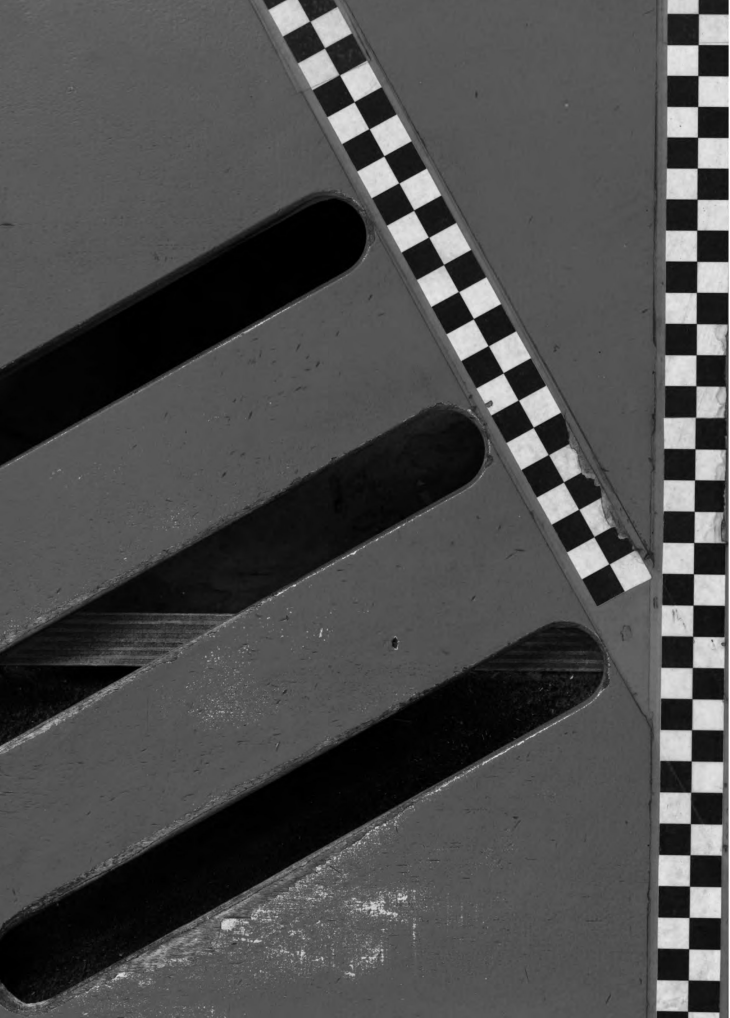FORM AND PERFORMANCE OF THE

DAIRY COW

Thesis for the Degree of B. S.

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1901

** T H E S I S **

— FORM AND PERFORMANCE OF THE DAIRY COW —

by

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Form and Performance of the Dairy Cow.

**** O ****

Much has been said and written upon the form of the dairy
cow, as indicating her production of milk and butter fat. Just
how much this form has to do with her production, or just what
this form should be are still disputed questions. The most
generally accepted theory is that the form does have consider-
able to do with the performance and that the form should cor-
respond closely to that indicated by the score card generally
used for dairy cows. Many opinions, however, are held in regard
to this matter. Among these are many ludicrous ones such as
the belief that because a cow has a long tail or a broad, silky
eccutcheon that she must necessarily be a heavy producer, or
that because she has a soft, pliable skin and good quality she
is a rich milker. Even among the best informed and most success-
ful dairymen we find a great difference of opinion. Some say
that the udder is by far the most important organ of the dairy
cow, and would seemingly overlook considerable deficiency in
other parts if this organ was well developed. Others would put
more dependence upon the size of the belly as indicating the
capacity for food and would overlook the udder, providing it
was not seriously deficient. Again, others would look first to

constitution; others to quality. Some would prefer the thinly
fleshed animal of the so-called milk type and make no discount
on the sway back and the high pelvic arch, while others would
have a larger animal with more pleasing form and a stronger
constitution.

Although much has been said upon this subject both in
farmer's and dairymen's meetings and in live stock journals,
but little accurate investigation has been made. It is natural
to conclude that because the milk is secreted by the mammary
glands that in order to have the largest production we must
have these organs well developed; or, that in order to convert
a large amount of food into milk, we must have well developed
digestive organs. All this is undoubtedly true, yet most of
such conclusions are theoretical and the theory is apt to be
carried too far. What man works out by theory does not always
accord with nature. A natural law is not established by theory
but by use of belated facts and inductive reasoning. Again,
wrong conclusions are often drawn from observations. A farmer
or dairyman may have a number of cows, a large portion of which
are perhaps related and have a similar form. If for instance,
this strain of cows are good producers and have good udders or
some other good feature, the owner is apt to conclude that the
udder or the other excellent quality is what causes the high
production, and overlooks other points of equal importance.

Practically nothing has been done to investigate this
subject . It is surprising indeed that a subject should be so

much talked about and be so prominently before the public,

and yet receive so little scientific investigation.

The object then which the authors of this thesis had

in mind, aside from the practice gained in judging cows and

planning an investigation, was to make a thorough study of

this subject,- to compare the form of the dairy cow with her

performance, - to ascertain if possible how much dependence

may be put upon her form as an indication of her milk and

butter production, - and to determine as closely as possible

the relative importance of the different qualities which

influence the production of the cow.

Many difficulties always attend such an investiagtion,

which, if not eliminated with the utmost care, so change the

results that it is impossible to make any satisfactory con-

clusions. First among these is the difficulty of securing

suitable herds to work upon. Accurate records of milk pro-

duction with frequent butter fat tests must be had. The cows

must be placed under exactly the same conditions as to care,

food and shelter. The different breeds of a herd also cause

difficulty, as the individuals of the breed for instance may

be larger and consume more food and give a larger production

than those of another breed, while the form may score nearly

the same. Another factor which may change the results is the

length of the period of lactation. This surely has much to do

with the yearly productionof a cow, but it is impossible to

show how much it is indicated in the form. Again, we may

study the form of a cow and compare it with her production,
while some ill health, some internal derangement, has vastly
altered the results indicated by that form. Further than this
some temporary derangement of the animal may cause incorrect
scoring. If the skin is tight and the coat rough and harsh
the judge is apt to discredit the quality, while the whole
trouble may be a temporary one caused, for instance, by indi-
gestion. The flesh of the cow, too, may cause a slight
deficiency in scoring while the stage of lactation at time of
scoring often has considerable effect upon the score of the
udder and milk veins. As to the condition of the three herds
studied, it might be said that they were as favorable, if not
the best obtainable without an immense outlay of capital. The
grade herd at the College was not of uniform breeding, yet
as they were all grades and with two exceptions all grade short-
horns, this feature was not particularly objectionable. Their
conditions as to care, food and shelter were exactly the same.
All the conditions with the registered College herd were
favorable, except that it contained four breeds which so
divided it that it was impossible to secure the most satisfactory
results from the comparatively small number of each breed.
The records of both these herds were accurately taken and
carefully recorded. The individuals of the Welch herd, of
which twenty-five were studied, were placed under the same
conditions as to care, food and shelter. The cows, which were
mostly grades, were somewhat divided as to breeds. The weights
of milk were sufficiently accurate but the butter fat tests

