The experiment, started in Bourges in 1970, involved three of the main French beef breeds: Charolais (CH), Limousin (LI), Maine-Anjou (MA) and a herd of 24 purebred Hereford animals of Canadian origin, used as an international control group.

The purposes were:
- to compare and analyse their performances (reproductive, fattening and slaughtering abilities) in the same environmental and management conditions.
- to attempt quantifying the improvement of productivity stemming to crossbreeding.

I - ANIMALS AND EXPERIMENTAL CONDITIONS.

I.1.- Animals

a) - culled cows

The foundation females (208 cows belonging to French breeds) obtained in 1970 as weaners, were mated (1971 to 1975) according to a factorial design with first calvings at the age of 2 years; when barren for 2 consecutive years they were culled in late autumn (1972, 73, 74, 75). They will be considered as young cows (93 animals) in the overall treatment of data.

After 5 breeding periods, the foundation cows were transferred from Bourges to another experimental farm (Vieux-Pin, Normandy), mated to bulls of their own breed, managed in a traditional suckling herd and culled when barren early in the winter (1977, 78, 79, 80). They will be considered as adult cows (43 animals). In 1977, as an exception, some pregnant cows were culled for sanitary reasons.

b) - young bulls

These animals were purebred males out of the previous foundation cows and born between 1972 and 1976 (98 animals).

c) - steers

These animals were also purebred males born out of the foundation cows in Vieux-Pin between 1977 and 1980 (57 animals up to weaning and 43 up to slaughter).

I.2.- Experimental conditions

All animals were fattened at the fattening unit of La Minière.
- **Young bulls** (15 or 18 months)

The calves were weaned at about 196 days of age, transferred to La Minière and kept in tie-up housing conditions. They were distributed into 4 series to reduce age variation at the beginning of fattening (9 months) after a nutritional transition period of 2-3 weeks; they were slaughtered at constant age (15 or 18 months) and the distribution between these 2 ages was made at random.

The diet, composed of 70% lucerne and 30% dried pulp was offered ad libitum in the form of pellets. The feeding value was 0.69 V.F.U. and 100 g. I.D.P. per kg dry matter.

- **Steers** (30 to 32 months)

The calves were weaned at about 208 days of age, on an average, and managed according to a traditional grazing system. Castration was made at about 8-9 months of age for the first series and subsequently practised at 1 year of age. Winter growth was restricted to 500 and 200-300 g per day during the first and second winters respectively, so as to use the compensatory growth during the 2 seasons of pasture when the animals did not receive any supplements. Fattening of the animals was finished at the trough, in groups, for 10-12 weeks, using a diet including hay supplemented with lucerne (3kg), dried pulp (5kg) and ground maize (2kg).

- **Cows**

The young cows were fattened under tie-up conditions for 50-60 days with a diet of pulps and dehydrated lucerne offered ad libitum. The adult cows after having received a straw diet in order to estimate their requirement for maintenance (7 weeks), were fattened during the 5-6 following weeks with a diet similar to that of the young bulls.

### II - VARIABLES USED - STATISTICAL ANALYSIS OF DATA.

The variables examined for the young bulls were: body weights at birth, at weaning, during early fattening, after 182 and 294 days, growth rates before weaning and during fattening, feed intake (kg per day), feed efficiency (g of live weight gain per kg feed ingested). For the steers, the variables were: weight at birth, at weaning, at slaughter and growth rates before and after weaning.

The carcasses of the 3 types of animals were evaluated in INRA slaughterhouses according to a method described by FREBLING et al (1967).

The following variables were analysed for slaughter data: live weight before slaughter, cold carcass weight, true carcass yield (warm carcass weight/empty live weight, estimated percentages of carcass muscle and carcass fat (ROBELIN J. et al.) on the basis of dissection of the 6th rib (steers) or 11th rib (cows, young bulls), weight of produced muscle (cold carcass weight x % carcass muscle) and two compactness and composition measures.
Study of the sources of variation of performances was made by means of the least squares method using a model involving breed and year effects; for adult cows the model also involved suckling and gestation effects and for the young bulls, slaughter age effect.

