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Researches into Sterility of Cows in South Africa.

The Influence of: (i) Dry Rations and (ii) Lack of Exercise on Sexual Maturity and the duration of the Ovarian Cycle in Beef Heifers.

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THE observations recorded in this publication are not directly concerned with the results of investigation previously published by Quinlan, 1929, 1934, and Quinlan and Roux, 1936. The data recorded are the results of observations on heifers born from the experimental cows used by Quinlan and Roux, 1936. These authors kept a number of beef heifers under restricted conditions of exercise and sunlight and fed them only on dry rations. The ration consisted of crushed yellow maize, 4 lb., wheaten bran, 1 lb., teff hay *ad lib.* (about 15 lb.). With the advent of maturity the ration was increased to 2 lb. bran and 25-30 lb. teff hay *per capita per diem*. During three winter months, June, July and August, maize silage was fed at the rate of 10-15 lb. *per capita per diem*, and during this period the hay ration was reduced. No minerals or mineral mixtures were fed to the animals during the course of the experiment.

According to the plan of the experiment, the cows were divided into three groups, A, B, and C, of which those in group C acted as controls, being unrestricted with regard to exercise and sunlight.

The association of the factors constituting these enforced environmental conditions was expected to produce a change from normal physiology of the genital tract of the experimental cattle. They were kept under observation from the age of 15 months until the termination of the third pregnancy. Oestrus and the ovarian cycle did not appear to be influenced abnormally. The number of services required to establish pregnancy was not abnormal when compared with cattle kept under environmental conditions considered favourable to fertility in South Africa. The length of the gestation period

was unaffected. The calves born in the experiment were normal in weight and vigour. Some of the experimental cattle were not mated until they had reached the age of 35 months, but the delay did not detrimentally affect their reproductive functions. There was, however, an indication that cows which maintained very high condition throughout the periods of gestation and lactation showed a tendency to produce small and light-weight calves.

It is considered necessary to indicate the environmental conditions under which the mothers of experimental heifers, now under discussion, were maintained during their gestation periods. An environment restricting exercise and sunlight, as well as dry rations, which in some cases produced a tendency to obesity, had been associated with unphysiological functioning of the genitalia. The relevant literature on the correlation of these factors with infertility has been discussed at length in Quinlan and Roux' previous publication, 1936. Consequently it is not considered necessary to give a further review in this paper.

This publication is confined to observations on sexual maturity and the duration of the ovarian cycle of beef heifers kept in an environment restricting exercise associated with the feeding of dry rations. Consideration has also been given to the fact that these heifers were the progeny of parents kept under artificial environmental conditions as indicated above.

The onset of maturity, that is the time at which the first oestrus is noticed, is without doubt influenced by breed and nutrition (Marshall and Hammond, 1926; Hammond, 1927). The indigenous cattle of this country mature less quickly than exogenous importations even when the breeds are maintained under similar environmental conditions. The delay in maturation naturally delays sexual maturity. Afrikander breeders, who have been consulted, state that Afrikander heifers run under ranching conditions of " free-breeding " rarely calve before attaining the age of three to three-and-one-half years. Schmaltz, 1921, has noted that steppe cattle do not become pregnant before the fourth year. Küpfer, 1925, 1928, in discussing puberty and full development states: " Die Vollentwicklung der weiblichen Keimdrüse fällt auf einen relativ späten Zeitpunkt der Entwicklung ihres Trägers. Die weibliche Keimdrüse erreicht ihre Vollentwicklung erst im geschlechtsreifen Alter des Tieres. Der Eintritt der Geschlechtsreife fällt beim Rind bekanntlich auf den 18 Lebensmonat." Anderson, 1936, although not recording the age of sexual maturity of Zebu Cattle in Kenya, noticed that the duration of oestrus was less than 2 hours, thereby indicating that breed or environment may influence the duration of oestrus if not the onset of sexual maturity. Hammond, 1927, states that the age of puberty for all breeds under normal conditions of feeding is about nine months, but it may vary from five to fifteen months. Stoss, 1928, states that heifers reach sexual maturity at nine months; Chaig, 1930, puts the period of sexual maturation as twelve to eighteen months; Saint-Cyr, quoted by Craig, 1930, twelve to fourteen months; Williams, 1931, six to eight months; Barker, 1930, six to sixteen months; Dechambre, 1922, and Curot, 1921, both quoted by

