significant; F = 5·04 as compared with a value of 3·77 for a probability of one per cent. against the difference being due to experimental error. The breeds rank in the following descending order: Afrikander, Shorthorn, Hereford, Aberdeen-Angus and Sussex.

TABLE VIII.

Analysis of Variance of Height at Withers. Final Measurements. Half-bred Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	143·5273	—	—	—
	Between breeds	4	7·9556	1·98	—	—
	Within breeds..	59	135·5717	2·29	1·51	1·55
1930.....	Total.....	53	99·8330	—	—	—
	Between breeds	4	6·2819	1·57	—	—
	Within breeds..	49	93·5511	1·91	1·38	1·22
1929.....	Total.....	49	167·2621	—	—	—
	Between breeds	4	51·7701	12·94	—	—
	Within breeds..	45	115·4920	2·57	1·59	**5·04**

MEAN DIFFERENCES.

		Shorthorn.	Hereford.	Ab.-Angus.	Sussex.
1931.....	Not significant.				
1930.....	Not significant.				
1929.....	Afrikander.....	0·54±0·81	0·61±0·68	**2·36±0·66**	**2·83±0·72**
	Shorthorn.....	—	0·07±0·81	*1·82±0·77*	*2·29±0·84*
	Hereford.....	—	—	1·75±0·66	2·22±0·72
	Ab.-Angus.....	—	—	—	0·47±0·69

The first three breeds are significantly higher over the withers than the Aberdeen-Angus and Sussex. The differences between all other breeds are not significant.

Table IX shows the analysis of variance of height over hips. The breed differences prove to be highly significant in each age group, the corresponding values for F for the one per cent. point being 3·65, 3·72 and 3·77 as compared with 4·39, 3·68 and 5·47 for the three groups respectively.

Inspection of the mean differences between individual breeds indicates that the Afrikanders are significantly higher over the hips than the Aberdeen-Angus in all age groups. In the 1931 group the Afrikanders are also significantly higher than the Shorthorns; in the 1930 group they are significantly higher than the Herefords, and in the 1929 groups significantly higher than the Sussex. In the 1931 group both Sussex and Herefords are signifiacntly higher than the Aberdeen-Angus and in the 1929 group the Herefords and the Shorthorns are significantly higher than the Aberdeen-Angus. In each case the Afrikanders show the greatest height over hips and the Aberdeen-Angus the least height except in the 1930 group where the Herefords show a slightly lower figure than the Aberdeen-Angus.

The other breeds occupy intermediate positions and show no consistency in their ranking with respect to each other from one age group to the next.

TABLE IX.

Analysis of Variance of Height over Hips. Final Measurement. Half-bred Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	186·4131	—	—	—
	Between breeds	4	42·8085	10·70	—	**4·39**
	Within breeds..	59	143·6046	2·43	1·56	—
1930.....	Total.....	53	125·1861	—	—	—
	Between breeds	4	28·9496	7·24	—	**3·68**
	Within breeds..	49	96·2365	1·96	1·40	—
1929.....	Total.....	49	163·7089	—	—	—
	Between breeds	4	53·5725	12·39	—	**5·47**
	Within breeds..	45	110·1364	2·45	1·56	—

MEAN DIFFERENCES.

		Sussex.	Hereford.	Shorthorn.	Ab.-Angus.
1931.....	Afrikander.....	0·43±0·56	0·68±0·60	*1·40±0·67*	**2·22±0·59**
	Sussex.....	—	0·25±0·60	0·97±0·64	**1·79±0·56**
	Hereford.....	—	—	0·72±0·67	*1·54±0·60*
	Shorthorn.....	—	—	—	0·82±0·67
		Shorthorn.	**Sussex.**	**Ab.-Angus.**	**Hereford.**
1930.....	Afrikander.....	0·59±0·60	0·80±0·58	*1·16±0·54*	*1·25±0·62*
	Shorthorn.....	—	0·21±0·64	0·57±0·61	0·66±0·68
	Sussex.....	—	—	0·36±0·57	0·45±0·66
	Ab.-Angus.....	—	—	—	0·09±0·63
		Hereford.	**Shorthorn.**	**Sussex.**	**Ab.-Angus.**
1929.....	Afrikander.....	0·82±0·67	1·00±0·79	**2·08±0·70**	**2·75±0·64**
	Hereford.....	—	0·18±0·79	1·26±0·70	**1·93±0·64**
	Shorthorn.....	—	—	1·08±0·82	*1·75±0·76*
	Sussex.....	—	—	—	0·67±0·68

It should be noted that the relative positions of the breeds in respect to height over hips are very similar to those for height at withers.

Inspection of Table X shows that the differences in body length between breeds is significant only in the 1929 group, although the values of F in the other groups approach significance. Referring to the mean differences between individual breeds in the lower part of the table it is quite apparent that the high value obtained for F in the 1929 group is due entirely to the exceptionally great length of

body of the Herefords as compared with the other breeds, the former being significantly longer than all other breeds. The differences between all other breeds are not statistically significant.

TABLE X.

Analysis of Variance of Body Length.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	234·0000	—	—	—
	Between breeds	4	26·2691	6·56	—	1·86
	Within breeds..	59	207·7309	3·52	1·88	—
1930.....	Total.....	53	225·2697	—	—	—
	Between breeds	4	30·9083	7·72	—	1·95
	Within breeds..	49	194·3614	3·96	1·99	—
1929.....	Total.....	49	283·9293	—	—	—
	Between breeds	4	60·0425	15·01	—	**3·03**
	Within breeds..	45	223·8868	4·97	2·23	—

MEAN DIFFERENCES.

		Ab.-Angus.	Shorthorn.	Afrikander.	Sussex.
1931.....	Not significant.				
1930.....	Not significant.				
1929.....	Hereford.....	*2·49±0·91*	*2·76±1·13*	**3·18±0·95**	**3·21±1·00**
	Ab.-Angus.....	—	0·27±0·08	0·69±0·91	0·72±0·97
	Shorthorn.....	—	—	0·42±1·13	0·45±1·17
	Afrikander.....	—	—	—	0·03±1·00

TABLE XI.

Analysis of Variance of Depth of Chest.

Final Measurement of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	37·9975	—	—	—
	Between breeds	4	5·4957	1·37	—	*2·49*
	Within breeds..	59	32·5018	0·55	0·74	—
1930.....	Total.....	53	44·2276	—	—	—
	Between breeds	4	8·9663	2·24	—	**3·11**
	Within breeds..	49	35·2615	0·72	0·84	—
1929.....	Total.....	49	44·9962	—	—	—
	Between breeds	4	8·7931	2·19	—	*2·73*
	Within breeds..	45	36·2031	0·80	0·89	—

TABLE XI (*cont.*).

MEAN DIFFERENCES.

		Hereford.	Ab.-Angus.	Shorthorn.	Afrikander.
1931.....	Sussex.....	0·12±0·29	0·42±0·27	0·53±0·30	**0·77±0·27**
	Hereford.....	—	0·30±0·28	0·41±0·32	*0·65±0·28*
	Ab.-Angus.....	—	—	0·11±0·32	0·35±0·28
	Shorthorn.....	—	—	—	0·24±0·32
		Hereford.	Ab.-Angus.	Shorthorn.	Afrikander.
1930.....	Sussex.....	0·44±0·40	*0·74±0·35*	**1·11±0·39**	**1·14±0·35**
	Hereford.....	—	0·30±0·38	0·67±0·41	0·70±0·37
	Ab.-Angus.....	—	—	0·37±0·37	0·40±0·33
	Shorthorn.....	—	—	—	0·03±0·36
		Afrikander.	Shorthorn.	Ab.-Angus.	Sussex.
1929.....	Hereford.....	0·55±0·38	0·80±0·45	*0·84±0·36*	**1·30±0·40**
	Afrikander.....	—	0·25±0·45	0·29±0·37	0·75±0·40
	Shorthorn.....	—	—	0·04±0·43	0·50±0·47
	Ab.-Angus.....	—	—	—	0·46±0·39

TABLE XII.

Analysis of Variance of Width of Chest.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	38·7956	—	—	—
	Between breeds	4	6·3735	1·59	—	*2·90*
	Within breeds..	59	32·4221	0·55	0·73	—
1930.....	Total.....	53	33·4253	—	—	—
	Between breeds	4	3·4735	0·87	—	1·42
	Within breeds..	49	29·9518	0·61	0·78	—
1929.....	Total.....	49	37·3113	—	—	—
	Between breeds	4	7·2418	1·81	—	*2·71*
	Within breeds..	45	30·0695	0·67	0·82	—

MEAN DIFFERENCES.

		Hereford.	Afrikander.	Ab.-Angus.	Shorthorn.
1931.....	Sussex.....	0·16±0·31	*0·54±0·26*	*0·56±0·26*	*0·78±0·30*
	Hereford.....	—	0·38±0·28	0·40±0·28	0·62±0·31
	Afrikander.....	—	—	0·02±0·28	0·24±0·31
	Ab.-Angus.....	—	—	—	0·22±0·26
1930.....	Not significant.				
		Afrikander.	Ab.-Angus.	Shorthorn.	Sussex.
1929.....	Hereford.....	0·64±0·35	*0·83±0·33*	*1·08±0·41*	**1·16±0·36**
	Afrikander.....	—	0·19±0·33	0·44±0·41	0·52±0·37
	Ab.-Angus.....	—	—	0·25±0·39	0·33±0·35
	Shorthorn.....	—	—	—	0·08±0·43

TABLE XIII.

Analysis of Variance of Heart Girth.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	296·4961	—	—	—
	Between breeds	4	45·9354	11·48	—	*2·70*
	Within breeds..	59	250·5604	4·25	2·06	—
1930.....	Total.....	53	369·3750	—	—	—
	Between breeds	4	52·7218	13·18	—	2·04
	Within breeds..	49	316·6532	6·46	2·54	—
1929.....	Total.....	49	290·4250	—	—	—
	Between breeds	4	51·6708	12·92	—	*2·43*
	Within breeds..	45	238·7542	5·31	2·30	—

MEAN DIFFERENCES.

		Sussex.	Ab.-Angus.	Shorthorn.	Afrikander.
1931.....	Hereford.....	0·23±0·80	1·48±0·79	*1·89±0·89*	*2·05±0·79*
	Sussex.....	—	1·25±0·74	1·66±0·85	*1·82±0·74*
	Ab.-Angus.....	—	—	0·41±0·88	0·57±0·78
	Shorthorn.....	—	—	—	0·16±0·88
1930.....	Not significant.				
		Shorthorn.	Afrikander.	Ab.-Angus.	Sussex.
1929.....	Hereford.....	1·69±1·17	1·72±0·98	*2·42±0·94*	*2·83±1·03*
	Shorthorn.....	—	0·03±1·17	0·73±1·11	1·14±1·21
	Afrikander.....	—	—	0·70±0·94	1·11±1·03
	Ab.-Angus.....	—	—	—	0·41±0·99

Tables XI to XIII show the differences in chest measurements between breeds. The values of F for depth of chest are significant for all age groups (Table XI). The mean differences in the 1931 group show a significant value only between the Sussex and the Afrikanders in favour of the former breed. In the 1930 group the Sussex are again significantly deeper in the chest than the Afrikanders. In addition, the Sussex also prove significantly deeper than both Aberdeen-Angus and Shorthorns. Other mean differences are not significant. In the 1929 group the only significant differences are those between the Herefords on the one hand and the Aberdeen-Angus and Sussex on the other hand, in favour of the former.

In width of chest the variance between breeds is significant for the 1931 and 1929 groups (Table XII). In the former the mean differences are significant between the Sussex on the one hand and the Afrikanders, Aberdeen-Angus and Shorthorns on the other. In the 1929 group the Herefords are significantly deeper than the Aberdeen-Angus, Shorthorns and Sussex. Other mean differences are not significant.

In heart girth the variance between breeds is significant in the 1931 and the 1932 groups (Table XIII). On analysis the mean differences show that in the former age group the measurements of the Herefords are significantly greater than those of the Shorthorns and Afrikanders. In the latter age group the Herefords exceed the Aberdeen-Angus and Sussex in a significant degree. The mean differences between other breeds are not significant.

TABLE XIV.

Analysis of Variance of Width of Loin.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	21·9678	—	—	—
	Between breeds	4	4·4647	1·12	—	**3·76**
	Within breeds..	59	17·5031	0·30	0·54	—
1930.....	Total.....	53	26·6309	—	—	—
	Between breeds	4	9·8736	2·47	—	**7·22**
	Within breeds..	49	16·7573	0·34	0·58	—
1929.....	Total.....	49	27·8263	—	—	—
	Between breeds	4	10·6203	2·65	—	**6·94**
	Within breeds..	45	17·2060	0·38	0·62	—

MEAN DIFFERENCES.