were not numerous enough to insure the greatest accuracy in
the average percent for the year, and less reliance should
be placed upon the butter comparisons of this herd as compared
with the others. (It must be remembered that comparisons
cannot be made between animals of different herds as their
conditions were different.)

The methods employed in this work may be described
as follows: In studying the form of the cow, use was made
of the ordinary score card for dairy cows which is here
presented.

Scale of Points.	Perfect	Students' Estimate	Cor'd
GENERAL APPEARANCE:			
Age, estimate------; corrected-----------			
Weight, estimated----lbs; corrected----- lbs.			
Form, wedge-shaped, viewed from front, side and above------------------------------------	9	----	---
Quality, hair fine; skin soft; medium thick's bone clean -------------------------------	7	----	---
Temperament, nervous --------------------	4	----	---
	20		
HEAD:			
Muzzle, clean cut; mouth large;nostrils large; face lean, long and dishing -------------	2	----	---
Eyes, full, mild, bright--------------------	1	---	---
Forehead, broad---------------------------	1	---	---
Ears, medium size, fine texture------------	1	---	---
Horn, small at base-----------------------	1	---	---
	6		
FOREQUARTERS:			
Neck, thin, medium length ---------------	2	---	---
Withers, lean sharp----- ---------------	2	---	---
Shoulders,light,oblique ------------------	2	---	---
Legs, short, straight, cleaned boned---------	1	---	---
	7		
BODY:			
Brisket, thin, sharp-----------------------	1	----	---
Chest, deep through lungs, girth large----ft--- inches--------- ------------------------	8	----	----
Ribs, well sprung, broad, far apart-----------	3	---	---
Belly, large, roomy------------------------	7	---	---
Chine, large, prominent open--------------	1	----	---
Back, high, lean -------------------------	1	---	---
Loin, broad------------------------------	2	---	---
Flank, deep, thin-------------------------	1	---	---
Navel, large-----------------------------	2	---	---
	26		
HINDQUARTERS:			
Hips, wide apart--------------------------	2	-----	---
Rump, long and high----------------------	2	-----	---
Pin Bones or Thurls, high wide apart---------	1	----	---
Thigh, thin, incurving---------------------	4	----	---
Tail, fine, reaching hock-------------------	1	-----	---
Escutcheon, spread'g and high-------------	1	-----	---
Udder, long, not fleshy, attached high; quar. even-----------------------------------	17	-----	---
Teats, large, evenly placed----------------	5	-----	---
Milk veins, large tortuous, branching--------	4	-----	---
Milk wells, large-------------------------	3	-----	----
Legs, short, clean boned, far apart----------	1	-----	---
	41		
Total-----------------------------------	100		

(In scoring polled or dehorned cows the credit usually given the
horns was added to quality under general appearance as the horns
are usually considered to be an indication of quality). The judges
each scored the cows separately, and while still before the cow,
carefully compared notes. If they agreed upon the individual
scores these were placed in the corrected column at once but if
there was a difference in the scores on the same point, that
quality was carefully examined again, and the proper mark decided
upon. If each judge continued to think that his first mark was
  correct, the difference between the two marks was divided and
the result placed in the corrected column as the proper score. It
might be said that a well fixed standard of scoring was established
  which was quite uniformly held throughout the time of judging.
The cows might have been scored a trifle too high or too low, but
that makes no material difference so long as a uniform basis was
employed. The accurate weights of all the cows were taken with
the exception of a few from the herd of A. M. Welch of Ionia, of
which the approximate weights were obtained. Measurements were
taken of the cows according to the system employed by the American
Holstein-Friesian Association and described in the "Outlines of
the Advanced Registry System" as follows: "The two items of
height are taken perpendicularly from the ground to the top of
the animal, the one immediately over the knee and center of the
shoulder and the other over the hook bone to the center of the
back; the length of the body is taken from the extreme front of
the shoulder point to the extreme rear and highest point of the
rump, diagonally in a straight line; the length of the rump,
from the extreme front side of the hook bone to the extreme of

the rump as described above; the width of hips from the outside
of one hook bone to the outside of the other in a straight line;
the width of the thurl from the outside of one thrul bone to
the outside of the other, also in a straight line; the girth
by a tape closely fitting the smallest circumference of the
chest". Although the authors of this work were unable to use
these measurements, they have been inserted in the tables with the
hopes that they may prove valuable to those wishing to make a
further study of the subject.

The milk and butter production of each cow for one year
was next obtained and compared with the corresponding total scores,
also with certain individual scores which were regarded as being
most important. In order to make this work more conclusive, three
bases of comparisons were adopted,-those of the butter production,
milk production and total score. To explain more fully each herd
was arranged in order according to butter production that is
upon a butter basis, the highest producer being placed first;then
the herd was divided into halves and the production of the separate
halves compared with the scores of those respective divisions.
(The M.A.C. grade herd was also divided into thirds). Each herd
was then arranged in order according to total scores and the above
comparisons made. The milk production was also compared with the
scores both upon a milk and total score basis.

Comparisona of scores and butter records upon a butter basis.

Table 1.

	Total scores	Average scores.	Total butter	Avr. But.
1st half	1094.7	81.	5019.8 #	371.8#
2nd half	1065.7	78.8	4003.2 #	296.5#

COLLEGE GRADE HERD.

