H7

APPRAISAL OF BEEF CARCASSES

by

D.R. Williams, R.W. Pomeroy and J.M. Harries

Meat Research Institute, Agricultural Research Council, Langford, Bristol

Introduction

Sixteen experiments on the visual assessment of beef carcass composition have been conducted, each experiment consisting of a judging session where 10 carcasses (20 sides) were assessed. Before each session the sides were photographed and measured and after each session one side was quartered between the 10th/11th ribs. The exposed cut surface was photographed and measured. Thereafter, the quarters were jointed and the joints separated into their main component tissues.

Six Fatstock Officers of the Meat and Livestock Commission and a panel of untrained judges took part in the sessions. However, all judges were not free to attend on every occasion.

Information on the consistency and discrimination of assessments by judges and on the relationship between these assessments and objective data was obtained from each session. It was not possible to dissect one side of every carcass so that the total for which both assessment and carcass data were available was reduced to 103 carcasses.

The early sessions were exploratory and it was from these that photographic standards for external (subcutaneous) fat on a 7-point scale were prepared. Seven photographs depicting carcasses having from 3.5 to 15.0% of the weight of the side (ex kidney knob and channel fat) as external fat comprised the scale. These standards were used in the assessment of carcass fat for 73 of the carcasses.

Plan of Experiments

In each of the judging sessions the following layout was adopted. Twenty sides, derived from 10 carcasses were arranged in two groups (A and B, etc.) of 10 intact sides, as indicated in Table I.

Table I

Beef Judging Sessions

Carcass Number	Allocation of sides to groups	
	Left Side	Right Side
1	A3	B5
2	B1	B8
3	A7	A2
4	B9	A10
5	A6	B2
6	B4	A1
7	A9	B7
8	B10	B3
9	A4	A8
10	B6	A5

Code letters and numbers were changed in successive sessions, with the restraint that not more than two carcasses were ever allocated entirely to one group. The sides which comprised group A were on view in one room and those comprising group B in another room. Judges assessed and scored each group independently. All of the assessments, by any one judge, were completed on one group and the score sheets collected, before he started his assessments on the second group.

Assessments were made on a 7 point scoring system which called for an estimate of the degree of development of the carcass characteristic. This is illustrated in Table II.

Table II - Estimated Lean/Bone Ratio.

		Carcass Number				
		1	2	9	10	
Extremely low	1					1
Very low	2					2
Low	3					3
Moderate	4					4
High	5					5
Very high	6					6
Extremely high	7					7

A seven point system was chosen because this was considered to provide the basis of a psychologically optimal scoring system (Millar, 1956). The paper by Millar - "The magical number seven, plus or minus two: Some limits on our capacity for processing information", is particularly interesting in this context.

In some or all of the sessions, the judges were asked to complete score sheets concerned with the following carcass characteristics.

A. Fatness

(1) Kidney knob and channel fat

(2). Subcutaneous fat covering

These were assessed in two ways:

(a) Without any standard (unaided) on a 7 point scale
(b) With photographic standards as a guide on a 7 point scale

(3) 'Feathering' - i.e. fat intermingled with lean between the ribs (indirect assessment of inter (or) intra muscular fat)

B. Lean and Bone Content

(1) Lean %

(2) Lean/Bone ratio

(3) 'Eye' muscle area in relation to side weight - without quartering.

C. Conformation

(1) Buttock

(2) Rump

(3) Loin

(4) Forerib

(5) Overall

D. Proportion of High Priced/Low Priced Parts

After each session, the kidney knob and channel fat was removed from both left and right sides. One side was then quartered between the 10th/11th ribs, 'eye' muscle and fat depth meaaurements were taken and the exposed cut surface was photographed. Cod or udder fat, and thoracic fat loosely adhering to the inner face of the rib cage, was then removed. Thereafter, the quarters were cut into wholesale joints according to the standardised method developed by Pomeroy (1965). Three of the joints were further sub-divided, - the 'Round' into a 'Rump' and 'Round' the Sirloin into a Loin and Foreloin (wing end) and the 'Crop' into a Forerib, Middlerib and Steak Piece. The method of jointing is illustrated in Figure 1. Each joint was then separated into its main tissue components.