		Shorthorn.	Hereford.	Ab.-Angus.	Afrikander.
1931.....	Sussex.....	0·40±0·22	*0·54±0·21*	*0·54±0·20*	*0·74±0·20*
	Shorthorn.....	—	0·14±0·23	0· 4±0·23	0·34±0·23
	Hereford.....	—	—	0·00	0·20±0·21
	Ab.-Angus.....	—	—	—	0·20±0·21
		Ab.-Angus.	**Shorthorn.**	**Hereford.**	**Afrikander.**
1930.....	Sussex.....	**0·69±0·24**	**0·72±0·27**	**0·75±0·28**	**1·23±0·24**
	Shorthorn.....	—	0·03±0·25	0·06±0·26	*0·54±0·22*
	Hereford.....	—	—	0·03±0·28	0·51±0·25
	Ab.-Angus.....	—	—	—	0·48±0·26
		Sussex.	**Ab.-Angus.**	**Shorthorn.**	**Afrikander.**
1929.....	Hereford.....	0·38±0·28	*0·65±0·25*	*0·84±0·31*	**1·35±0·26**
	Sussex.....	—	0·27±0·27	0·46±0·32	**0·97±0·28**
	Ab.-Angus.....	—	—	0·19±0·30	**0·70±0·25**
	Shorthorn.....	—	—	—	0·51±0·31

It will be noted that the breeds do not maintain the same relative positions to each other in the three age groups in respect of chest measurements. In the 1931 and 1930 groups the Herefords and Sussex show the highest values for each of these measurements while

in the 1929 (oldest) group the Sussex have the smallest values for these measurements. A possible explanation for this inconsistency in the behaviour of the Sussex may be sought in a differential growth rate at different ages. This view is supported by the fact that the Sussex showed the second highest average depth of chest and heart girth, in the initial measurements of the 1929 group at the age of 20 months as compared with the highest and second highest averages respectively at the same age in the 1930 and 1931 groups. Similarly in width of chest the average initial measurement of the animals of this breed are midway between those of the other breeds and only slightly below that of the Herefords.

TABLE XV.

Analysis of Variance of Width at Hooks.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	23·8302	—	—	—
	Between breeds	4	8·3190	2·08	—	**7·91**
	Within breeds..	59	15·5112	0·25	0·50	—
1930.....	Total.....	53	62·9503	—	—	—
	Between breeds	4	21·8905	5·47	—	**6·53**
	Within breeds..	49	41·0598	0·84	0·91	—
1929.....	Total.....	49	54·7513	—	—	—
	Between breeds	4	37·0389	9·26	—	**23·52**
	Within breeds..	45	17·7124	0·39	0·63	—

MEAN DIFFERENCES.

		Hereford.	Ab.-Angus.	Shorthorn.	Afrikander.
1931.....	Sussex.....	0·17±0·19	**0·54±0·18**	**0·64±0·21**	**1·74±0·18**
	Hereford.....	—	0·37±0·19	*0·47±0·22*	**1·57±0·19**
	Ab.-Angus.....	—	—	0·10±0·21	**1·20±0·19**
	Shorthorn.....	—	—	—	**1·10±0·21**
		Shorthorn.	Hereford.	Ab.-Angus.	Afrikander.
1930.....	Sussex.....	0·13±0·42	0·14±0·43	0·20±0·37	**1·52±0·38**
	Shorthorn.....	—	0·01±0·44	0·07±0·40	**1·39±0·39**
	Hereford.....	—	—	0·06±0·41	**1·38±0·40**
	Ab.-Angus.....	—	—	—	**1·32±0·35**
		Sussex.	Shorthorn.	Ab.-Angus.	Afrikander.
1929.....	Hereford.....	**0·81±0·28**	**0·98±0·32**	**1·54±0·26**	**2·41±0·27**
	Sussex.....	—	0·17±0·33	**0·73±0·27**	**1·60±0·28**
	Shorthorn.....	—	—	0·56±0·30	**1·43±0·32**
	Ab.-Angus.....	—	—	—	**0·87±0·26**

TABLE XVI.

Analysis of Variance of Width at Thurls.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	36·9961	—	—	—
	Between breeds	4	8·8739	2·22	—	**4·65**
	Within breeds..	59	28·1222	0·48	0·68	—
1930.....	Total.....	53	25·0834	—	—	—
	Between breeds	4	8·9401	2·23	—	**6·78**
	Within breeds..	49	16·1433	0·33	0·57	—
1929.....	Total.....	49	34·4108	—	—	—
	Between breeds	4	16·3589	4·09	—	**10·20**
	Within breeds..	45	18·0519	0·40	0·63	—

MEAN DIFFERENCES.

		Sussex.	Shorthorn.	Ab.-Angus.	Afrikander.
1931.....	Hereford.....	0·17±0·26	0·50±0·29	*0·66±0·26*	**0·73±0·26**
	Sussex.....	—	0·33±0·28	0·49±0·25	*0·56±0·25*
	Shorthorn.....	—	—	0·16±0·29	0·23±0·29
	Ab.-Angus.....	—	—	—	0·07±0·26
		Shorthorn.	Hereford.	Ab.-Angus.	Afrikander.
1930.....	Sussex.....	0·10±0·26	0·13±0·27	0·44±0·23	**0·91±0·24**
	Shorthorn.....	—	0·03±0·28	0·34±0·25	**0·81±0·24**
	Hereford.....	—	—	0·31±0·26	**0·78±0·25**
	Ab.-Angus.....	—	—	—	*0·47±0·22*
		Sussex.	Shorthorn.	Ab.-Angus.	Afrikander.
1929.....	Hereford.....	**1·25±0·28**	**1·28±0·32**	**1·36±0·26**	**1·52±0·28**
	Sussex.....	—	0·03±0·33	0·11±0·27	0·27±0·28
	Shorthorn.....	—	—	0·08±0·31	0·24±0·32
	Ab.-Angus.....	—	—	—	0·16±0·26

The measurements of width in the hindquarter are analyzed in Tables XIV to XVI. The following measurements are included: width of loin, width of thurls and width at hooks.

In width of loin (Table XIV) the variance between breeds is highly significant for all age groups. In the 1931 group the Sussex exceed the Hereford, Aberdeen-Angus and Afrikanders in a significant degree. In the 1930 group this breed exceeds all other breeds, the differences being highly significant. In this group the Afrikanders also prove to be significantly narrower in the loin than the Aberdeen-Angus and Shorthorns. Likewise, in the 1929 group the Afrikanders are significantly smaller in the loin than all other breeds except the Shorthorns. In this age group the Herefords also exceed the Aberdeen-Angus and Shorthorns in a significant degree.

In width at hooks the breed differences are also highly significant for all age groups. In each group the Afrikanders show significantly smaller figures than all other breeds. In the 1931 group the figures for the Sussex and Herefords are significantly higher than those of the Shorthorn. In addition, the Sussex exceed the Aberdeen-Angus to a significant extent. In the 1929 group the Herefords and Sussex also exceed the Aberdeen-Angus and in addition the Herefords exceed the Sussex and Shorthorn.

In width at thurls (Table XVI) the Herefords exceed the Afrikanders in all age groups. In the 1931 group they also exceed the Aberdeen-Angus while the Afrikanders are exceeded by the Sussex. In the 1930 group the Afrikanders are exceeded by all groups in a highly significant degree. In the 1929 group the figure for the Herefords is significantly higher than those for all other breeds.

It will be noted that the respective values of F are exceptionally large for all three measurements. This is largely the result of the large mean differences between the Herefords and Sussex at the one extreme and the Afrikanders at the other extreme. The other breeds fall between these extremes and the mean differences between these are small and mostly insignificant.

TABLE XVII.

Analysis of Variance of Depth of Flank.
Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	48·0933	—	—	—
	Between breeds	4	9·7578	2·44	—	**3·75**
	Within breeds..	59	38·3355	0·65	0·81	—
1930.....	Total.....	53	66·0429	—	—	—
	Between breeds	4	5·8912	1·47	—	1·20
	Within breeds..	49	60·1517	1·23	1·11	—
1929.....	Total.....	49	49·7200	—	—	—
	Between breeds	5	20·7804	5·19	—	**7·62**
	Within breeds..	45	28·9396	0·65	0·81	—

MEAN DIFFERENCES.

		Afrikander.	Sussex.	Shorthorn.	Ab.-Angus.
1931.....	Hereford.....	0·03±0·31	0·17±0·31	*0·86±0·35*	*0·89±0·31*
	Afrikander.....	—	0·14±0·29	*0·83±0·34*	*0·86±0·30*
	Sussex.....	—	—	*0·69±0·33*	*0·72±0·29*
	Shorthorn.....	—	—	—	0·03±0·34
1930.....	Not significant.				
		Hereford.	Shorthorn.	Sussex.	Ab.-Angus.
1929.....	Afrikander.....	0·41±0·36	**1·24±0·41**	**1·49±0·36**	**1·55±0·33**
	Hereford.....	—	*0·83±0·40*	**1·08±0·36**	**1·14±0·33**
	Shorthorn.....	—	—	0·25±0·42	0·31±0·39
	Sussex.....	—	—	—	0·06±0·33

Referring to Tables XVII and XVIII it is seen that the mean differences between breeds in the 1931 group are significant for depth of flank (Table XVII) but not significant for flank girth (Table XVIII). In the case of the former measurement the Herefords, Afrikanders and Sussex are significantly deeper than the Shorthorns and Aberdeen-Angus.

In the 1930 group the differences are not significant for either measurement. In the 1929 groups the figure for the Herefords is significantly higher than all other breeds in respect of flank girth, and significantly higher than those of the Shorthorns, Sussex and Aberdeen-Angus in respect of depth of flank. The Afrikanders rank second in flank girth and first in depth of flank. In the latter this breed exceeds all breeds, except the Herefords, in a significant degree.

TABLE XVIII.

Analysis of Variance of Flank Girth.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	414·7874	—	—	—
	Between breeds	4	53·6898	13·42	—	2·19
	Within breeds..	59	361·0976	6·12	2·44	—
1930.....	Total.....	53	476·0787	—	—	—
	Between breeds	4	22·1710	5·54	—	1·67
	Within breeds..	49	453·9077	9·26	3·04	—
1929.....	Total.....	49	190·3800	—	—	—
	Between breeds	4	66·0583	16·51	—	**5·98**
	Within breeds..	45	124·3217	2·76	1·72	—

MEAN DIFFERENCES.

		Afrikander.	Ab.-Angus.	Shorthorn.	Sussex.
1931.....	Not significant.				
1930.....	Not significant.				
1929.....	Hereford.....	**2·14±0·73**	**2·87±0·70**	**2·91±0·87**	**2·91±0·77**
	Afrikander.....	—	0·73±0·70	0·77±0·87	0·77±0·77
	Ab.-Angus.....	—	—	0·04±0·83	0·04±0·74
	Shorthorn.....	—	—	—	0·00

In length of pelvis (Table XIX) only the 1929 group shows significant mean differences. The value of F = 9·575 is very highly significant but the heterogeneity is largely due to the high figure for the Herefords. The mean differences between this and all other breeds are highly significant. The mean difference between Shorthorns and Sussex is also significant.

The Afrikanders show the smallest values in conformity with the other measurements of the hindquarter.

Table XX shows the analysis of variance of paunch girth. The mean differences between breeds are not significant for the 1931 and 1930 groups. In the 1929 groups only the Herefords exhibit a significantly higher figure than the other breeds except the Sussex.

The relatively large standard deviations indicate that there is great variation within the breeds. It should be noted that in the case of the 1930 group the variance within breeds is greater than that between breeds although not significantly so.

The results obtained by analysis of variance of all body measurements are interpreted to show that the breeds used in this experiment may be variously grouped into two categories depending upon the measurements involved.

TABLE XIX.

Analysis of Variance of Length of Pelvis.

Final Measurements. Half-bred Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	24·9990	—	—	—
	Between breeds	4	2·7824	0·69	—	1·85
	Within breeds..	59	22·2166	0·37	0·61	—
1930.....	Total.....	53	28·3304	—	—	—
	Between breeds	4	3·5803	0·89	—	1·77
	Within breeds..	49	24·7501	0·50	0·71	—
1929.....	Total.....	49	31·0313	—	—	—
	Between breeds	4	14·2792	3·56	—	**9·57**
	Within breeds..	45	16·7521	0·37	0·60	—

MEAN DIFFERENCES.

1931.....	Not significant.				
1930.....	Not significant.				
		Shorthorn.	Ab.-Angus.	Afrikander.	Sussex.
1929.....	Hereford.....	*0·74±0·30*	**1·21±0·25**	**1·25±0·26**	**1·44±0·27**
	Shorthorn.....	—	0·47±0·29	0·51±0·30	*0·70±0·32*
	Ab.-Angus.....	—	—	0·04±0·25	0·23±0·26
	Afrikander.....	—	—	—	0·19±0·27

In height at withers and height over hips the Afrikanders consistently show the highest figures and the Aberdeen-Angus the lowest. The other breeds fall somewhere in between with no consistent order. However, the Shorthorns and Herefords rank closer to the Afrikanders, while the Sussex are more nearly of the same size as the Aberdeen Angus.

TABLE XX.

Analysis of Variance of Paunch Girth.

Final Measurements of Steers.

