The findings of behaviour studies of sheep and cattle under rangeland farming, intensive grazing conditions and highly intensive units are examined. Studies of feral and semi-wild sheep and cattle help determine species-specific behaviour responses.

Two concepts which have been proposed to understand animal responses, the home range suggested from temperate studies, and the piosphere from semi-arid regions, are examined and a way of extending the piosphere is suggested.

Smaller unit subdivision emphasizes the social interactions of flock sheep and the dairy herd, and social factors provide some basis for understanding and utilising stock behaviour on intensive pastoral farms.

The precise control of the environment and the social group, which occurs in highly intensive units is shown to pose new strains on animal adjustment; and behaviour studies are suggested as elucidating some principles and methods to minimise problems arising from new forms of housing, feeding and handling.

I. INTRODUCTION

This review deals with current knowledge of the behaviour of farm animals under three broad farming categories: extensive pastoral or rangeland farming, intensive grazing conditions, and highly intensive units.

Studies of feral species in a variety of habitats have built up a picture of species-specific behaviour patterns which will be expressed in different ways within each of these three broad farming systems. Appendix 1 lists some of these studies which can provide a fund of information and hypotheses for behaviour work with domestic breeds.

II. BEHAVIOUR UNDER EXTENSIVE PASTORAL RANGELAND CONDITIONS

Many hilly or semi-arid areas of the world are utilised for animal grazing in large units from several hundred hectares to many square kilometers. Knowledge of the way in which patterns of animal movement, grazing activity, home territories, and sexual and maternal behaviour interact with various husbandry practices under range conditions is still limited.

Hunter (1954) reported that sheep appeared to have an intimate knowledge of their grazing areas. In hilly country, in summer, Scottish Blackface sheep made direct movement from their camping spots to area of young heather. In winter, they moved directly to pasture from which the sun would lift the frost. In later studies (Hunter 1960; Hunter and Milner 1963; Hunter and Davies 1963; Hunter 1964), the concept of "home range" developed by Burt (1949), was applied to account for sheep behaviour in a 140 ha block. Several home range areas were maintained, and sheep in one range were "fenced from the others by social behaviour", (Hunter 1964). Home range groups were largely composed of related sheep, lambs and two-year-olds having stayed together with their dams. As sheep as a species show the characteristics of a "follower-type" relationship between ewe and lamb (Walther 1972), such closely related groups should be expected. It is not possible to know from these studies whether rams kept to these home-range areas during tupping. They were brought in and were strangers to the topography. They were distributed at random across the home ranges, possibly as a result of herding the ewes into a group once or twice.
each day. Other implications of home-range behaviour cited by these studies were the difficulty of placing supplementary feed conveniently for all stock, and the tendency to select replacement stock from home-ranges on easier country. The expected effects of changes in stocking rate, the improvement of pastures, the positions of fences, and some reasons for the development of home-range behaviour were discussed.

The feral behaviour of Soay sheep (Grubb and Jewell 1966) agrees well with Hunter's observations. Marked ewes retained their own home range for at least five years and the few recorded shifts were associated with disturbances. Ranges fluctuated in size according to season and it appeared that the home ranges were most clearly delineated where grazing pressure was highest. Rams normally living in all-male groups ranged widely during the mating season but subsequently returned to their same groups and home range areas.

Attempts to define home-range areas in extensive sheep holdings in Australia have encountered at least two difficulties. Lynch and Alexander (1973) reported that in times of adequate feed and cool temperatures merinos associated in large mobs, but when temperatures rose the group size diminished. With shortages of feed sheep moved in small groups of two to five irrespective of temperature. Different breeds vary in their responses to temperature change and feed conditions, as well as to the paucity of watering points and the seasonal changes in those available, and this prevents the establishment of stable home range areas. Lange (1969) proposed the concept of 'piosphere' as the basic grazing zone around the watering point, available to animals under arid and semi-arid conditions. Aerial photographs of terrain that could be sharply incised by travelling sheep, showed an almost radial pattern of tracks from water holes. These tracks were often as narrow as 15 cm indicating regular use and movement and were deflected by changes in vegetation and fence lines. The influence of fences could extend into the piosphere for up to 300 m. Tracks radiating from trees indicated their use as shade or shelter, and it seemed that there was no chance of any plant escaping the attention of moving stock.