On the assumption that, for most characteristics the left and right sides of meat carcasses are the same; the score sheets completed during each session gave the basic data necessary for an assessment of each judges' discrimination and consistency. The jointing and dissection procedure which followed each session gave the basic information with which to relate the visual assessments and objective measurements to carcass composition.

The experiments were conducted in two series. In the first series the results from one session were analysed before the next took place, and the scoring system was modified as the sessions succeeded one another. When it was thought that no further improvements could be made a second series of nine judging sessions was carried out with the same 7 point scale used throughout. Some of the estimates called for in the first series, - for example, bone %, 'eye' muscle area and the proportion of high priced/low priced parts were omitted. This second series yielded a complete set of assessments, replicated in successive weeks, on 40 carcasses for which we have supporting compositional data. This layout of this series was illustrated and described by Williams and Pomeroy (1970).

Results

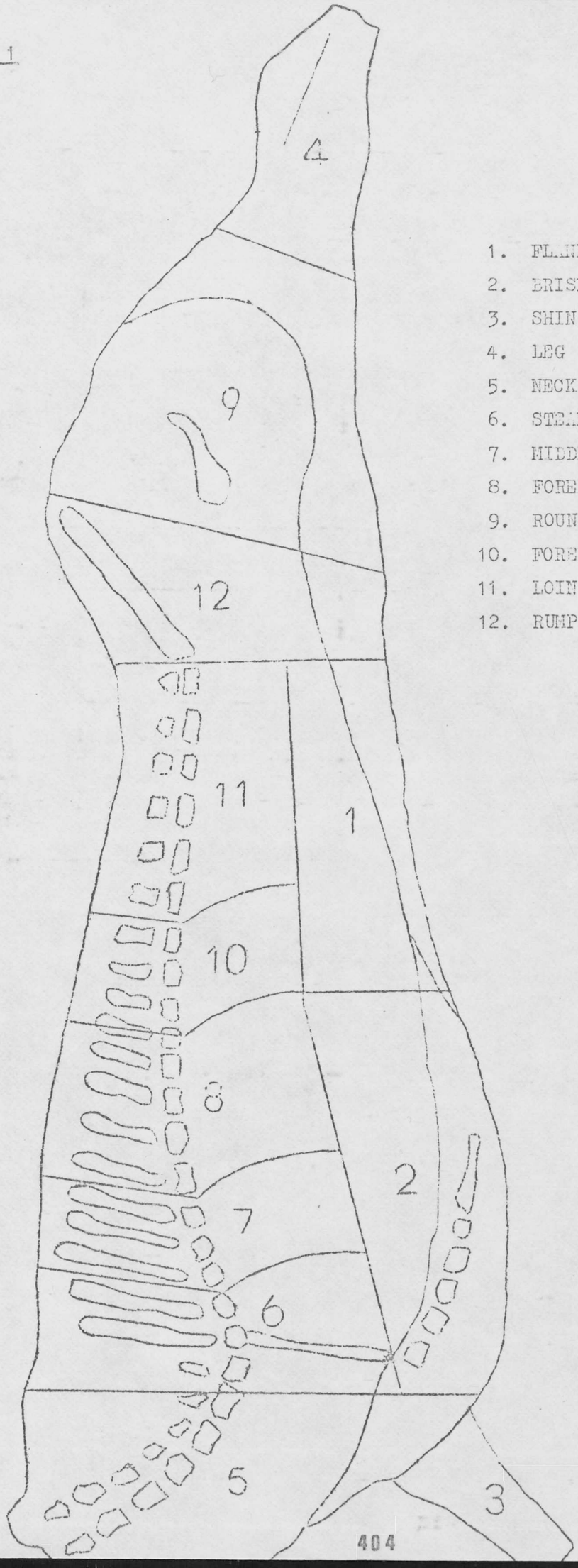
Statistical analysis of the results is not yet completed, but some preliminary results can be given.