Group.	Source of Variation.	Degrees of Freedom.	Sums of Squares.	Mean Squares.	Standard Deviation.	F.
1931.....	Total.....	63	592·7109	—	—	—
	Between breeds	4	88·2303	22·06	—	—
	Within breeds..	59	504·4606	8·55	2·92	2·58
1930.....	Total.....	53	562·2593	—	—	—
	Between breeds	4	16·7879	4·19	—	—
	Within breeds..	49	545·4714	11·13	3·33	2·65
1929.....	Total.....	49	331·1300	—	—	—
	Between breeds	4	91·1301	22·78	—	—
	Within breeds..	45	240·9990	5·33	2·31	**4·27**

MEAN DIFFERENCES.

		Sussex.	Afrikander.	Shorthorn.	Ab.-Angus.
1931.....	Not significant.				
1930.....	Not significant.				
1929.....	Hereford.....	2·01±1·04	*2·28±0·98*	*2·56±1·17*	**3·88±0·94**
	Sussex.....	—	0·27±1·04	0·55±1·22	1·87±1·06
	Afrikander.....	—	—	0·28±1·17	1·60±0·94
	Shorthorn.....	—	—	—	1·32±1·12

In chest measurements the Herefords and Sussex are at the one extreme and the Aberdeen-Angus, Shorthorns and Afrikanders at the other. However, with increasing age the Sussex lag behind and are overtaken by the other breeds, the Herefords maintaining the lead.

In development of hindquarter, the Herefords, Sussex and Shorthorns fall into one class and the Aberdeen-Angus and Afrikanders into the second. In flank measurements the Afrikanders again show high values and are grouped with the Herefords while the other breeds constitute the second group with appreciably lower values.

The tendency to develop a hump coupled with a relatively drooping rump with a consequent prominence in the sacral region, accounts for the high over-all relative height in the Afrikander. Apart from this exception, however, the sum total of all other measurements shows that the Afrikander and Aberdeen-Angus half-breds are significantly smaller in body build than the Herefords and Sussex. The Shorthorn, which is considered the largest and heaviest among the beef breeds falls between these two groups.

Table XXI.

Mean Differences in Body Measurements between Males and Females at the age of 14 months.
(Excess in favour of Males.)

Inches.

Group.	Height at Withers.	Height over Hips.	Depth of Chest.	Width of Chest.	Length of Pelvis.	Width of Hooks.	Width of Loin.	Heart Girth.	Length of Body.
1931 (Measured May, 1933).....	2·23 (±1·51)	0·97 (±1·56)	1·07 (±0·74)	0·58 (±0·73)	0·65 (±0·61)	0·83 (±0·50)	2·22 (±0·54)	0·23 (±2·06)	1·11 (±1·88)
1930 (Measured January, 1933).....	2·83 (±1·38)	2·93 (±1·40)	1·10 (±0·85)	0·06 (±0·78)	0·56 (±0·71)	−0·48 (±0·91)	2·09 (±0·58)	−0·15 (±2·54)	1·97 (±1·99)
1929 (Measured January, 1933).....	4·27 (±1·59)	4·40 (±1·56)	2·59 (±0·89)	1·42 (±0·82)	1·15 (±0·60)	0·70 (±0·63)	7·18 (±0·62)	0·60 (±2·30)	4·22 (±2·23)

Table XXII.

Analysis of Variance of Height at Withers, Height over Hips, Depth of Chest and Paunch Girth of 1929 Heifers at 44 months of age.

Body Measurement.	Source of Variation.	Degrees of Freedom.	Sum of Squares.	Mean Squares.	Standard Deviation.	F.	Standard Deviations for Steers.
Height at Withers.....	Total.....	46	108·0950	—	—	—	—
	Between breeds.....	4	13·3221	3·33	—	—	—
	Within breeds.....	42	94·7729	2·25	1·50	1·21	1·59
Height over hips.....	Total.....	46	12·6876	—	—	—	—
	Between breeds.....	4	3·4196	0·85	—	—	—
	Within breeds.....	42	9·2680	0·22	0·47	**3·87**	1·56
Depth of Chest.....	Total.....	46	45·4557	—	—	—	—
	Between breeds.....	4	1·8696	0·47	—	—	—
	Within breeds.....	42	43·5861	1·04	1·02	2·22	0·89
Width of chest.....	Total.....	46	64·4894	—	—	—	—
	Between breeds.....	4	7·6151	1·90	—	—	—
	Within breeds.....	42	56·8743	1·35	1·16	1·41	0·82
Paunch girth.....	Total.....	46	530·9401	—	—	—	—
	Between breeds.....	4	87·7670	21·94	—	—	—
	Within breeds.....	42	443·1731	10·55	3·25	2·08	2·31

Sex Differences.

In view of the fact that comparable measurements are not available for the females it is not possible to determine accurately sex differences for the various body measurements. However, it is possible to compare the means of the sexes for the dates on which final measurements were taken on the heifers. Such comparison is necessarily unsatisfactory but it will serve to furnish some idea of sex differences in body shape. In the following table mean differences between males and females are given for the most important measurements on a specified date. Standard errors of mean differences have not been calculated but the standard deviations obtained for corresponding final measurements of all steers are indicated in brackets.

It will be seen from Table XXI that the steers exceed the heifers in body measurements in all three age groups. The sex differences are greatest in the following measurements: Height at withers, height over hips, width of loin and body length; and least in length of pelvis, width at hooks and heart girth. Although the differences are relatively small in certain measurements, they are consistent throughout except in the case of width at hooks and heart girth in which the females exceed the males at certain stages of development. It is, of course, a well-known phenomenon in cattle as well as in some other species of farm animals that development of the pelvic region relative to the other body parts is greater in the female than in the male.

It would appear that the females of the same breed are less uniform in shape of body than the males of such breeds but the breed averages do not vary greatly. In order to test this point five measurements for which the 1929 groups of steers show highly significant breed differences were selected and analyzed for the 1929 females. The latter, however, were four months younger than the steers when these measurements were taken.

In the last column of Table XXII the standard deviations of the same measurements for the 1929 steers are indicated. It will be observed that the standard deviations of the chest measurements and paunch girth are greater for the females. That for height at withers is equal to that of the males while in height over hips the females show a comparatively small standard deviation.

In comparing the values of F it is observed that in the case of height over hips only is the figure significant as compared with highly significant figures for all five measurements in the case of the steers. Hence it is concluded on the basis of these five body measurements that there is less difference between breeds in the females than there is in the males.

It should be pointed out that the figures used for the females in this analysis are those obtained from the measurements taken in January 1933, at the termination of nine months lactation. If the above body measurements are affected to any extent in the growing animal by lactation, it is possible that the differences between Herefords and Aberdeen-Angus are minimized since a higher percentage of the animals in the former breed passed through a period of lactation. Conversely, the differences between the Afrikanders, on the

one hand, and the Shorthorns and Sussex, on the other, might be exaggerated in view of the higher calving percentage among the former. On the average, however, it is not expected that the means of the females as a whole are greatly influenced by the differential calving rate.

GENERAL DISCUSSION.

The results obtained from the analysis of both live weights and body measurements tend to show that there are significant differences in growth and development between the breeds studied. The breeds may be divided into two groups, the first comprising Herefords and Sussex showing more rapid growth in all respects, except in over-all height, than the second group consisting of Aberdeen-Angus and Afrikanders. The Shorthorns occupy an intermediate position which is rather surprising and difficult to explain since the purebred Shorthorn is considered one of the most early maturing and largest of all beef breeds. In his study of the weights of bulls, steers and heifers of the various beef breeds, Hammond (1920) found that Shorthorns were appreciably heavier than Herefords, Sussex or Aberdeen-Angus. There is no basis of comparison available for the Afrikander but this breed is generally more rangy in conformation than any of the British beef breeds.

There is no satisfactory method for expressing relative size in exact mathematical terms. Yapp's (1923) dimension-weight index, when applied to the present data, gives the following figures:—

Age Group.	1929.	1930.	1931.
Sussex half-breds	4·962	4·988	5·467
Hereford half-breds	5·038	5·178	5·150
Aberdeen-Angus half-breds	5·132	5·046	5·581
Shorthorn half-breds	5·310	5·447	5·583
Afrikander half-breds	5·330	5·583	5·540

These figures are in substantial agreement with the above classification of the breeds. It should be noted that the dimension-weight index diminishes with age as pointed out by Yapp. The index of the Shorthorns at any age is practically the same as that for the Afrikanders. This shows that the former were comparatively as rangy as the Afrikanders. What is the explanation for this inconsistency in the development of the Shorthorn half-breds? It is difficult to estimate the relative importance of environmental and genetic factors involved in the growth of the animal. In this case all breeds were exposed to more or less similar environmental conditions. Under natural range conditions the cattle are dependent upon the natural pasturage for their nutritional requirements throughout the year. The seasonal effects upon the development of these animals has been clearly demonstrated in preceding pages. The supply of natural forage is intimately associated with season and the question of seasonal influence on growth and development resolves itself largely into one of nutrition. Other seasonal factors, such as temperature and humidity, undoubtedly also exert some influence but the nutritional factor appears to be the most important.

No explanation is offered for the peculiar behaviour of the Shorthorn half-breds. It is possible, of course, that the pure-bred bulls used were exceptionally poor specimens of the breed although precautions were taken to ensure that they should be representative. Alternatively, the Shorthorn may not be so well adapted as the other breeds to the severe climatic conditions, including poor feed supply, obtaining under these conditions. It is believed, however, that an explanation must be sought in a combination of these factors. The bulls when purchased as young animals, showed comparatively good type but they became more rangy at maturity. The question as to whether they produced rangy offspring because they were of a more rangy constitution genetically than the average of the breed or whether both the bulls and their offspring developed ranginess consequent upon conditions of severe climate or inadequate nutrition, remains unanswered. Attention is drawn to the fact that the dimension-weight index of the Shorthorns in the youngest (1931) age group is approximately the same as those of all other breeds, with the exception of the Hereford, but shows relatively little change with increasing age. For purposes of comparison the dimension-weight index of the dams of the 1929 group is given below:—

	Dimension-Weight Index.
Dams of Sussex half-breds	5·011
,, ,, Hereford half-breds	5·230
,, ,, Aberdeen-Angus half-breds	5·202
,, ,, Shorthorn half-breds	4·978
,, ,, Afrikander half-breds	5·282

It will be seen that the figure for the dams of the Shorthorns is the lowest, indicating the least ranginess, although the differences between all groups are relatively unimportant.

There is no satisfactory method of measuring the relative "prepotency" of the sires of different breeds used. The limited number of sires (two of each breed) and the fact that no breeding records of individual bulls of the same breed were kept preclude the use of sire-offspring correlations. Only well defined breed characteristics such as the colour pattern of the Hereford, the polled condition of the Angus and the distinguishing features of the Afrikander, viz., sleekness of coat, loose skin and a tendency to develop a hump are clearly shown in the offspring. These traits may be easily observed in the illustrations of half-bred calves of different breeding shown in Appendix figures 33 to 37. More or less typical half-bred cows of the different breeds are illustrated in Figures 38 to 43.

In the discussion on the comparative weights of dams and daughters it was observed that the difference in average weights between dams and daughters was exceedingly small and the question was raised whether any improvement has been brought about by the use of pure-bred bulls on the nondescript cows. The situation is identical in regard to all body measurements. The daughters were only 48 months old at the time the final weights were taken and consequently had not reached maximum development in body size but it is doubtful if they would exceed their dams in weight to any

marked extent even at maturity. Hansen (1925) states that the Black and White Lowland cattle of Eastern Prussia do not show any appreciable growth in weight after 4 years of age but Hammond (1920) states: "The continental breeds on the whole show slightly greater early maturity ratios than those of the British breeds—for bulls: Simmentaler 86·2 per cent., Black and White Lowland 88·4 per cent. and Allgau 80·9 per cent."

In the crossing of two distinct races or breeds of animals the offspring usually exhibit increased size and vigour over the parental types due to the phenomenon of heterosis, especially where there has been some inbreeding in the parental strains. Visual appraisal of the animals failed to indicate marked heterosis in these half-breds, particularly in the case of the females. This may be due to the fact that their dams were not representative of a distinct type since blood of the European and British breeds have been introduced into the native stock at various times. Better results might be expected if cows of the distinct native types had been used as some of these types have been bred along the same lines for many generations and inbreeding in various degrees commonly occurred—usually unintentionally.

The inheritance in animals is controlled by genes which may be either specific or general in their effects. It would appear from data on the Afrikander that height over hips may be controlled to some extent at least, by specific genes. The same applies to height over withers. The possibility of the existence of "group" factors for hip height, wither height and hump in the Afrikander, must also be considered. From his analysis of growth data on the rabbit, Wright (1932) concludes that the influence of general size factors preponderates but he found indications of such group factors affecting head growth apart from general size, others for fore-limbs and hind-limps collectively, and a third group for the hind-limbs separately. Gregory (1933) from his studies on the inheritance of size in dairy cattle found indications of at least three different genetic compositions involved in height.

