OBSERVATIONS ON THE USE OF THE HAMMOND SYSTEM OF PIG CARCASE APPRAISAL IN QUEENSLAND.

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SUMMARY.

An examination of measurements of 950 carcases entered in fresh and cured pig carcase competitions conducted in Queensland, and judged by the Hammond system, was made.

In the sections body length, eye muscle thickness and leg length, the Hammond standards favoured certain weight ranges. No bias was shown for the character backfat thickness.

No overall bias was shown by a comparison of total marks and weight range.

Mean values for various measurements of fresh and cured carcases are compared.

INTRODUCTION.

During recent years, in an endeavour to improve the quality of pig carcases produced in Queensland, the Australian Meat Board and various district agricultural show societies have conducted competitions for both fresh and cured carcases. The Hammond or Smithfield method of carcase appraisal (Davidson, Hammond, Swain and Wright, 1937) has provided the basis for competition judging. However, since the prevailing export market requirement has been for carcases of bacon weight, attention has been focussed on carcases within the range of 120-180 lb. dressed weight.

The competitions have provided a considerable volume of data and these have been analysed firstly to define present bacon carcase performance, as measured against the Hammond ideal, of pigs reared in the Queensland environment, and secondly to determine whether the carcase weight of entries has any effect on such comparisons.

MATERIALS AND METHODS.

Measurements for 950 carcases (379 fresh and 571 cured) were available. The characters considered in the analysis are body length, eye muscle thickness, back fat thickness and leg length. Each was studied individually and separately for fresh and cured sides. For each of them a regression line was fitted for the character versus weight class, on the assumption that the lineal

relationship would be adequate for the 120-180 lb. weight range considered, which proved to be correct. The mean increment for increase in weight for each character was determined and compared with the standards set down by the Hammond appraisal method to determine whether there was any difference favouring particular weight ranges. Carcase weight was based on the cold dressed figure in both cured and fresh carcase competitions.

Finally, from differences between observed results in cured and fresh sides an estimate of the mean change in measurement resulting from the curing process or other factors was made.

RESULTS.

Body Length.

This measurement gives an indication of the length of the valuable loin joint which can be cut from the carcase. The higher the ratio of length to carcase weight, the greater is the value of the carcase for cutting purposes.

The marks allotted for body length under the Hammond system of appraisal are given in Table 1, and Table 2 is a summary of the body length measurements of the 950 carcases included in the survey.

Table 1.

HAMMOND SYSTEM MARKS FOR BODY LENGTH IN THE 120–179 LB. RANGE.

Marks.	Carcase Weight (Lb.)											
	120 to 124	125 to 129	130 to 134	135 to 139	140 to 144	145 to 149	150 to 154	155 to 159	160 to 164	165 to 169	170 to 174	175 to 179
	Body Length (mm.).											
1 ..	670	680	690	700	710	720	730	740	750	760	770	780
2 ..	675	685	695	705	715	725	735	745	755	765	775	785
3 ..	680	690	700	710	720	730	740	750	760	770	780	790
4 ..	685	695	705	715	725	735	745	755	765	775	785	795
5 ..	690	700	710	720	730	740	750	760	770	780	790	800
6 ..	695	705	715	725	735	745	755	765	775	785	795	805
7 ..	700	710	720	730	740	750	760	770	780	790	800	810
8 ..	705	715	725	735	745	755	765	775	785	795	805	815
9 ..	710	720	730	740	750	760	770	780	790	800	810	820
10 ..	715	725	735	745	755	765	775	785	795	805	815	825
11 ..	720	730	740	750	760	770	780	790	800	810	820	830
12 ..	725	735	745	755	765	775	785	795	805	815	825	835
13 ..	730	740	750	760	770	780	790	800	810	820	830	840
14 ..	735	745	755	765	775	785	795	805	815	825	835	845
15 ..	740	750	760	770	780	790	800	810	820	830	840	850
16 ..	745	755	765	775	785	795	805	815	825	835	845	855
17 ..	750	760	770	780	790	800	810	820	830	840	850	860
18 ..	755	765	775	785	795	805	815	825	835	845	855	865
19 ..	760	770	780	790	800	810	820	830	840	850	860	870
20 ..	765	775	785	795	805	815	825	835	845	855	865	875

Table 2.