Analysis of Judging Sessions

Table III illustrates the methods of analysis and the kind of results which emerged at the end of each session of the first series.

Fig. 1

H7



1. FLANK
2. BRISKET
3. SHIN
4. LEG
5. NECK AND CLOD
6. STEAKPIECE
7. MIDDLERIB
8. FORERIB
9. ROUND
10. FORSLOIN
11. LOIN
12. RUMP

TABLE III

H7

SAMPLE RESULTS - BEEF JUDGING TRIAL

(A) Variance ratios as an indication of judging ability in terms of consistency and discrimination

Judge No.	Subcutaneous fat cover	Kidney knob and channel fat	'Feathering' on rib cage	Muscle /bone ratio	Eye Muscle area/weight	High/low priced parts
26						
27	29.22	18.78	2.22	19.78	41.00	25.00
28	23.19	14.41	12.44	4.04	14.41	7.89
29	35.59	9.67	18.56	5.55	3.76	8.11
30	36.11	10.44	4.66	21.52	16.20	7.67
	25.96	9.00	5.78	10.56	12.67	15.78

(B) Correlation coefficient between scores and dissection data

	Subcut.fat and % of subcut.fat	KK and Ch fat and % of KK and Ch fat	'Feathering' & % chem. fat in L. dorsi	Muscle /bone ratio	Eye muscle Score & $\frac{AxB}{W}$	High/low priced parts
26						
27	0.88	0.85	0.42	0.63	0.22	-0.31
28	0.95	0.89	0.92	0.80	0.07	-0.07
29	0.94	0.77	0.93	0.65	0.30	-0.04
30	0.93	0.92	0.87	0.61	0.17	-0.06
	0.97	0.91	0.68	0.59	0.19	-0.10

Part (A) of this table, which is based on data from one session only, is derived from an analysis of the scores alone. This first method of analysis measures the extent to which each judge could reproduce his scores for two (assumed identical) sides of the same carcass without knowing their identity, whilst still being able to allot different scores to different carcasses. The results are expressed in terms of a variance ratio, - the variance between pairs of sides divided by the variance within pairs. This statistic is widely used as a test of significance in the analysis of experimental results, but in this context it is used simply as a measure of consistency and discrimination. The method was described by Harries (1960) in connection with the quality control of food, and in connection with carcass judging by Gatherum, Harrington and Pomeroy (1959, 60, 61). Its use and usefulness was further illustrated in judging lamb carcasses by Williams, (1969).

The numerator reflects the capacity of a judge to discriminate between different carcasses; the denominator is increased if he is inaccurate in his matching of the two sides of the same carcass. A judge with high discrimination and good consistency will therefore have a high variance ratio. Ratios of infinity are possible if the matching is perfect, but a judge who achieves this by simply giving the same scores to everything will also have a numerator of zero. Genuine ratios of infinity were achieved, very occasionally, in this series of trials.

Ratios below 2.0 are very poor. Ratios of 5.0 and upwards indicate a good performance and ratios above 20.0 can be considered excellent.

In Table III, judge number 26, for example, has given a very good performance for every assessment, except that of 'Feathering'. This rather unusual term has been used to describe the intermingling of fat with lean in the intercostal muscles seen from the inside of the carcass.

