SOME ASPECTS OF OESTRUS IN CATTLE, WITH REFERENCE TO FERTILITY ON ARTIFICIAL INSEMINATION

3. BODY TEMPERATURE AND THE OESTROUS CYCLE

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SUMMARY.

Two groups, each of 10 Jersey cows, were observed for periods of 99 and 86 days, respectively, in succeeding years.

Mean body temperature was 100.2±0.8°F (n=1,824) in the morning and 101.4±0.8°F. (n=1,764) in the evening. Eighteen oestrous periods were detected in the morning; 13 were noted in the evening; and in 6 cases oestrus was evident at morning and evening.

No correlation could be established between stages of the oestrous cycle and morning or evening temperature trends, except that a thermogenic response ($P<0.001$) in the presence of oestrus was noted.

Preliminary investigations indicate that the response persists for the duration of oestrus. It is suggested that the use of the temperature rise at oestrus could be an adjunct to more conventional methods of oestrus detection if exercised with care and judgment.

The significance of the thermogenic response at oestrus in relation to metabolic processes is considered, and attention is drawn to its possible importance in heat regulation and in adaptation to unfavourable environments.

I. INTRODUCTION.

The psychic changes associated with maturation of the Graafian follicle in the cow are normally of sufficient intensity as to allow the competent observer to define the presence of oestrus. On the other hand, the determination of ovulation requires intricate techniques, but is facilitated by the readiness with which the cow's ovaries may be examined by rectal palpation.

However, under various circumstances the intensity and duration of oestrous symptoms may be partially or largely suppressed. In the application of artificial insemination to beef cattle under Queensland conditions "teasers" such as vasectomised bulls have been used to identify cows in oestrus, though the efficiency of this technique has been called into doubt by Wiltbank, Burris and Priode (1956) and by J. F. Kennedy in a private communication, and such bulls may provide a reservoir for venereal pathogens (J. N. Shelton and L. Donaldson, personal communication).

Conventional methods of detecting oestrus and ovulation have presented grave difficulties and sources of error in the study of pathological conditions such as anoestrus. Furthermore, the lack of more objective means of defining these phenomena constitutes a problem in the study of endocrine therapy and related fields.

From time to time various techniques have been proposed as adjuncts to the subjective determination of oestrus. For example, some success has been reported in the correlation of cervical mucus crystallisation with the oestrous cycle in beef cattle (Alliston, Patterson and Ulberg 1958). However, anomalies with this method have been noted in the anoestrous state (Fallon and Crofts 1959).

Variations in body temperature throughout the menstrual cycle were reported by Van de Velde (1904) and have since been used extensively for the determination of ovulation in women (Zuck 1938; Viergiver and Pommerenke 1946). The technique has been extended to other species and a biphasic temperature curve during the cow's oestrous cycle has been reported (Vollman and Vollman 1942).

The widespread nature of anoestrus in south-eastern Queensland (McTackett 1956) and a high incidence of atypical oestrous cycles (Fallon 1958) have been reported. Ovulation patterns in such conditions have not been thoroughly investigated because of the practical difficulties in arranging extensive programmes of ovarian examinations.

The present study was undertaken to determine if temperature observations made in conjunction with normal milking-shed routine might be of sufficient accuracy to reflect ovarian activity.

II. MATERIAL AND METHODS.

The observations were made in a commercial herd of Jersey cows at Hunchy (26°29′S, 152°80′E) near Nambour in south-eastern Queensland. Two observation periods were used—from Nov. 18, 1957, to Feb. 24, 1958, and from Sept. 17 to Dec. 11, 1958. During each period the rectal temperatures of 10 cows was taken twice daily at milking times (approximately 6.30 a.m. and 6.00 p.m.) with clinical thermometers graduated at intervals of $0 \cdot 2$ deg. F. Determination of oestrus was based on behavioural changes in the trial animals.

III. RESULTS.

Calving and oestrus data are presented in Table 1. Considerable incidence of anoestrus and atypical oestrous cycles is evident in the records. In the present study the temperature observations have been assigned in each case to the nearest observed oestrus. Temperature records taken more than 10 days before or after an observed oestrus are not considered here, except to say that the mean rectal temperature for the total of 1,824 morning records was $100 \cdot 2 \pm 0 \cdot 8$ deg. F. and for 1,764 evening records $101 \cdot 4 \pm 0 \cdot 8$ deg. F.

Table 1.

CALVING AND OESTRUS DATA.