Name	Breed	% Fat	lbs. Milk	lbs. Butter	Total Score	Gen'l. app	Head	Fore quar	Body	Chest	Ribs	Belly
18	G.S.	3.96	8357	449.9	80.8	17.6	4.1	5.6	20.3	7.6	2.4	5.5
87	G. H.	3.6	10706	449.6	79.6	17.1	4.7	5.7	21.4	7.5	2.4	5.6
92	G. S.	3.7	9435½	418.3	78.2	17.2	4.	5.3	21.9	7.8	2.5	5.8
139	G. S.	3.9	8869	403.5	82.8	16.6	4.4	5.6	22.2	7.7	2.6	6.6
98	G. S.	4.	8356	389.9	87.	19.5	4.7	6.5	22.8	7.8	2.8	6.2
103	G. S.	4.3	7795	381.9	79.7	17.3	4.5	4.9	21.	7.8	2.5	6.2
142	G. S.	3.8	9015	357.6	79.2	17.3	4.3	6.6	18.9	5.7	2.3	4.4
86	G. J.	4.3	7109	348.3	83.6	18.4	4.4	6.1	21.4	7.7	2.3	5.4
89	G. S.	3.8	7744	3433	88.1	19.1	4.5	5.6	21.6	7.5	2.5	6.1
39	G. S.	3.7	7758	335.	77.6	15.8	3.6	5.5	19.8	7.7	2.	5.2
143	G. S.	3.6	7286	331.2	83.6	16.5	4.5	6.3	21.5	7.7	2.8	5.8
95	G. S.	3.8	7438	329.7	80.5	15.8	4.2	6.	20.4	6.7	2.4	6.
109	G. S.	3.6	7963	325.1	74.2	17.8	4.1	5.7	19.2	6.6	2.3	5.6
90	G. S.	3.2	8706	325.	79.6	16.7	4.2	5.2	20.8	7.7	1.9	5.7
140	G. S.	4.	7044	320.5	80.1	17.2	4.1	6.	20.4	7.8	2.5	5.6
97	G. S.	3.9	7009	318.9	82.3	17.7	4.5	5.9	21.7	7.	2.6	5.7
141	G. S.	3.8	7026	311.5	72.3	15.	3.8	5.2	18.	6.4	2.2	4.8
106	G. S.	3.2	8291	306.8	78.9	15.6	3.4	5.6	21.2	7.5	2.7	5
94	G. S.	3.9	6586	304.5	68.9	16.5	4.2	5.1	20.5	7.7	2.3	5.7
96	G. S.	4.2	6193	303.4	88.	16.2	4.6	6.1	23.8	7.7	2.9	6.
108	G. S.	3.7	7008	302.5	79.6	18.5	4.	5.9	22.4	7.7	2.9	6.6
93	G. S.	3.8	6735	298.6	75.1	15.5	3.6	4.9	20.8	7.7	2.1	5.5
107	G. S.	3.6	6886	288.9	79.2	17	4.3	6.1	19.4	6.5	1.9	4.5
88	G. S.	3.8	6442	285.6	76.8	17.4	4.1	5.8	20.9	6.7	2.5	5.6
110	G. S.	3.5	6751	279.7	75.	17.8	3.7	5.9	20.6	7.6	1.7	4.7
138	G. S.	3.4	6448	263.5	89.3	18.9	4.6	5.7	22.8	7.	2.6	6.8
105	G. S.	3.	7120	256.3	80.4	17.	4.4	5.8	22.4	7.8	2.8	6.3

COLLEGE GRADE HERD.

nd ar	Udder	Tests	Milk veins	Milk wells	Wt. lbs.	Girth	Lgth. body	Height Shou- lders	Hips	Wid. of Hips	Thl. Rump	Bones
.8	13.	4.8	3.	2.4	1047	5-11½	5-1	4-1½	4-2	1-8½	1-8	1-1
.7	11.	4.	2.6	2.8	1124	6-2	5-3½	4-2½	4-3½	1-11	1-10	1-
.8	11.5	4.3	2.7	2.4	1208	6-5	5-4	4-5	4-6	1-10½	1-10	1-1
.	14.5	4.7	3.5	2.2	1145	6-	5-1	4-1½	4- ½	1-8	1-8	1-3
.5	13.	4.6	3.	3.	945	5-11	4-11½	4-2	4-2	1-8	1-7½	11½
	12.5	3.6	3.5	2.7	1343	6-8	6 1	4-4	4-4	1-11	1-9½	1-1
.1	12.	4.3	2.9	2.8	947	5-9½	5-3	4-4	4-5	1-8	1-10	1-2
.3	13.	4.5	2.8	2.4	895	5-8	5-	4-2½	4-2	1-8½	1-8½	1-½
.3	16.3	4.9	3.5	2.8	1033	6-3	5-½	4-4	4-3½	1-10½	1-7½	1-1½
.9	13.	4.6	3.2	2.6	960	6-	5-1½	4-3	4-2	1-9½	1-8½	-11¼
.7	13.	4.5	3.8	2.7	942	5-10	5-2	4-4	4-3	1-8½	1-9	1-1
.1	15.5	4.7	2.8	1.8	1107	6-4	5-1	4-4	4-4½	1-10	1-10	11½
.4	10.	2.8	1.6	2.5	982	6-	5-3	3-11	4-	1-9½	1-9½	1
.7	13.6	4.6	3.4	2.4	1083	6-1	5-1½	4-3	4-3½	1-7½	1-8	1
.4	12.5	4.8	3.5	2.8	1104	6-3	5-2	4-4	4-5	1-8	1-10	1
.5	12.4	4.	2.9	2.8	985	6-	5-2	4-2	4-2	1-10	1-8½	1-1
.3	11.5	4.3	3.	2.	996	5-9	5-½	4-1½	4-2	1-8½	1-7½	1-½
.1	14.	4.4	2.6	1.9	1098	6-1	5-3½	4-3	4-1	1-10½	1-10½	1
.6	8.8	2.5	2.	1.6	983	5-10	4-11	4-2	4-1½	1-7½	1-8½	11
.4	14.5	4.8	3.5	3	886	5-10½	4-9½	4-	4-1	1-9	1-8	1-1
.8	10.	3.7	2.	2.8	1247	6-5	5-5	4-½	4-3	1-10	1-9	1-1
.3	11.7	3.8	3.	2.5	1181	6-7	5-4	4-4½	4-7	1-11	1-10½	1-1½
.4	13.	4.	2.5	2.5	1052							
.6	10.	3.9	2.4	2.7	1017	5-11	5-5	4-2	4-1	1-8	1-8½	1-
.	10.	3.	2.	2.2	1075	6-1	5-½	4-2½	4-3½	1-10	1-9½	1-1
.3	15.1	4.8	3.6	2.8	1202	6-3	5-3	4-3	4-4	1-10½	1-10	1-3
.8	11.	4.3	2.5	2.	1159	6-5	5-6	4-2	4-1	2-	1-10	1-1