Other records of movement patterns of sheep in dry areas have come from Lynch (1973b), who plotted merinos on a 2,000 ha block, and from Squires (1970b, 1971), Squires and Hindley (1970) and Squires and Wilson (1971), using paddock and experimental studies. Squires and Hindley (1970) in a survey of the Central Riverine plain of N.S.W. found that 49% of the land lay further than 2 km from permanent water and the maximum distance to water was over 3.2 km in 45% of the subdivisions. A piosphere containing saltbush was heavily overgrazed for a radius of 1.2 km from water but areas beyond 2 km were only lightly grazed. Sheep and cattle, being selective grazers (Arnold 1966a, 1966b), can completely eradicate preferred pasture species within a 0.4 km radius of water. Other possible consequences of normal piosphere grazing patterns, could be greatly reduced intake in very dry periods, watering difficulties for lactating stock, and the possible separation of the young from the mother, though Squires (1970a) found that day-old lambs under average heat conditions (27°C) could travel up to 2.2 km.

Using a laneway with a water supply at one end and food supply with a 15% salt content at the other, Squires (1971) found that merinos could travel to drink up to 3.2 km twice daily at an average walking speed of 2.5 km per hour. This took about 40% of daylight hours. A regular daily pattern was followed by sheep under both experimental and field conditions. Similar distances from water and daily movement patterns were recorded by Lynch (1973b), though in cooler regions water was not taken daily and distance walked was less dependent of the positions of waterholes.

Some form of pasture subdivision particularly at times of drought seems necessary for control of stock movement and pasture utilisation.

A possible subdivision design based on behaviour studies of the piosphere is shown in Figure 1. Laneways radiating from permanent water for a distance (x km)
depending on distances walked and the radius of overgrazing, widen into funnel-shaped fence lines ending beyond the maximum distances walked from water.

The laneway could take stock rapidly beyond the normally overgrazed areas, perhaps focussing them onto resources not frequently grazed, and the funnel would ensure stock returning for water were directed onto the laneway. As finance became available three or four similar laneways could be built. As the fencing is open-ended, stock could not easily be trapped during floods and such fencing would effectively utilize the piosphere and could reduce the number of permanent water holes required. Paddocks between laneways could be reserved as lambing paddocks or for use during drought feeding. Similar sub-division might be used with range cattle where wind-driven electric fences could provide cheap fencing.

Browns (1971), studying three breeds of sheep in mountain summer ranges in Utah, found a daylight travelling range of 3 km for Columbias to 4.6 km for Rambouillets. Bedding-down was done on the same grounds on higher ridges and these areas became heavily overgrazed. The careful use of ridge fencing and placement of salt rations would ensure more uniform grazing of this rangeland.

Group structure and flocking behaviour of sheep has been studied by Arnold and Pahl (1967) and Dudzinski and Arnold (1967). Flocks of sheep under range conditions may refuse to integrate as one flock over a year or more. Dudzinski, Pahl and Arnold (1969) using aerial photographs defined a group as all sheep within 15 m from one other animal. Lynch (1973a) defined a group as sheep within visual contact which would flock into one mob if disturbed.

The use of revolving lick feeders to dispense molasses and urea to cattle during dry periods can also help disperse animals to fresh pasture or shade, provided stock are already accustomed to this type of feeding. Self-operated feeders minimise the effects of social dominance as each animal has to work longer for its rations.

The degree of predation of calves by dingoes also appears to be related to the piosphere. In contrast to sheep, cattle as a species show a "lying-out type" relationship between cow and calf (Walther 1972). Rankine and Donaldson (1968) reported that as calves normally do not travel to water until seven days of age they are left by water-seeking dams for periods of an hour or longer. Although a dingo can pass by an undetected calf as close as 10 m, a number of "lying-out" calves are killed and many are bitten. Cows and calves should not be shifted during the calving season as many new born calves could be left behind. Beginning at the age
of six weeks calves begin to congregate in groups of 20 to 25 with one or two cows nearby. Both the early behaviour patterns and the later "creche" type patterns make difficult, under range conditions, the identification of parentage of calves which is so important when breeding programmes are implemented.