Cow.	Calving Date.	Oestrus Dates.
A ..	20/6/57	14/9, 6/10, 19/1 (x), 4/2 (x)
B ..	1/9/57	22/11 (x)
C ..	30/9/57	16/2 (x)
D ..	29/8/57	29/1 (x), 25/2 (x), 4/3 (x)
E ..	29/8/57	19/10, 7/11, 26/11 (x)
F ..	2/10/57	26/2, 5/3 (x)
G ..	6/9/57	15/10, 5/11, 26/11 (x)
H ..	1/9/57	26/10, 3/11, 22/11 (x), 12/12 (x)
I ..	1/9/57	26/11 (x), 3/12 (x)
J ..	27/9/57	25/11 (x), 16/12 (x), 5/2 (x), 28/2 (x)
K ..	21/8/58	30/9, 21/10, 13/11, 4–5/12 (x)
L ..	13/8/58	5/9, 27/9, 19/10, 10–11/11, 30/11 (x)
M ..	26/8/58	27/10, 13–14/11, 1/12 (x)
N ..	24/8/58	21/12 (x)
O ..	4/9/58	5/12 (x), 26/12 (x), 15/1 (x)
P ..	11/9/58	23/11 (x), 30/11–1/12 (x)
Q ..	3/9/58	20/10, 28/10, 17/11 (x)
R ..	6/9/58	10/10, 8/11, 16/11 (x)
S ..	6/9/58	10/11, 17/11 (x)
T ..	11/9/58	23/10, 22/11 (x)

"x" denotes service, natural or artificial.

Available temperature data for each day of the oestrous cycle have been bulked and averaged. The calculated means are set out in Table 2: 18 oestrous periods were detected in the morning, 13 were noted in the evening, and in 6 cases oestrus was evident at morning and evening milkings. Body temperature trends throughout the oestrous cycle are illustrated in Fig. 1.

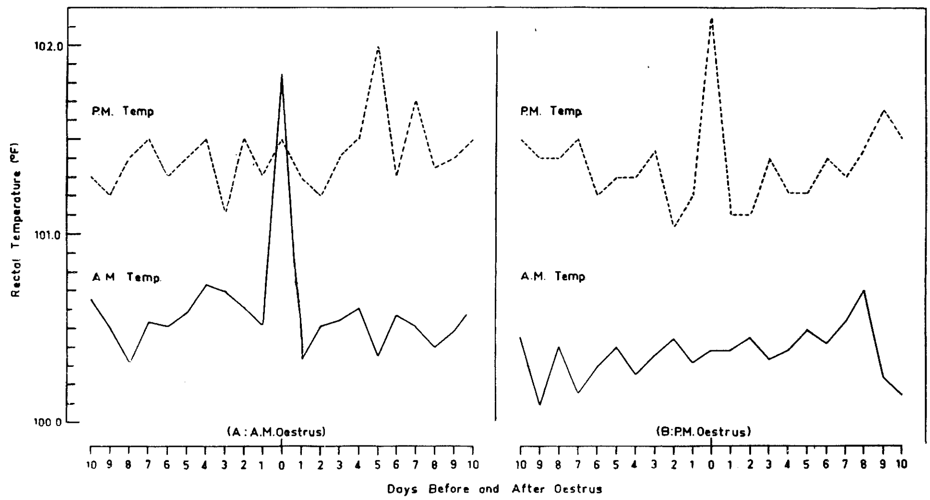

Fig. 1.

Variations in Body Temperature in Relation to the Oestrous Cycle.

No correlation between body temperature and the stage of the cycle could be established, though a thermogenic response in the presence of oestrus was highly significant ($P<0\cdot001$). The distribution of body temperature on the day of oestrus in relation to the specific time of oestrus is presented in Fig. 2.

Table 2.

BODY TEMPERATURE AND THE OESTROUS CYCLE.

Days Before and After Oestrus.	Morning Oestrus.				Evening Oestrus.			
	n	A.M. Temp.	n	P.M. Temp.	n	A.M. Temp.	n	P.M. Temp.
10	14	100·64	11	101·32	8	100·45	10	101·50
9	14	100·50	11	101·20	9	100·09	11	101·43
8	18	100·32	11	101·42	9	100·38	13	101·43
7	19	100·53	15	101·48	10	100·16	14	101·47
6	19	100·51	15	101·28	10	100·28	14	101·23
5	19	100·58	15	101·44	10	100·42	15	101·29
4	23	100·73	17	101·52	12	100·27	17	101·29
3	24	100·69	17	101·14	11	100·36	17	101·44
2	24	100·61	15	101·49	11	100·44	18	101·06
1	24	100·52	16	101·34	12	100·32	18	101·19
0	24	101·85	16	101·53	12	100·38	19	102·16
1	24	100·33	16	101·28	12	100·38	18	101·10
2	24	100·51	17	101·18	12	100·45	18	101·08
3	24	100·54	16	101·44	12	100·33	19	101·37
4	22	100·60	15	101·53	12	100·38	16	101·23
5	21	100·35	13	101·97	11	100·49	15	101·23
6	21	100·57	10	101·30	11	100·42	16	101·38
7	19	100·51	12	101·67	11	100·53	17	101·27
8	19	100·40	11	101·35	11	100·71	16	101·46
9	18	100·48	11	101·40	10	100·24	14	101·66
10	17	100·62	10	101·54	10	100·14	14	101·50
Mean (Oestrus excepted)	407	100·53	274	101·42	214	100·38	310	101·32

(N.B.—Rectal temperatures were recorded in degrees Fahrenheit).

