IMPROVEMENT OF BEEF CATTLE STRAINS

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Summary
Data obtained from ten strains of cattle on the relationship of carcass weight and certain skin characters supported the hypothesis that selection to strengthen a strong trait in a breed for crossbreeding purposes is warranted rather than selection to improve weak traits without crossbreeding.

The data obtained was taken from a breeding experiment designed to test the hypothesis that creating hybrid vigour by selecting for distinctiveness of required characters of the breeds and for the special attributes of individuals is an effective method to improve beef production in Northern Australia.

I. INTRODUCTION
Since cattle production is critical to Northern Australian land use and economy, a survey was made in 1950 to 52 to investigate the breeding methods being used. A search was made for strains of British breeds (Bos taurus) which were reputed to be performing maximally under stressful conditions of climate and parasites. Evidence of any objective selection was not found in the recognised outstanding herds which were inspected. Invariably, crossbreeding and colour mark selection or outcrossing and good management accounted for superior performance recorded by individual cattlemen (Dowling, unpublished data). Clearly, selection for productive adaptability was feasible, if practical, but management and climatic factors were of overriding importance in an area so lacking in communication and capital.

Crossbreeding the species Bos taurus and Bus indicus was also the best and most expeditious method to obtain tick resistance (Kelly 1932). Further, the continued need for crossing to strengthen Bos indicus characteristics and desirable carcass merits are patently obvious as environmental and management conditions alter (Dowling 1967). And in actual fact, crossbreeding for advantages of vigour and performance and to include attributes for an area or special market requirements is becoming the feature of cattle breeding of the twentieth century. The development of new “pure” breeds or strains is a logical consequence and the purpose of this paper is to report advances in this direction.

II. MATERIALS AND METHODS
(a) Animals and Management
Cattle of both beef and dairy breeds in both harsh and hot tropical areas were examined (Dowling 1958, 1960). The code for the groups names is AF,
Africander; F. Friesian; RP, Red Poll; RPP, Red Poll (purebred registered); SUSS, Sussex; Z, Zebu X Shorthorn; A, Shorthorn A (“adapted” local); S, Shorthorn (“adapted” selected); R, Shorthorn R. (unselected control); AIS, Australian Illawarra Shorthorn.

The cattle were all the same age. Eight strains were Bos taurus if the Australian Illawarra Shorthorn can be accepted in this species. One group containing Zebu (Bos indicus) by Shorthorn crossbreds and a group of Africanders were included for comparison.

The animals were compared on the basis of carcass weight and skin characters. The criterion of desirability in this case was taken as high carcass weight to represent high biological efficiency. The skin characters measured were hair population per unit area, sweat gland volume, skin thickness and hide weight (Dowling 1956, 1964).

III. RESULTS

Table 1 gives a list of all the relevant means and standard errors of the five variables considered. The results of the analysis of these variables are shown in Table 2.

The skin variables, viz. (1) hair population, (2) sweat gland volume, (3) skin thickness, (4) hide weight, and carcass weight were found to be very highly significantly different (P < 0.001) between breeds within areas (Table 2). However, only in the case of carcass weight was the effect of different environments significant (P < 0.001), irrespective of strain or breed. In order to examine the relationship between sweat gland volume and carcass weight, the correlations of sweat gland volume with carcass weight were calculated separately for each breed. The correlations were significant only in the case where the group is not a strain, that of the Zebu crossbred (r = 0.82).

A graph (Figure 1) of relationship of mean sweat gland volume to mean carcass weight was plotted and the calculated linear relation indicated. The correlation of 0.50 was highly significant (P < 0.001).

Variables 1-4 were regarded as independent variables (x₁ – x₄) carcass weight (Y) as a variable dependent on these four. With this in mind, the following regression model was fitted.

\[ Y = 1010 \times x₁^{0.21} + 16.21 \times x₂ + 52.78 \times x₃ - 52.79 \times x₄ + 629.7 \]