SUMMARY OF DATA FOR BODY LENGTH IN FRESH AND CURED CARCASES.

Carcase Weight.	Fresh.			Hammond Ideal.	Cured.		
	No.	Observed.	Calculated.		No.	Observed.	Calculated.
Lb.		mm.	mm.	mm.		mm.	mm.
120–124 ..	12	761·3	748·4	765	43	726·8	727·7
125–129 ..	25	755·7	755·3	775	34	739·0	734·9
130–134 ..	37	758·8	762·2	785	58	739·3	742·2
135–139 ..	45	770·0	769·2	795	77	753·5	749·5
140–144 ..	35	770·5	776·1	805	76	753·8	756·7
145–149 ..	36	783·5	783·0	815	59	763·2	764·0
150–154 ..	48	791·9	790·0	825	60	772·3	771·2
155–159 ..	24	800·7	796·9	835	49	775·7	778·5
160–164 ..	34	799·0	803·8	845	46	782·7	785·8
165–169 ..	41	811·3	810·8	855	39	801·6	793·0
170–174 ..	22	814·1	817·7	865	20	795·0	800·3
175–179 ..	20	831·6	824·6	875	10	809·1	807·6
Totals ..	379				571		

——	Ideal.	Fresh.	Cured.	Mean.
	mm.	mm.	mm.	mm.
Increase/5 lb.	10	6·93	7·26	7·12
s.e.	..	±·374	±·359	..

The results indicate that the observed rate of increase in length (a mean of 7·12 mm. for each 5 lb. increase in carcase weight for both cured and fresh sides) is considerably lower than the Hammond standard (10·00 mm. per 5 lb. increase). The deficiency in fresh carcases is 16·6 mm. in the 120-124 lb. range and 50·4 mm. in the 175-179 lb. range, and throughout the whole range these differences from the standard are sufficient to favour the lighter carcase and penalise the heavier carcase.

The deficiency in carcase length shown by competition entries suggests that there is considerable room for improvement in the body length-carcase weight relationship of the general pig population.

In Figure 1, linear regression lines of body length on carcase weight have been fitted to the observed results. It is obvious from these lines that the "rate of growth" for body length of pigs in Queensland is not as high as the Hammond standard. Presumably this standard was fixed after examination of a range of carcases from Great Britain and the Dominions, but the data have not been published. Whether or not this comparative lack of response of body length to increase in weight is peculiar to the Queensland environment*, to the particular sample of data, or to some other factor would be difficult to determine.

* This is not likely, since subsequent analyses of competition results in some other Australian States reveal similar trends.