Schmidt (1969) found some cattle in the Barkly Tablelands would walk 6 to 7 km in a single file from water before stopping to graze, and if pasture was sparse they could do without water for 3 days and travel 11 km. Other cattle groups grazed out slowly from the water hole. This further reinforces the behavioural basis for subdivision patterns as suggested in Figure 1.

Wagnon (1965), Wagnon and Carroll (1966), and Wagnon et al. (1972) reported that range cattle which were moved from familiar environments or from well-established routines, walked fencelines for several days and did not settle easily into new range routines. Some did not come to food troughs, others did not eat well, and there was some indication of short oestrous cycles in range heifers under stress. Data were provided on the effect of calling range cattle to supplementary feed, and the influence of social dominance on trough feeding. Problems were experienced in detecting heifers in oestrus though the best times for observations were when animals were resting, idling or ruminating. Range cattle are nervous of man and oestrous mounting is inhibited when the cattle are disturbed or are in yards.

From a New Zealand study on extensive grazing in High Country, Allison and Davis (1972) reported on ram ratios under two stocking intensities. They concluded that a ram ratio of 1:33 was required to cover two-year-old ewes adequately and that stocking density was of minor importance.

Many gaps still exist in our knowledge of behaviour of sheep and cattle under range conditions.

III. BEHAVIOUR UNDER INTENSIVE GRAZING CONDITIONS

Knowledge of how restrictions imposed by intensive grazing conditions interact with the basic behaviour patterns of each species can influence animal production. The degree of paddock subdivision restricts stock movement and the basic decisions as to the state of the pasture and its usage, times of mating, weaning of young stock, controlling stock parasites and other husbandry options must be made by the manager, thus further limiting the expression of "natural" stock behaviour. As grazing on most research stations is of the intensive type, much of the recorded behaviour comes from animals' reactions to intensive conditions.

Because grassland farmers have been translating their observations of behaviour into practical management decisions for many years, it is sometimes claimed that behaviour research merely records information already known to animal husbandmen. Yet, although behaviour observations have radically altered farming practice in all eras, some facets have been overlooked and their full implications for prediction have not been realised. The probability of lamb and calf poaching is increasing with synchronised parturition, multiple births and higher stocking intensities. Sound genetic programmes can be hampered by such poaching and it must be prevented in pilot projects using elite animals to improve breed strains. A survey of stud sheep practices at parturition in New Zealand (Welch and Kilgour 1972) highlights such difficulties.

The importance of social factors in sheep behaviour has been shown in many studies. Southcott, Roe and Newton Turner (1962) studied sheep in groups of two, four, eight, 16 and 30 and found that some productive traits in the group of two were not representative of larger flocks. The two sheep of the first group spent less time grazing, and more time in activity along the fence line separating them from the group of four sheep. Both these factors made two sheep less suitable for parasitological studies. The group of 30 sheep walked appreciably further than groups of four to 16 sheep. From studies of sheep at pasture (Crofton 1958) it seems that five sheep constitute the smallest representative group for this species.
Social facilitation effects in the grazing sheep were recorded by Tribe (1950) and Scott (1945) describing the nature and development of social interactions in a naturally increasing flock of sheep.

Evbank (1967) found some evidence for a social facilitation effect in the nursing behaviour of Clun Forest ewes. If one ewe began to nurse her lamb other ewes nearby would follow suit. The role of the presence of the male in the early induction of oestrus in ewes has been documented (Watson and Radford 1960; Edgar and Bilkey 1963; Welch and Tervit 1970) and sight and hearing are among the senses involved. Fletcher and Lindsay (1971) discussed a direct psychic inhibition of ewes by rams which exerts some control over the expression of oestrous behaviour. Other social factors which complicate mating patterns include ewes competing for ram attention, ewes being overlooked for some period after onset of oestrus or individual rams expressing some type of ewe preference. Hunter (1969) showed that even when Progesterone impregnated vaginal sponges were used to initiate oestrus, the presence of rams had a facilitatory effect. Libido tests of rams in pens should include enough sheep to make up a group of five animals (Mattner, Braden and George 1971a).

