UNIVERSITY OF MISSOURI COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION
BULLETIN 336

Growth Standards for Dairy Cattle

A. C. RAGSDALE

COLUMBIA, MISSOURI
MAY, 1934

SUMMARY

Normal growth standards for female and male dairy cattle are presented in tables and curves. These data represent various lines of breeding and systems of management and are based upon weights and measurements taken in the Missouri, Kansas and Iowa Agricultural Experiment Station herds. Measurements taken in the herds of representative breeders and dairy farmers in the several states are presented in the form of curves and compared with the normal standards.

Reference is made to data indicating that the growing dairy animal uses food less efficiently with advancing age and that greater economy may be attained by growing heifers and bulls somewhat more rapidly than is customary on many dairy farms.

It is suggested that chronological age is not necessarily an index of physiological and developmental age and that developmental ages also be used as a guide in breeding dairy heifers.

ACKNOWLEDGMENT

The author acknowledges and expresses appreciation to Professors J. B. Fitch of the Kansas Agricultural Experiment Station and C. Y. Cannon of the Iowa Agricultural Experiment Station for their cooperation and assistance in permitting a representative of the Missouri Station to take weights and measurements of dairy animals in their respective herds and for additional data supplied by them. S. Brody and R. C. Procter of this Station assisted in tabulating the data and in the preparation of the curves. Several graduate and advanced students assisted in taking the weights and measurements.

Growth Standards for Dairy Cattle

A. C. RAGSDALE

Breeders of dairy cattle are interested in knowing whether animals of various ages are approximately normal in size for the breed. Such information is valuable as a guide in feeding, breeding and management practices and may be helpful in making sales.

The collection of data on the rate of growth of dairy cattle was initiated at the Missouri Agricultural Experiment Station in 1906 by Dr. C. H. Eckles. Standards of normal growth of females in individual Experiment Station herds, have since been published by this and other experiment stations. The purpose of this publication is to present normal growth data on both females and males obtained in the Missouri Station herd since 1921 in combination with similar data obtained in other midwestern experiment stations and representative breeders' herds, where the attempt has been made to keep within what is considered to be the approximate limits of good dairy practice. It is believed that these data, representative of various lines of breeding and systems of management may have at least as wide applications in connection with the growing and management of dairy cattle as normal growth standards for humans have had in connection with child-welfare work.

The "standard" values are given in tables and curves. The tables give the birth weights and mature weights of females and males (Table 1); live weight, height at withers, circumference of chest, and width at hips at monthly intervals from birth to maturity (Tables 2 to 9). The number of animals included at each age and for each measurement is given so that the reader may have some idea of the reliability of these growth standards. In general, individual animals may deviate from the standards approximately 10 per cent or even 15 to 20 per cent in live weight and still be considered normal. Variations in linear measurements will as a rule not exceed 5 to 10 per cent.

By way of summary and to better visualize the course and rate of growth, the standards for live weight and height at withers of the females are also presented in the form of curves (Figures 1 and 2).