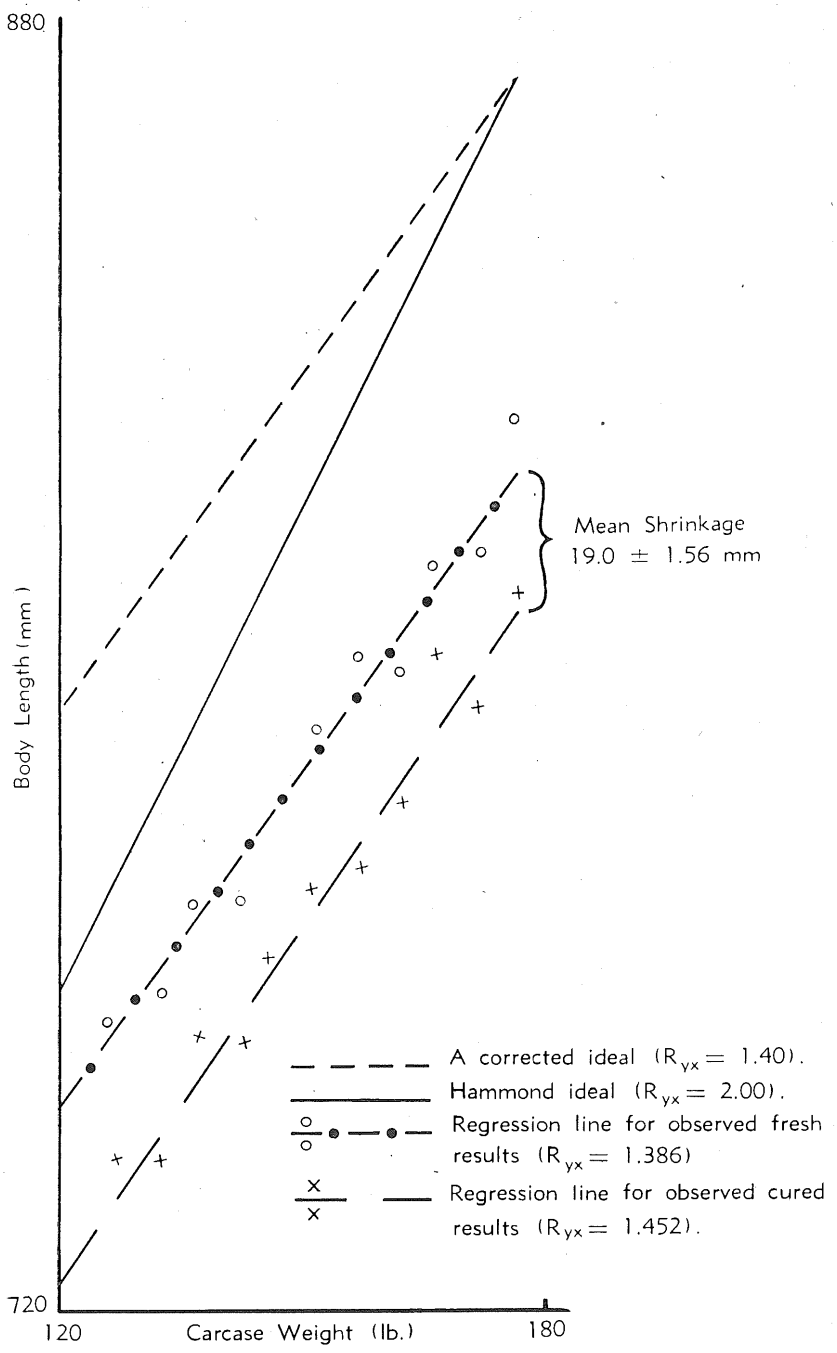

Fig. 1.

Regression Lines for Body Length on Carcase Weight.

The explanation may lie in differences in the breed composition of the Queensland carcases and those on which the Hammond standard was based. Undoubtedly differences in breed maturity would affect the relationship between carcase character and weight range. The 371 fresh carcases included in the current survey had the following breed composition:—

	Per cent.
Crossbred	42
Large White	34
Berkshire	18
Tamworth	3
Wessex Saddleback	3

If desired, a corrected "ideal" could be fixed at any position relative to the observed regression line, and provided it is parallel to it would correct any bias favouring the lighter ranges. An example of such an "ideal" is shown in Figure 1.

Many of the competitions which provided the data for analysis, particularly those sponsored by show societies, were conducted for cured bacon carcases. For the judging of these, the Hammond tables for fresh carcases were used. The question has often arisen as to whether these tables could be adjusted for judging cured sides by making appropriate allowances for differences in measurement encountered between the two classes.

An estimate of the mean change in length as a result of the curing process, or peculiar to competition conditions, has been made; it has the value 19·0 ± 1·56 mm. Such an estimate is quite valid if both the regression lines are considered to be characteristic of carcase competition entries as a whole. It is probable, however, that there would be differences in both the shrinkage capacity of individual carcases and the curing processes at various centres.

In the special case of body length, a most important factor is that fresh carcases are measured "on the hook," whereas the cured sides have been judged "on the table." Lush (1936) reported that Danish workers estimated an average "stretching effect" of 15 mm. in body length when carcases are measured "on the hook."

Eye Muscle Thickness.

The thickness or depth of the eye muscle is used in the Hammond system as an index of the total weight of muscle in the carcase. When viewed in proportion to carcase weight, an estimate can be made of the relative amount of lean meat in the carcase.