Note – All measurements for this and following tables are given in feet and inches.
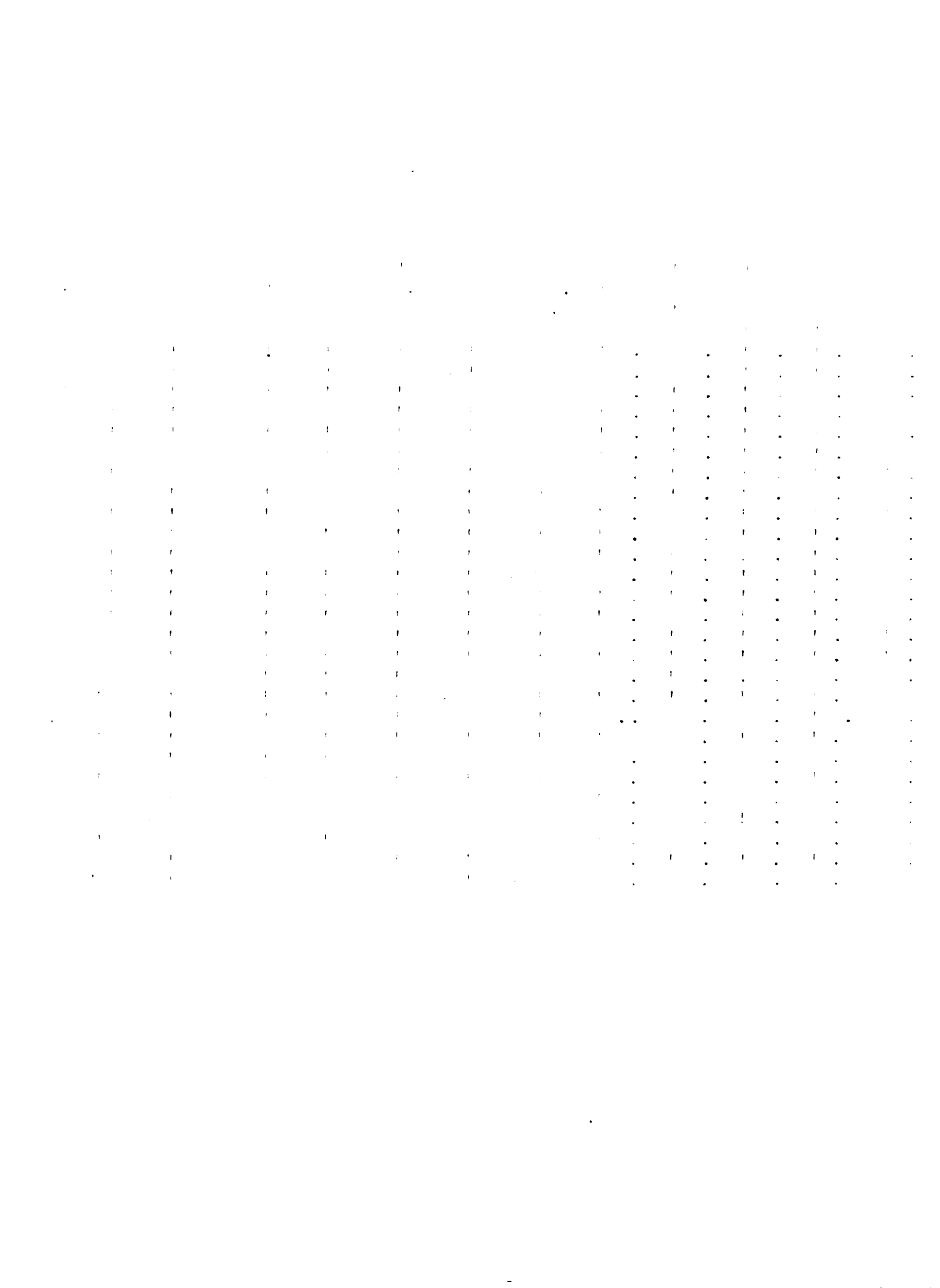
Table 2.

	Total scores.	Avr. scores	Total butter.	Avr. butter.
1st. div.	734.	81.5	3542.3 lbs.	393.6 lbs
2nd. "	709.1	78.8	2903.7 "	322.6 "
3rd. "	712.3	79.1	2583. "	287. "

In the first table we notice that the half having the highest butter record also has the highest scores, while in Table 2 the scores of the third division are a trifle higher than those of the second. The general tendency in this comparison is for the best scores to correspond to the best butter production, although the latter table may be regarded as an exception to the "dairy farm" theory.

Comparison of scores and butter records upon a score basis.

Table 3.

	Tot. scores.	Avr. scores	Tot. butter.	Avr. butter.
1st. half	1126.	83.4	4582.3 lbs.	339.4 lbs
2nd. half	1034.4	76.6	4437.8 "	328.7 "

Table 4.

	Tot. scores.	Avr. scores.	Tot. butter.	Avr. butter
1st. div.	765.5	85.1	3152.3 lbs.	350.2 lbs.
2nd. "	717.9	79.7	3012.2 "	334.7 "
3rd. "	677.1	75.2	2865.1 "	318.3 "

Here we find that the highest scores in either table correspond with the best butter production, a drop of 6.8 points in the first table being equivalent to 10.7 lbs. of butter.

The decrease in Table 4, though very perceptible, is not so marked as in Table 3.

Comparison of scores and milk records upon a milk basis.

Table 5.

	Totl. milk	Avr. milk	Tot'l. scores	Av. scores.
1st. half	114076 lbs.	8450 lbs.	1093.4	80.9
2nd. half	92000 "	6815 "	1072.8	79.4

Table 6.