Hammond, 1927, twelve months. Hammond, 1927, quoting Eckles, 1920, gives the age of puberty of different breeds as follows: Jersey, 8 months; Guernseys, 11 months; Friesians, 11 months; and Ayrshires, 13 months. Marshall and Hammond, 1925, have indicated that the time of the year during which rabbits are born influences the age of puberty. Eckles, 1924, states that the ration influences the age at which a heifer shows first oestrus. Heavy-fed Holsteins reached sexual maturity 112 days earlier than light-fed heifers. In the case of Jerseys heavy feeding shortened the period by 76 days. Quinlan and Roux, 1936, working with high grade Sussex-Afrikander heifers, restricted in exercise and sunlight and fed on dry rations, showed that they reached sexual maturity between 16 and 23 months, with an average of approximately 19·5 months. Another group of similarly bred heifers kept under the same nutritional conditions, but with unlimited sunlight and exercise, reached sexual maturity between 16 and 23 months, with an average period of 19·25 months. It must be pointed out, however, that these heifers were purchased at the age of approximately 15 months from a private ranch and their previous genital history was unknown. It is probable, however, that all the heifers showed oestrus for the first time after being placed under observation as the first appearance of oestrus in any of the heifers was 40 days following the commencement of the experiment.

The observations would indicate that the age of sexual maturity in cattle in South Africa is later than that recorded in Europe. However, the enforced environment was artificial and may have delayed the onset of sexual maturity.

From the above short review of recorded observations by well known authorities, it will be seen that there is a great variation in the age of onset of sexual maturity. It appears highly probable that the causes of such variation are genetic and environic.

So far as the authors are aware, there is no publication on the age of sexual maturity or the duration of the ovarian cycle of cattle in South Africa other than the data of Quinlan and Roux, 1936. This hiatus in our knowledge is at the moment being filled by a study of the sex physiology of high grades of Friesian, Red Poll, Sussex, and Afrikander breeds. The study which is now in progress begins with observations from birth and continues until the termination of first pregnancy.

Quinlan and Roux, 1936, have indicated that the dioestrous cycle of heifers, kept on dry rations with restriction of sunlight and exercise, and control heifers, with abundance of sunlight and exercise, shows a mode of 20 days, short periods of 10 days and long ones of 123 days were experienced, but about 75 per cent. of dioestrous cycles fell between 18-23 days. In a total number of 516 ovarian cycles observed over 4 periods, one period of which was prior to the first gestation, the mode for 3 groups of heifers varied only from 20 to 22 days. Williams, 1931, Craig, 1930, and Stoss, 1928, state that heifers maintained under normal conditions show regular oestrus every three weeks. All authorities are agreed that the rhythm of dioestrus in the domesticated cow is maintained

throughout the year. Heape, 1900, cited by Hammond, 1927, maintains, however that wild cattle have a limited breeding season, although when confined in zoological gardens they will breed at any time of the year. Marshall and Hammond, 1926, and Hammond, 1927, says that the length of the normal oestrous cycle in the cow is on an average about 19½ days, but it has varied from 17½ days to 24 days. Hammond has observed that Jerseys have usually a rather longer period than Friesians and Devons. Schmid, 1902, quoted by Hammond, 1927, found that the variation in the duration of recurrent dioestrous cycles may be somewhat wide, but, in view of subsequent research, it appears that some of these cases cannot be considered normal. Küpfer, 1925, 1928, and Zietzschmann, 1921, 1922, quoted by Hammond, 1927, have found the average oestrous cycle of the cow to be 21 days. Barker, 1930, indicates that the duration of the cycle in English cattle varies between 19 and 21 days.

Struve, 1906, 1911, quoted by Hammond, 1927, found that the majority of oestrous cycles fell between the 17th and 23rd day. The range of variation was between the 8th and 30th day. Weber, 1911, also quoted by Hammond, 1927, found the dioestrous cycle of cattle recurring between 2½ to 4 weeks. The cycle for cows with intense heat periods was 3 weeks.

Anderson, 1936, working with Zebu cattle, apparently observed a seasonal fertility in that fertile matings appeared to occur more frequently at a certain time of the year. The duration of the dioestrous cycle in five Zebu cattle for 63 cycles varied from 17·9 to 24·2 days, with a mean of 20·1 days. In comparison with European cattle the duration of oestrus was remarkably short, varying from 81 minutes to 171 minutes.