The marks allotted in the Hammond system for thickness of eye muscle in relation to carcase weight are as shown in Table 3. Table 4 summarizes the data for this relationship obtained from measurements made in Queensland, and Figure 2 is a graphic representation of the values.

The observed rate of increase in eye muscle thickness was found to be 2·468 mm. for each 20 lb. increase in body weight, compared with the Hammond

Table 3.

HAMMOND SYSTEM MARKS FOR EYE MUSCLE THICKNESS IN THE 120–179 LB. RANGE.

Marks.	Carcase Weight (Lb.)		
	120 to 139.	140 to 159.	160 to 179.
Thickness of Eye Muscle (mm.).			
1	32	33	34
3	33	34	35
5	34	35	36
7	35	36	37
9	36	37	38
11	37	38	39
13	38	39	40
14	39	40	41
15	40	41	42
16	41	42	43
17	42	43	44
18	43	44	45
19	44	45	46
20	45	46	47
21	46	47	48
22	47	48	49
23	48	49	50
24	49	50	51
25	50	51	52
26	51	52	53
27	52	53	54
28	53	54	55

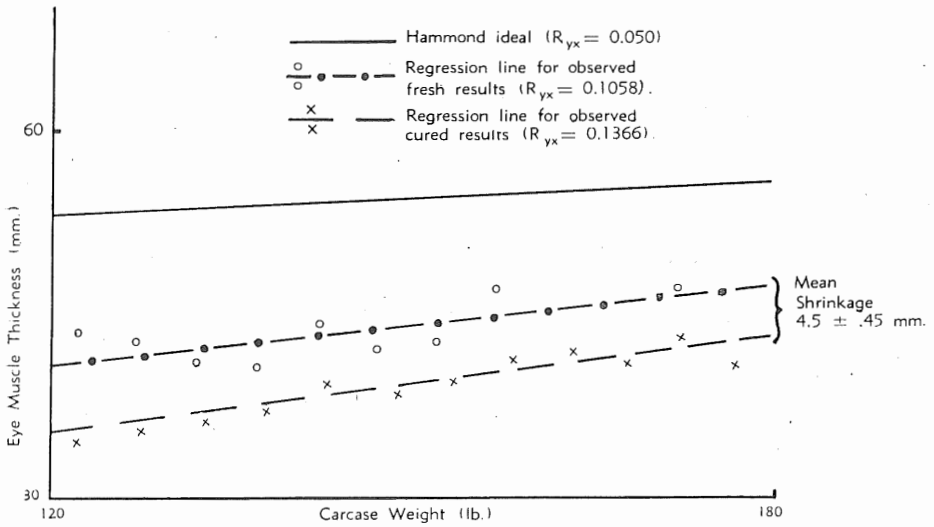

Fig. 2.

Regression Lines for Eye Muscle Thickness on Carcase Weight.

Table 4.

SUMMARY OF DATA FOR EYE MUSCLE THICKNESS IN FRESH AND CURED CARCASES.

Carcase Weight.	Fresh.			Hammond Ideal.	Cured.		
	No.	Observed.	Calculated.		No.	Observed.	Calculated.
Lb.		mm.	mm.	mm.		mm.	mm.
120–124 ..	12	43·3	40·5		43	34·8	35·2
125–129 ..	25	42·2	41·0	53	34	35·7	35·9
130–134 ..	37	41·1	41·6		58	36·5	36·6
135–139 ..	45	40·7	42·1		77	37·2	37·2
140–144 ..	35	43·7	42·6		76	38·9	37·9
145–149 ..	36	42·0	43·2	54	59	37·8	38·6
150–154 ..	48	42·3	43·7		60	39·1	39·3
155–159 ..	24	46·6	44·2		49	40·0	40·0
160–164 ..	34	45·2	44·7		46	41·7	40·7
165–169 ..	41	45·6	45·3	55	39	40·8	41·4
170–174 ..	22	46·5	45·8		20	42·3	42·0
175–179 ..	20	45·7	46·3		10	40·8	42·7
Totals ..	379				571		

—	Ideal.	Fresh.	Cured.	Mean.
	mm.	mm.	mm.	mm.
Increase/5 lb.	·250	·529	·683	·617
	..	±·1039	±·1060	..

standard increase of 1·0 mm. per 20 lb. The difference favours the heavier carcases.