	Tot. milk	Avr. milk	Tot'l scores.	Avr. scores.
1st. div.	79530 lbs	8836.6 lbs.	931.2	81.2
2nd. "	66488 "	7387.5 "	720.8	80.1
3rd. "	60058 "	6673. "	714.2	79.3

In each of the above tables it should be noticed that the results confirm the theory that the best formed animals are the best producers.

Comparison of scores and milk records upon a score basis.

Table 7.

	Tot. sc.	Avr. sc.	Tot. milk	Avr. milk
1st. half	1126.	83.4	100472 lbs.	744.2 lbs.
2nd. half	1034.2	77.4	105904 "	784.4 "

Table 8.

	Tot. sc.	Avr. sc.	Tot. milk	Avr. milk
1st. div.	765.5	85.1	67571 lbs.	7508 lbs
2nd. div	717.9	79.7	71818 "	7979 "
3rd. div.	676.8	75.2	66987 "	7443 "

In this comparison the results are just the reverse of
those in the two previous tables. In table 7 we find a difference
of 402 lbs of milk in favor of the lower average score, but in
table 8, the production of the first division is only slightly
in advance of the third; while the second division shows a
much larger production than either of the other two.

As considerable attention is usually given to the udder
and milk veins in judging dairy cows, it was thought best to
prepare the following tables to show the comparison between
these points and the milk and butter production. (The score
used is the combined score of udder and milk veins.)

Comparison of udder and milk vein score with butter records
upon a score basis.

Table 9.

	Tot. sc.	Avr. score	Tot. butter	Avr. butter.
1st. half	230.7	17.	4655.8 lbs.	344.8 lbs
2nd. half	182.2	13.5	4372.6 "	323.1 "

Table 10.

	Tot. sc.	Avr. score	Tot. butter.	Avr. butter
1st. div.	159.4	17.7	2941.4 lbs.	326.8 lbs.
2nd. div	139.1	15.4	3155.9 "	350.6 "
3rd. div.	114.6	12.7	2933.1 "	325.9 "

In Table 9, a difference of 3.5 in the average scores of
the two halves of the herd corresponds to an increased pro-
duction of 21.7 lbs. of butter in favor of the first half. In
table 10, however, there is only the slight difference of .9 lbs
of butter between the first and third divisions as corresponding

to a difference of 5 between the average scores, while the second division shows an approximate butter production of 24 lbs. more than either of the others.

Comparison of udder and milk vein score with butter records upon a butter basis.

Table 11.

	Tot. butter.	Avr. butter	Total sc.	Avr. score.
1st. half	5025.8 lbs	372.2 lbs	215.7	15.9
2nd. half	4002.7 "	296,5 "	197.4	14.6

Table 12.

	Tot. butter	Avr. butter	Total sc.	Avr. score.
1st. div.	3542.3 lbs	393.6 lbs.	144.3	16.
2nd. "	2903.2 "	322.6 "	141.3	15.7
3rd. "	2583. "	287. "	127.	14.2

In both of the above tables the "dairy farm" theory holds good. In Table 11 a difference of 1.3 between the average scores corresponds to a difference of 75.7 lbs of butter in favor of the better form. In Table 12, a difference of .3 between the average scores of the first and second divisions corresponds to a difference of 71. lbs in favor of the first, while a difference of 1.5 between the average scores of the second and third divisions corresponds to a difference of 35.6 lbs in favor of the second.

Comparison of udder and milk vein scores with milk records on a score basis.

Table 13.

	Tot. sc.	Avr. sc.	Tot. milk	Avr. milk
1st. half	230.9	17.	103693 lbs.	7681. lbs
2nd. half	182.2	13.5	102283 "	7576 "

Table 14.

1st. div.	159.4	17.7	68733 "	7637 "
2nd. div.	139.1	15.4	68306 "	7589 "
3rd. div.	114.6	12.7	69037 "	7671. "

In Table 13, a difference of 3.5 between the average scores, corresponds to a difference of 1¢5 lbs of milk in favor of the higher score, while in Table 14 the results are reversed, the production of the third division being greater than either of the others.

In making a further study of the individual scores of this herd in order to determine the relative importance of each in the judging of dairy cows, the following plan was adopted. The cows were first arranged according to a milk or butter basis as before, the herd divided into three equal parts, and those points of the score card seledted which were regarded as most important. The scores of each division were then averaged and figured in percents, the perfect mark of each point on the score card being considered as 100%. These percents were then compared with each other and with the milk and butter production.

Comparison of leading points upon a butter basis.

Table 15.

	Avr. tol. butter	scores	Genl app	H'd	quar	b'd	ch't	rbs	bly	quar	Udr	tts	vs	ws
1st div	393.6#	82%	84%	88%	82%	81%	93%	83%	82%	80%	76%	88	76	86
2nd div	322.6#	79	82	81	82	78	90	79	78	7_8	75	86	72	80
3rd div	287.	79	82	83	81	82	92	80	82	75	68	81	65	82
Average	334.4#	80	82.6	84	81.6	80.3	91.6	80.6	80.6	77.6	73	85	81	82

(Header spanning groups: "Fore" over H'd, quar; "Hind" over quar, Udr, tts; "mk mk" over vs, ws)

Here we note considerable variation in the relation of
scores to butter production. Although the percents in the
second division do not complete an even gradation from the first
to the third, and in some points are even lower than the third;
yet in nearly every case we find that the percents of the first
division, are greater than those of the third, especially those
of the head, hind quarters, udder, teats, milk veins, and milk
wells. As the head is of minor importance so far as the pro-
duction of butter is concerned, and the high percent of the hind
quarters is due largely to the development of the mammary organs;
we conclude that the latter have the most marked influence on
the butter production, while the percents for the chest, ribs
and belly in their respective divisions were more nearly equal.

Comparison of leading points upon a milk basis.

Table 16.

	Avr. Milk	T'tl score	Genl app	Hd	Fore quar	Body	Cht	Rbs	Bly	Hind quar	Udr	Tts	Mlk vns	Mlk wls
div	8836.6	81%	82%	85	81%	81%	93%	82%	81%	79%	75%	87%	75%	84%
div	7387.5	80%	81%	83	83%	79%	91%	81%	80%	79%	76%	87%	71%	80%
div	6673.	79%	82%	83	81%	82%	91%	80%	81%	75%	69%	76%	66%	85%
;	7632.3	80%	81.3	83.6	81.6	80.6	91.6	81	80.6	77.6	73.3	83.3	70.6	83

In this table the results compare very favorably with those of the previous table, in that the udder,teats and milk veins are most indicative of the milk and butter production. The percents of the chest and ribs also compare very satisfact-orily.