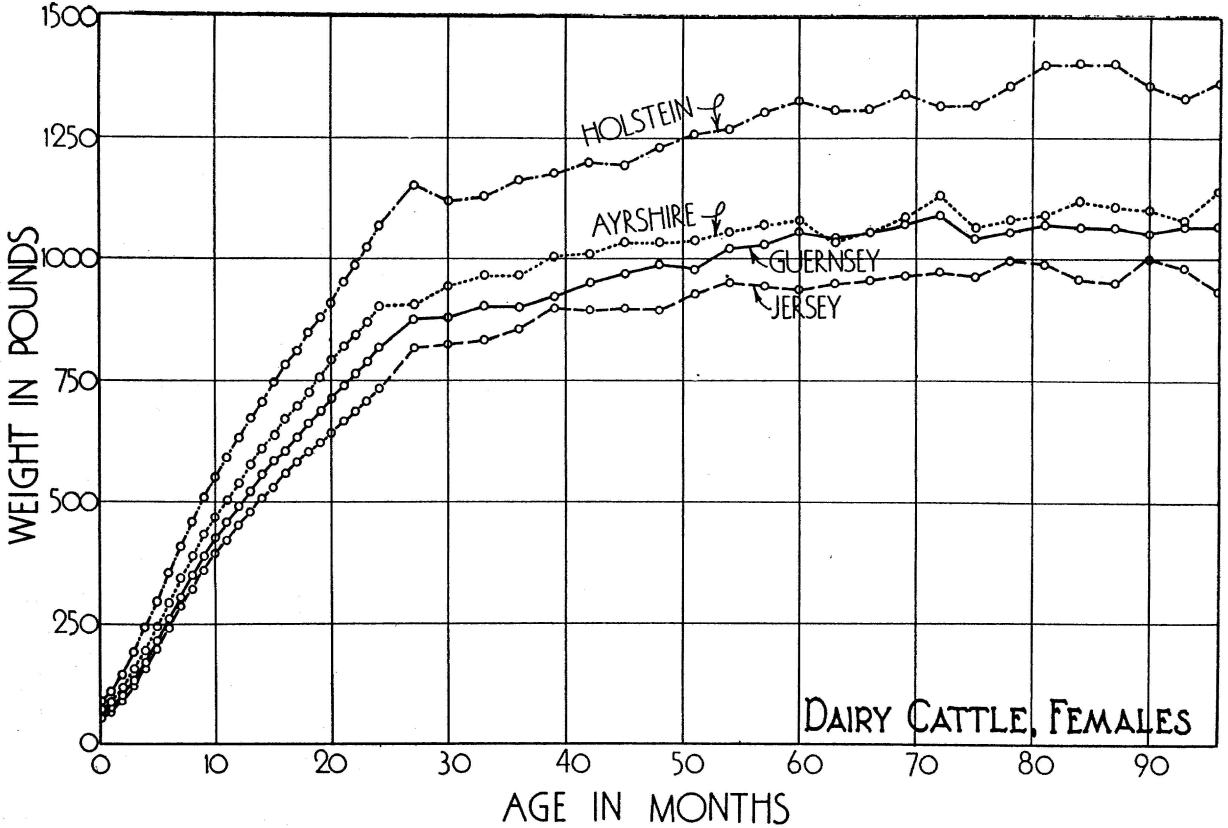

Fig. 1.—The course of growth in live weight with age of dairy cattle, illustrating the numerical values in Tables 2, 3, 4 and 5. Irregularities in the curves after about 26 months are due chiefly to recurrent gestation and lactation. Maximum live weight is reached at about 7 years of age.