The social nature of sheep must also be considered during handling and the design of facilities. Stress as reflected in shifts in blood cortisol levels is less in sheep handled in a group than in those handled as individuals (Kilgour and de Langen 1970; Purchas 1973).

As the initial social bonding between mother and young at birth will play such an important role for the species throughout life, sheep tend to seek a secluded place to lamb. Even in two pens 13 m by 13 m with feeders in one and small shelters in the other, merinos sort out the isolated shelters for lambing (Bray 1971). Ewes tend to show a strong attraction for any newborn lamb several hours before parturition. This trait could lead to lamb-poaching (Winfield 1970; Welch and Kilgour 1970). Any farming practice at lambing may be judged successful if it allows the development of strong bonds between ewe and lamb.

Among further social phenomenon, camping by sheep has relevance to the spread of soil fertility and the parasite infestation of certain pasture areas. The flocking tendencies of sheep are taken for granted by shepherds using dogs, though Burns (1969) reported a training technique needed to teach local breeds in Ghana to flock for dogs. The preference for rams to mate with ewes of their own breed (Lees and Weatherhead 1970) is presumably superimposed upon normally developing social patterns. The refusal of some rams to mate during the tupping season may be due to some rearing factors, which upsets normally developing social processes (Mattner, Braden, and George 1971b).

O’Connor (pers. comm.) found that sheep on lucerne trials showed some effects from increasing stocking rates. With ewes with lambs at foot, lambs made good weight gains at 60 sheep per ha but when this was increased to 400 per ha, one third of the ewes dried off and lambs lost weight. When ewes alone were stocked at 2500 per ha they moved about and grazed but at 4000 to the hectare, grazing was inhibited.

There are many carefully controlled behaviour studies which provide specific details of broad social behaviour patterns in sheep but these are reviewed elsewhere (Box 1973; Hafez et al. 1969; Lynch and Alexander 1973; McBride et al. 1967). Studies of cattle behaviour in intensive pastoral units are limited and almost completely related to practical issues which have arisen as a result of new technological developments. The extensive use of artificial breeding and the resurgent interest in raising non-castrated beef animals has led to a number of studies on bull behaviour (Crombach 1961; Dalton, Pearson and Sheard 1967; Hale 1966; Hunter and Edwards 1964; Kerruish 1955; Kilgour and Campin 1973; Smith 1951) and to numerous discussions on the problems involved in the detection of
oestrus in dairy and beef cattle. MacKinnon (1972) summarised the New Zealand data on short oestrous cycles in herds of different sizes; Esselmont (1973) summarised some of the British work on heat detection methods and Saacke (1972) discussed the practical applications of research to date. The use of heat detector strips can lift the percentage of cows detected in oestrus from about 5% by human observation alone to over 90% (Williamson 1972).

The organisation of the dairy herd includes rankings of social dominance (Bouissou 1971; Brantas 1968; Dickson, Barr and Weickert 1967; Guhl and Akeson 1959; Schein and Fohrman 1955; Wagoner 1965), leadership (Kilgour and Scott 1959), milking orders (Albright et al. 1968) or submissive orders (Donaldson 1970). These have been considered in relationship to one another and to various factors such as milk production (Beilharz, Butcher and Freeman 1966), the spread of disease through the milking machine and milking order (Wilkinson 1969), dairy temperament (Dickson et al. 1970) and order of movement through yards or crushes (Beilharz and Mylrea 1965). The dairy herd is a highly complex social unit which is still not well understood.

Walker (1962) examined the patterns of suckling in beef cattle, and the behaviour of nurse cows suckling several fostered calves has been studied (Kilgour 1972b). Cow and calf behaviour after parturition has been described by Selman, Mylrea and Fisher (1970a, 1970b).

"Male libido" has been treated as a simple phenomenon in both the ram and the bull but definitions and testing procedures used have varied widely from worker to worker which indicates the complexity of this concept. (Table I).