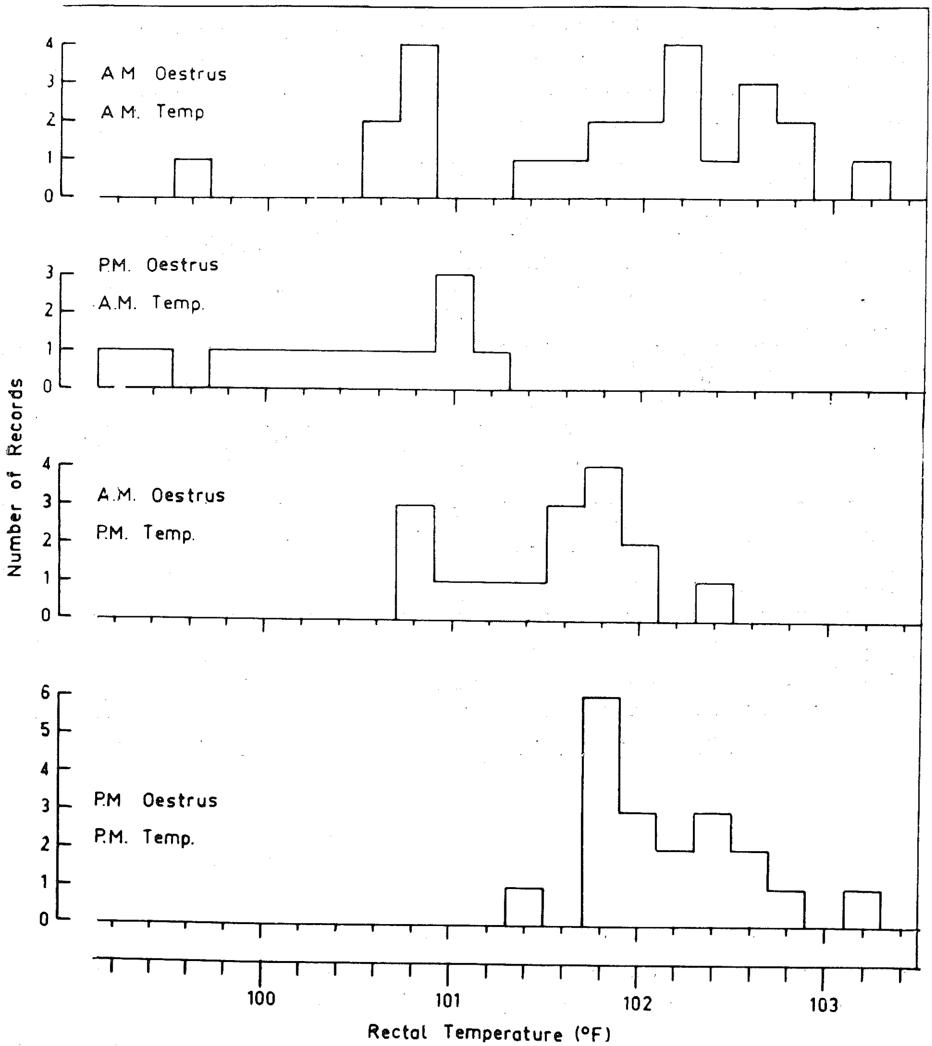

Fig. 2.

Distribution of Body Temperature Records on the Day of Oestrus in Relation to the Time of Oestrus Observation.

IV. DISCUSSION.

Since the present study was commenced, a similar investigation has been reported from Beltsville (Wrenn, Bitman and Sykes 1958), where vaginal temperatures of cows were recorded between 11 a.m. and noon. The workers were able to define a biphasic curve in body temperature in association with about 90 per cent. of 54 oestrous cycles, and they attributed the pattern to the thermogenic influence of endogenous progesterone.

In the present study, however, it was found that except for temperatures recorded during oestrus the daily variation was random in nature throughout the cycle, with a standard deviation of about 0·6 deg. F. Similarly, Greenstein, Murray and Foley (1958) found daily temperature records unreliable indicators of individual cyclic behaviour patterns. In addition, they were unable to demonstrate a thermogenic response to exogenous progesterone in intact heifers.