III - RESULTS

III.1 - Young bulls (BONAITI et al.)

Before weaning (QUESNEL, 1980) the genotype of the calf was a highly significant source of variation for growth rate, independently of milk production, calving difficulty, sex, year and calving season. MA cows had the heaviest calves at weaning and CH calves were between MA calves (-5%) and LI calves (+9%).

A summary of data obtained during fattening and slaughter at 15 or 18 months is given in table 1.

The differences between French breeds in "weighted productivity" (muscle produced per day) were small as the joint effect of differences in slaughter yield [LI (+2.3), CH (0), MA (-1.0)] and proportion of muscle in the carcass [LI (+2.5), CH (0), MA (-3.5)] allowed to eliminate weight differences and to compensate growth differences [MA (+104), CH (0), LI (-120 g per day)]. In the case of feed efficiency, the differences were reversed for the three breeds [LI (+2%), CH (0), MA (-9%)]. The muscle/bone ratio presented large differences among the 3 breeds. The carcasses of the HE breed were markedly inferior to those of the three other breeds whatever the criterion used, except for the thigh thickness/leg symphysis length ratio and feed efficiency which were comparable to those of MA.

Between 15 and 18 months, the growth differences decreased despite the differences in levels of feed intake, and this led to a large increase in feed efficiency differences between the 3 French breeds, LI giving the best results and MA the poorest. This difference in favour of LI increased with age in the case of true carcass yield, the carcass composition remaining stable contrary to the other breeds in which the fat depots increased. The muscle/bone ratio increased with age in the 3 French breeds (LI increasing its advantage) and remained unchanged with age in HE.

The differences which could be obtained at a constant carcass weight (300 and 360 kg) were also estimated. The difference between the carcass composition of the 3 French breeds was smaller at constant weight, with the heaviest breeds (CH and MA) compensating their handicap with a lower degree of maturity. However, the differences recorded relative to HE were larger. Between 300 kg and 360 kg, the carcass composition differences between French breeds increased and this clearly showed that the 2 most muscled breeds (CH and LI) were maturing less early, in particular LI.

III.2 - Steers (except HE).

Growth rates of MA and CH before and after weaning, as well as during fattening were almost the same; the weights at any age except at
### TABLE 1 - FATTENING AND SLAUGHTER PERFORMANCE MEAN VALUES ACCORDING TO BREED AND TYPE OF PRODUCTION.

<table>
<thead>
<tr>
<th>Type</th>
<th>Breed</th>
<th>n</th>
<th>P₀</th>
<th>Gain</th>
<th>Weight at weaning</th>
<th>Feed (kg per day)</th>
<th>Weaning to slaughter</th>
<th>Weight at slaughter</th>
<th>Cold carcass weight</th>
<th>True carcass yield</th>
<th>Muscle %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>30</td>
<td>204 b</td>
<td>201 b</td>
<td>1361 b</td>
<td>10,6 c</td>
<td>129,3 a</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HE</td>
<td>26</td>
<td>-101 b</td>
<td>-66 d</td>
<td>-111 d</td>
<td>0,9 b</td>
<td>9,5 b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MA</td>
<td>21</td>
<td>+2,4 a</td>
<td>+21 a</td>
<td>+106 a</td>
<td>2,0 d</td>
<td>11,8 b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LI</td>
<td>21</td>
<td>-20,2 c</td>
<td>-88 d</td>
<td>-210 d</td>
<td>-0,9 a</td>
<td>9,5 b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Means of the same column, for the same type of production exhibiting different letters (a, b, c, d) are significantly different.

The same letter with different figures (a1, a2) indicates significant differences at the critical level of 10%.

