The Application of Scientific Methods to Meat Production

E.L.

ref. 17.11.58

351

## By J.HAMMOND

In applying scientific methods to meat production two aspects have to be considered. Firstly increase in quantity, for with the increased standards of living now taking place in all civilized countries there will be an increasing demand for meat. Surveys made in this country have shown that as the income level rises more meat is eaten.

Secondly improvement in quality is required for if the quality is poor the consumer turns to alternative foods, such as fish, cheese or eggs. Throughout this paper the definition of quality is taken as that for which the consumer will pay more than the average price. Both aspects will be dealt with in this paper.

<u>Beef</u> - The highest quality comes from the pure beef breeds, but in a thickly populated area such as Europe this is expensive to produce, for the breeding cow produces only one calf per year. The best beef we can produce at a reasonable price is that which comes from dual-purpose cows in dairy herds crossed with a beef bull, preferably one which colour-marks the calves so that they can be distinguished as bred for beef purposes. Calves born from cows in dairy herds are a by-product of the dairy industry and so are cheaper than those from beef cows kept solely for the purpose of producing calves.

The extension of Artificial Insemination has made possible the production of colour-marked calves even in the smallest herds. Better breeding from bulls proven for good milk yields and greater efficiency in the Dairy Industry (freedom from T.B. and Contageous Abortion) have led to fewer heifers being required for herd replacements and so only the better cows in the herd are now inseminated from a dairy or dual-purpose bull to breed replacements, and the worst third of the cows can be mated with a beef bull to breed calves to be reared for beef.

In many cases too all the heifers are mated to a beef bull for the calves of beef breeds are smaller than are those of dairy and dual-purpose breeds and so there is less difficulty in calving. Experiments in crossing large and small breeds of cattle show that while nutrition limits the size of the calf in the small dam genetics limits it in the large one. These maternal effects last for a considerable period of the young animals life and so in crosses between small beef bulls and large dairy cows one obtains a calf which grows more quickly than from a pure beef breed. That this effect is a maternal one and not due to sex-linked growth factors is shown by the fact that fertilized eggs of the small Welsh ewe transplanted into a large Border-Leicester ewe produce lambs which grow more quickly than do those left in the Welsh ewe.

A method which is now available for increasing the number of calves for beef production without increasing the number of cows kept is that of producing twins by hormone injection. This method has been tested experimentally with cattle but so far has not been used in practice, although with sheep it has been used on many farms. The blood serum of mares pregnant between 45 and 90 days contains a substance, P.M.S. which when injected subcutaneously in appropriate amounts (2,000 i.u.) 4 days before cestrus is due will cause on the average two eggs to ripen, although individuals vary from 1 to 3. In order that the twins shall be strong at birth it is necessary for the cow to be well fed during the last 6 weeks of pregnancy.

The newborn calf is all head, legs and bone but as it grows up the body first lengthens and then deepens and the muscle to bone ratio increases. The rate at which these changes occur depend on the plane of nutrition on which it is reared. Calves reared for beef purposes therefore have to be reared on a higher plane of nutrition than that adopted for rearing dairy heifers. Two main systems of rearing colour-marked beef calves are used (1) Multiple suckling whereby a cow yielding 9,000 lbs of milk rears 10 calves in groups of 4, 3, 2 and 1 in succession, each group being suckled for 90 days and the cow going to them night and morning (2) Early weaning whereby the calf after 3 weeks on milk is fed dry pellets of suitable composition with no further milk. Experiments at Cambridge have shown that a calf reared for beef needs high plane feeding for 8 months and this not only enables it to be slaughtered a year sconer, but also gives an animal of better conformation, for on low plane nutrition bone has priority of growth over muscle and fat (see later).

The conformation and composition of the animal is of great importance in determining its value to the retailer, for the producer has not only to please the consumer, but also to give the retailer a carcass which will show him a profit when cut up. A high proportion of rump (38 d. per lb.) and loin and buttock (28 d. per lb.) is required as compared with neck (10 d. per lb.) and brisket (7 d. per lb.). A young animal which has been well fed throughout