The following dam-offspring correlation coefficients were obtained for live weight and certain body measurements specified:—

	Dam-Offspring Correlations.
Height at withers	*·38*
Width at thurls	*·32*
Width at hooks	*·31*
Live weight	*·27*
Body length	*·24*
Heart girth	·18
Width of chest	·13
Depth of chest	·10

The above correlations are a weighted average of the correlations within the various breeds computed by the method of analysis of covariance after Fisher (1933), by means of which the necessary corrections have been made for group (breed) heterogeneity.

It will be noticed that the figures for live weight, height at withers, width at thurls, width at hooks and body length are significant. That for heart girth borders on significance while those for width and depth of chest respectively are not significant. It is possible by the application of Wrigth's (1921) formula for the parent-offspring correlation to estimate the proportion (h^2) of the variance within each group due to heredity assuming that there is no dominance or interaction (nicking), mating being at random within groups as in the present case.

$$r_{po} = 1/2\ h^2$$

then h^2 has the following values for the different traits:—

	Variance.	
	Hereditary.	*Environmental.*
Heigth at withers	·76	·24
Width at thurls	·64	·36
Width at hooks	·62	·38
Live weight	·54	·46
Body length	·48	·52
Heart girth	·36	·64
Width of chest	·26	·74
Depth of chest	·20	·80

The figures in the last column indicate the proportion of the variance in different body traits, within the animals under the conditions of this experiment, due to factors other than genetic ones which can be expressed as combining additively.

It will be observed that a high proportion of the variance found in height over withers is hereditary and this measurement is apparently least affected by external agencies. Likewise in width at thurls and width at hooks more than 60 per cent. of the variance is genetic. In body length more than half the variance is shown as due to environmental factors. However, this measurement is influenced to a considerable extent by the position in which the animal stands at the time of measuring and is probably not very accurate. Random inaccuracies would increase the proportion of variance listed in the above correlation as environmental.

In the case of the chest measurements it would appear that the variance is but slightly hereditary. The extremely small correlation coefficient for depth of chest is difficult to explain. While heart girth and width of chest are known to be influenced to a considerable extent by environmental factors one would not expect the same situation in depth of chest which depends mostly upon dimensions of bones.

In live weight approximately half of the variance in these animals is due to causes other than genetic in origin. This varying degree of susceptibility to environmental influences explains why such factors as seasonal fluctuations and feed supply exert a noticeably greater influence on development in body weight and certain body measurements than on others in the present study as shown by the growth curves in figures 7 and 8.

In a study of the genetic constitution of pure-bred Jersey cattle in the United States, Gowen (1933) found great variability in the relation between dam's type and daughters' type within certain herds but he concludes that inheritance accounts for most of the variation in the size of the animals, such environmental differences as do exist playing but little part in the ultimate constitution of the animals. It will be readily understood, of course, that high grade dairy cattle are usually kept under uniformly good conditions and that they are not likely to have been subjected to as extreme a range of environmental conditions as these range cattle in the Northern Transvaal. Furthermore it is quite probable that a fairly high degree of assortative mating genetically has occurred in the Jersey breed.

The dam-offspring correlations in the present study clearly show the varying degree of susceptibility of various body traits to environmental influences. This leads to the conclusion that no sharp and universally valid line can be drawn between environmental and genetic factors in their relative importance in growth and development. Both have a physiological basis. In the words of Wright (1933) it is rather common " to treat environmental influences as requiring detailed physiological analysis but to assume that assignment of an effect to heredity ends the matter. The genes carried in the nuclei of the cells can only control growth, or any other character, through physiological channels, starting from primary effects on cell metabolism ". There is thus clearly plenty of room for control of growth characters both by breeding and management.

SUMMARY.

Data are presented on the growth of range cattle over a period of four years in a semi-arid region of South Africa. A total of 176 half-bred animals of five different breeds are included in this study.

The data consist of live weights taken at bi-monthly intervals of all animals, and linear body measurements taken at bi-monthly intervals for a period of 28 months for three different age groups.

Growth in weight is strictly seasonal from weaning to maturity. These seasonal fluctuations are shown to be closely allied to monthly rainfall. The bulk of the annual precipitation occurs from November to February and the period of greatest relative growth in weight lags approximately three months behind the period of heaviest precipitation.

The greatest increase in body weight occurs from January to March and the periods of smallest increase or greatest loss in weight occur from July to September. Body measurements are also influenced by seasonal changes but to a lesser extent than body weight. The following measurements are least affected: height at withers, height over hips, body length, depth of chest and depth of flank. The measurements markedly influenced by season of the year are length of pelvis, width at hooks, width at thurls, width of loin and width of chest.

Significant differences between the sexes exist from birth, males being heavier than females.

Sex differences in body measurements are not so marked, especially in the earlier age groups. When maturity is approached the steers exceed the heifers to a marked degree in all body measurements except those of the pelvic region.

The breeds may be divided into two classes in respect to weight and size, Herefords and Sussex comprising one class and Aberdeen-Angus and Afrikander constituting another. The animals of the first class exceed those of the second class in weight and most body measurements. The Shorthorns occupy an intermediate position and the peculiar behaviour of this breed is discussed.

The Afrikanders proved to have greater wither height and hip height than all other breeds.

The relative importance of genetic and environmental factors on the growth of the animals is discussed.

It is shown that the variance in height at withers in this population is approximately three-fourths genetic and one-fourth environmental in origin. In width at thurls and width at hooks more than 60 per cent of the variance is genetic. The variance in body length and live weight is accounted for equally by genetic and environmental factors. In all chest measurements the variance appears to be only slightly hereditary.

It is shown that the factor of nutrition plays a very important rôle in the growth of range cattle under the conditions of this experiment. It is not possible to determine from this study whether permanent stunting results from inadequate nutrition but it is concluded that growth is retarded and maturity delayed.

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Table XXIII.

Average Live Weights in Pounds 1931 Half-breds.

Breed of Sire	Hereford.		Shorthorn.		Sussex.		Afrikander.		Ab.-Angus.	
Sex	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.
No. of Animals	12	14	9	6	15	10	14	14	14	9
Average Birth Date	5 June.	31 May.	26 May.	6 June.	5 June.	13 June.	8 June.	17 June.	31 May.	2 June.
Average Birth Weight	72	66	66	68	72	61	62	57	56	58
1931.										
Weight on—										
22 July	143	133	137	134	139	123	134	113	127	136
18 September	212	188	207	197	217	192	198	181	198	207
19 November	306	280	283	286	313	280	287	262	284	290
1932.										
20 January	442	399	413	405	419	380	409	372	373	375
18 March	496	438	450	443	501	456	465	412	435	433
18 May	526	479	489	483	541	495	502	437	470	462
17 July	547	493	505	504	559	511	519	451	484	478
17 September	572	499	526	507	580	508	529	448	502	486
23 November	545	494	498	498	557	500	507	445	485	473
1933.										
20 January	618	555	571	561	627	566	569	499	554	535
17 March	692	612	629	618	699	632	652	558	616	594
20 April	765	690	705	683	765	695	710	626	689	659
15 May	789	709	714	710	779	719	727	631	707	684
15 June	751	703	690	699	756	720	694	634	696	678
18 July	788	711	721	712	791	731	739	645	721	691
16 August	804	685	723	690	798	706	746	625	724	670

Table XXIV.

Average Live Weights in Pounds 1930 *Half-breds.*

Breed of Sire	Hereford.		Shorthorn.		Sussex.		Afrikander.		Ab.-Angus.	
Sex	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.
No. of Animals	8	12	9	8	10	7	14	16	13	10
Average Birth Date	14 May.	9 May.	11 May.	3 May.	21 May.	11 May.	18 May.	10 May.	8 May.	5 May.
Average Birth Weight	66	65	69	59	72	69	65	61	61	56
1931.										
Weight on—										
16 January	362	367	411	370	401	397	339	368	393	366
16 March	455	421	464	421	462	450	403	416	442	412
18 May	510	492	505	471	515	507	469	478	497	466
17 July	502	501	493	475	520	504	470	474	493	464
16 September	558	547	567	530	585	572	519	525	549	519
16 November	601	570	597	544	614	587	555	546	600	541
1932.										
18 January	716	694	713	664	742	703	664	652	694	615
16 March	730	709	732	690	763	723	708	677	715	662
16 May	810	780	820	745	856	791	755	746	801	734
15 July	833	813	825	777	868	831	789	775	816	754
16 September	835	816	812	778	853	841	781	781	798	758
21 November	795	779	803	769	848	840	770	771	792	741
1933.										
19 January	893	837	884	842	937	900	852	831	874	795
15 March	960	865	943	864	1,003	908	912	846	929	795
20 April	1,021	910	1,004	834	1,059	908	967	864	991	837
15 May	1,027	924	1,006	836	1,075	923	972	881	1,001	855
14 June	1,002	908	967	812	1,050	862	946	862	964	834
18 July	984	921	959	794	1,018	864	926	860	953	847
16 August	1,015	894	994	755	1,059	843	948	836	984	820

Table XXV.

Average Live Weight in Pounds 1929 Half-breds.

Breed of Sire	Hereford.		Shorthorn.		Sussex.		Afrikander.		Ab.-Angus.	
Sex	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.	Steers.	Heifers.
No. of Animals	11	12	6	10	9	8	12	10	13	8
Average Birth Date	23 May.	1 June.	19 May.	18 May.	20 May.	13 May.	27 May.	25 May.	11 June.	23 May.
Average Birth weight	67	59	69	57	68	71	62	56	56	56
1930.										
Weight on—										
13 January	406	361	387	368	377	413	382	341	346	340
11 March	480	405	456	412	443	473	457	405	411	406
14 May	604	523	579	535	550	593	565	502	512	514
14 July	607	515	563	518	556	594	559	492	513	510
13 September	635	551	586	541	588	623	583	515	533	532
14 November	635	542	575	547	590	616	562	512	521	522
1931.										
16 January	691	607	642	599	654	680	651	510	601	582
16 March	767	659	713	656	725	725	720	626	674	649
18 May	833	703	764	710	762	774	774	680	724	682
17 July	844	706	765	728	763	738	777	684	723	677
16 September	880	726	795	720	783	758	805	705	763	693
16 November	857	732	805	716	800	755	812	715	775	693
1932.										
18 January	1,009	844	954	829	922	856	933	824	897	782
16 March	998	831	957	831	928	873	943	839	908	765
16 May	1,125	859	1,059	865	1,022	924	1,033	842	1,004	821
15 July	1,147	847	1,057	871	1,034	914	1,052	820	1,019	836
16 September	1,133	813	1,019	854	1,001	897	1,028	800	985	835
19 November	1,074	735	966	789	963	824	998	732	961	768
1933.										
18 January	1,163	802	1,067	876	1,050	917	1,072	794	1,048	834
16 March	1,227	829	1,118	928	1,097	962	1,121	848	1,091	870
18 April	1,289	884	1,173	956	1,147	1,017	1,181	886	1,149	911
15 May	1,312	905	1,187	953	1,159	1,037	1,197	900	1,154	905
14 June	1,257	869	1,139	884	1,117	1,018	1,148	885	1,115	862
18 July	1,257	864	1,143	884	1,123	1,023	1,158	895	1,129	869
16 August	1,270	864	1,179	866	1,105	1,009	1,153	856	1,119	858
Average weights of dams	949	922	972	846	962	956	870	844	835	892

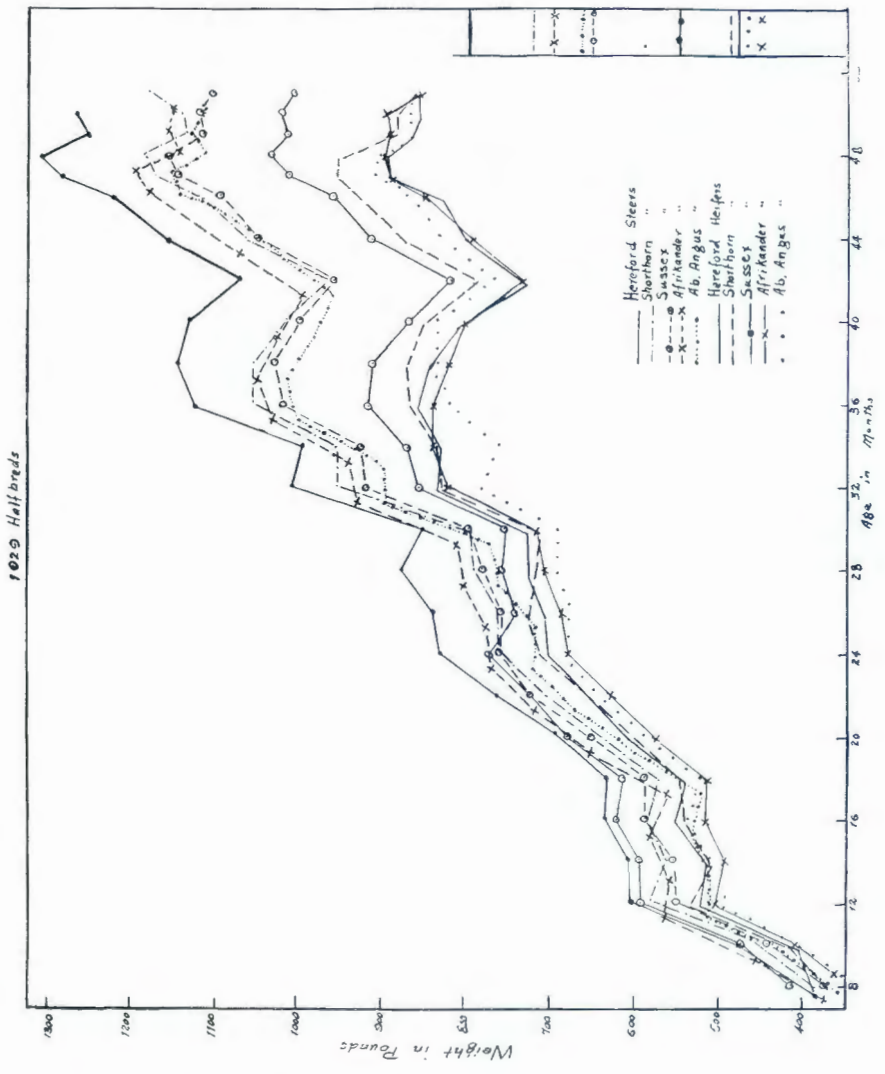

Fig. 9.—Average growth curves of steers and heifers. Live weight.

