M. C. FRANKLIN MEMORIAL SYMPOSIUM

DROUGHT FEEDING OF SHEEP

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I. INTRODUCTION

Drought may be regarded as an extended period of nutritional deficiency, that is a period during which the rate of production of feed is less than its rate of consumption. During the past century, eight major and many minor droughts have had striking effects on the Australian sheep industry (Foley 1957). These effects, some obvious, some less obvious may be summarised as follows:

(a) Reduction in stock numbers.

(b) Reduction in the amount and quality of wool produced.

(c) Delays in mating and hence lower reproduction rate.

(d) Long term effects on feed production.

(e) Prolonged post-drought effects on growth, production and reproduction.

(f) Decline in the rate of increase in productivity, i.e., decline in the rate of increase of the ewe flock (Bishop 1964).

The principal aims in feeding sheep during drought are to minimize losses, to reduce long term effects by avoiding excessive damage to pastures, and to maintain sheep in a physiological state such that productivity will return to normal with the least delay at the end of the drought. This paper will briefly review the classes of animals and feeds involved, the nutrient requirements of sheep, supplementary and hand feeding, and finally will summarise the strategies to be adopted in drought feeding.

II. ANIMALS AND FEED

The national flock is distributed almost equally between three main geographical areas, namely the pastoral, wheat-sheep and high rainfall zones. The likelihood of drought is highest in the pastoral zone and the possibility of production of supplementary feed is least. There are both a lower expectancy of drought and improved chances of fodder production in the other two zones, but systems of land usage and stocking rates determined by land values and other economic factors influence the extent to which feed is available during droughts. The feed available to sheep during droughts will consist of varying proportions of:

(a) Pasture, usually mature and of low nutritive value.

(b) Pasture residues, seeds and burrs.

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(c) Shrubs such as saltbush grazed by sheep only when other feeds not available (Leigh and Mulham 1964).
(d) Tall shrubs and trees.

Drought feeding strategy consists first in deciding which classes of sheep—rams, wethers, dry, pregnant and lactating ewes, and unweaned and weaned lambs -should be fed, second in supplementing the available feed, and finally, as that supply decreases, in feeding the sheep to satisfy the whole nutritional requirements.

III. NUTRITIONAL REQUIREMENTS OF SHEEP DURING DROUGHT

Much of the present information on nutrient requirements of sheep during drought was derived from experiments conducted at the Burdekin Drought Feeding Unit under- the leadership of Dr. M. C. Franklin.

(a) Energy

Allowances originally determined by reference to the Starch Equivalent System were modified in the light of experimental results to provide a practical indication of nutritional requirements. The allowances recommended, derived from this work, were published in the Commonwealth Scientific and Industrial Research Organization leaflet on 'Drought Feeding of Sheep' (C.S.I.R.O. 1958) and are reproduced in Table 1. They have recently received substantial confirmation from recommendations made by the Agricultural Research Council (1965) after a detailed examination of evidence drawn from the world literature. The A.R.C. gives requirements in terms of metabolizable energy (M.E.) which is the gross energy of the feed minus the losses of energy in faeces, urine, and gaseous products of digestion, and which allows more satisfactory description than by the Starch Equivalent System of requirements and of the energy value of feeds. It is shown in Table 2 that the amounts of various grains calculated from the A.R.C. publication to be required for maintenance of a 30-35 kg sheep are in good agreement with those established by the work at the Burdekin Unit.

The metabolizable energy content of diets of various digestibilities (Mcal/kg dry matter) ranges from 1.2 to 1.8 for straws, 1.6 to 2.2 for hays of varying maturity, 2.1 to 3.2 for dried grasses and 2.9 to 3.3 for grains. With increasingly fibrous diets, the energy expended in chewing activities increases (Weston and Hogan 1968) and so does the requirement of sheep expressed in terms of M.E.