In Part (B) of Table III, some results from the second method of analysis are presented. Here, the scores are compared with the physical composition of the sides determined by dissection. In this paper, such results are reported and discussed in terms of correlation coefficients, though, in fact, care has been exercised to ensure that close relationships have not been missed because they are non-linear. In all work concerned with sensory assessments, logarithmic relationships occur very frequently. However, at least as regards the assessment of subcutaneous fat covering, linear correlation coefficients were adequate as a comparative measure of a judge's performance in reflecting, in their scores, the true quantity or proportion of the tissues. This can be seen from Fig.2. We appreciate, however, that simple correlation coefficients are not entirely suitable to investigate the multi-variate relationships inherent in this situation.

From part (B) of Table III, it is seen that the most meaningful assessments relate to the subcutaneous fat covering. Those for eye muscle area and the proportion of high priced/low priced parts are of no practical value. It is instructive that, although judge number 26 achieved the highest variance ratio in the table i.e. 41.0 for eye muscle area and a very high ratio of 25.0 for the proportion of high priced/low priced parts, these performances were not reflected in the true values. It is clear that, whatever characteristics of the carcasses this judge was assessing so well, they were not, in fact, either the eye muscle area or the proportion of high/low priced parts.

The examination of results such as these presented in Table III, allowed us to enter into fruitful discussions with the judges after each session and to make improvements to the assessment scheme as the series continued.

Of the characteristics assessed and later checked by tissue separation, those related to the fatness of carcasses proved to be of most value for the prediction of carcass composition.