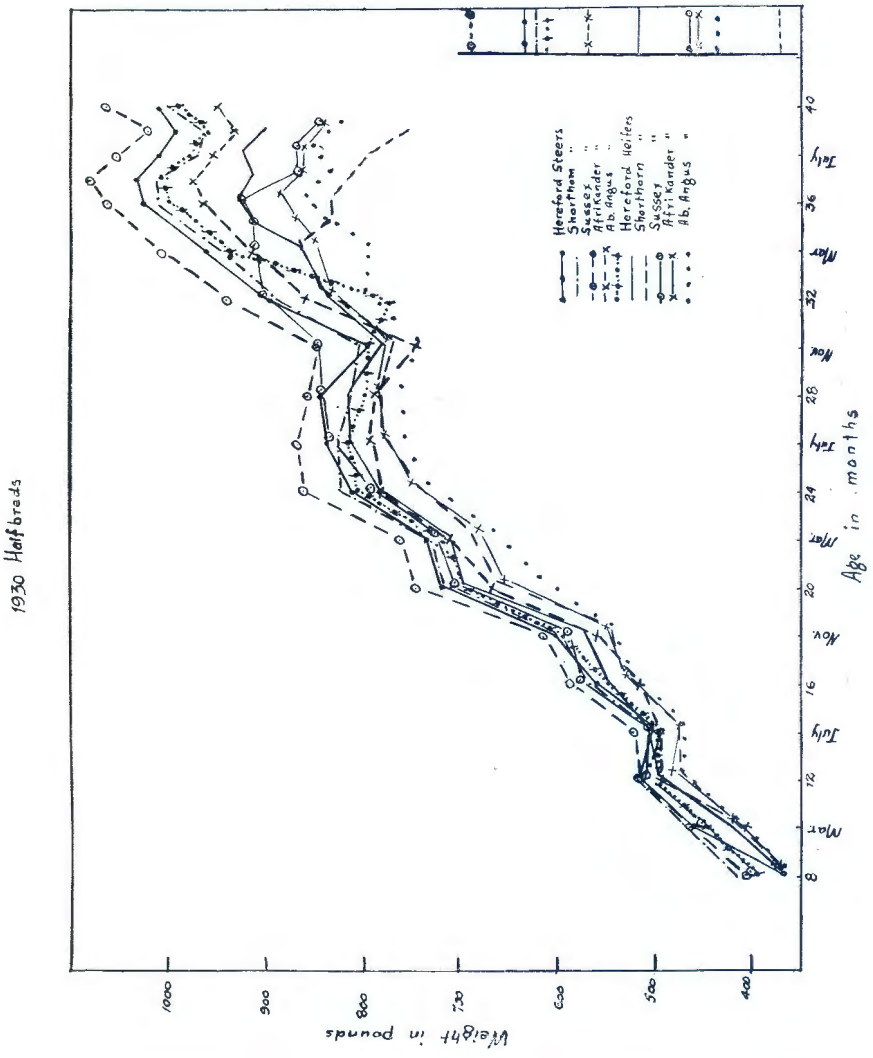

Fig. 10.—Average growth curves of steers and heifers. Live weight.

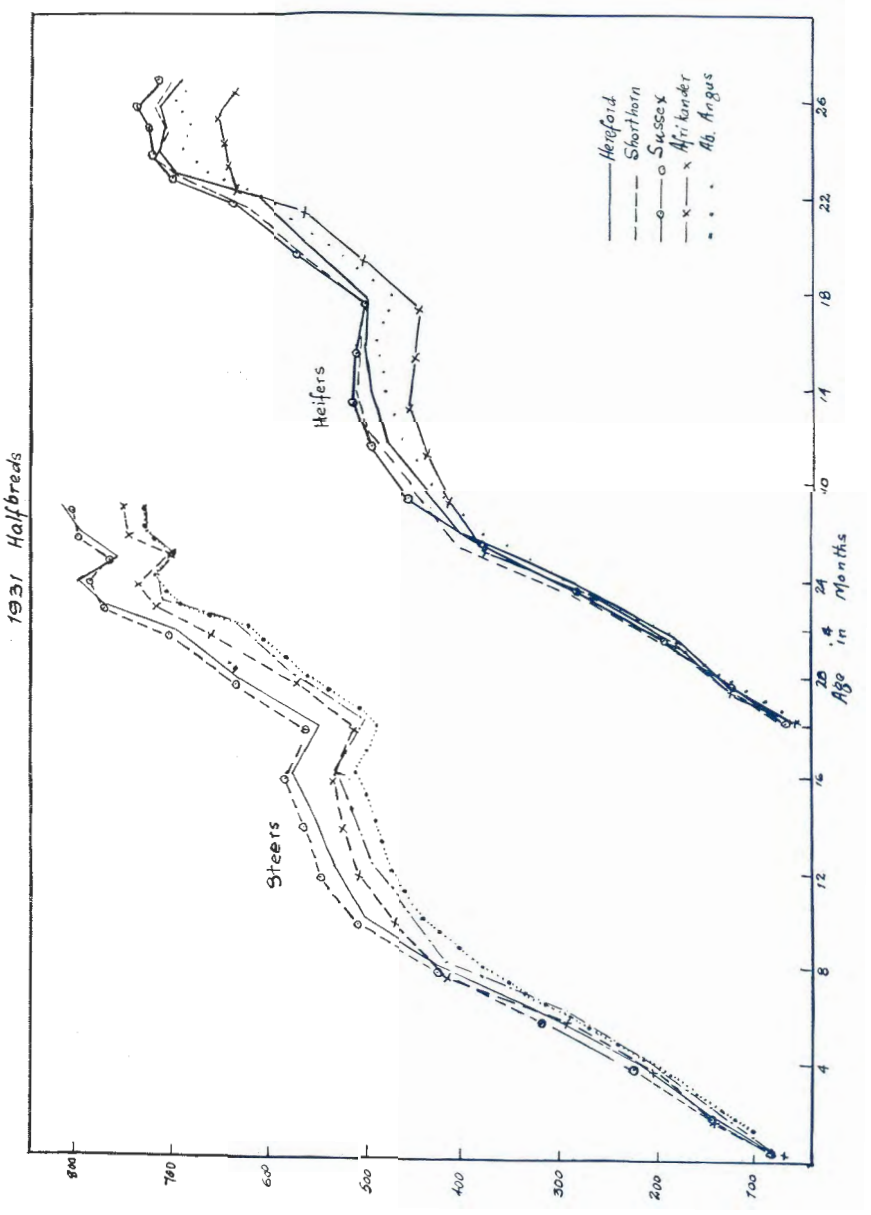

Fig. 11.—Average growth curves of steers and heifers. Live weight.

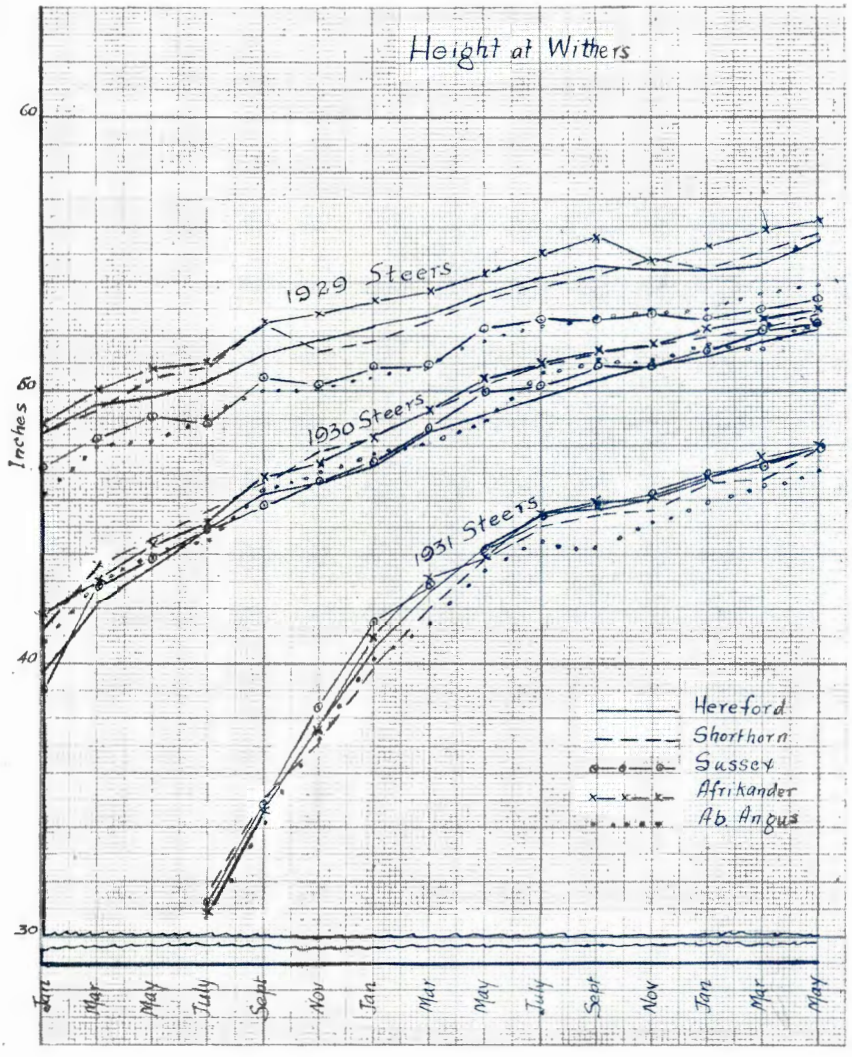

Fig. 12.—Average growth curves of steers. Height at withers.

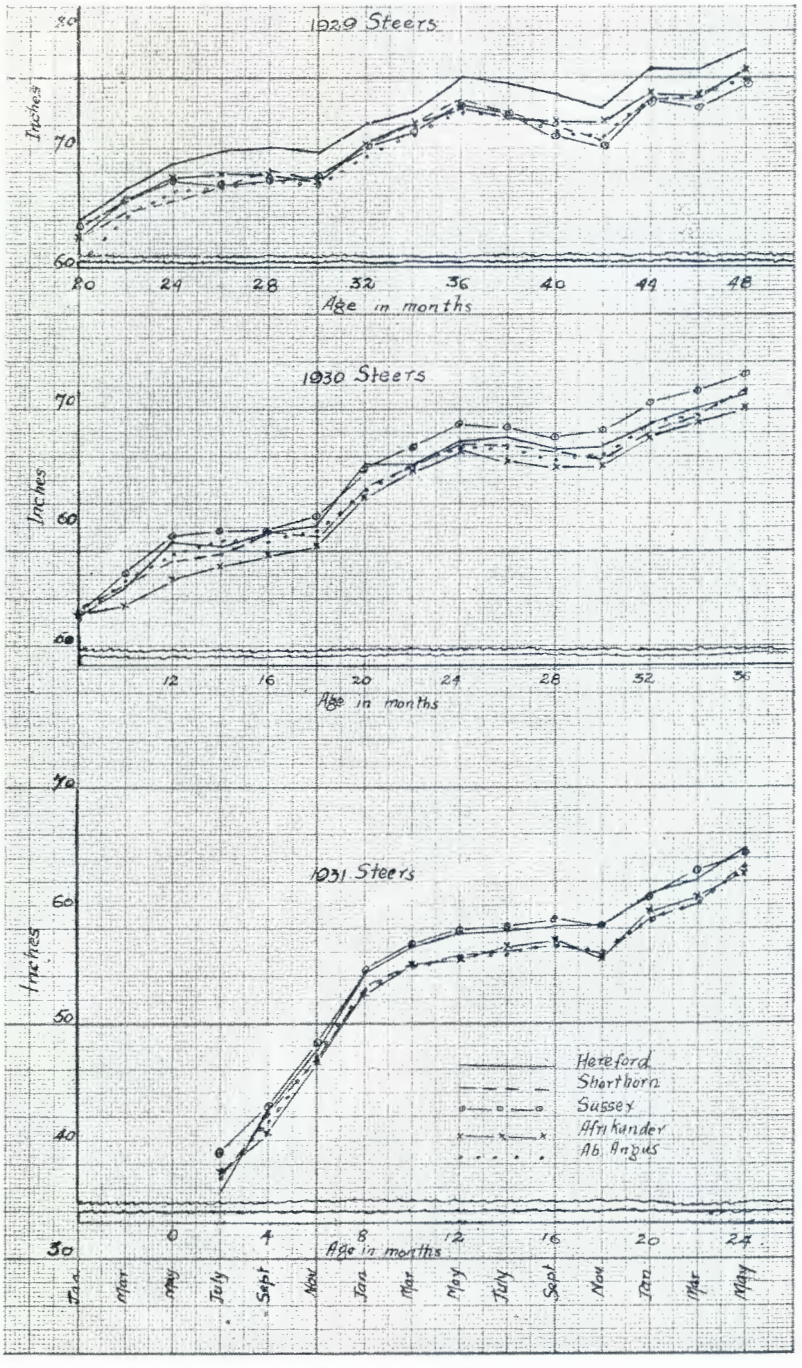

Fig. 13.—Average growth curves of steers. Heart girth.