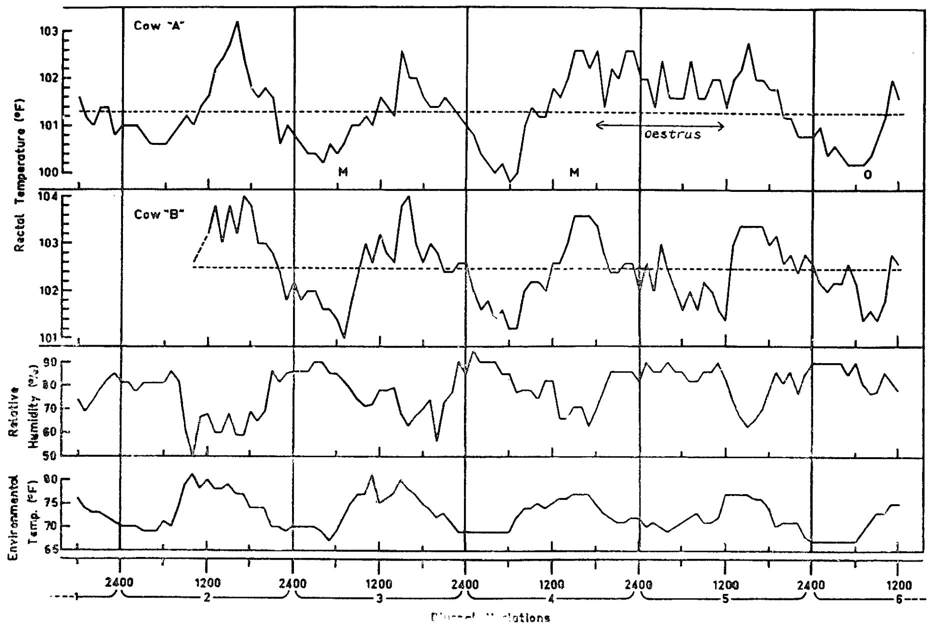

Fig. 3.

Body Temperature Trends in Terminal Stages of Oestrous Cycle in Cow A, Compared with Pregnant Cow B. (M: cervical mucus discharge; O: ovulation).

It should be noted that such animal studies as are reported here differ from the human investigations in that in the latter work temperatures are measured while the subject is in the "post-absorptive state."

The significant temperature response at oestrus is of particular interest. The phenomenon was not reported by Swiss workers (Vollman and Vollman 1942), but was noted by Wrenn, Bitman and Sykes (1958). Present data indicate that the temperature elevation is of such short duration that it could have been missed in a number of cases if recordings had been made only once daily.

Preliminary studies of the nature of the thermogenic response at oestrus have been initiated. In one investigation (see Fig. 3) the experimental animal was an aged cow afflicted with a long-standing dislocation of the hip joint. Thus, the activity response which is characteristic of oestrus (Wang 1923; Altmann 1941; Farris 1954) was markedly reduced. However, the thermogenic response persisted for the duration of oestrus. Normal diurnal body temperature rhythm was resumed before ovulation occurred.

While the temperature response at oestrus has been demonstrated, it is apparent that the use of this fact as an adjunct to more conventional methods of oestrus detection would need to be exercised with care and judgment. The significance of the individuality of the cow in respect of repeatability of body temperature was discussed by Kriss (1921). Such individuality in behaviour may explain the failure of some workers (e.g., Melampy, Hanka and Eness 1956) to demonstrate a thermogenic response at oestrus.

It remains for the nature of the temperature response in the oestrous cow to be elucidated. While augmented muscular activity undoubtedly contributes to the increased heat production, small-animal studies (Lee and Van Buskirk 1928) suggest that basal metabolism may be increased at or about oestrus independent of activity trends.

Soliman and Reineke (1954) demonstrated increased thyroid activity during oestrus in the rat, and more recently experimental evidence has been presented indicating that the increased elaboration of oestrogens in late pregnancy in the cow may exert a thyrotrophic effect (Pipes, Premachandra and Turner 1958). It is possible that such an effect might operate during oestrus in the cow, but apparently the thyroid status of the oestrous cow has not been critically examined. It is relevant that Spielman, Petersen, Fitch and Pomeroy (1945) demonstrated a reversible suppression of oestrus in the thyroidectomised heifer, although ovulation was apparently not impaired.

It is considered that the thermogenic response of the cow at oestrus is of more than academic interest in relation to bovine reproduction in tropical regions. Low calving rates are a feature in such areas (Hart and Guilbert 1928; Chester 1952; Van Rensburg 1956; Beattie 1956). This may be explained in part by the tendency for cattle in unfavourable environments to pass into anoestrus in alternate years (Hart 1955). While the condition has a nutritional basis (Guilbert and Hart 1946), its etiology is complex and may be appropriately considered in terms of the ''adaptive sterility'' hypothesis of Schaetz (1956).

Although the role of temperature in the suppression of oestrus in cattle is not clear (Hammond 1955), it is apparent that the thermogenic component of oestrus offers an interesting field of consideration in respect of heat-regulating mechanisms and adaptation of cattle to unfavourable environments.

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