, but the evidence does suggest that ova in young sheep tend to pass more quickly through the Fallopian tubes and enter the uterus at an earlier stage of development than in mature ewes. In consequence, the survival of such ova may be prejudiced. In ovum transfer experiments, Averill and Rowson (1958) found that the survival rate of 6- to 16-cell ova transferred to the uterus of recipient ewes increased as the interval between oestrus and transfer in these recipient ewes increased up to four days.

Tarkowski (1961) considered his lack of success in transferring ova to the uterus of mice in the morning compared with the evening of the third day after mating was due to the un-

TABLE 1: PROPORTIONS OF YOUNG AND MATURE EWES RETURNING TO SERVICE

	<i>Ewes Aged</i>	
	<i>1½ yr</i>	<i>5 yr</i>
Ewes tupped	148	241
Ewes returning to service	44 (30%)	39 (16%)

TABLE 2: REPRODUCTIVE STATE OF YOUNG AND MATURE EWES EXAMINED 2 TO 4 DAYS POST-TUPPING

	<i>Ewes Aged</i>	
	<i>1½ yr</i>	<i>5 yr</i>
Ewes from which ova recovered	99	71
Ewes with dividing ova	82	60
Ewes with ova not dividing	17 (17%)	11 (16%)

TABLE 3: EWES WITH OVA IN FALLOPIAN TUBES OR UTERUS ON THIRD DAY POST-TUPPING

	<i>Ewes Aged</i>	
	<i>1½ yr</i>	<i>5 yr</i>
Ova in Fallopian tubes	44	38
Ova in uterus	12 (22%)	2 (5%)
Totals	56	40

TABLE 4: POSITION AND STAGE OF DEVELOPMENT OF DIVIDING OVA OF YOUNG AND MATURE EWES ON THIRD DAY POST-TUPPING

	<i>46 Ewes Aged 1½ yr</i>	<i>25 Ewes Aged 5yr</i>
Ova in Fallopian tubes:		
8 cells or less	34	20
Over 8 cells	8	10
Ova in uterus:		
8 cells or less	10	0
Over 8 cells	2	3

TABLE 5: POSITION AND STAGE OF DEVELOPMENT OF DIVIDING OVA OF YOUNG AND MATURE EWES ON FOURTH DAY POST-TUPPING

	<i>10 Ewes Aged 1½ yr</i>	<i>35 Ewes Aged 5yr</i>
Ova in Fallopian tubes:		
8 cells or less	1	8
Over 8 cells	3	7
Ova in uterus:		
8 cells or less	4	1
Over 8 cells	3	31

prepared state of the uterus. Failure of ova which reach the uterus too soon might be due, on the other hand, to their premature removal from tubal secretions, from which radioactive sulphur has been shown to penetrate the developing ovum (Friz, 1959).

As Edgar and Asdell (1960a) showed that oestrogen induced the valve-like action of the utero-tubal junction, its earlier relaxation in young ewes might be due to their level of oestrogen secretion being lower than that of mature sheep. The shorter oestrus (Lambourne, 1956) and less intense *libido* (Inkster, 1957) of young ewes lend weight to this possibility.

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