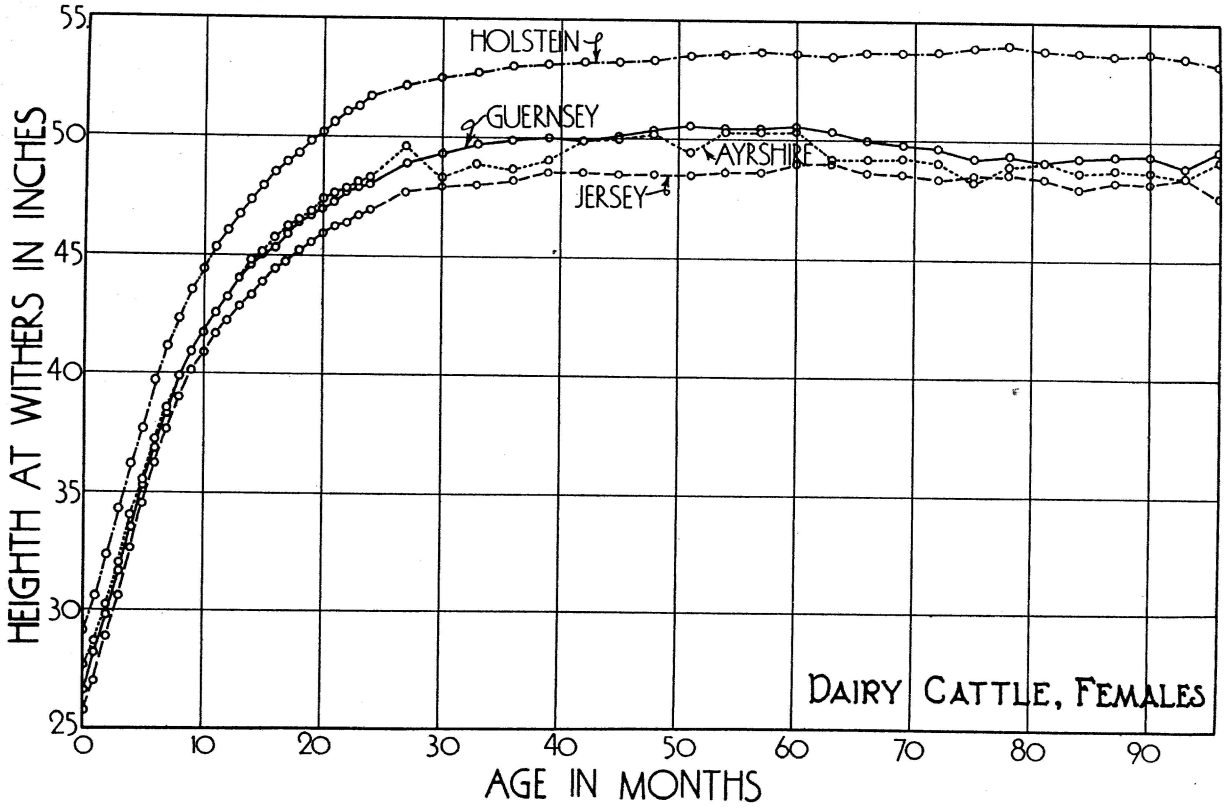

Fig. 2.—The course of growth of height at withers with age in dairy cattle, illustrating the numerical values in Tables 2, 3, 4, and 5. Maturity in skeletal growth as measured by height at withers is reached at about 5 years of age.

TABLE 1.—AVERAGE BIRTH WEIGHTS AND MATURE WEIGHTS OF HOLSTEIN, JERSEY, AYRSHIRE, GUERNSEY AND BROWN SWISS CATTLE—MALES AND FEMALES

Breed	Birth Weights		Mature Weights	
	Males	Females	Males*	Females
	Lbs.	Lbs.	Lbs.	Lbs.
Holstein	95	90	2200	1370
Jerseys	60	53	1500	970
Ayrshire	80	72	1850	1100
Guernseys	71	65	1700	1070
Brown Swiss*	85	80	2000	1300

*Mature weights of males and all data on Brown Swiss are estimated.

TABLE 2.—HOLSTEIN FEMALES

Age Mos.	Weight		Height at withers		Circumference of chest		Width at hips	
	No. of animals	lbs.	No of animals	inches	No. of animals	inches	No. of animals	inches
Birth	239	90	169	29.1	81	30.8	81	6.7
1	237	112	207	30.6	87	33.9	123	7.3
2	237	148	218	32.3	87	37.0	132	8.4
3	234	193	215	34.3	85	39.9	130	9.2
4	234	243	212	36.2	85	42.9	130	10.1
5	233	297	214	37.7	86	46.0	133	11.1
6	231	355	213	39.7	84	48.7	131	11.9
7	229	410	210	41.1	82	51.1	129	12.7
8	224	462	205	42.3	77	53.2	124	13.4
9	217	509	199	43.5	73	54.6	119	14.0
10	213	552	195	44.4	71	56.3	117	14.5
11	204	593	186	45.3	63	58.2	109	15.1
12	200	632	183	46.0	59	58.9	106	15.5
13	197	671	181	46.7	57	59.8	104	15.8
14	191	705	178	47.3	56	61.4	103	16.2
15	185	746	173	47.9	51	62.6	98	16.5
16	185	782	173	48.5	50	63.6	97	16.9
17	174	809	162	48.9	47	64.2	93	17.2
18	165	845	153	49.3	43	64.9	89	17.5
19	159	878	147	49.8	42	65.5	88	17.8
20	154	912	142	50.2	41	66.7	86	18.1
21	150	952	138	50.6	39	67.9	84	18.3
22	154	986	141	51.0	41	68.8	85	18.7
23	147	1024	134	51.3	37	70.1	78	19.2
24	140	1069	131	51.7	35	71.3	80	19.4
27	81	1151	69	52.2	35	74.0	69	20.3
30	79	1120	61	52.5	33	72.5	61	20.4
33	81	1130	61	52.7	34	72.5	61	20.7
36	75	1165	55	53.0	28	73.8	55	21.0
39	69	1176	50	53.1	26	74.3	50	21.1
42	64	1202	46	53.2	22	75.3	46	21.4
45	58	1197	40	53.2	20	74.7	40	21.6
48	48	1232	31	53.3	12	75.2	31	21.8
51	46	1261	31	53.5	12	76.6	31	22.1
54	43	1271	28	53.6	10	76.9	28	22.1
57	41	1305	30	53.7	9	77.0	30	22.6
60	41	1330	27	53.6	8	76.3	27	22.5
63	51	1310	36	53.5	17	76.2	36	22.5
66	44	1312	30	53.7	16	76.7	30	22.6
69	45	1343	31	53.7	18	77.6	31	22.8
72	45	1317	31	53.7	18	76.3	31	22.8
75	37	1320	24	53.9	12	77.2	24	22.7
78	33	1357	20	54.0	8	78.3	20	23.0
81	30	1400	17	53.8	6	79.6	17	22.9
84	27	1401	17	53.7	6	76.5	17	23.0
87	25	1402	16	53.6	6	78.6	16	23.1
90	29	1358	16	53.7	6	79.0	16	23.0
93	25	1335	13	53.5	6	80.3	13	22.8
96	24	1365	12	53.2	6	80.4	12	22.9