A suggested correction of the present standard would be to divide the scale into 10 lb. carcase weight classes. The increments would then be 1·0 mm. per 10 lb. increase in weight. This should eliminate most of the small bias favouring the heavier carcases.

The estimate for mean shrinkage in eye muscle thickness in cured carcases was 4·5 ± 0·45 mm.

Backfat Thickness.

The marks allotted for thickness of fat over the loin in the Hammond system are given in Table 5.

The data for the character obtained in the survey are summarized in Table 6.

Statistical analysis did not reveal any significant difference between the observed regression coefficient and that of the Hammond standard.

Backfat thickness differs from the characters already considered in that the ideal is intermediate between the two extremes. For the purpose of analysis there appeared to be no disadvantage attaching to bulking the results of the "underfat" and the "overfat" carcases. However, the distribution of these in the results considered is of interest (Table 7).

Table 5.

HAMMOND SYSTEM MARKS FOR BACKFAT THICKNESS IN THE 120–179 LB. RANGE.

Marks.	Carcase Weight (Lb.)					
	120 to 129	130 to 139	140 to 149	150 to 159	160 to 169	170 to 179
Thickness of Fat over Loin (mm.).						
1	7	8	9	10	11	12
4	8	9	10	11	12	13
7	9	10	11	12	13	14
10	10	11	12	13	14	15
12	11	12	13	14	15	16
14	12	13	14	15	16	17
15	..	14	15	16	17	18
16	13	15	16	17	18	19
17	14	16	17	18	19	20
18	15	17	18	19	20	21
19	16	18	19	20	21	22
20	17	19	20	21	22	23
19	18	20	21	22	23	24
18	19	21	22	23	24	25
17	20	22	23	24	25	26
16	21	23	24	25	26	27
14	22	24	25	26	27	28
12	23	25	26	27	28	29
10	24	26	27	28	29	30
7	25	27	28	29	30	31
4	26	28	29	30	31	32
1	27	29	30	31	32	33

Table 6.

SUMMARY OF DATA FOR BACKFAT THICKNESS IN FRESH AND CURED CARCASES.

Carcase Weight.	Fresh.			Hammond Ideal.	Cured.		
	No.	Observed.	Calculated.		No.	Observed.	Calculated.
Lb.		mm.	mm.	mm.		mm.	mm.
120–124 ..	12	14·7	16·6	17	43	18·0	18·7
125–129 ..	25	16·0	17·3		34	19·1	19·3
130–134 ..	37	19·1	18·0	18	58	20·7	20·0
135–139 ..	45	18·6	18·7		77	20·9	20·6
140–144 ..	35	20·9	19·4	20	76	21·2	21·3
145–149 ..	36	20·3	20·1		59	22·3	21·9
150–154 ..	48	20·7	20·8	21	60	21·1	22·6
155–159 ..	24	19·8	21·6		49	23·9	23·2
160–164 ..	34	22·7	22·3	22	46	24·7	23·9
165–169 ..	41	23·0	23·0		39	23·2	24·5
170–174 ..	22	22·9	23·7	23	20	23·8	25·2
175–179 ..	20	24·8	24·4		10	30·0	25·8
Totals ..	379				571		

Table 6—continued.

—	Ideal.	Fresh.	Cured.	Mean.
Increase/5 lb.	mm. 1 to ·5	mm. ·714	mm. ·649	mm. ·677
	..	±·0816	±·0874	..

Table 7.

DISTRIBUTION OF CARCASES ON THE BASIS OF FATNESS.

—	Percentage of Carcases Examined.	
	Fresh.	Cured.
Underfat	46·7	40·3
Ideal	10·3	7·5
Overfat	43·0	52·2

It would appear that the underfinished pig is represented just as strongly as the overfat type, so apparently farmers entering carcases in competitions are aware of the undesirability of overfatness.

The small but quite regular expansion in backfat thickness in the cured carcases (1·8±0·37 mm.) is of interest. This would contribute in part to the percentage of overfat cured carcases.

Leg Length.