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TABLE 1
Divergent assessment methods and definitions used by various workers studying male libido

<table>
<thead>
<tr>
<th>Species</th>
<th>Definition</th>
<th>Time to mount</th>
<th>Ejaculate rate</th>
<th>Dominance index</th>
<th>Total time allowed</th>
<th>No. of rams</th>
<th>No. of q</th>
<th>Size</th>
<th>Study cited</th>
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<tr>
<td>SHEEP</td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>6 x 1 crate</td>
<td>1 x 141</td>
<td>13 m²</td>
<td>Ahmed 1955</td>
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<tr>
<td></td>
<td>x</td>
<td>x</td>
<td>1 h</td>
<td>-</td>
<td>-</td>
<td>1 x 1 d</td>
<td>1 x 38</td>
<td>m²</td>
<td>Borrull et al. 1969</td>
</tr>
<tr>
<td></td>
<td>x</td>
<td>x</td>
<td>10 min</td>
<td>-</td>
<td>-</td>
<td>1 x 20 min</td>
<td>1 x 50</td>
<td>m²</td>
<td>Hulet et al. 1962</td>
</tr>
<tr>
<td>CATTLE</td>
<td>x</td>
<td>x</td>
<td>30 min</td>
<td>-</td>
<td>-</td>
<td>1 x 30 min</td>
<td>1 x 4</td>
<td>h</td>
<td>Marinowitz, Pretorius &amp; Herbst 1966</td>
</tr>
<tr>
<td></td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 x 4</td>
<td>1 x 1</td>
<td>x</td>
<td>Warrick et al. 1961</td>
</tr>
<tr>
<td></td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 x 1 yard</td>
<td>1 x 1</td>
<td>yard</td>
<td>Wiggins, Fairall &amp; Enik 1953</td>
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<tr>
<td></td>
<td>x</td>
<td>x</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1 x 1 yard</td>
<td>1 x 1</td>
<td>Osborn, Williams and Galloway 1970</td>
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Often when farmers experience problems in which behaviour is a component, such as mounting in weaner male calves, they experiment with changes in husbandry and management, before the research team, critically short of manpower and resources, can make their assessment of the issue. In some cases the changes have been costly and unsuccessful.
Highly intensive units are characterised by their severe restriction of animal movement, their monotonous environment and a general lack of sensory stimulation for the animals concerned. Housing shields animals from solar radiation and the elements and creates its own microclimate. Pens or cages isolate animals or separate them into groups of the same size and age during development. Stalled dairy cows have very limited opportunities to express oestrous behaviour (Prawirosudirdjo 1963). At certain times of the day mechanical feeding devices spill out sufficient precisely formulated food to satisfy appetite; and overhead rails above the back may be used in attempts to force animals to defecate in the appropriate dunging channels. As more mechanical techniques are used, the possibility of changes in animal behaviour being noticed directly by the husbandman become more remote. As units increase in size, the labour force becomes less involved with basic husbandry decisions. Past routines become consolidated and only extreme examples of deviant behaviour in the animals will be noted. With routines so well established, it is possible on the basis of a simple 24-hour watch of behaviour in intensive units such as piggeries, to adjust feeding schedules, cleaning schedules, and patterns of human activity, to lessen the human work load ‘and change pig habits. In one farrowing house it was found that piglets of all ages were suckling at the 40 minute interval set by the vocalisations of the youngest piglets in the 200 sow unit. Little creep feed was being taken and post-weaning weight losses had been inexplicably high.

A number of reviews have attempted to define the importance of the animals' adjustments to intensive conditions (Bryant 1972; Ewbank 1969; Goodwin 1969; Kilgour 1971a, 1972a, 1973; Waring 1970) and several Veterinary and Animal Science symposia have been concerned with practical issues. Wood-Gush (1971) drew up four guidelines for husbandry practice including the selection of the better adapted animals for breeding, allowing adequate space for the animal to indulge in redirected activity when temporarily frustrated (thus preventing the occurrence of more deviant behaviour), avoiding total isolation of highly social animals and providing enough variation in the environment to prevent "boredom". Although the public has come to look upon pasture farming as "natural" for domestic animals, many people are suspicious of intensive farming practices and a growing number of new Welfare Acts and Codes are being designed for Statutory law. Many consider these guidelines too permissive. There is an urgent need for more information on behaviour under intensive conditions. 