Various factors, environmental and nutritional, have been inculpated as of aetiological significance in disturbing oestrus and oestrous rhythm. It is well known that disturbance of oestrous rhythm follows prolonged droughts in South Africa. The dioestrous periods become longer, oestrus becomes less intense and as animals lose condition the psychological phenomena disappear altogether. The reproduction of cattle during very dry seasons becomes abnormally low. These changes in genital physiology have been associated with nutrition deficiencies (Theiler, Green, and du Toit, 1928; du Toit and Bisschop, 1929). In South Africa there is a general phosphorus deficiency in the veld and during the winter months, over a large part of the country, a protein and carbohydrate deficiency exists in addition.

Anderson, 1936, has found that cattle grazed on a pasture low in phosphorus, protein, ash and chlorine, with a seasonal variation of these nutritional constituents, showed no genital response to the changing nutriment. The changes in the ovarian cycle which were observed appear to be seasonal rather than nutritional. He points out, however, that there was no check on the amount of pasture consumed so that the method of correlating seasonal variation in the ovarian cycle with seasonal variation in the nutrient constituents will not lead to useful results.

Anderson, 1936, again discusses climatic factors which may be associated with genital changes in cattle in Kenya. He states that rain-fall and temperature do not appear to influence the periodicity and duration of oestrus in Zebu cattle. It is indicated, however, that the question of light, as a factor which may influence the ovarian cycle, is worthy of further investigation. These experiments were carried out almost on the equator. The observations of Quinlan and Roux, 1936, in connection with the influence of light would appear to indicate that the daily requirement of sunlight for normal sexual physiology of cattle is very short indeed. There was no significant difference in the groups of cattle restricted in sunlight as compared with those allowed several hours of exposure daily.

Marshall, 1937, says that in a large number of animals the influence of daylight appears to be an important factor in controlling the sexual cycle. In this respect, however, the ruminants are exceptional since if they react to light at all it appears to be to diminution rather than to increase.

Experimental Observations.

The experimental calves were the progeny of a pure-bred Sussex bull mated with high-grade Sussex heifers. The basal-stock females were Africander type cows. The females in groups A and B were restricted in sunlight and exercise, while those in group C had no such restriction; the latter were allowed into a small kraal for several hours daily. All three groups were fed only dry rations. The group to which the dam of each heifer belonged is indicated in Table I. The calves were removed from their dams immediately after birth and were housed in a small cement-floored yard with a "lean-to" roof. They were allowed to suckle their dams thrice daily for the first month and thereafter twice daily, care being taken not to allow the calves too much milk, and to strip the udders of the cows by hand if necessary. The calves were put with their dams to suckle after the latter had consumed their concentrate rations. Teff hay and water were available to the calves during the day and, as deemed necessary, a small supplementary concentrate ration was fed. Feeding of concentrates was commenced about a month before weaning. They were weaned at about six months old when they weighed approximately 400 lb. The ration consisted of crushed yellow maize, 2 parts, and wheaten bran, 1 part, by weight. The commencing ration was 0·5 lb. per calf per day. The calves were weighed at monthly intervals. According to requirements the concentrate rations were increased at intervals by 0·5 lb. until the heifers received 2·5 lb. per head per day at the age of 18 months. The ration was fed according to requirements until the adults were consuming 4·5 lb. of the concentrate ration, and teff hay 25 to 30 lb. each per day. During three winter months, July, August and September, maize silage was fed in varying quantity, according to age, until the adults consumed 10 to 15 lb. *per capita per diem*. During this period the hay ration was reduced.

The concentrate ration was fed in equal feeds twice daily. Ensilage, when fed, was mixed with the concentrate. The hay was fed in hay racks. No minerals or mineral mixtures were fed during

the course of the observations. The heifers after weaning were driven to water twice daily, a distance of about 70 yards from their shed. The watering periods occupied about twenty minutes each. The exercise of the heifers was restricted as far as possible during the watering periods. It was estimated that they walked less than 300 yards daily.

Prior to being watered, the heifers were allowed into a yard, 13 by 38 yards, daily at 8.30 a.m. and 4.30 p.m. for observation on oestrus. Heifers showing oestrus were easily observed on being released from the shed. In most instances individuals showing oestrus tried to mount their comrades. During mounting clear mucus issued from the vulva. Prior to mounting the heifer depressed the back and stood alongside the heifer it intended to mount. The heifer showing oestrus, stood and allowed herself to be mounted by her comrades. Heifers in oestrus showed excitability and frequently bellowed. In some cases a mucous discharge was observed 36 to 48 hours prior to the onset of oestrus. Accurate observations were not made to determine the duration of oestrus, but it had usually disappeared inside 24 hours. Menstruation sometimes followed oestrus within 38 to 48 hours, but it was not consistently present in the heifers. Annual tests were done for contagious abortion and tuberculosis with negative results. Vaccinations against anthrax and blackleg were carried out annually. Dipping, as a preventive against tick infestation, was carried out as a routine measure during the summer months at intervals of approximately four weeks: For this purpose a 14-day arsenite of soda dip was used. It was found necessary to trim the hoofs of the adults at intervals. All the cattle were weighed at birth and at monthly intervals following.