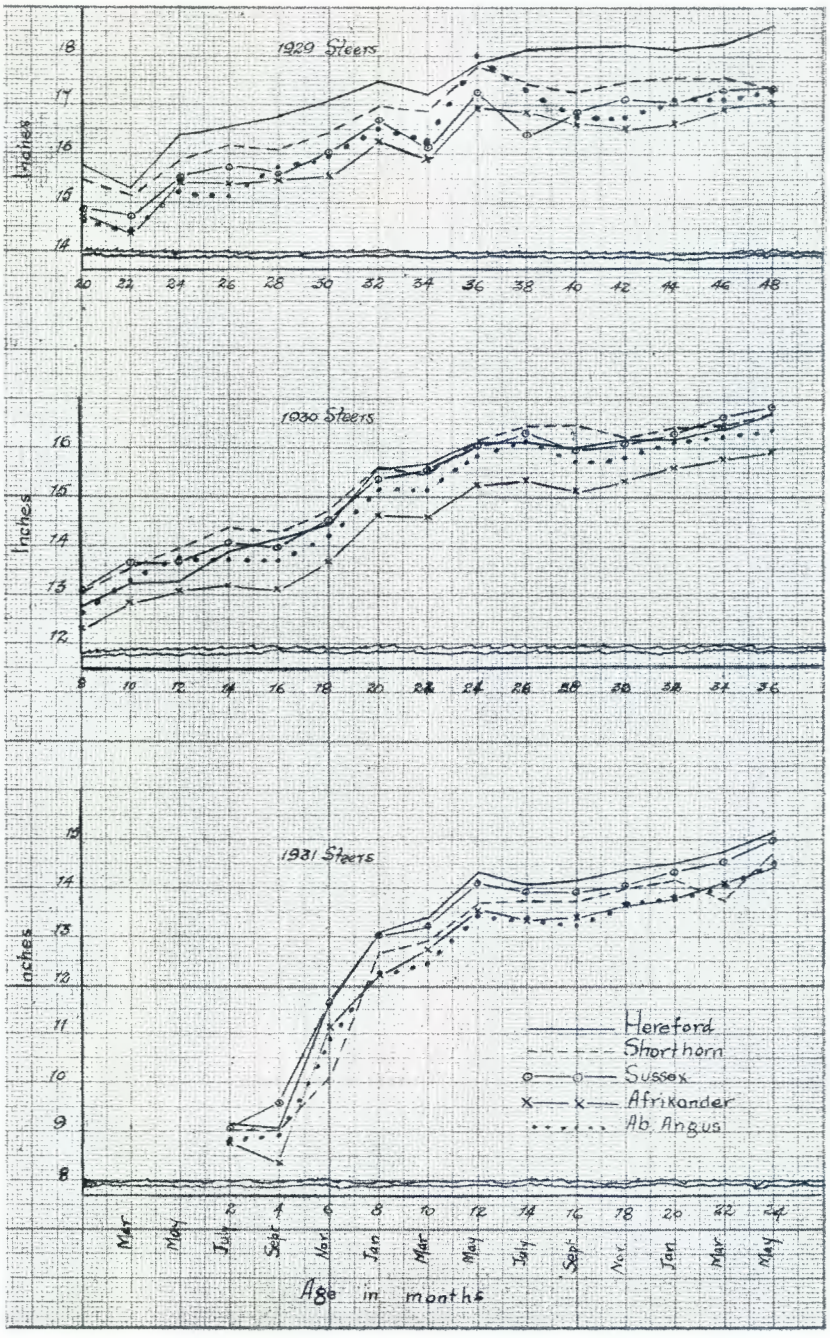

Fig. 14.—Average growth curves of steers. Width at thurls.

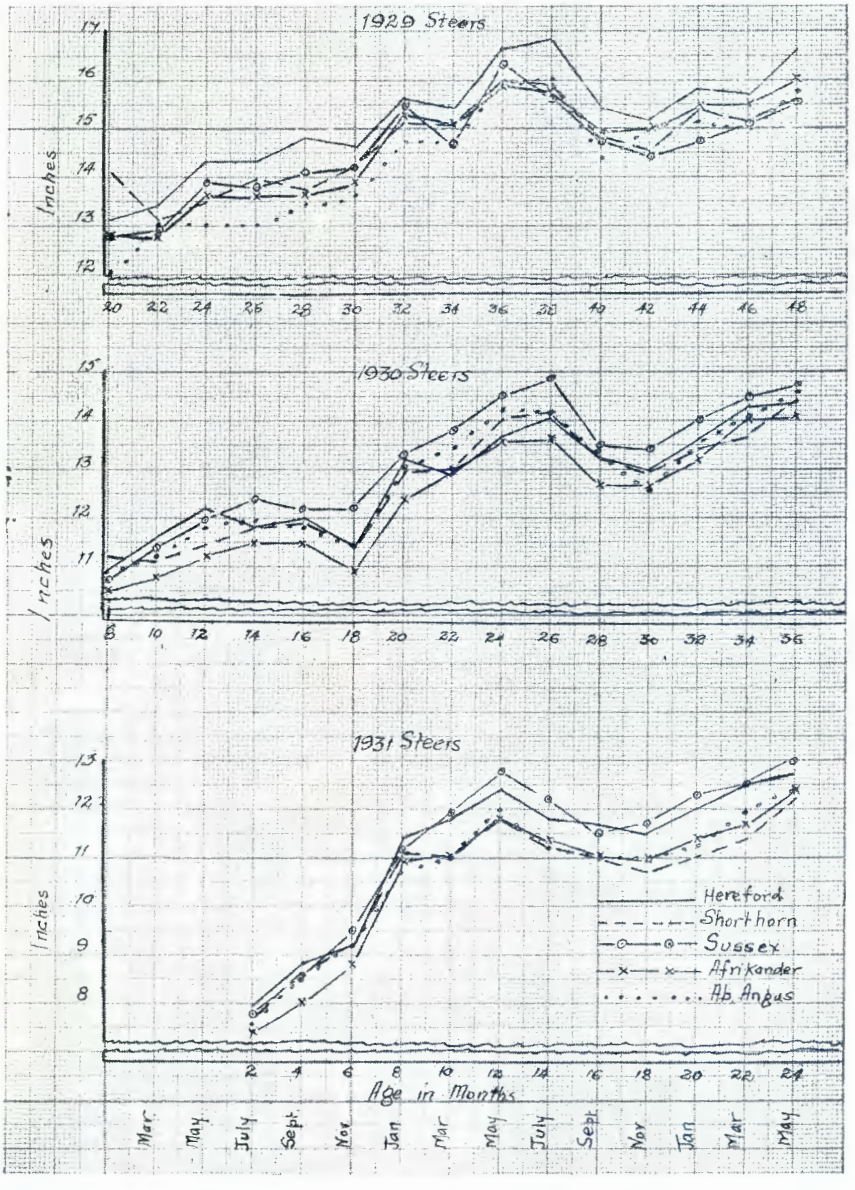

Fig. 15.—Average growth curves of steers. Width of chest.

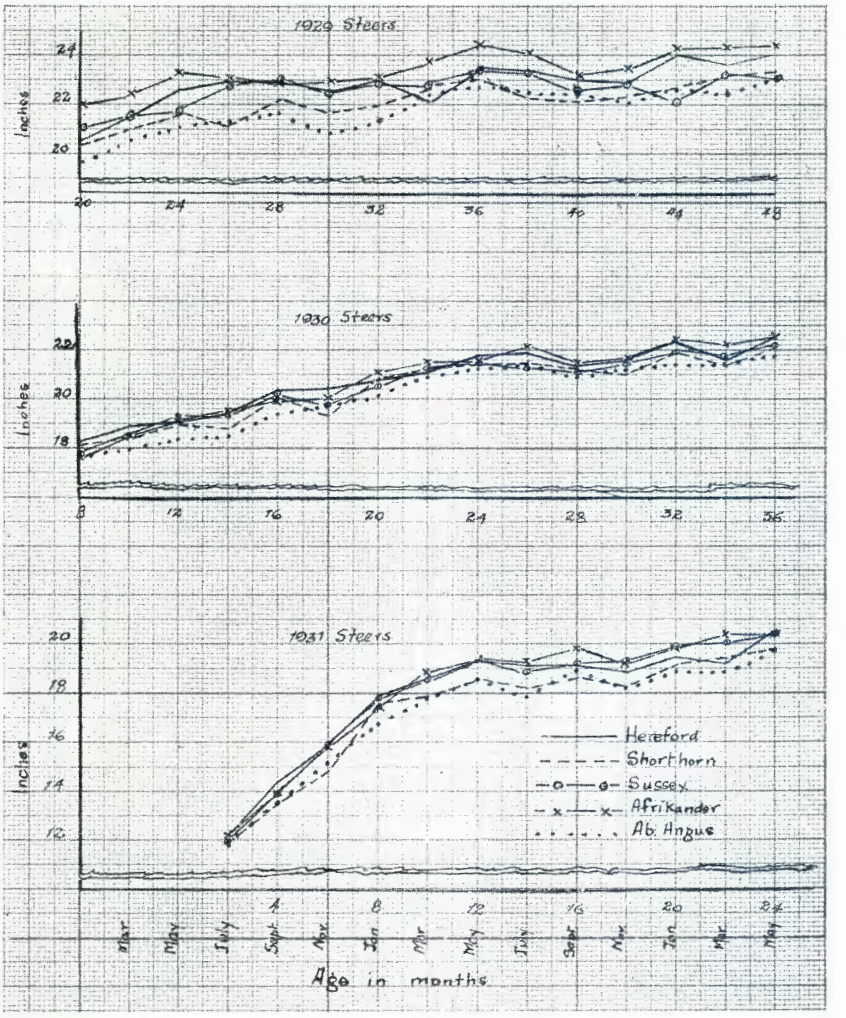

Fig. 16.—Average growth curves of steers. Depth of flank.