Brumby (1959) using monozygotic cattle twins indicated the importance of general environmental influences on stock production, and Holcombe (1957) found elevated urinary corticoids for 30 days after cattle had been shifted onto a new farm property. More recently Thurley (1972), monitoring plasma cortisol levels, found that new cattle placed in unfamiliar environments showed cortisol to levels beyond the expected diurnal variations and sheep at this time were susceptible to acute stress. Over the next 14 days the basal levels returned to normal and the same stress applied at this time was less upsetting to the animals. Early training of young animals may help their adjustments to later confinement and some preconditioning of stock will ease their acceptance of intensive conditions. Drugs have been used to decrease aggression when strange groups of pigs were mixed, and to aid handling of wild horses. The effects of sudden changes of sensory input on housed stock such as changing light intensities, general noise or sonic booms have been infrequently studied (Bond et al. 1965; Ames and Arehart 1972).

Several studies of animal responses during travel by sea, air and land are providing information on "travel stress" on stock. Sutton and Van der Heever (1968) described sheep during rail travel and Sutton, Fourie and Retief (1967) recorded cattle responses during loading and travel by rail. Kilgour and Mullord (1973) found that calves made better adjustments to road travel with increasing experience over a five-day journey.
As more attempts are being made to rear calves and lambs artificially from birth, mother-offspring interactions under pastoral conditions have been re-examined to determine the maternal senses involved in accepting alien offspring (Crowley and Darby 1971), and frequency of feeding and changes with increasing age (Ewbank 1969; Selman, McEwan and Fisher 1970a, 1970b). Attempts can then be made to simulate these conditions indoors. In general there is a paucity of behavioural information available and indoor husbandry decisions must be made on a trial and error basis. Orskov, Benzie and Kay (1970) and Lawlor, Hopkins and Kealy (1971) reported that poor feeding motivation, seen as biting rather than sucking of nipples can lead to "milk splash" in the rumen and ill-thrift. Riggott and Quarmby (1971) described bullying in pen-fed calves and recommended 18 as a maximum group size. Owen and Davies (1972) found that, in well-reared intensively-housed ram lambs, normal sexual instincts were impaired, perhaps by the unnatural rearing in exclusively male groups.

Some zoo mammals react to boredom by becoming moody and morose or by developing rigid compulsive behaviour patterns. New puzzles to do and regular changes in environment provide "mental activity" and enabled such animals to thrive in confinement, (Morris 1962). Apart from dangling chains in pig pens, few successful techniques have been implemented to overcome "boredom" in mildly stimulated tightly-penned domestic animals. It is always recommended that deviant behaviour, such as tail- and ear-biting in pigs, rail-chewing in penned cattle, excessive body-grooming or wool-chewing in cattle and sheep, crib-biting in horses and feather-pecking in hens be prevented if possible, as cures for outbreaks of these vices have been singularly unsuccessful. Deviant behaviour usually involves a variety of causes and though some of these have been enumerated, vice habits must be recognised as a normal hazard of intensive farming. Arehart et al. (1972) studied space requirements for indoor ewes with lambs. There was a high incidence of intersuckling by lambs. Ewes with twins were dirty with cotted fleece as lambs jumped on their backs. This behaviour was not prevented by doubling the space per animal.

More careful attention to schedules of feeding and the techniques involved could alleviate boredom. Ray and Roubicek (1971) found two peaks of feeding, at sunrise and late afternoon, in feedlot behaviour of 144 steers, and Schake and Riggs (1969) found in hopper-fed cattle, that those fed least spend more time idling, walking and licking than well-fed beasts. Arnold and Bush (1968) when training sheep to accept drought rations found that sheep classed themselves into several groups, those that always refused to feed, those that initially fed well and then stopped, and those that were periodic non-feeders. The principle of using self-operated feeders programmed to function according to variable schedules (Skinner 1938) could help maintain thriving housed animals. Fowl hysteria occurring in large pens could be prevented by complicating the environment by a few well-placed subdivisions (McBride pers. comm.). Mechanical feeding has increased the ingestion of metal hardware and Albright, Briggs and Jessup (1962) found that at least 9% of hopper fed cattle were involved though in some units the percentage was much higher.