Table I shows the group of the dam, the date of birth, the age at first oestrus, the number of dioestrous cycles, the period between the appearance of first and final oestrus, the average duration of all dioestrous cycles, the average duration of all cycles between 14 and 27 days, and the average duration of all cycles between 18 and 23 days.

Discussion.

The length of period from birth to 1st oestrus.—Age of sexual maturity.

The average length of the period from birth to the first oestrus for 28 heifers is 528·5 days. The spread about this mean shows a coefficient of variation of 20 per cent. The actual range of the length of the period is very great, from 297 to 688 days. Of the 28 experimental heifers, 16 were born in summer and 12 in winter. Sexual maturity was reached on an average of 553 days by those born in summer and on 496 days by those born in winter, a difference of 57 days in earlier maturity; a difference which is not significant.

Dam in Group.	D.O.B. No.	Born.	Age at 1st Oestrus. Days.	1936. April.	May.	June.	July.	August.	Sept.	October.
"A"	6358	6/10/34	583	—	11 26	14	4 24	12	2 22	13
"A"	6362	23/10/34	545	20	6 29	13 29	—	12 31	23	13
"A"	6363	25/10/34	564	—	11 31	21	11 31	20	10	1 21
"A"	6377	22/11/34	546	—	21	—	1 23	10 13	2 23	13
"A"	6452	7/ 6/35	514	—	—	—	—	—	—	—
"A"	6495	22/10/35	492	—	—	—	—	—	—	—
"A"	7045	17/12/35	554	—	—	—	—	—	—	—
"A"	7189	11/ 5/36	515	—	—	—	—	—	—	—
"A"	7277	27/10/36	457	—	—	—	—	—	—	—
"B"	6292	31/ 7/34	627	18	9 29	20	10 31	20	11	3 25
"B"	6423	13/ 5/35	477	—	—	—	—	—	1 22	13
"B"	6442	8/ 7/35	600	—	—	—	—	—	—	—
"B"	7172	10/ 4/36	540	—	—	—	—	—	—	—
"B"	7346	30/ 1/37	453	—	—	—	—	—	—	—
"C"	6496	22/10/35	466	—	—	—	—	—	—	—
"C"	7157	2/ 3/36	458	—	—	—	—	—	—	—
"C"	7271	14/10/36	427	—	—	—	—	—	—	—
"C"	7276	15/10/36	487	—	—	—	—	—	—	—
"C"	7269	5/10/36	541	—	—	—	—	—	—	—

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	D.O.B. No.	Born.	Age at 1st Oestrus. Days.	1932. May.	June.	July.	August.	Sept.	Oct.	Nov.
"A"	4610	21/ 7/31	344	—	29	—	—	—	—	—
"A"	5405	4/ 4/33	614	—	—	—	—	—	—	—
"B"	5289	16/ 1/33	680	—	—	—	—	—	—	—
"B"	5298	23/ 1/33	685	—	—	—	—	—	—	—
"B"	5299	23/ 1/33	679	—	—	—	—	—	—	—
"B"	5305	1/ 2/33	688	—	—	—	—	—	—	—
"B"	5419	8/ 6/33	639	—	—	—	—	—	—	—
"C"	4615	4/ 8/31	325	—	24	—	—	—	—	—
"C"	4616	5/ 8/31	297	28	15	5 27	14	3 22	—	—

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Table I.

Date of Subseqent Oestrus.