WELCH HERD.

Name	Breed	%Fat	lbs. Milk	lbs. Butter	Total score	Gen'l app	Head	Fore quar	Body	Chest	Ribs	Belly
Brockle	G.S.	3.75	12607	551.5	84.3	16.8	4.2	5.7	23.1	7.2	2.3	5.8
Red Nell	G.S.	4.6	9927	532.7	984.3	18.7	4.	5.8	20.6	6.6	2.4	6.6
Giraffe	G.J.	5.75	7272	487.8	75.1	16.	3.5	5.2	20.	7.3	2.1	5.5
Sleepy	G. S.	4.17	9538	464.	84.8	16.3	4.2	6.1	22.1	7.2	2.6	6.1
Straddle	G.S.	4.	11880	454.4	84.5	18.7	3.9	6.2	22.2	7.3	2.	6.
Taylor	G.J.	5.73	6746	454.1	71.	16.9	4.5	5.7	20.8	7.3	2.4	5.6
Michigan	G.S.	3.72	10267	445.58	82.7	15.9	5.1	5.7	21.5	6.8	2.5	6.4
Straight horn	J.	5.2	7271	441.1	85.	17.8	4.5	6.5	20.7	6.8	2.6	5.6
Shorty	G.S.	3.45	10841	436.3	87.7	18.2	4.	5.9	22.2	6.8	2.7	6.8
Hayes	G.J.	5.	7223	421.3	84.7	18.6	4.2	5.3	20.4	6.2	2.4	6.5
Wolvert	G.S.	3.7	9710	419.14	82.8	17.9	3.8	6.1	22.	7.2	2.5	6.
Cornell	J.	5.17	6911	416.83	78.1	16.	4.5	5.	21.3	7.3	2.1	5.8
Madison	G.S.	3.95	8783	400.24	87.2	18.9	4.3	6.	21.1	6.5	2.5	5.7
Sprague	G.H.	3.87	8709	393.2	88.9	18.2	4.3	6.3	21.6	7.3	2.3	6.5
P.Lassie	J.	3.45	6171	392.4	84.2	17.6	4.6	6.3	20.7	6.	2.8	6.3
Old Nell	J.	4.6	7305	392.03	88.1	18.6	4.8	6.	22.1	7.5	2.5	6.7
Cutter	G.J.	4.	8028	374.6	85.4	18.7	4.1	5.	22.3	7.	2.5	6.7
Piercy	G.J.	5.37	5681	355.9	76.9	13.5	5.3	6.1	20.6	7.2	2.2	5.2
Zoe	G	5.2	5832	353.8	78.9	16.7	4.2	6.4	20.3	7.	2.6	5.4
High-blood	J	3.4	8772	347.9	81.4	17.8	4.4	5.3	21.6	7.3	2.6	6.6
Spot	G.S.	4.22	6958	342.55	80.5	16.7	4.1	4.9	20.4	7.5	2.5	6.
Rosy	J.	4.62	6322	340.7	80.2	18.4	4.4	5.3	21.9	7.4	2.8	6.5
Slivers	G.	4.32	6692	337.31	85.2	17.9	4.2	6.5	21.1	7.5	2.3	5.8
Coltrin	G.	4.9	3888	222.3	78.9	16.1	4.2	6.1	20.1	6.8	2.2	5.6
Cherry	G'S.	4.2	4200	205.8	75.1	15.1	4.	5.6	19.9	6.2	2.7	6.

WELCH HERD

Number Udder	Teats	Milk veins	Milk wells	Wt. lbs.	Girth	lgth. body	Height Shoulders	Hips	Wd. of Hips	Rump	Thl. Bones
.5'15.	4.	3.5	2.5	1105	6-1	5-2	4-3	4-6	1-9½	1-8	1-1½
.8'15.	4.5	3.	2.5	1100	6-0		4-3	4-3	1-9	1-7	1-
.4'13.5	4.5	2.5	1.6	1050	5-9	5-3	4-5½	4-5½	1-9½	1-8½	1-1½
.1'15.5	4.4	3.7	2.7	1262	6-2	6-3	4-4	4-4	1-8½	1-8	1-2
.5'13.7	3.5	2.8	3.	1250	6-	5-2	4-4½	4-2½	1-11	1-9½	1-2
.1'13.4	4.5	2.5	2.3	1015	5-11	5-2	4-2½	4-2	1-8	1-9	1-1
.5'13.	4.6	3.5	3.9	1620	5-9	5-8	4-6	4-7	1-11	1-9	1-3
.5'14.4	4.7	3.4	2.6	820	5-5	4-10½	4-1	4-½	1-7	1-8	1-
.4'16.7	4.7	3.6	2.6	1185	5-11	5-½	4-1	4-1½	1-8	1-8½	1-
.2'16.1	4.8	3.4	2.7	1050	5-10	4-9½	3-11	4-½	1-8	1-7	11½
. '14.	3.5	3.	2.9	1080	6-1	5-1	4-4	4-3½	1-9	1-9½	1-1/2
.3'12.5	4.4	3.	2.4	1050	5-10	5-½	4-1	4-	1-8	1-7	1-½
.9'15.6	4.9	3.4	2.6	1300	6-	5-5	4-5	4-5	1-10	1-8	1-1
.5'15.8	4.3	3.9	2.9	1200	6-2	4-10	4-1	4-2	1-8	1-7	1-1
. '14.2	4.3	3.9	2.9	790	5-4	4-9½	3-9	3-10½	1-5	1-7	11½
.6'16.4	4.6	3.1	2.6	931	5-10	4-7	3-11	3-9½	1-7½	1-8	11
.3'15.5	4.5	3.1	2.7	1150	6-1	5-	4-3	4-3	1-8½	1-8½	11½
.4'13.8	3.3	2.5	2.5	1035	5-9	5-3½	4-2½	4-4	1-7½	1-9	.1-1
.3'12.2	3.9	3.	2.2	925	5-7	5-1	4-	4-3	1-7½	1-7	1-
.3'13.	3.	3.6	2.8	1150	6-	5-3	4-1	4-1	1-9	1-9½	1-1½
.4'14.9	4.7	2.7	2.6	1180	6-3	5-2	4-3	4-3	1-8	1-8	1-1
.2'12'	3-2	2.9	2.1	875	5-8	4-9	3-10	3-11	1-7	1-7	11
.5'15.	4.2	3.5	2.8	805	5-6	5-1	4-1	4-½	1-6	1-7	1-½
.4'14.	4.3	2.7	2.	750	5-8	4-10	4-3	4-4	1-7	1-8	11
.2'10.5	4.7	1.6	2.7	1250	6-3	5-	4-2	4-2	1-9½	1-9½	1-1

Comparison of total scores with butter records upon a butter basis.