The careful recording of behavioural responses and animal preferences has enabled more precise planning details to be outlined for cattle stall sizes (Hedren 1971; Wander 1965), type of floor and bedding materials (Crowe 1952; Hacker et al. 1969) preferred designs for stock housing (Estep, Winters and Davies 1962; Schmisseur et al. 1966; Albright and Alliston 1971; Hazen 1971), and optimum numbers of animals per set pen size in pigs (Ewbank and Bryant 1972) and in calves (Riggott and Quarmby 1971).

Some attempts have been made to put stock to more intensive use out of doors. Goot (1962) developed a harness to restrain sheep from browsing fruit trees in citrus orchards. Cattle can graze in conifer forests if certain precautions are taken. Brantas (1968) has taught cattle to operate one-way flap gates in cafeteria-type housing, and these could be used out-of-doors.
Evbank (1968) reviewed the information on the behaviour of farm animals under various forms of restraint, and some of the pertinent observations of behaviour important for handling animals in farm stock yards or meat freezing plants have been summarised by Kilgour (1971b). It has been found that bulls maintain a social distance of about 6 m without fighting and may be handled more easily in yards designed as oblong rather than square pens. The design of yards to aid animal flow patterns in the dairy shed would overcome a major time loss in the milking operation. A greater research effort is warranted to help the understanding of behaviour in different handling procedures and to assess the effects of currently available drugs to aid the humane handling of stock.

V. GENERAL

Carefully sampled behavioural observations can provide the basis for sound husbandry-decisions and consequently improve animal production. The most intimate interplay between managerial decisions and animal behaviour has been practised in intensive pastoral units.

Under rangeland conditions some farming practices could be altered as an understanding of animal behaviour within the piosphere grows. The practical applications of the contrasting species' patterns of mother-offspring behaviour, with sheep being "followers" and cattle being "lying-out" types, have not been fully explored.

Close subdivision practised in intensive grassland farms accentuates the social behaviour patterns of stock and the implications of social facilitation effects are poorly understood by both farmer and research worker. Field trials of stocking rate effects, on small paddocks with direct visual contact between groups, are frequently confounded by social variables, and social dominance effects become more pronounced as food and water supplies diminish.

As a result of the regular daily routines carried out in intensive units, behavioural baselines are stable. Short periods of controlled observation can provide reliable data as a basis for husbandry decisions. The principles of Pavlovian and Operant Conditioning have yet to be fully utilised by intensive enterprises. The adoption of variable interval feeding schedules for example may well increase the time spent feeding and help limit outbreaks of animal "vice".

The understanding of behaviour patterns of one farming system and the skills developed are frequently required by farmers of another system. Extensive graziers require knowledge of intensive husbandry skills at times of drought feeding and intensive grassland farmers require handling skills for successful artificial insemination. There are indications that some enterprises may require intensively raised animals to perform under extensive mating systems. The transfer of this knowledge is a major task of Agricultural Extension.

It should be possible, as an overall understanding of species-specific behavioural responses grows, to predict adjustment patterns when animals are subjected to new handling facilities or husbandry practices. This will greatly assist the welfare of domestic stock and eliminate costly mistakes.

VI. ACKNOWLEDGMENTS

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VII. REFERENCES

Selected studies reporting behavioural responses of feral animals or related wild species.

<table>
<thead>
<tr>
<th>Species</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Sheep</td>
<td>Boyd et al. 1964; Davis 1938; Geist 1971; Katz 1949; McCann 1956.</td>
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<tr>
<td>Goats</td>
<td>Asahi 1960; Darling 1937; Geist 1965; Lentfer 1955; Riney and Caughley 1959; Rudge 1969, 1970; Shanks 1972; Williams and Rudge 1969; Yocom 1967.</td>
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