		1937.								
November.	Dec.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.
2 21	11 31	20	8 28	20	8 28	17	5 23	14	2 12	1 22
1 20	10 29	19 27	18	10 31	18	7 25	13	2 22	0 30	17
9 29	19	9 29	18	12	1 22	11	2 23	14	1 22	10 30
2 23	13	9 26	17	9 29	18	8 27	17	7 27	18	6 26
2 21	12	1 22	12	4 24	14	4 24	14	5 26	14	3 23
—	—	—	25	17	6 27	20	11	2 25	15	5 26
—	—	—	—	—	—	—	23	7 27	21	9
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
14	5	16	7 27	22	12	4 24	13	5 26	17	7 29
3 30	21	12	3 25	19	10	1 23	13	5 26	17	8 29
—	—	—	27	20	10	1 20	8 27	18	7 28	20
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	30	18	10 31	19	8 27	16	6 27	15	4 25
—	—	—	—	—	—	—	3 23	14	2 21	10 28
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—

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	1934.									
Dec.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	Oct.
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—

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1938.							Observation Period. Days.	All Periods. Average. Days.	14 to 27 Day Period. Average. Days.	18 to 23 Periods. Average. Days.
Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.				
1 21	9 29	—	6 25	11	3 24	11	700	19 (19·4)	19·5	19·6
7 28	15	5 24	14	4 23	15	7 27	737	20 (19·9)	19·6	19·9
21	10 29	20	8 26	14	7 29	16	705	20 (20·1)	20·1	20·1
16	4 25	14	3 20	12	4 24	11	690	20 (20·3)	20·3	20·3
15	4 22	11	1 22	12	5 27	17	531	20 (20·4)	20·4	20·4
18	8 30	21	10 30	21	12	5 28	427	21 (21·4)	21·4	21·2
2 22	11	2 21	10	1 21	17	5 28	309	21 (20·6)	20·6	20·5
8 29	20	11	1 19	9	2 22	14	188	21 (20·9)	20·9	20·9
—	—	—	27	14	7 31	20	83	21 (20·8)	20·8	19·7
18	7 27	19	7 16	7	1 25	12	724	21 (21·3)	21·0	20·9
19	9	1 22	10	1 21	16	6 27	603	22 (21·5)	21·5	21·3
27	15	6 29	19	6 27	16	6 28	425	21 (21·3)	20·4	20·6
2	10 30	20	8 29	18	11 31	19	199	22 (22·1)	20·0	20·0
—	—	—	—	—	—	28	—	—	—	—
14	4 24	11	2 21	10	2 25	13	438	20 (19·9)	19·9	20·0
17	7 25	14	2 21	10	3 24	13	314	20 (19·6)	19·6	19·6
—	—	15	4 21	8 26	18	6 25	131	19 (18·7)	18·7	19·0
—	—	—	—	14	7 26	15	60	20 (20·0)	20·0	20·0
—	—	—	—	—	30	20	21	21	—	—

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1935.							Observation Period. Days.	Average. Days.	Average. Days.	Average. Days.
Nov.	Dec.	Jan.	Feb.	March.	April.	May.				
—	—	—	—	—	—	—	—	—	—	—
—	9 28	20	—	9 23	—	—	104	26	18·7	21·0
27	18	12	1 22	14	—	—	107	21 (21·4)	21·4	20·5
—	9 31	21 19	10	2 24	—	—	105	21 (21·0)	21·0	21·0
—	3	26	16	7 24	—	—	111	28 (27·8)	19·0	20·0
—	21	10 28	16	13	—	—	82	21 (20·5)	20·5	19·0
—	—	—	—	9	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	117	20 (19·5)	19·5	19·5

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There is a striking difference in the length of the period of heifers born in different years, as shown by the following table of means:—

TABLE 2.

No. of Heifers.	Year of Birth.	Average length of period between birth and first oestrus.
6	1933	664 days.
5	1934	573 „
6	1935	577 „
7	1936	489 „
3	1931	322 „
1	1937	453 „

The significant difference between the average length of the period between birth and sexual maturity of the heifers born in different years is difficult to explain as the heifers were of the same breed and they were kept under similar environmental conditions throughout the course of the observations.

A factor taken into consideration was the rainfall during the years 1933 to 1937, but there was nothing significant to explain the difference. The heifers were the progeny of two bulls; one No. 4242, was used up to December, 1933, the other, No. 6021, subsequently. It was thought that there may perhaps be some hereditary factor, but this line of analysis was also without significance. The mean period for 10 heifers sired by bull No. 4242, was 557·80 days, that for 18 heifers sired by bull No. 6021 was 512·17 days.

It is impossible to draw any significant conclusions as to the influence of the month of birth, and season of the year on the age of sexual maturity as the numbers of heifers born in each month is insufficient.

There is also a difference in the age of sexual maturity of the heifers born from the groups A, B, and C as the following averages show:—

TABLE 3.

Group of Dam.	Number of Heifers.	Period between birth and first oestrus. Average days.	
A	11	520·7	561·7
B	10	606·8	
C	7	428·7	

As explained elsewhere in the text, there was no difference in the treatment of the heifers, but their mothers had somewhat different treatment. The cows in group B were mated six months later than groups A and C, while those in group C were unrestricted with regard to exercise and sunlight.