TABLE 1

Weekly Feed Requirements for ***Drought Maintenance*** of ***Merino Sheep****

Class of Sheep	Food Units	Oats (lb)	Wheat (lb)	Prime Hay (lb)
Weaners	3	5.0	4.2	7.5
Adult dry sheep (liveweight 75 lb)	4	6.7	5.5	10.0
Ewes (six weeks before lambing)	5	8.3	6.9	12.5
Ewes (with lambs at foot)	7	11.7	9.7	17.5

*The exact requirements will vary according to the condition of the sheep. Thus, weaners in good condition can subsist on 2½ food units, and adult sheep on 3. Ewes in the later stages of pregnancy may require up to 8. and ewes with lambs at foot up to 10 food units per week.

TABLE 2

Comparison** of **the Estimated Maintenance Requirements** of **30-35 kg 'Sheep With A.R.C. (1965) Values

Grain	Briggs, Franklin and McClymont (1956) (kg/sheep/week)	A.R.C. (1965)* (kg/sheep/week)
Wheat	2.58	2.61
Maize	2.38	2.46
Oats	3.10	2.89
Barley	2.62	2.65
Grain Sorghum	2.48	2.56

*A.R.C. gives no value for grain sorghum. A calculated M.E. value of 3.2 Mcal/kg dry weight was used.

An indication of the variation in feed requirement with different types of diet, derived from Agricultural Research Council (1965), is presented in Table 3.

(b) Protein

Protein in drought rations must first satisfy the needs of the rumen micro-organism on whom the sheep depends for most of its carbohydrate digestion. Deficiencies of protein for this purpose probably exist with diets of lower protein content than wheaten hay (Briggs ***et al.*** 1960). Protein requirements for wool production in diets fed at maintenance energy levels are undergoing re-appraisal in the light of responses in wool growth to the addition of protein to the abomasum and of denatured protein to the diet (McDonald 1968). Calculations from Agricultural Research Council (1965) suggest that the adult sheep requires 30-40 g/day digestible crude protein; the requirement for the growing lamb is probably of the same order.

(c) Minerals

The mineral requirements of the adult sheep at maintenance are probably about 3 g/day calcium, 2 g/day phosphorus and 0.5 g/day magnesium; lactating ewes probably require about twice these amounts (A.R.C. 1965). Sheep fed all grain diets benefit from the addition to the diet of 1.5% ground limestone (Franklin 1942). The addition of finely ground limestone to grain diets for ewes

TABLE, 3

Quantity** of **feed, kg dry matter per day, required by lambs and sheep in relation to metabolizable energy content** of **the feed (Mcal M.E./kg dry matter)

Mcal M.E./kg. dry matter	Quantity of feed (kg dry matter/day) for		
	20 kg lambs		40 kg adult sheep Maintenance
	Maintenance	Gaining 50 g/day	
1.8 (straws)	1.00	1.58	1.59
2.2 (hays)	0.97	1.42	1.54
2.6 (dried grasses)	0.93	1.29	1.48
3.0 (grains)	0.87	1.20	1.42

with lambs is particularly required to ensure normal dental development in the lambs (Franklin 1950).

(d) Vitamin A

The requirements of the sheep under drought feeding conditions has not been clearly defined. The type of animal most susceptible to vitamin A deficiency is undoubtedly the lamb; lambs are born with low reserves (Eveleth, Bolin and Goldsby 1949) and rely on transfer from the coldstrum and milk. Peirce (1945) observed depleted liver reserves of vitamin A in lambs, while Franklin *et al.* (1955) showed that 7 month old lambs fed on drought rations required vitamin A supplementation for survival.

There is evidence that the reserves in the body are depleted only slowly. Peirce (1954) observed deficiency only after ewes had been fed for 19 months on an otherwise adequate diet that supplied only 10 μg carotene/kg bodyweight per day.