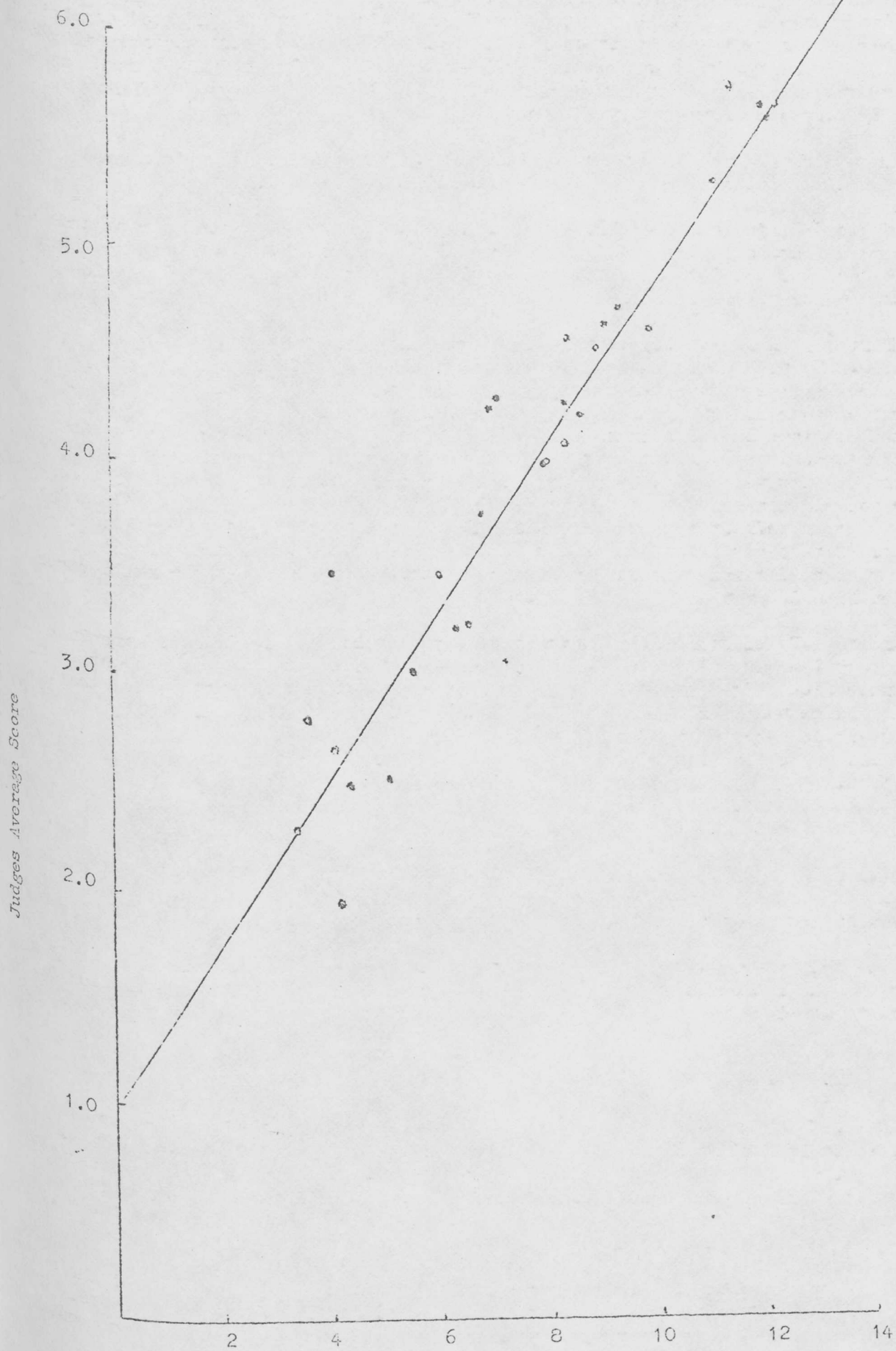
Assessment of External Fat

Table IV shows how 43 of the carcasses in the first series of judging trials varied in their content of subcutaneous fat. They ranged from 2.6% to 22.3% of the side weight (excluding kidney knob and channel fat). There were only 3 carcasses of less than 4% and only 4 with more than 12%. For comparative purposes, the frequency of the use of the 7 scores available is also shown in the same table for eight of the judges who scored all 43 of the carcasses.

It will be seen that the scores tend to cluster around the mid-point of the scale, where the most difficulty was experienced in discriminating between carcasses. When scores of 1 and 7 were used, they were better reflections of the carcass composition.

H7

Fig. 2. % Subcut. Fat and Judges Average Score



The 43 carcasses were assessed both with and without the aid of photographic guides which had been developed from earlier sessions. Table V shows the performance of 12 untrained and 8 experienced judges, each of whom judged at least 30 of the 43 carcasses.

Eight of the 12 untrained judges and six of the 8 experienced judges improved or maintained their predicting ability for the percentage of subcutaneous fat when the photographic guides were used. As would be expected the correlations with total fat are in general lower than with subcutaneous fat.

It is concluded that, with the aid of photographic standards, visual assessment of external fat covering sufficiently accurate for most purposes relating to carcass classification can be made. Similar standards for kidney knob and channel fat development have also been prepared.

However, experience has shown that the external fat scale needs to be extended in both directions. An additional photograph of a carcass having about 20% external fat would give better coverage of the range of fatness found in the British market. European colleagues have indicated that an additional photograph depicting a carcass having about 2% external fat would also be needed to accommodate the leaner continental carcasses within the scale. A 9-point photographic standard, with these points in mind, is in preparation.

References

Millar, George, A. (1956). The Psychological Review, 63, 81-97.

Gatherum, D.P., Harrington, G. and Pomeroy, R.W. (1959). J. Agric. Sci., 52, 320.

Harries, J.M. (1960). The quality control of food by sensory assessment. Soc. Chem. Ind. (London). Monograph 8, 128-37).

Gatherum, D.P., Harrington, G. and Pomeroy, R.W. (1960). J. Agric. Sci., 54, 145.

Gatherum, D.P., Harrington, G. and Pomeroy, R.W. (1961). J. Agric. Sci., 57, 401.

Pomeroy, R.W. (1965). Standardised cutting of beef carcasses and sample joint dissection. A.R.C. Carcass Quality Studies Group Sub-group on sheep and cattle, July, 1965.

Williams, D.R. (1969). J. Agric. Sci., 73, 495-499.