There is a significant difference between the age at sexual maturity of the heifers born from the cows restricted with regard to sunlight and exercise, namely groups A and B, and those which were in no way limited, group C. The actual difference is 133 days. This would appear to indicate that heifers born from cows with restricted sunlight and exercise matured considerably later than those from mothers having access to unlimited sunlight and which were exercised daily.

On analysing the figures carefully the apparent differences must be looked upon with some reserve. If the group means are taken it is seen that the difference between B and A is 86·1 days, but these two groups were similarly treated except that B was mated 6 months later than A. The difference between A and C is 92·0 days, while the difference between B and C is 178·1 days. The probability of the difference between A and B and B and C groups being due to chance would be 1 in 20, while it would be 1 in 100 in the case of groups B and C.

Length of the oestrous cycle.

The oestrous periods of each of 24 heifers were noted from the time of 1st oestrus until the heifer was removed to another experiment and placed in a different environment. The number of successive cycles recorded were as follows:—

TABLE 4.

Successive cycles.	Heifers.
1– 5	8
6–10	4
11–15	1
16–20	3
21–25	1
25–30	2
34–57	5
TOTAL	24

In all 384 cycles were recorded, but in one case an 18-day cycle has been combined with a 3-day cycle, immediately following, to make a 21-day cycle. Three hundred and eighty-three cycles have been analysed in detail.

Assuming that the normal length of an oestrous cycle ranges from 18 to 23 days, the details are summarised as follows:—

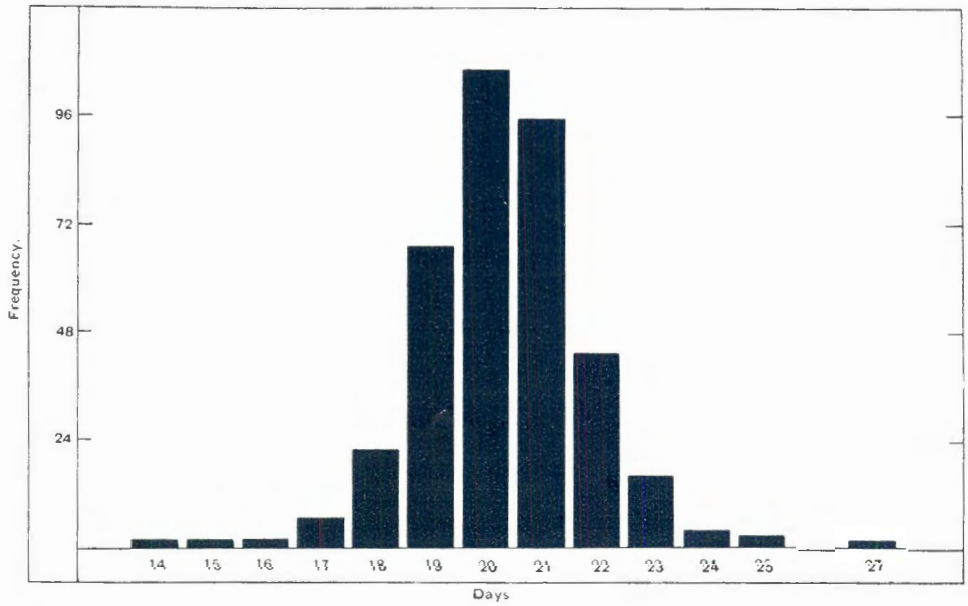
TABLE 5.

	Number.	Per cent. of Total.
Normal Cycles, 18 to 23 days.....	349	91·12
Abnormal Cycles—		
Short Cycles, 14 to 17 days.....13		3·39
Long Cycles, 24 to 27 days..... 9		2·35
Half Cycles, 8 to 10 days..... 4	34	1·04 } 8·88
Double Cycles, 37 to 48 days..... 7		1·83
Triple Cycles, 54 days..... 1		0·26
TOTAL.....	383	100

A half cycle of 8 to 10 days appears to arise at random without evidence of recurrent aberration. It may be preceded and followed by cycles of normal length. The same holds true for a double cycle in which case it seems as if the heifer merely skips an oestrous period, or, if ovulation actually occurs after the normal interval it is not accompanied by the usual psychological phenomena, hence the term " silent heat ". It may be worthy of note that 4 of the 7 double cycles occurred within three months of the commencement of the oestrous periods. The one 54 day cycle recorded is the very first dioestrous cycle of heifer No. 5299, Table I.