Length of leg is a measurement which is correlated with the amount of bone in the carcase. The marks given for this character in the Hammond system are shown in Table 8, and the observations on fresh carcases are summarized in Table 9. The cured carcases are not considered, as leg length could not be measured in the cured carcase competitions.

The observed increment was found to be 3·59 mm. for each 5 lb. increase in body weight (R_{yx} = 0·718). This was significantly different from the present standard increase of 5·00 mm. per 5 lb. increase (R_{yx} = 1·00), and indicates that a considerable bias in favour of the heavier weight ranges exists.

Carcase Distribution According to Weight Range.

Though the Hammond system provides for the allotment of marks in special circumstances for suitability of carcase weight (Table 10), this aspect of appraisal is not generally applied in competitions in Australia. The view taken is that any carcase within the 120-180 lb. dressed weight range, with optimum measurements for essential competition characters, will make ideal bacon.

Table 8.

HAMMOND SYSTEM MARKS FOR LEG LENGTH IN THE 120–179-LB. RANGE.

Marks.	Carcase Weight (Lb.)											
	120 to 124	125 to 129	130 to 134	135 to 139	140 to 144	145 to 149	150 to 154	155 to 159	160 to 164	165 to 169	170 to 174	175 to 179
	Leg Length (mm.).											
1	570	575	580	585	590	595	600	605	610	615	620	625
2	569 to 560	574 to 565	579 to 570	584 to 575	589 to 580	594 to 585	599 to 590	604 to 595	609 to 600	614 to 605	619 to 610	624 to 615
3	559 to 550	564 to 555	569 to 560	574 to 565	579 to 570	584 to 575	589 to 580	594 to 585	599 to 590	604 to 595	609 to 600	614 to 605
4	549 to 540	554 to 545	559 to 550	564 to 555	569 to 560	574 to 565	579 to 570	584 to 575	589 to 580	594 to 585	599 to 590	604 to 595
5	539	544	549	554	559	564	569	574	579	584	589	594

Table 9.

SUMMARY OF DATA FOR LEG LENGTH IN FRESH CARCASES.

Carcase Weight.	Leg Length.			
	No.	Observed.	Calculated.	Hammond Ideal.
Lb.		mm.	mm.	mm.
120–124	12	566·5	558·5	539
125–129	25	560·6	562·1	544
130–134	37	564·1	565·7	549
135–139	45	569·1	569·3	554
140–144	35	567·2	572·8	559
145–149	36	576·6	576·4	564
150–154	48	584·7	580·0	569
155–159	24	587·0	583·6	574
160–164	34	586·1	587·2	579
165–169	41	591·0	590·8	584
170–174	22	588·9	594·4	589
175–179	20	600·2	598·0	594
	379	..	..	..

—	Ideal.	Fresh.
	mm.	mm.
Increase/5 lb.	5	3·59
	..	±·329

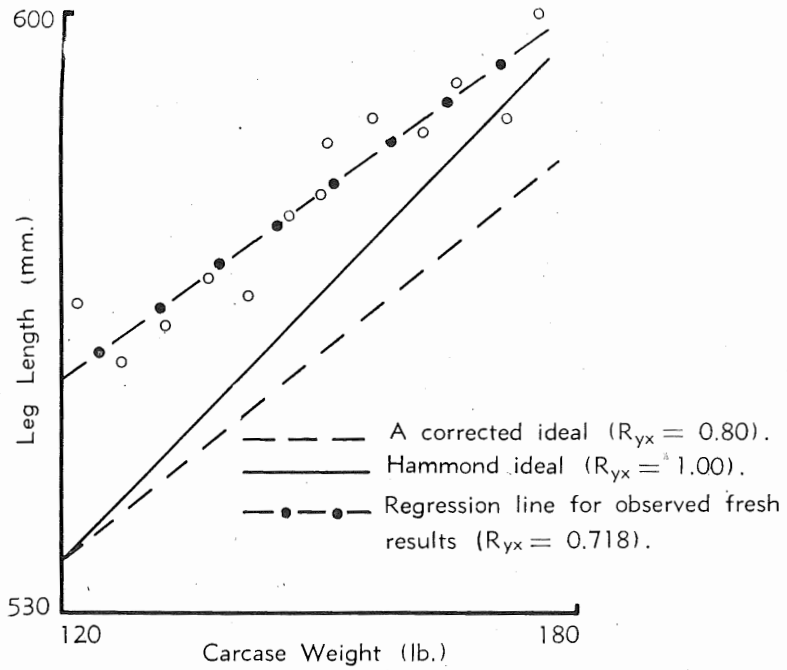

Fig. 3.