Table 1.

	Tot. butter.	Av. butter.	Tot. sc.	Avr. Score.
1st half	5724.7#	457.9#	1028.6	82.2
2nd half	4258.4#	340.6#	1027.3	82.2

From this table the development of form shows no relation to butter production, the average scores of each half being equal.

Comparison of total scores with butter records upon a score basis.

Table 2.

	Tot. sc.	Avr. sc.	Total butter.	Avr. butter
1st half	1074.2	85.9	5384.6#	431.5#
2nd half	982.7	78.6	4588.5#	367. #

In this table we obtain a difference of 64.5# in the average butter production corresponding to a difference of 7.3 between the average scores, in favor of the higher production.

Comparison of total scores and milk records upon a milk basis.

Table 3.

	Tot. milk	Avr. milk	Tot. score	Avr. score.
1st half	120003#	9600 #	1059.6	84.7
2nd half	77531#	6202	996.2	79.7

Comparison of total scores and milk records upon a score basis.

Table 4.

	Tot. sc.	Avr. sc	Total milk	Avr. milk
1st half	1072.2	85.7	111889#	9591 #
2nd half	983.7	78.7	85344#	6827 #

In both of the above tables the better developed dairy forms are indicative of the higher milk production.

An interesting comparison was made between the milk and butter production of the Grade Shorthorns, the Thoroughbred and Grade Jerseys, and the Guernseys.

Table 5.

Breed	No. of cows	Tot milk	Avr milk	Tot. of butter	Avr butter	Avr scores
Shorthorns	10	94711	9481	4252.1 #	425.2	83.4
Jerseys	11	77702	7063	4224.6 #	329.5	80.9
Guernseys	3	16412	5470	913.4 #	304.4	81.

In this table only a small number of cows were considered. The results in this case, however, show that the milk and butter production of the Grade Shorthorn is greater in proportion to total scores than either the Jerseys or Guernseys, which we

conclude to be a point in favor of the general purpose Short-
horn.

Another interesting conclusion drawn from this table shows
that for every pound of weight the Shorthorns gave .34# of
butter per year, the Guernseys .36# and the Jerseys .4#. Also
that for every pound of weight the Shorthorns gave 7.6# of
milk per year, the Jerseys 7. # and the Guernseys 6.6#

Another comparison was made by taking the Grade Shorthorns
of the herd, ten in number, arranging them in order according
to milk or butter production and dividing them into lots of
five each. The leading scores of each half were averaged
and reduced to percents.

Comparison of scores and butter records upon a butter
basis.

Table 6.

	Avr butter	'Tot. scors	'Genl' app	'Fore' hd	'quar	'bdy	'cht	'bbs	'Hind' bly	'quar	'Udr	'Mk tts	'Mk vns	'wls'
1st half	'448.9'	84%	'86%	'71	'84%	'84%	'88%	'79%	'88%	'88%	'85%	'84%	'83%	'84%
2nd half	'360.5'	83%	'87%	'67	'81%	.81%	'86%	'86%	'87%	'84%	'84%	'90%	'71%	'89%
Average	'404.7	'83'5	'86.5	'69	'82.5	'82.5	'87	'82.5	'87.5	'84.5	'84.5	'87	'77	'865

Table 7.

Comparison of scores and milk records upon a milk basis.

Avr. butter	Tot. scores	Genl app	hd	Fore quar	bdy	cht	rbs	bly	Hind qmar	Udr	tts	mk vns	mk wl
1st half 11104	86.1	88½	71½	84%	84%	87½	79%	90%	85%	86%	85%	82%	83
2nd half 7839	80.	85	68	82	81	87	85	88	83	83	89	72	80
Average 9472	83	86.5	69.5	83	82.5	87	82	89	84	84.5	87	77	86.5

In the above tables we conclude that there is a tendency for the body, chest, belly, udder and milk veins to be best developed in those cows which excel in milk and butter production.

A similar comparison was made with the Guernseys, Grade Jerseys and Jerseys, fourteen in number.

Comparison of scores and butter records upon a butter basis.

Table 8.

Avr. butter	Tot. scores	Genl app	hd	Fore quar	bdy	cht	rbs	bly	Hind quar	Udr	tts	mk vns	mk wl
1st half 429.3	81%	87%	73%	83%	81%	86%	81%	86%	82%	84%	91%	78	81
2nd half 333.1	81	85	73	83	82	90	82	86	80	80	75	76	81
Average 378.5	81	86	73	82.5	81.5	88	81.5	86	81	82	83	77	81

Comparison of scores and milk records upon a milk basis.

Table 9.

	Avr milk	Tot. scrs	Genl app	hd	Fore quar	Bdy	cht	rbs	bly	Hind quar	udr	tts	mk vns	mk wls
1st half	7540	83%	88%	71%	78%	82%	88%	80%	89%	83%	84%	87%	80%	83%
2nd half	5904	79	84	75	87	80	88	82	82	80	80	79	75	80
Average	6722	81	86	73	82½	81	88	81	85½	81½	82	83	77½	81½

In this comparison with but few exceptions, the highest scores correspond to the higher production.

COLLEGE REGISTERED HERD.