The effect on storage in the liver of the vitamin when diets are nutritionally inadequate has not been investigated. However, Hart and Guilbert (1933) observed deficiency symptoms in ewes grazing dry range. Subsequently Guilbert, Miller and Hughes (1937) suggested that an intake of 25-35 μg/kg bodyweight per day carotene would be needed for ewes but Peirce (1954) placed the requirement at the higher level of 50 μg/kg per day for reproducing ewes.

Gunn, Sanders and Grainger (1942) observed sterility in rams fed for six months on a carotene deficient ration. No information is available on requirements of rams for the vitamin but the small proportion of rams in a flock readily permits the occasional use of strategic doses to guard against possible deficiency.

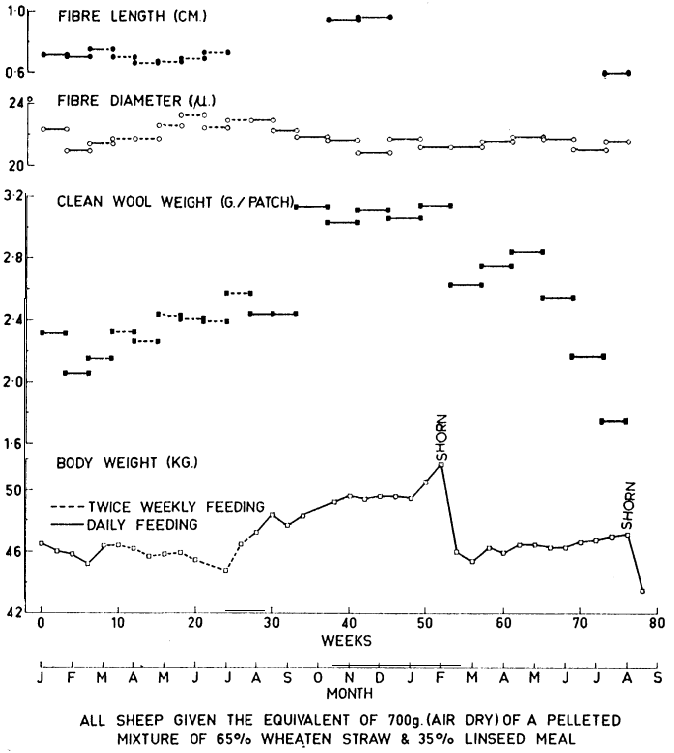
IV. SUPPLEMENTARY FEEDING

The aim of supplementary feeding is to raise the intake of nutrients to levels sufficient for maintenance. As outlined above, much of the available food is apt to consist of low quality roughage. In hand fed sheep, the intake of such roughage can be increased by the addition of urea (Briggs *et al.* 1960); however the resulting increase in the quantity of nutrients obtained is comparatively small (Weston 1968). There is no clear evidence of improvement in the nutritional status of grazing sheep by supplementation with urea (Loosli and McDonald 1968). Before embarking on large scale use of urea blocks, the' grazier would be advised to try such supplements on a small scale, looking for measurable response such as increases in bodyweight of the sheep. Substantial increases in food intake can probably be achieved only by grinding the roughage. The intake and nutritional value of ground roughage can be further increased by supplementation with protein, which has raised the intake of digestible organic matter of a wheaten hay diet by 87% (Weston 1968). The use of mobile hammer mills to render low quality roughage, twigs and small stems and even noxious weeds available to sheep during droughts deserves more attention.