GRAPH 1.

Frequency Diagram of 371 Oestrous Cycles.



All observations—371: Mean=20·30 days: S.D.=1·63: Coef. of variation=8·04%.
Excluding periods <18 and> 23 days—349: Mean=20·34 days: S.D.=1·23: Coef. of variation=6·05 %.

The three types of cycles, i.e. half, double, and triple cycles, are so abnormal that they have been omitted from the following calculations.

From the frequency diagram (Graph I) it appears that the remaining 371 cycles are distributed about what must be considered a normal average of 20·3 days, with a standard deviation of 1·63 days, and hence a coefficient of variation equal to 8·04 per cent.

An elementary test of probability shows that a cycle of 14, 15, 26 and 27 days occur too infrequently in this distribution for it to be compatible with the assumption that it is normal.

The average duration of the oestrous cycle has been calculated for each heifer and is shown in Table I. The first column of averages gives the average of all cycles, abnormal as well as normal. The second column includes the average of cycles between 14 and 27 days, and the third column reflects the average of cycles falling within a period of 18 to 23 days.

The last column is decidedly less variable than the first, as may be expected, but it is nevertheless interesting to find that the average cycles are not the same for all the heifers. The graph (Graph 2) illustrates the length of successive cycles of two heifers Nos. 6292 and 6358.

The odds are against this difference being due to chance and, consequently, it is considered an individual factor.

Summary.

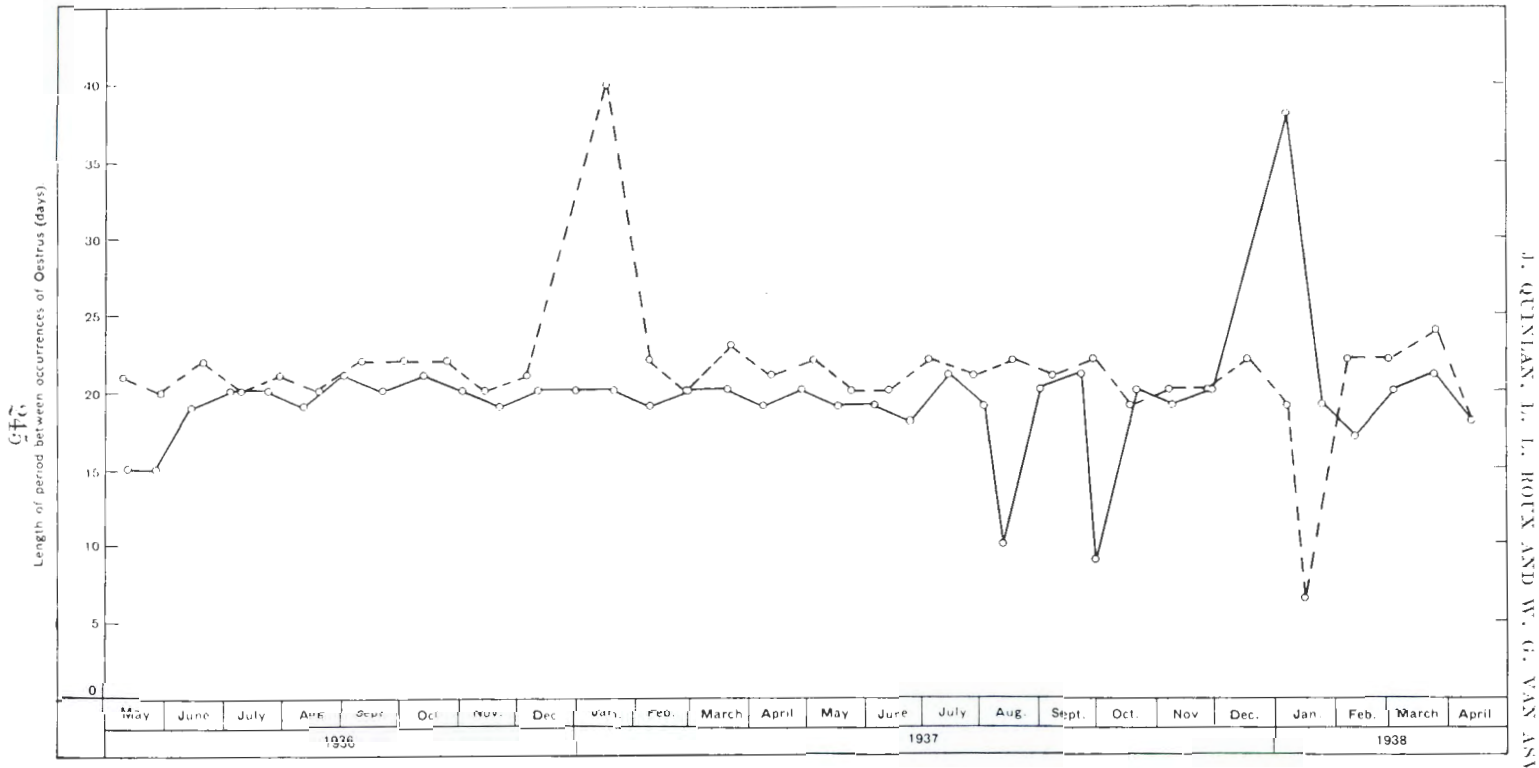
1. Twenty-eight high grade Sussex X Afrikander heifers, maintained in an artificial environment, enforcing dry rations and restricted exercise, have been observed regarding (1) the length of the period between birth and first oestrus, and (2) the length of the dioestrous cycle.