Name	Brd	%Fat	lbs. Milk	lbs. Butter	Total score	Genl app	Head	Fore quar	Body	Chst	Ribs	B'
Bell Sarcastic	H	3.17	23149	839.3	83.2	18.9	4.7	5.7	23.3	7.5	2.4	6.
Col. Rosa Bonheur	H	3.25	13962	529.9	86.7	17.5	3.9	6.	22.4	7.2	23.5	6.
Becky	B.S	3.56	10148	422.6	85.3	17.	4.9	5.9	22.3	7.4	2.8	6.
Col. Pauline Wayne	H	3.2	11090	415.6	90.	19.1	4.9	5.7	22.3	7.3	2.3	6.
Pogis IV	J	4.28	6294	314.3	85.8	17.9	5.5	6.5	22.9	7.	2.8	65
Col. Houwtje Maid	H	3.43	7282	299.6	83.4	17.5	3.8	5.4	20.2	7.	1.9	6.
Pogis III	J	4.5	5326	283.7	88.6	19.1	4.8	6.1	23.5	7.5	2.6	6.
Col. Belle	H	3.2	7489	279.7	83.1	16.6	3.9	5.1	21.6	7.7	2.3	5.
Col. Rosa B. Queen	H	3.47	6603	267.8	81.	15.8	4.4	6.	22.1	6.8	2.6	6.
Col. Becky	B.S	3.47	6231	252.2	77.3	16.	4.9	5.7	22.1	7.6	2.2	5.
Col Pandora	J	4.77	4447	247.6	79.5	15.3	3.6	6.4	20.3	7.3	3.4	5.
Col. Cara	R.P	4.2	5543	232.8	80.4	17.8	4.1	5.7	20.9	7.3	2.6	5.
Col. Content	J	4.76	3993	221.7	83.	17.1	5.5	6.1	21.3	6.9	2.5	5.
Cara	R.P	4.09	4142	198.3	75.4	17.4	4.1	6.1	20.4	7.3	2.5	5.
Houwtje III	H	3.19	5126	190.8	76.4	15.3	5.	5.8	20.2	7.	2.3	5.

COLLEGE REGISTERED HERD.

Hind quar	Udder	Milk Teats	Milk veins	wt. wells	lbs	Girth	lgth body	Height Shou	Hips	wd of Hips	Rump	Thl Bones
1.6	11.7	3.	3.8	2.9	1593	6-10	5-7	4-4	4-5	1-11½	1-11	1-2½
6.9	15.2	4.7	3.7	2.7	1412	6-9	5-6½	4-9	4-8	1-11½	1-11	1-4
5.2	15.	4.6	3.7	2.3	1278	6-2	5-1	4-4	4-4	1-9½	1-9	1-3
7.	16.	4.7	3.7	2.8	1444	6-6	5-4	4-5	4-5	1-11	1-9	1-3½
3.2	14.	4.	2.5	2.6	802	5-4	4-10	3-11½	4-1	1-6	1-6	11
6.5	16.	4.7	3.	2.2	1234	6-	5-3	4-4½	4-4½	1-10	1-9	1-3
5.1	15.	4.3	2.	2.8	880	5-5	4-11	4-1½	4-	1-8	1-8	1-
5.0	15.	4.7	3.3	2.7	1504	6-10	5-5	4-6	4-4	1-11	1-10½	1-3
2.8	14.	4.7	3.	1.5	1154	5-11	5-2½	4-4½	4-5½	1-8	1-9	1-3
8.7	11.2	3.1	3.	2	1036	5-9	5-	4-1	4-4	1-7	1-8	1-2½
4.	14.	4.6	2.6	2.7	772	5-5½	4-11	4-1	4-1	1-6	1-7	11
1.9	13	3.8	2.5	2.6	945	5-8	4-11	4-1	4-	1-7	1-7½	1-1
3.	14.5	4.7	2.	1.8	700	5-2	4-8½	3-9	3-10	1-5½	1-6½	-11
7.4	11.3	2.3	2.4	2.6	980	5-8	5-1	4-2	4-	1-7½	1-8	1-
0.1	12.5	4.	2.1	1.5	1222	6-	5-1	4-4	4-5	1-9	1-9	1-2½

This herd does not present the most favorable conditions
for study along this line, as it is so small and, so divided
into different breeds. The largest number in any one breed
is that of the Holsteins, and one of these, Belle Sarcastic,
would have to be thrown out, as her record was made under extra-
ordinary conditions quite unlike the others. Two of the other
Holsteins are young heifers, and should not be compared with
the older cows. The number of cows in each of the other breeds
is still smaller, and no comparisons can be made between them.
For these reasons, and because of the lack of time on the part
of the authors no study has been made of this herd. Hoping that
the records and measurements of this herd may prove of value to
other workers, the above table has been inserted.

In summing up the results of this investigation the follow-
ing conclusions were drawn. First, that no infallible rule can
be made concerning the relation of dairy form to milk and butter
production, and second, that there is a marked tendency for the
best developed cows to be the best producers. With regard to
the first, the authors are satisfied that no definite line can
be drawn between individual cows, for an inspection of the large
tables will convince anyone that striking differences in the
milk or butter production exist between cows having approximately
the same weight or the same total score. It is to be noticed
also that a wide difference in production often exists between
cows having certain qualities equally well developed, or that

cows widely different in perhaps the same qualities are equally
productive. Owing to the variable results obtained from the
comparison, a definite statement regarding the second con-
clusion is more difficult to make. There is as the tables show
considerable evidence both for and against the "dairy form"
theory especially in the comparisons between total score, and
milk and butter production. In studying the comparisons of
individual scores with the production, however, the results
obtained show a marked tendency in favor of the above theory.
Although there is considerable variation even here among some
of the different points, yet, we find that the above statement
holds true in the majority of cases, and especially with the
mammary organs whose development we must conclude to be a
highly important factor in the performance of the dairy cow.

This work has proven a very interesting study and the
investigators realize more than ever the importance of the sub-
ject. The results obtained though as good as could be expected
from existing conditions are not as satisfactory as might be
desired. In order to make this study more conclusive, more
favorable circumstances should be had. First of all an even
herd of 75 to 100 mature cows of one breed but of different
form is required. The conditions as to care, shelter and food
should be exactly the same, and the weight of each cows food
should be accurately determined and taken into account in com-
paring the form and performance. The investigation should

continue throughout a period of at least two years and pre-
ferably longer.   The cows should be scored at least twice
each year and the results averaged for the final score.
These conditions together with accurate milk and butter
records would prove the foundation of an important and
conclusive investigation.

Doubtless the authors have derived much more from this
investigation than it is possible for anyone else to obtain
by studying their work. It is, however, hoped that this thesis
may prove of some value to others if not from its own merits
at least as an inspiration to some student to continue the
same study, as it surely is an important one, and one upon
which the farmers and dairymen of our State should be
enlightened.