CH, CHAROLAIS - LI, LIMOUSINE - MA, MAINE-ANJOU.
birth were also similar in those two breeds. The growth handicap of LI was large (-17%) and increased with age (-13% before weaning).

When compared to CH and MA, this handicap was too large and lasted too long (-10% muscle produced per day) to be compensated by the higher carcass quality, contrary to the results obtained in young bulls. The amounts of muscle produced per day in CH and MA were very similar but carcass conformation and composition were significantly better in Charolais steers.

III.3- Culled cows

The significant differences in carcass yield and morphology in favour of CH as compared to MA, increased with age. Carcass weight, amount of muscle produced and carcass composition were comparable in these two breeds when the animals were young but thereafter, the values observed in CH exceeded those of MA which had difficulties in maintaining its beef value.

The differences between CH and LI did not change with age : a significantly higher carcass weight (+11,5 to + 7%) and a higher amount of muscle produced (6,5 ot 5,5%) in CH and a significantly higher carcass quality (true carcass yield, muscle/bone, carcass composition) in LI. For all criteria studied, the results obtained with HE were definitely inferior to those observed in the 3 French breeds.

CONCLUSION

A marked muscle producing capacity was observed in the 3 French breeds studied. This was either due to excellent carcass qualities such as yield, morphology, composition (LI,CH) or to a remarkable growth potential (MA,CH).

No conclusion can be drawn about the superiority of one or the other of these three breeds as the results obtained varied with the production type considered.

In intensive production of young LI opposite to a more extensive production of older LI, the animals compensate their lower growth rate and produce an amount of muscle similar to that of the other two breeds, but with a better feed efficiency.

The remarkable carcass qualities of young and even older (CH and LI) culled cows are clearly shown in this study. This superiority in comparison to British breeds should be considered in the economic balance of suckling cow herds and might lead to a better acceptance of a slightly lower breeding ability.

SUMMARY

The slaughter performances of 4 beef breeds (Charolais, CH, Limousine, LI, Maine-Anjou, MA and Hereford, HE) were compared on the basis of the performances of 98 young bulls intensively fattened and slaughtered at a constant age (15 or 18 months), 44 bullocks fed at the trough during the finishing period.
and slaughtered towards the age of 30-32 months and 139 culled cows slaughtered between the age of 3 and 10 years.

In the intensive production system (young bulls), the weight gain was similar for the 3 French breeds (kg muscle per day), MA et CH exhibited the highest growth rate and LI the best feed efficiency and carcass quality.

In the less intensive production system (bullocks) the lower growth rate of LI relative to CH and MA (-17%) was not compensated by a higher carcass quality; these differences were also found in culled cows where they remained comparable with age in CH and LI while the age reduced the carcass quality of MA. HE generally showed a lower slaughter performance than the 3 French breeds.

RESUME

Nous avons comparé expérimentalement les aptitudes bouchères de 4 races à viandes : CHAROLAISE (CH), LIMOUSINE (LI), MAINE-ANJOU (MA) et HEREFORD (HE) à partir des performances de 98 taurillons engraisés intensivement et abattus à âge constant (15 ou 18 mois), de 44 bouvillons finis à l'auge et abattus vers 30-32 mois et de 139 vaches de réforme abattues entre 3 et 10 ans.

En système d'engraissement intensif (taurillons) les 3 races françaises ont une productivité pondérale comparable (kg de muscle par jour de vie) = MA et CH ont la meilleure vitesse de croissance et LI a une efficacité alimentaire et des qualités de carcasse supérieures.

Par contre pour un type de production moins intensif (bouvillons), la moindre vitesse de croissance de LI par rapport à CH et MA (-17%) n'est pas compensée par la supériorité de ses qualités de carcasse ; ces différences se retrouvent sur les vaches de réforme en se maintenant comparables avec l'âge pour CH et LI tandis que cet âge réduit les qualités de carcasse de la MA. Enfin la HE présente généralement des aptitudes bouchères inférieures aux 3 races françaises.

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