Williams, D.R. and Pomeroy, R.W. (1970) E.A.A.P. Budapest, August 1970.

TABLE IV SUBCUTANEOUS FAT PER CENT DISTRIBUTION OF CARCASSES

AND OF SCORES FOR 43 CARCASSES

Range of per cent subcut. fat	Percentage Frequency 43 (carcasses)	Subjective Score	Per cent frequency distribution of subjective scores (Unaided Assessments) Judge Number								Percentage Total Scores All 8 judges
			26	27	25	31	28	12	30	35	
2 but less than 4	7.0	1 (thin)	5.8	7.0	8.1	8.1	1.2	7.0	8.1	1.2	5.8
4 but less than 6	27.9	2	16.3	12.8	14.0	18.6	10.5	11.6	11.6	2.3	12.2
6 " " " 8	16.3	3	27.9	20.9	22.1	19.8	36.0	19.8	23.3	15.1	23.1
8 " " " 10	30.2	4	34.9	41.9	38.4	24.4	39.5	25.6	50.0	34.9	36.2
10 " " " 12	9.3	5	9.3	11.6	10.4	14.0	8.1	24.4	4.7	31.4	14.2
12 " " " 14	7.0	6	3.5	3.5	4.7	9.3	2.3	9.3	2.3	11.6	5.8
14 or more	2.3	7 (thick)	2.3	2.3	2.3	5.8	2.3	2.3	-	3.5	2.6

TABLE V.

CORRELATION OF SUBJECTIVE SCORES (SUBCUTANEOUS FAT) WITH

DISSECTION FINDINGS - (SUBCUT. FAT AND TOTAL OF SUBCUT. + INTERMUSCULAR FAT)

SCORING AIDED BY PHOTOGRAPHIC 7 - POINT SCALE (P) AND UNAIDED BY PHOTOGRAPHS (U)

Judge Identity Number	Number of Judgements	Subcutaneous fat				Total subcut. + intermuscular fat			
		Percentage		Absol. Quantity		Percentage		Absol. Quantity	
		P	U	P	U	P	U	P	U
	Naive Judges								
5	40	0.91	0.84	0.91	0.78	0.85	0.81	0.89	0.77
44	40	0.84	0.82	0.78	0.74	0.79	0.82	0.76	0.75
34	30	0.83	0.78	0.88	0.78	0.71	0.69	0.83	0.73
3	40	0.82	0.72	0.80	0.63	0.75	0.68	0.77	0.62
50	20	0.82	0.77	0.85	0.84	0.75	0.67	0.81	0.79
42	40	0.81	0,80	0.69	0.69	0.82	0.81	0.69	0.70
35	43	0.73	0.63	0.61	0.53	0.79	0.59	0.63	0.50
2	40	0.83	0.83	0.80	0.79	0.78	0.76	0.77	0.76
43	30	0.84	0.91	0.79	0.85	0.75	0.82	0.74	0.80
37	30	0,80	0.84	0.72	0.79	0.77	0.75	0.70	0.73
12	43	0.78	0.85	0.67	0.80	0.76	0.83	0.83	0.80
40	40	0.73	0.74	0.67	0.71	0.67	0 75	0.64	0.73
	Experienced Judges								
25	43	0.93	0.89	0.89	0.82	0.88	0.86	0.87	0.80
26	43	0.93	0.90	0.89	0.83	0.88	0.91	0.86	0.84
29	33	0.91	0.87	0.86	0.82	0.88	0.85	0.84	0.80
28	43	0.90	0.88	0.86	0.87	0.87	0.81	0.84	0.85
30	43	0.89	0.84	0.87	0.74	0 87	0.86	0.86	0.75
31	43	0.89	0.89	0.82	0.81	0.85	0.83	0.80	0179
27	43	0.87	0.90	0.86	0.83	0.83	0.90	0.85	0.83
52	43	0.81	0.85	0.83	0.84	0.71	0.82	0.79	0.84

LH