Regression Lines for Body Length on Carcase Weight.

Table 10.

HAMMOND SYSTEM MARKS FOR SUITABILITY OF CARCASE WEIGHT IN BACON PIGS.

Marks.	Carcase Weight. (Lb.)
1	110–114
4	115–119
7	120–124
10	125–129
13	130–134
15	135–154
14	155–159
13	160–164
12	165–169
11	170–174
9	175–179
7	180–184
5	185–189
3	190–194
1	195–199

Under the Hammond system the ideal carcase weight for the Wiltshire trade was defined as being within the 135-154 lb. range. The width of this range was supposed to allow for breed and cross maturity differences.

By restricting the competitions to carcases within the 120-180 lb. range, the application of marks for suitability of carcase weights loses much of its value. In any case, it can be seen from the distribution of the data considered in this study that 46 per cent. of the entries fall within the ideal range (Table 11).

Table 11.

FREQUENCY VERSUS WEIGHT RANGE FOR FRESH AND CURED CARCASE DATA.

Weight Range.	Fresh.	Cured.	Total.
120–124 ..	12	43	55
125–129 ..	25	34	59
130–134 ..	37	58	95
135–139 ..	45	77	122
140–144 ..	35	76	111
145–149 ..	36	59	95
150–154 ..	48	60	108
155–159 ..	24	49	73
160–164 ..	34	46	80
165–169 ..	41	39	80
170–174 ..	22	20	42
175–179 ..	20	10	30
Totals ..	379	571	950

Table 12.

REGRESSION COEFFICIENTS FOR MEASURED CHARACTERS.

	——	Hammond.	Observed.	Remarks.
Fresh—	Body Length	2·00	1·386	Significant Difference
	Eye Muscle Thickness ..	0·050	0·1058	Significant Difference
	Backfat Thickness ..	0·100	0·1428	No Significant Difference
	Leg Length	1·00	0·7180	Significant Difference
Cured—	Body Length	2·00	1·452	Significant Difference
	Eye Muscle Thickness ..	0·050	0·1366	Significant Difference
	Backfat Thickness ..	0·100	0·1298	No Significant Difference

The distribution, as shown in Figure 4, indicates a slight tendency to favour lighter carcases. However, it is not suggested that competitors are aware that weight range may affect competition results. It is unfortunate that extreme ranges include relatively few individuals in their classes, but the regression lines that have been calculated for the characters in question were based on weighted means and thus due importance was placed on class frequency.