TABLE 3.—JERSEY FEMALES

Age Mos.	Weight		Height at withers		Circumference of chest		Width at hips	
	No. of animals	lbs.	No. of animals	inches	No. of animals	inches	No. of animals	inches
Birth.	173	53	100	25.7	58	27.4	58	5.7
1	151	67	137	27.0	62	29.8	98	6.0
2	159	90	145	28.9	62	32.5	104	6.8
3	158	121	145	30.6	61	35.4	104	7.7
4	159	158	146	32.6	61	38.1	105	8.5
5	166	199	153	34.5	63	40.9	110	9.4
6	167	243	154	36.2	63	43.7	111	10.3
7	167	286	154	37.7	62	46.3	111	11.0
8	167	324	154	39.0	62	48.4	111	11.7
9	163	360	150	40.1	61	50.1	110	12.4
10	163	393	150	40.9	60	51.5	110	13.4
11	160	420	147	41.7	59	52.8	108	13.3
12	159	450	146	42.2	56	54.0	106	13.7
13	141	479	145	42.8	55	55.3	106	14.1
14	147	507	136	43.3	48	56.3	99	14.5
15	143	530	132	43.9	46	57.5	98	14.9
16	138	558	127	44.4	43	58.6	95	15.2
17	134	580	125	44.7	42	59.5	94	15.6
18	129	601	121	45.2	40	60.0	92	15.8
19	127	622	121	45.5	40	61.1	92	16.0
20	125	642	120	45.9	40	61.9	92	16.4
21	123	665	118	46.2	38	62.8	89	16.5
22	120	684	115	46.4	36	63.8	87	16.8
23	117	708	112	46.7	37	64.5	88	17.1
24	118	733	113	46.9	36	65.3	87	17.5
27	77	816	64	47.7	36	67.0	64	18.1
30	82	824	65	47.9	39	67.5	65	18.5
33	80	832	65	48.0	39	67.8	65	18.7
36	77	855	60	48.2	37	68.2	60	19.0
39	70	899	53	48.6	34	69.2	53	19.5
42	61	895	48	48.6	28	69.1	48	19.5
45	55	898	40	48.5	21	68.9	40	19.7
48	49	897	35	48.5	18	68.7	35	19.8
51	42	927	30	48.5	15	70.1	30	19.9
54	39	952	28	48.6	13	70.5	28	20.0
57	40	944	30	48.6	12	70.2	30	19.9
60	36	937	26	49.0	9	69.8	26	20.1
63	57	948	45	49.0	29	70.2	45	20.3
66	46	955	36	48.7	20	70.9	36	20.2
69	43	966	32	48.6	16	71.0	32	20.4
72	38	973	29	48.4	14	70.8	29	20.2
75	36	964	29	48.5	16	70.1	29	20.1
78	36	998	27	48.6	15	71.1	27	20.3
81	31	991	21	48.4	12	70.6	22	20.3
84	25	959	18	48.0	9	70.7	18	20.3
87	21	952	14	48.3	7	69.9	14	19.9
90	21	1002	13	48.2	6	72.8	13	20.1
93	18	984	12	48.4	5	73.0	12	20.0
96	13	909	5	47.7	--	----	5	19.6