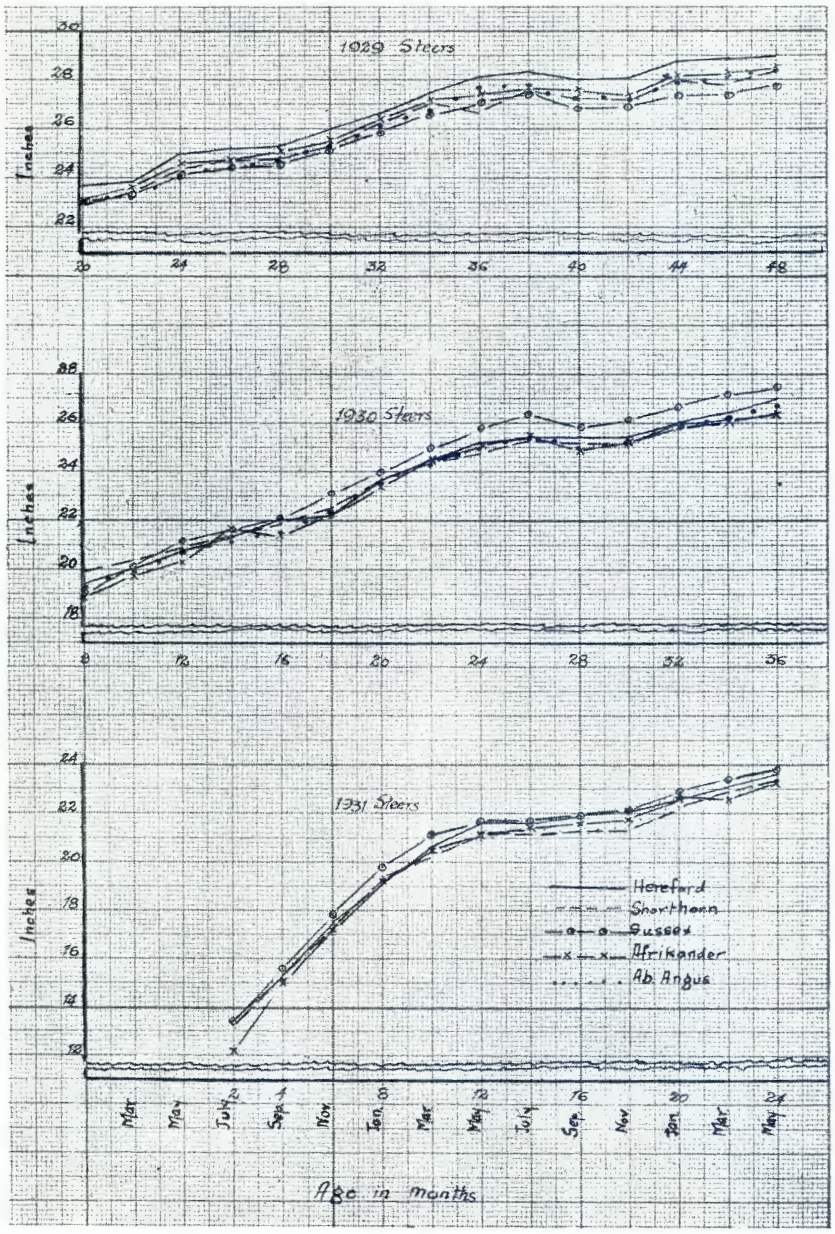

Fig. 17.—Average growth curves of steers. Depth of chest.

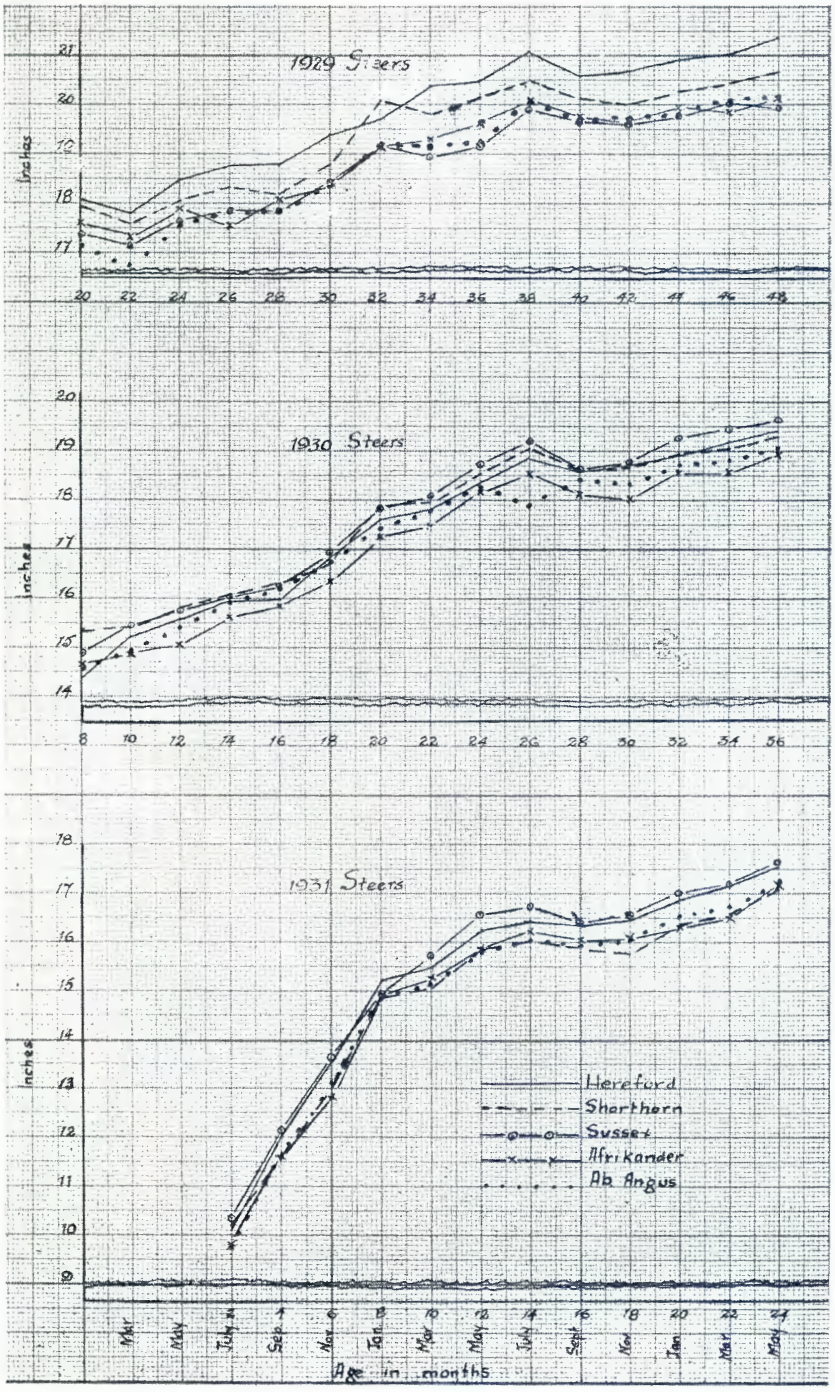

Fig. 18.—Average growth curves of steers. Length of pelvis.

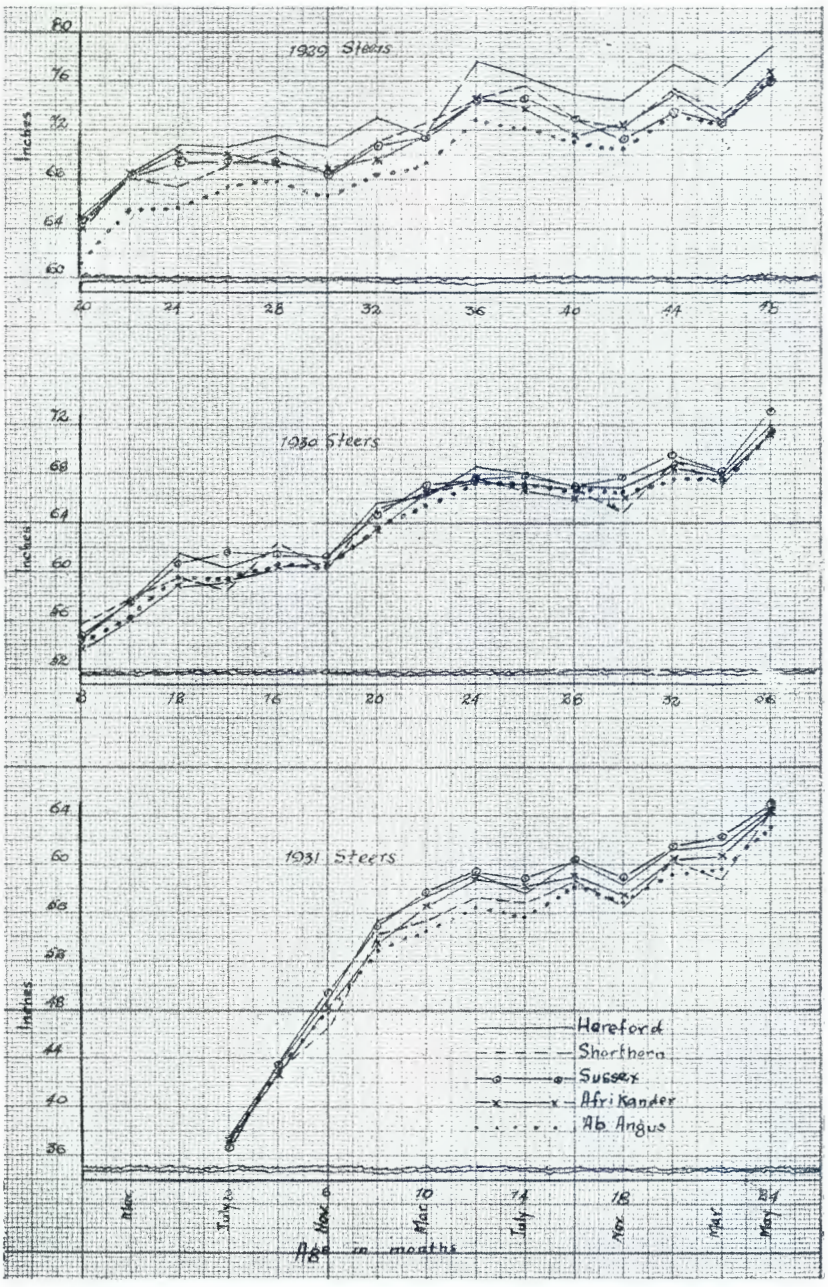

Fig. 19.—Average growth curves of steers. Flank girth.

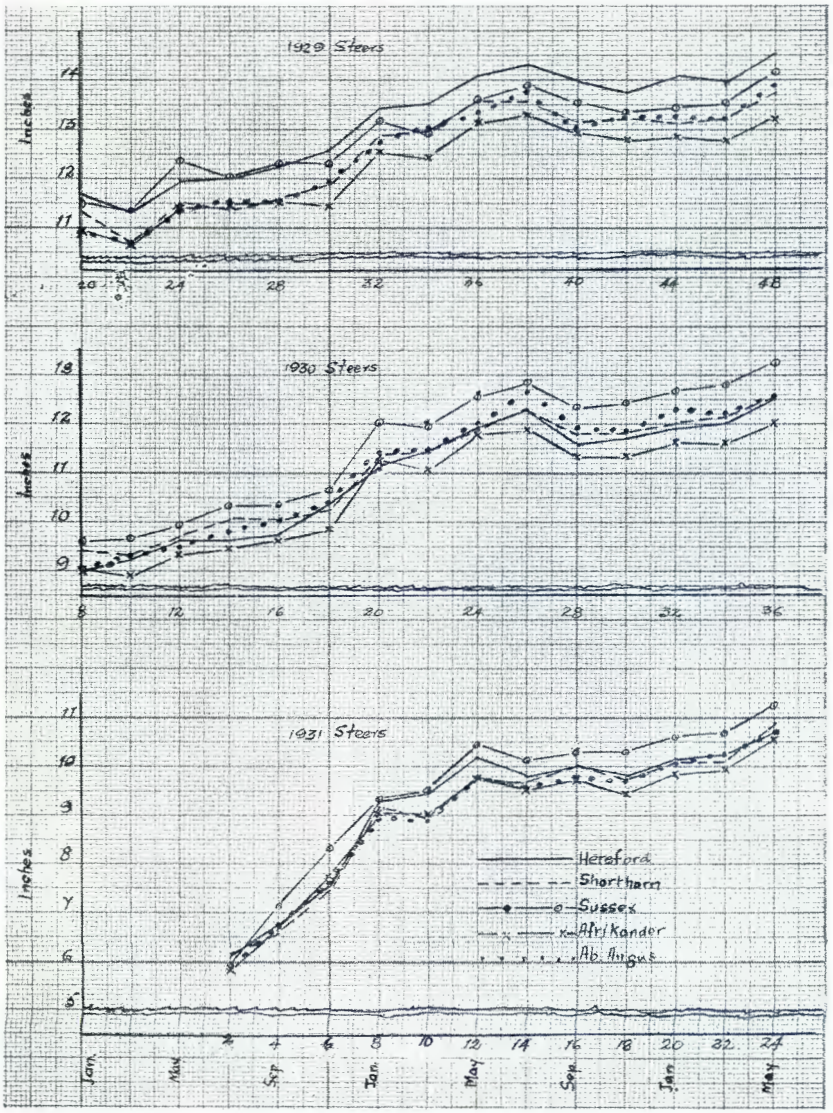

Fig. 20.—Average growth curves of steers. Width of loin.