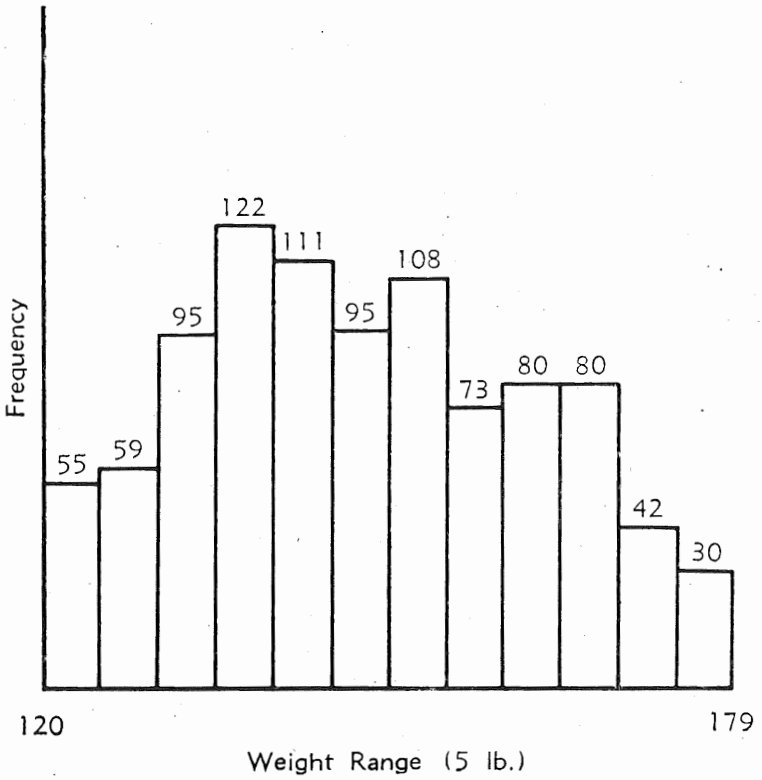

Fig. 4.

Distribution of Carcases According to Weight.

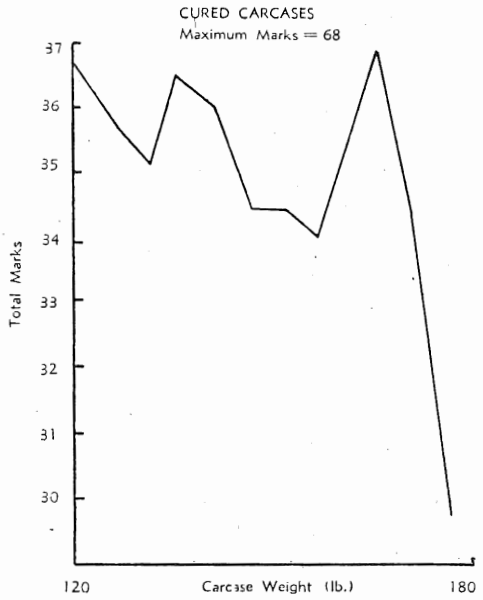

Fig. 5.

Relationship of Total Marks to Weight—Cured Carcases.

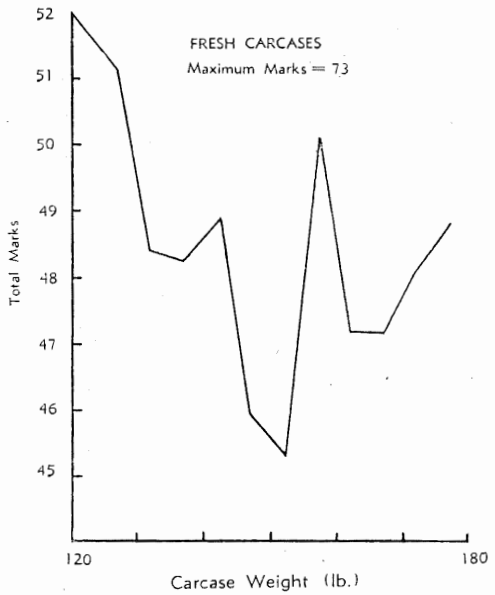

Fig. 6.

Relationship of Total Marks to Weight—Fresh Carcases.

CONCLUSIONS.

Table 12 sets out the regression coefficients that have been calculated for the various measured characters and the significance of differences from the Hammond standard. Since the difference is considerable in some cases, and is sufficient to affect certain carcase weight ranges, an assessment was made to determine if any overall bias sufficient to affect competition results for measured characters exists.

It can be seen from Figures 5 and 6 that, though there may be a slight tendency for the system to favour the lighter carcase, this is not significant in either the cured or the fresh carcase classes.

The following general conclusions are drawn from the study:—

1. Analysis of observations made on the measured characters of body length, eye muscle thickness and leg length reveal the existence of biases favouring certain weight ranges when the Hammond standards are used under Queensland conditions. There was no apparent difference between observed values and the Hammond ideal for backfat thickness.

2. There was no significant overall bias apparent when total marks were considered against weight range. This suggests either that the individual biases have a cancelling effect or that the sampling error was too large to reveal any significant trend.

3. The weight distribution of the carcases submitted lends support to the view that the application of Hammond's table of marks for weight range suitability is not warranted under pig carcase competition conditions in Queensland.

4. Under-finished and overfat types were encountered in equal numbers.

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