The data presented in the tables and curves level out at twenty-six to thirty months of age when most heifers drop their first calves. The irregularities from there on, especially in weight, are due chiefly to gestation and lactation. The extent of the irregularities in weight due to pregnancy and lactation will become clear from the following example: A Holstein heifer is likely to gain approximately 300 pounds during her first pregnancy, of which about one-half or 150 pounds is due to increase in her body weight; 90 to 95 pounds is accounted for because of the weight of the calf; and approximately 60 pounds represents the weight of the placenta and amniotic fluids. Following calving the heifer will ordinarily continue to lose body weight for about 4 or 5 weeks losing approxi-

TABLE 4.—AYRSHIRE FEMALES

Age Mos.	Weight		Height at withers		Circumference of chest		Width at hips	
	No. of animals	lbs.	No. of animals	inches	No. of animals	inches	No. of animals	inches
Birth	124	72	97	27.6	15	28.9	15	6.1
1	122	89	123	28.6	15	31.1	42	6.5
2	123	119	123	30.2	15	34.3	43	7.2
3	123	158	123	31.9	15	37.6	43	8.3
4	120	198	120	34.0	15	40.8	43	9.3
5	118	245	118	35.5	15	43.2	43	10.1
6	119	293	119	37.2	15	45.4	42	10.9
7	117	344	117	38.5	15	47.9	42	11.7
8	113	389	113	39.9	14	50.2	40	12.5
9	112	433	112	40.9	14	51.3	40	13.0
10	112	469	112	41.7	14	52.8	40	12.6
11	113	502	113	42.5	14	54.2	41	13.8
12	114	538	114	43.2	14	55.7	41	14.3
13	113	577	113	44.0	13	56.6	40	14.7
14	113	611	113	44.8	13	57.8	40	15.1
15	108	638	108	45.1	13	59.3	38	15.5
16	101	669	101	45.7	10	59.6	36	15.8
17	95	697	95	46.2	10	60.5	36	16.1
18	94	725	94	46.5	9	61.3	35	16.3
19	94	758	94	46.8	9	61.4	36	16.7
20	96	793	95	47.4	9	63.3	37	16.8
21	92	818	91	47.6	9	63.3	37	17.2
22	81	844	90	47.8	9	64.6	36	17.4
23	86	871	86	48.1	9	64.8	36	17.6
24	87	902	86	48.3	9	66.3	35	18.0
27	35	909	31	48.1	8	68.1	35	18.7
30	34	945	30	48.3	8	67.9	34	19.1
33	31	965	25	48.9	6	70.3	31	19.6
36	28	968	23	48.7	5	70.0	28	19.8
39	25	1007	19	49.1	5	71.2	25	20.0
42	25	1014	20	49.9	6	71.0	25	20.4
45	20	1038	16	50.0	3	71.3	20	20.6
48	19	1035	15	50.2	3	72.0	19	20.6
51	20	1040	15	49.4	3	70.9	20	20.7
54	18	1058	13	50.3	3	71.7	18	20.5
57	21	1073	15	50.3	3	76.1	21	20.8
60	20	1080	15	50.4	3	74.9	20	21.0
63	21	1037	16	49.2	6	71.9	16	22.8
66	19	1055	14	49.2	6	72.7	14	20.2
69	18	1088	13	49.3	6	75.5	13	21.0
72	16	1132	12	49.1	5	73.9	12	20.9
75	14	1067	9	48.3	3	69.3	9	20.3
78	13	1080	9	48.9	2	69.9	9	20.5
81	13	1092	9	49.1	2	72.4	9	20.8
84	9	1122	9	48.7	--	----	5	20.7
87	9	1109	5	48.8	--	----	5	21.0
90	8	1103	4	48.7	--	----	4	20.4
93	8	1083	4	48.5	--	----	4	20.4
96	7	1143	3	49.2	--	----	3	21.0

mately 50 pounds, depending on her condition of flesh at calving time. Thereafter live weight remains nearly constant until about the fourth or fifth month of lactation when it again increases with renewal of gestation and decreasing lactation. This makes it clear that just before calving the Holstein heifer or cow is likely to weigh about 150 pounds more than she would if she were not pregnant; and five weeks after calving probably 50 pounds less than she would if she were not milking. The situation is in approximately the same proportion in relation to live weight with the other breeds.