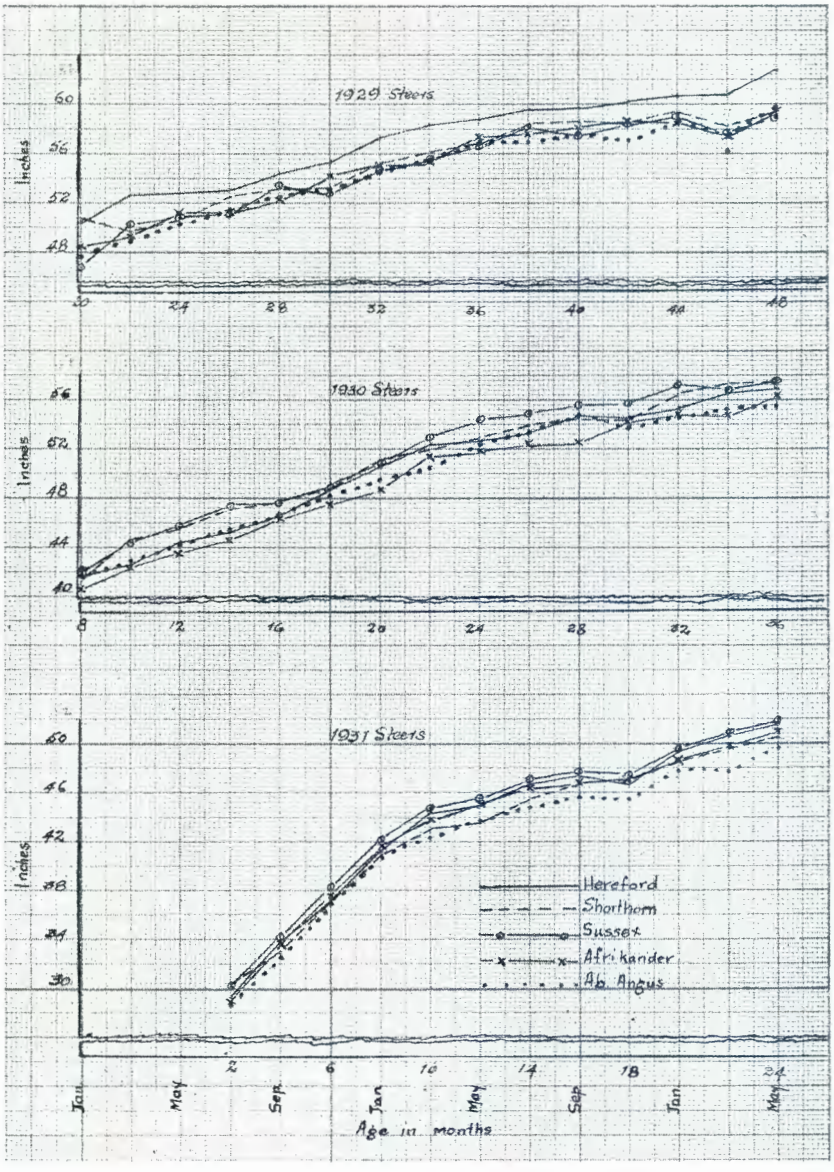

Fig. 21.—Average growth curves of steers. Length of body.

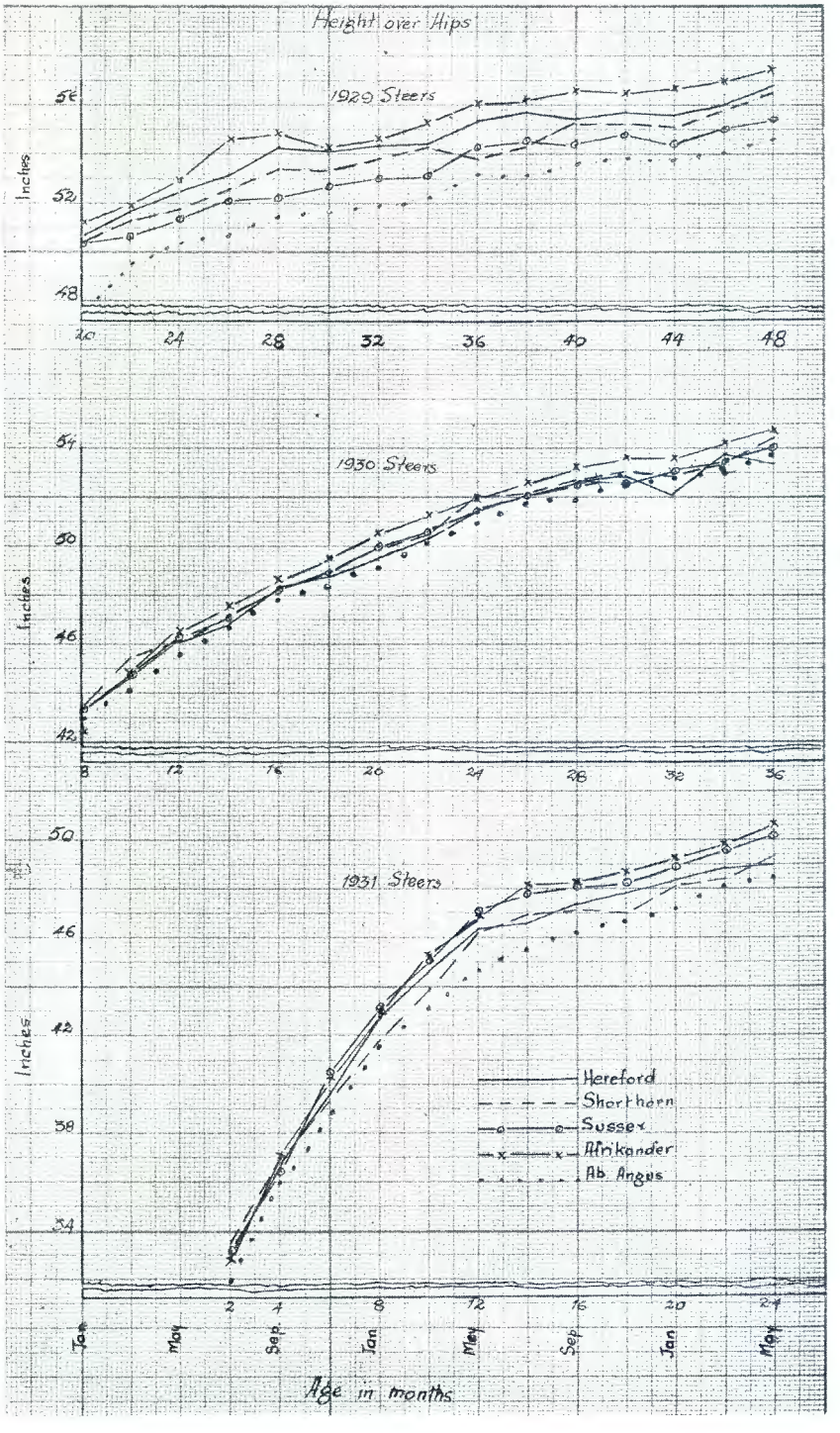

Fig. 22.—Average growth curves of steers. Height over hips.

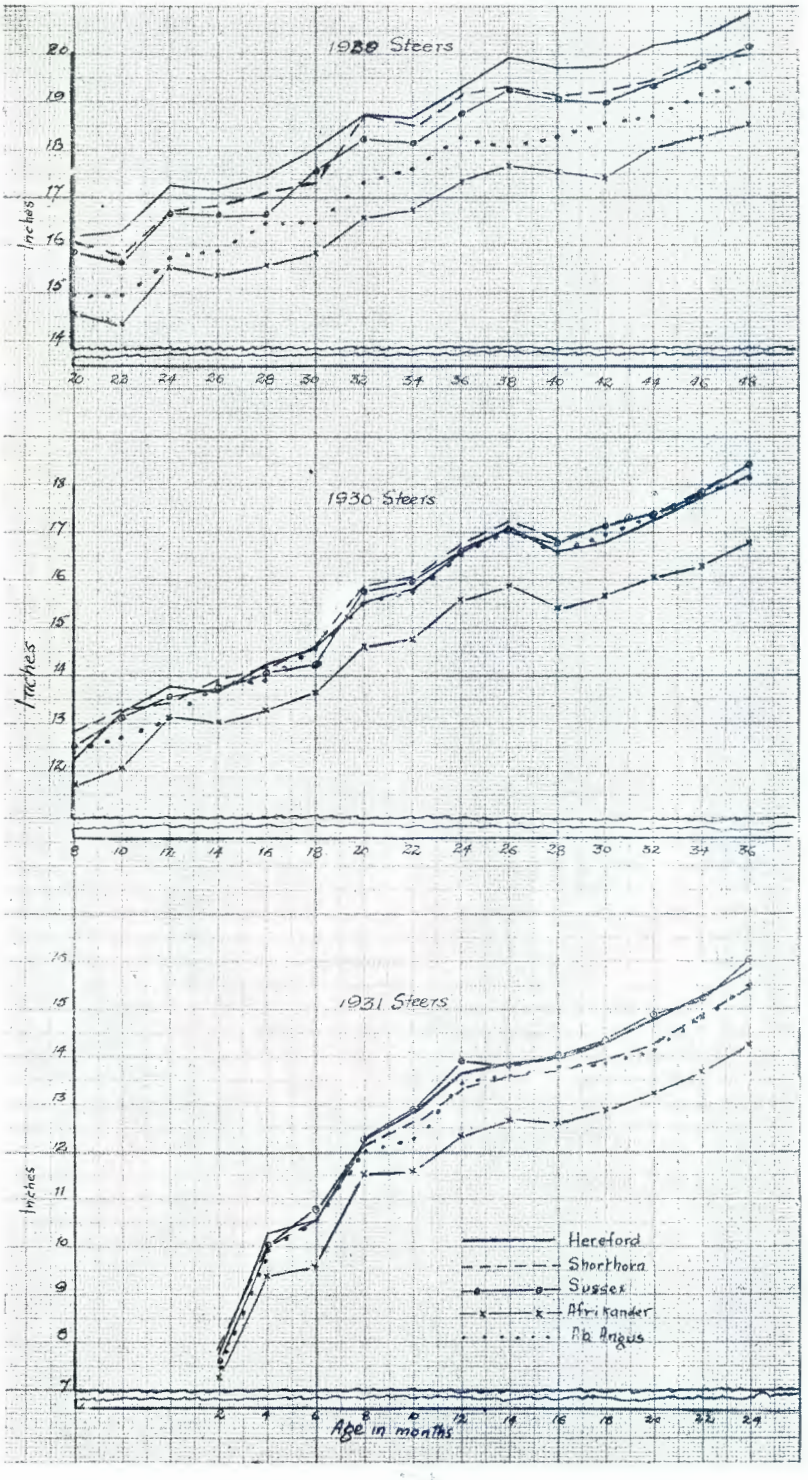

Fig. 23.—Average growth curves of steers. Width at hooks.

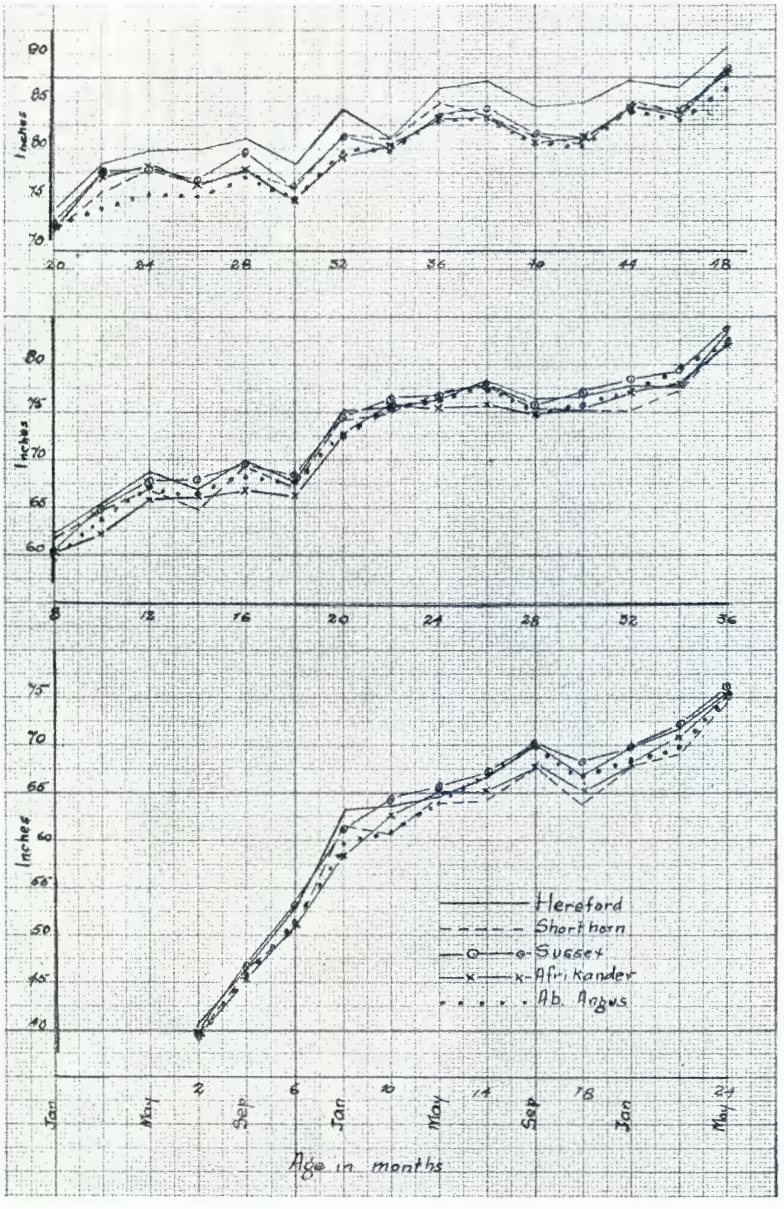

Fig. 24.—Average growth curves of steers. Paunch girth.