V. METHODS OF HAND FEEDING

(a) Early weaning

Lambs have been weaned successfully with more than 80% of survivors on to a diet of equal parts lucerne chaff and oats or wheat (C.S.I.R.O. 1958) or on



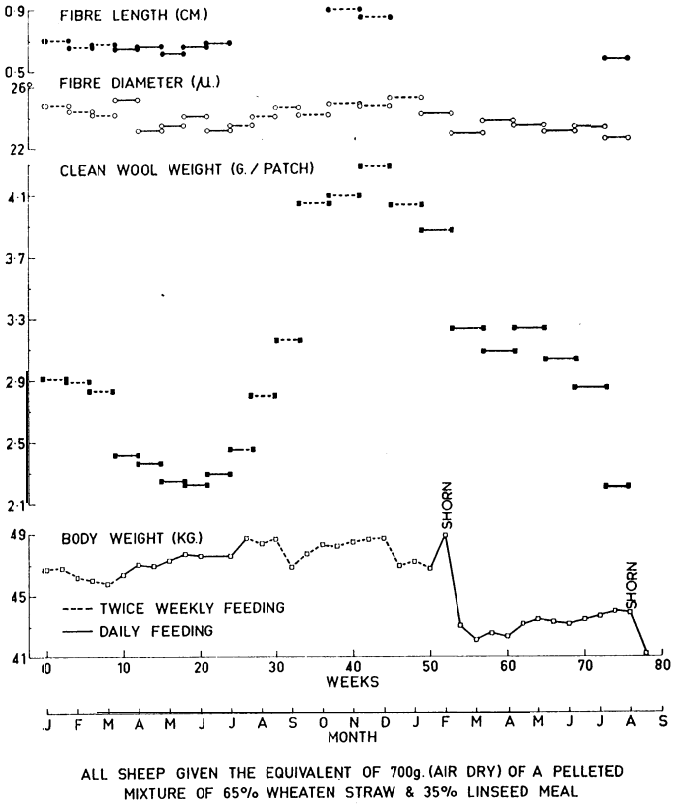


Fig. 1. — Changes in body weight and features of the wool growth of Merino wethers when fed daily or twice weekly.

to a high protein feed mixture (Franklin, McInnes and Briggs 1964; McInnes and Briggs 1964).

(b) Feeding adult sheep

There is abundant evidence of improved survival with intermittent feeding (twice weekly and weekly) of dry adult sheep, weaners and pregnant ewes, with diets varying from all roughage to all grain, and mixtures of the two (Franklin and Sutton 1952; Franklin ***et al.*** 1955; Briggs, Franklin and McClymont 1956, 1957). Evidence of improved wool production with intermittent feeding is also emerging from the work of Hill and McClymont (this Journal) and Briggs (unpublished data). In the latter work, two groups of 5 Merino wethers were offered the equivalent of 700 g/sheep/day of a high protein pelleted diet which contained 27 g N. All sheep were fed individually, the first group daily, the others twice weekly. After 12 weeks the feeding system was reversed. The results (Figure 1) were complicated by seasonal variation in the rate of wool growth; however the change in feeding from daily to twice weekly consistently produced small increases in both fibre diameter and fibre length, which resulted, particularly at the time of maximum wool production, in an appreciably higher rate of wool growth.

For intermittent feeding, it is recommended that sheep be confined to a feeding unit such as that used by Kennedy and Bettenay (1950) for the following reasons:

(i) Sheep will use less energy in searching futilely for feed.
(ii) Shelter can readily be provided if necessary.
(iii) Early weaning techniques can most readily be adopted.
(iv) After the drought breaks, sheep can be held until the pasture has recovered sufficiently to support them.

There is less feed wastage if the feed is provided in troughs. Troughs also facilitate the mixing of the recommended addition of ground limestone to grain diets.

VI. FURTHER DEVELOPMENTS

Franklin (195 8, 1962) has given an excellent summary of the steps involved in drought mitigation, which need not be repeated here, and his work and writings have clearly indicated aspects that deserve further attention, including:

(a) Studies of the physiology of the chronically under-nourished 'animal-the digestion and metabolism of carbohydrates, protein, minerals, and vitamins.
(b) Studies of long term effects of undernutrition on reproduction and on wool production.
(c) Development of modified diets to provide for production in addition to maintenance.
(d) The development and investigation of pasture plant species of improved drought tolerance and of shrubs and trees to serve as fodder reserves.

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