Differences due to these causes explain why some heifers have weights and measurements in excess of older animals. Maturity in skeletal growth is reached at about 5 years but increase in body

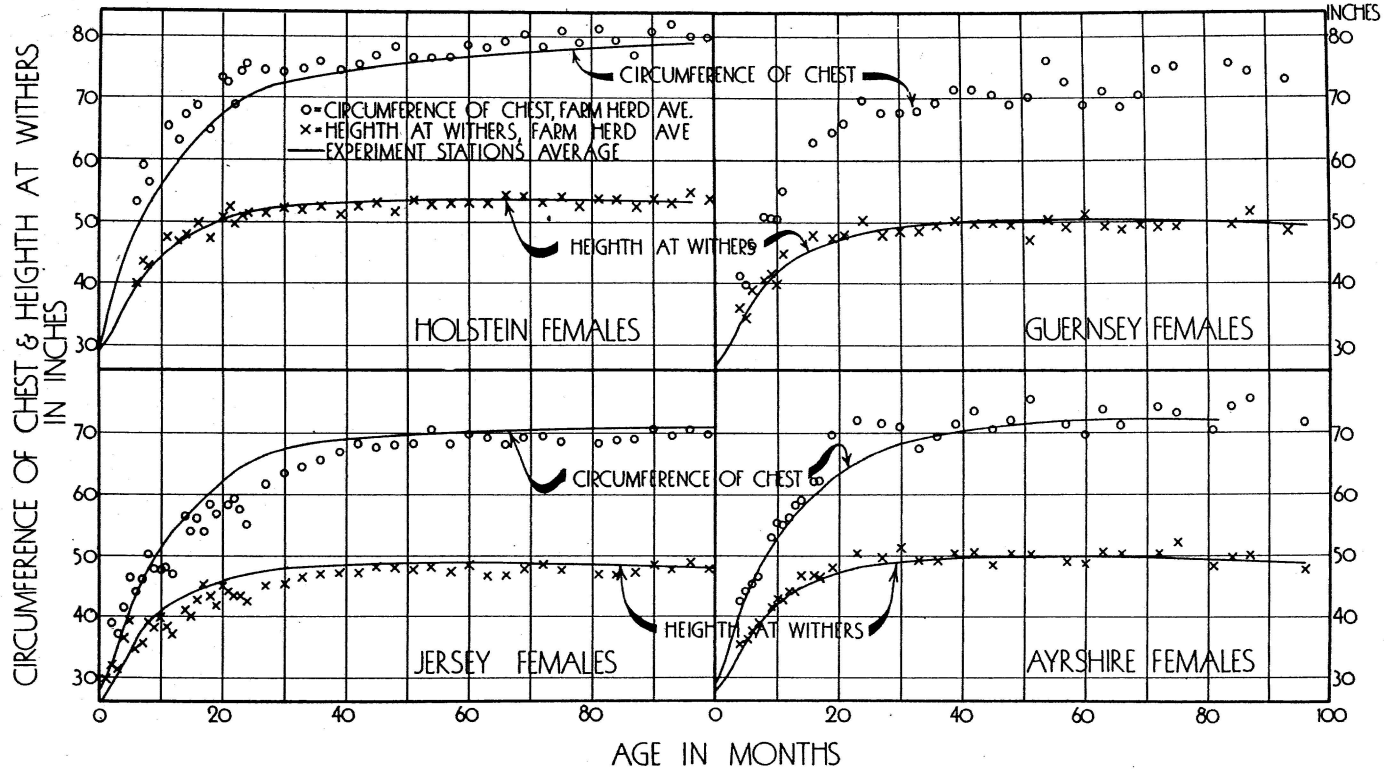

Fig. 3.—A comparison of growth in circumference of chest and height at withers of normal dairy animals in agricultural experiment station herds (based on the numerical values in Tables 2, 3, 4, and 5) with similar measurements taken in the herds of representative breeders and dairy farmers. The smooth lines represent the measurements of the animals in the experiment station herds. The crosses (X) and circles (O) represent the measurements obtained in the herds of representative breeders and on dairy farms. The measurements taken on Holstein and Ayrshire cattle were chiefly in the herds of the better class of breeding establishments; whereas, the measurements taken on Jersey cattle were limited almost entirely to farm dairymen, which explains to some extent why a larger proportion of these measurements, especially at the earlier ages, fall below the average of the animals in the experiment station herds.