- 2 -

has a much better conformation in this respect than one which has had a store period. The ribs are late growing parts of the body and in old animals they form too large a proportion of the carcass and so lower its value as a whole. There are many advantages in slaughtering cattle at an early age and light weight as compared with that at which they were formerly killed. The average live weight at slaughter in England and Wales is now  $9\frac{1}{2}$  cwt. and ages range from  $1\frac{1}{2}$  to  $2\frac{1}{2}$  years. The farmers money is turned over more quickly, the food conversion ratio is better, the carcass yields a greater proportion of the high price joints and the grain of the meat is finer so that it is tender without the necessity for adding marbling fat. One of the reasons why our pure beef breeds of cattle are small is that the grain, or size of muscle bundle, is finer and so gives better eating qualities. This fineness of grain however can be also obtained by killing the larger colour-marked crosses at an earlier age. Much more work is required on muscle fibre and muscle bundle size related to eating qualities. In sheep after about the third month of foetal life muscle fibre formation ceases and thereafter all increase in weight of muscle is due to increase in muscle fibre size.

Mutton and Lamb - There are two main reasons why the production of lamb is increasing and mutton decreasing in this country. The first is a matter of production and the second a matter of carcass quality.

The first reason is that of convenience of production. The limit on our output of meat is set by the supply of winter feed. If mutton is produced it involves winter feed and a reduction in the number of ewes that can be wintered. Since most of our sheep are kept on grassland lambing just before the grass begins to grow in the spring enables the flush of spring grass to be cashed without labour costs through the lamb crop which is sold to the butcher before or as the grass growth slows down later in the year. Under these conditions high fertility and good milking ability in the ewes is important for by this means the greatest differences between winter and summer feed requirements are obtained. Fat lambs are usually marketed at from 10 to 16 weeks old at oarcass weights of 35 to 50 lbs. In general the industry is stratified in breeds and crosses to suit environmental conditions. On the hills and mountains hardy breeds of low fertility are kept : some of these are crossed with rams of breeds of high fertility and milk yield and their female offspring sent to

- 3 -

good lowland grass to become the dams of fat lambs when mated with early maturing mutton type rams. Experiments with injections of P.M.S. hormone (700 i.u.) 12 days after the last cestrus have shown that the lambing percentages can be considerably increased. Attempts now being made to increase output by twice a year lambing by injections of progesterone followed by P.M.S. have met with limited success.

The second reason why lamb is preferred to mutton is that the quality of the meat is higher; the joints are smaller, the grain is finer, there is less fat and the proportion of weight in the low priced joints such as the ribs is relatively smaller. The price per lb. of carcasses of different weights shows that while in most breeds the price falls as the carcass increases in weight it falls much more quickly in early maturing breeds such as the Southdown where heavy weight animals have a lot of fat than in late maturing breeds like the Scottish Blackface where little fat is put on.

Dissection results from sheep of different ages show that the maximum rate of growth occurs in the different tissues of the carcass in a definite order. Central Nervous System first, followed by bone, then muscle and lastly fat. In an early maturing breed the peaks of these growth curves come closer together so that it fattens as it grows. While in late maturing breeds the peaks of the curves are drawn wider apart. Similarly on a high plane of nutrition the peaks come closer together while on a low plane of nutrition they are drawn wider apart.

0

The physiological basis whereby these differences in level of nutrition affect the composition of the animal and the proportion of its parts is that the early developing tissues and parts of the body have priority over the later growing tissues and parts for the nutrients from the blood stream. When on a high plane of nutrition all tissues get equally supplied with nutrition according to their growth requirements, but when the animal is on a low plane of nutrition the Central Nervous System and bone have priority over muscle and fat and they continue to grow while fat and muscle growth ceases. Under very low planes of nutrition such as sub-maintenance fat and muscle tissue is absorbed into the blood stream and nerve tissue and bone continue to increase in weight from this source.

- 4 -

A points scale has been drawn up for evaluating quality in a lamb carcass based partly on measurements and partly on eye appraisal. Standards were set by a carcass selected by meat traders on Smithfield market as being an ideal one. In order to find out how a lamb should be fed in order to produce this ideal type of carcass, lambs were reared on different planes of mutrition to a carcass weight of 30 lbs., changes in plane of mutrition being made when the lambs were 6 weeks old. The most suitable lambs were the High-High plane (56 days old) followed by the Low-High (125 days): the High-Low (125 days) came next and the Low-Low (295 days) last. Those finished on low plane had a higher proportion of bone to meat, as might be expected from the priority of nutrients theory given above, while the older animals had a higher proportion of the low priced ribe for these bones are late developing ones.

- 5 -

355