2. The average age at sexual maturity, or the appearance of the first oestrus, was 528·5 days. Sixteen heifers born during the warm season showed oestrus for the first time at an average age of 553 days. Twelve heifers born during the cold season showed the first oestrus at an average age of 496 days.

3. There was a striking difference in the age of sexual maturity of the heifers born in different years. This difference cannot be explained as all the heifers were kept under similar conditions. The influence of rainfall on sexual maturity was not significant, neither could hereditary influence be proved.

4. The heifers born from cows having access to unlimited sunlight and exercise showed the first oestrus on an average 133 days earlier than heifers whose mothers were kept with a minimum of sunlight and exercise. However, in view of the fact that there was a significant difference in the age of sexual maturity of the heifers born from two groups of cows with unlimited sunlight and exercise, one group of which was mated six months later than the other, the difference of 133 days must be taken with reserve.

Graph 2.



		C.V.
Heifer 6292 :	Average length of Oestrous Cycle = 21·0 days.	8·30 %
Heifer 6358 :	Average length of Oestrous Cycle = 19·5 days.	6·10 %
Difference	1·5 ± ·31	Sig. at P = ·01.

5. The average age of sexual maturity was, as a rule, much greater than that recorded in Europe and America.

6. The total number of dioestrous cycles recorded was 383. The average length of the dioestrous cycle was 20·3 days, with a range of 18 to 23 days for 349 cycles, or 91·12 per cent. of the total. There were 34 dioestrous cycles outside this range, or 8·88 per cent. These were considered abnormal cycles.

7. The length of the dioestrous cycle would appear to conform to that recorded in Europe and America.

8. There appears to be tendency to individual variation in the length of the dioestrous cycle in some cases.

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APPENDIX.

The accompanying photographs show the type of heifer on which the observations were carried out.

FIGURES 1-3. HEIFERS OF GROUP A COWS.

Fig. 1.—D.O.B. Nos. 6358, 6363, 6362. Photographed 3.9.38.

Fig. 2.—D.O.B. Nos. 7277, 7045, 7189. Photographed 3.9.38.

Fig. 3.—D.O.B. Nos. 6377, 6495, 6452. Photographed 3.9.38.

FIGURES 4-5. HEIFERS OF GROUP B COWS.

Fig. 4.—D.O.B. Nos. 6292, 6423, 6442. Photographed 3.9.38.

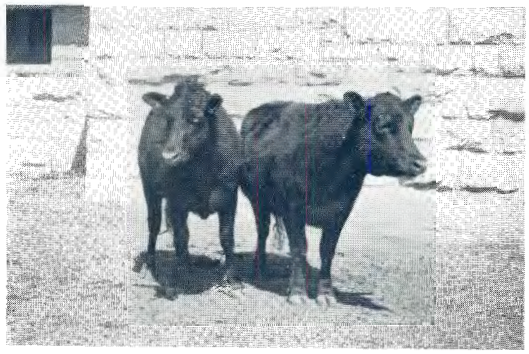

Fig. 5.—D.O.B. Nos. 7346, 7172. Photographed 3.9.38.

FIGURES 6-7. HEIFERS OF GROUP C COWS.

Fig. 6.—D.O.B. Nos. 6269, 7271, 7276. Photographed 3.9.38.

Fig. 7.—D.O.B. Nos. 7157, 6496. Photographed 3.9.38.