TABLE 5.—GUERNSEY FEMALES

Age Mos.	Weight		Height at withers		Width at hips	
	No. of animals	lbs.	No. of animals	inches	No of animals	inches
Birth	108	65	38	26.6	--	---
1	82	77	75	28.2	37	6.1
2	86	102	79	29.8	40	6.9
3	86	133	78	31.6	40	7.7
4	86	173	78	33.5	40	8.7
5	87	216	79	35.3	41	9.4
6	86	260	78	36.9	41	10.1
7	86	305	75	38.4	38	11.0
8	85	350	76	39.9	39	11.7
9	88	389	79	40.9	40	12.3
10	85	427	76	41.7	40	12.9
11	87	459	79	42.6	40	13.3
12	87	490	79	43.3	40	13.7
13	88	524	80	43.9	41	14.2
14	88	556	80	44.6	41	14.6
15	85	584	77	45.0	40	14.9
16	85	605	77	45.3	43	15.2
17	87	634	79	45.9	43	15.4
18	82	663	74	46.4	41	15.8
19	80	686	73	46.7	42	15.9
20	79	712	72	47.0	42	16.1
21	78	737	71	47.3	42	16.5
22	74	763	68	47.7	41	16.7
23	71	788	67	47.9	40	17.1
24	67	818	63	48.0	38	17.3
27	29	876	23	48.9	23	18.2
30	29	880	20	49.3	20	18.5
33	29	905	18	49.7	18	18.7
36	29	901	16	49.9	16	19.1
39	29	924	16	50.0	16	19.3
42	28	952	16	49.9	16	19.6
45	29	971	15	50.1	15	19.8
48	25	990	12	50.4	12	19.7
51	23	980	11	50.6	11	19.9
54	21	1024	11	50.5	11	20.2
57	25	1031	13	50.5	13	20.2
60	25	1055	11	50.6	11	20.0
63	24	1043	10	50.4	10	19.9
66	20	1051	8	50.0	8	20.0
69	19	1073	7	49.8	7	20.1
72	15	1093	6	49.7	6	20.3
75	16	1042	5	49.3	5	19.5
78	14	1084	5	49.4	5	19.8
81	15	1071	5	49.2	5	19.6
84	16	1066	5	49.3	5	19.5
87	16	1065	5	49.4	5	19.7
90	14	1053	4	49.4	4	19.7
93	13	1067	4	48.9	4	19.6
96	13	1070	4	49.6	4	19.7

weight continues until about 7 years of age. Judgment is therefore needed in the use of normal growth standards of dairy cattle.

Measurements taken in the herds of a number of representative breeders and farm dairymen throughout Missouri and nearby states, while not included in the tables, show these animals in some instances, especially in the farm herds, to be slightly smaller at puberty and at time of calving than the animals of the corresponding ages in the several experiment station herds included in the "standards" (Figure 3). These differences between the station and farm-bred cattle are largely overcome with advancing age indicating that they are not hereditary but represent a condition of retarded growth due to lighter feeding. It is evident therefore

TABLE 6.—HOLSTEIN MALES

Age Mos.	Weight		Height at withers		Circumference of chest	
	No. of animals	lbs.	No. of animals	inches	No. of animals	inches
Birth	159	94	159	29.4	89	31.3
1	159	125	159	31.2	90	34.1
2	159	164	159	33.2	90	37.3
3	152	214	152	34.8	88	40.6
4	146	269	146	36.4	87	43.9
5	131	336	131	38.8	77	47.2
6	120	399	120	40.5	69	50.0
7	104	456	104	41.9	61	52.6
8	88	514	88	43.1	54	54.7
9	70	563	70	44.2	42	56.6
10	53	620	53	45.1	35	58.7
11	46	683	46	46.4	31	60.6
12	35	741	35	47.5	25	62.5
13	16	796	16	48.2	16	64.4
14	13	870	13	48.8	13	66.1
15	7	978	7	49.7	7	69.1
16	3	1035	3	50.5	3	71.7
17	3	1090	3	50.7	3	72.7
18	2	1176	2	52.2	2	74.4
19	2	1236	2	53.3	2	75.2
20	2	1286	2	53.3	2	76.0
21	2	1345	2	54.3	2	76.6
22	2	1364	2	54.3	2	77.4
23	2	1410	2	54.9	2	78.5
24	2	1438	2	55.9	2	78.9