Thus, it can be seen that hair population (x₁) did not affect the carcass weight although it was significantly different as between breeds. The Bos indicus had a higher hair density and performed relatively well in the tropical conditions. The lighter the carcass weight, or the more poorly the Bos taurus strain (R) is growing under similar conditions, the relatively higher the density compared to the adaptable, better performing selected (c) strain. Hence, it may be unwise to select on this character. Sweat gland volume (x₂) had a very strong positive effect on carcass weight (P < 0.001). Skin thickness (x₃) had a negative effect on carcass weight (P < 0.01). This was a breed effect explicable in much the same fashion as for hair density. Hide weight (x₄) and carcass weight were significantly positively
<table>
<thead>
<tr>
<th>Group</th>
<th>Hair Population No.</th>
<th>Sweat Gland Vol. ($\mu^3 \times 10^8$)</th>
<th>Skin Thickness (mm)</th>
<th>Hide Weight (kg)</th>
<th>Carcass weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF</td>
<td>772.0 ± 34.21†</td>
<td>11.8 ± 0.86†</td>
<td>8.31 ± 0.12†</td>
<td>30.09 ± 1.21</td>
<td>300.92 ± 6.09†</td>
</tr>
<tr>
<td>F</td>
<td>803.4 ± 26.17</td>
<td>4.73 ± 0.37</td>
<td>6.53 ± 0.06</td>
<td>31.12 ± 1.05</td>
<td>280.51 ± 11.96</td>
</tr>
<tr>
<td>RP</td>
<td>851.0 ± 54.82</td>
<td>5.08 ± 0.4</td>
<td>6.64 ± 0.186</td>
<td>31.62 ± 1.43</td>
<td>257.37 ± 13.3</td>
</tr>
<tr>
<td>RPP</td>
<td>825.6 ± 38.08</td>
<td>4.52 ± 0.36</td>
<td>6.43 ± 0.17</td>
<td>30.89 ± 1.51</td>
<td>264.9 ± 8.04</td>
</tr>
<tr>
<td>SUSS</td>
<td>714.6 ± 12.88</td>
<td>7.07 ± 0.42</td>
<td>7.1 ± 0.27</td>
<td>33.48 ± 0.69</td>
<td>272.57 ± 6.9</td>
</tr>
<tr>
<td>Z</td>
<td>1105.4 ± 57.76</td>
<td>11.23 ± 0.98</td>
<td>7.65 ± 0.12</td>
<td>37.69 ± 1.2</td>
<td>364.51 ± 9.15</td>
</tr>
<tr>
<td>AIS</td>
<td>742.2 ± 44.84</td>
<td>7.29 ± 0.4</td>
<td>6.66 ± 0.13</td>
<td>31.93 ± 0.62</td>
<td>322.92 ± 7.75</td>
</tr>
<tr>
<td>S</td>
<td>817.4 ± 28.5</td>
<td>8.19 ± 0.69</td>
<td>6.12 ± 0.15</td>
<td>32.43 ± 0.82</td>
<td>351.36 ± 6.94</td>
</tr>
<tr>
<td>A</td>
<td>743.5 ± 36.0</td>
<td>7.20 ± 0.56</td>
<td>6.54 ± 0.14</td>
<td>32.02 ± 1.32</td>
<td>338.07 ± 7.26</td>
</tr>
<tr>
<td>R</td>
<td>847.0 ± 55.6</td>
<td>5.24 ± 0.33</td>
<td>5.91 ± 0.1</td>
<td>28.85 ± 1.02</td>
<td>295.25 ± 11.16</td>
</tr>
<tr>
<td>TOTAL</td>
<td>825.4</td>
<td>7.35</td>
<td>6.76</td>
<td>33.52</td>
<td>309.04</td>
</tr>
</tbody>
</table>

†Standard errors.
TABLE 2
The effect of different environments on the skin variables and carcass weight

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Significance of F ratio for:—</th>
<th>Hair population</th>
<th>Sweat gland volume</th>
<th>Skin thickness</th>
<th>Hide weight</th>
<th>Carcass weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>N.S.</td>
<td>***</td>
<td>***</td>
</tr>
<tr>
<td>Breeds within areas</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>***</td>
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<td>***</td>
</tr>
</tbody>
</table>

N.S.—Not significant.

***P < 0.001.

related (P < 0.05). Carcass weight was significantly different between strains (Table 2).

The conclusion drawn from this information was that most of the differences were a breed effect. The concept of selecting strains highly significantly stronger in characteristics needed (e.g. stress resistance, meat composition) for inclusion in the existing strains of cattle is creditable.

IV. DISCUSSION

The ‘strains varied significantly in production characters yet represented distinctiveness for a particular strain. The results in this paper are restricted but do strengthen the practicability of the concept of selecting strains highly significantly stronger in characteristics needed for inclusion in the existing cattle. Presently, the problem of determining the types of cattle required for tropical Australia has not been solved. Chester 1952; Alexander and Chester 1956; Alexander 1965, 1968; Sutherland 1967; Rendel 1969). Cattle on the coastal tick-infested areas challenged with parasites, mineral deficiencies and nutritional stresses were facing a survival situation. Heat tolerance was not the critical problem (Dowling 1958). Bos taurus type cattle may phase their skin function to withstand even the

![Graph showing the relationship between sweat gland volume and carcass weight.]

Fig. 1.—The relationship of sweat gland volume and carcass weight.
intense heat of the dry inland tropical regions of Australia (Dowling 1956). The \textit{Bos taurus} Group were bred from Shorthorns selected on the reproductive performance of the cow, probably the most important factor in beef production, and growth rate of the bulls, and subjected to climatic exposure and stress tests of exercise in the summer radiant heat of Northern Australia. Subsequently, in keeping with the above concept, two Sahiwal bulls were introduced on selected Shorthorn females in 1958 to develop a strain to be inseminated with Charolais (1969).

This hypothesis was based on the assumption that beef production and health are indivisal and the \textit{Bos indicus} infusion is necessary for resistance to ticks, disease and climatic stress (i.e. after selection for productive adaptability, e.g. fertility and growth for beef, within the existing \textit{Bos taurus} cattle), because a high proportion of cattle in Northern Australia are located on the more humid, wetter coastal strip which is infested with the cattle tick (\textit{Boophilus microplus}) carrying tick fever parasites. The development of improved pastures calls for a further efficient combination for carcass merit (Charolais, Devon, Garonais, Limosiun, etc.) combined with ease of calving and mothering advantages.

The above findings are relevant with respect to the ample breeding areas of the inland, where it is imperative to capitalise on grass growth when it may occur. Then better transport facilities from the cheaper breeding grounds to the balanced, quality pastures in the warm, wetter coastal conditions make for the economical quality beef production, if pure breeds with the critical characteristics are combined for efficient utilisation of grass and supplementation. So it is concluded that breeding programmes designed on the concept of acquiring the required traits to produce cattle of high biological merit, capable of maximum productive adaptability for consumer requirements, could increase significantly the value of Queensland’s greatest asset.

V. ACKNOWLEDGMENTS

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VI. REFERENCES