that chronological age is not necessarily an index of physiological and developmental age. As a matter of fact it has been shown that the diet may accelerate the growth rate enormously. Studies with rats for example have shown that improved diet resulted in animals reaching mature body weight in about half the normal time.

Data collected at this station have shown that the efficiency of growth in dairy cattle declines with advancing age. This is important inasmuch as the feed cost of making a given amount of

TABLE 7.—JERSEY MALES

Age Mos.	Weight		Height at withers		Circumference of chest	
	No. of animals	lbs.	No of animals	inches	No. of animals	inches
Birth	100	60	100	26.2	65	27.9
1	99	78	99	27.9	66	30.1
2	97	104	97	29.7	66	32.8
3	97	141	97	31.5	66	35.9
4	97	184	97	33.6	66	39.4
5	92	233	92	35.5	65	42.6
6	82	282	82	37.2	58	45.2
7	65	326	65	38.4	42	47.4
8	55	371	55	39.5	34	49.7
9	46	410	46	40.4	28	52.0
10	39	452	39	41.4	22	53.9
11	30	497	30	42.7	20	55.4
12	23	531	23	43.0	15	56.9
13	13	566	13	43.9	13	58.3
14	11	613	11	45.0	11	59.5
15	9	643	9	45.5	9	60.7
16	8	679	8	46.1	8	62.2
17	7	726	7	47.0	7	63.6
18	5	745	5	47.5	5	64.3
19	4	826	4	48.4	4	67.7
20	4	856	4	48.6	4	67.5
21	3	875	3	48.9	3	68.1
22	3	904	3	49.3	3	68.2
23	3	931	3	50.0	3	71.2
24	3	969	3	50.3	3	71.0

TABLE 8.—AYRSHIRE MALES

Age Mos.	Weight		Height at withers		Circumference of chest	
	No. of animals	lbs.	No. of animals	inches	No of animals	inches
Birth	92	81	91	27.9	11	29.7
1	74	101	74	29.4	12	31.9
2	67	133	67	30.9	12	35.1
3	60	173	60	32.7	11	38.1
4	59	217	59	34.5	11	41.0
5	56	267	56	36.1	12	44.3
6	51	321	51	37.9	12	47.0
7	41	378	41	39.4	10	49.4
8	35	433	35	40.7	8	50.9
9	31	488	31	41.8	7	52.7
10	27	536	27	42.7	5	54.8
11	19	601	19	44.1	3	56.2

TABLE 9.—GUERNSEY MALES

Age Mos.	Weight		Height at withers		Circumference of chest	
	No. of animals	lbs.	No. of animals	inches	No. of animals	inches
Birth	50	71	50	27.7	8	29.4
1	45	87	45	29.3	8	31.5
2	42	113	42	30.6	8	34.1
3	38	147	38	32.4	8	37.2
4	34	190	34	34.2	8	40.2
5	33	237	33	36.1	7	43.8
6	28	291	28	37.8	5	46.8
7	26	345	26	39.2	5	48.8
8	22	401	22	40.3	4	50.0
9	15	443	15	41.5	--	----
10	12	494	12	42.5	--	----
11	9	547	9	43.3	--	----
12	7	609	7	44.5	--	----

growth is directly proportional to the time required to make the growth. This arises from the fact that maintenance is the largest item in the cost of growth and the longer the period of growth in proportion to the amount of growth made, the greater the expenditure for maintenance. While the data available are not adequate to warrant very definite conclusions, it appears that it is most economical to grow animals with reasonable rapidity so that inherited growth potentialities may be realized to the fullest extent while they are young. This suggests the idea that animals should be bred not at given chronologic ages but at approximate developmental ages as when they reach given sizes, namely, about two-thirds their mature weight, nine-tenths of mature height at withers and four-fifths of their mature heart girth and width at hips.