BEEF CATTLE BEHAVIOR, HANDLING and FACILITIES DESIGN

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CORRAL DESIGN BOOK

This book contains the best corral layouts I have developed during the last fifteen years. Many of these designs have been constructed on ranches and feedlots all over the U.S. and Canada. There are layouts for both small and large operations. For ranchers on a tight budget there are economical designs which provide good sorting capabilities. A lack of pens and alleys for sorting is a major problem in some corral systems. Most of the designs have curved lanes, and round holding pens to facilitate handling. The two articles in this book explain the principles of cattle behavior and how it relates to corral design. In the back of the book there are details for gates, loading ramp, V chute and round crowd pen.

To make it easier to lay the systems out on the site many of the corral layouts have layout lines marked on them. In corral systems that have a curved single file chute, round crowd pen, and wide curved lane the radius points line up on the layout line. The layout line should be marked on the site with a string. The curved single file chute, round crowd pen and curved lane are formed by making three half circles with the radius points on the string.

If you have any questions feel free to call. I also provide the service of custom design of special corral layouts. Full sized construction drawings are available for many of the designs in this book. I also have drawings available for buffalo, sheep and hog handling facilities. I also provide consulting expertise on livestock transport, humane slaughter systems and layout of auctions and meat plant stockyards.

Sincerely,

Temple Grandin, Ph.D.
President

Consultant & Designer of livestock handling facilities for feed lots, ranches, packing plants & auctions
Cattle are visual animals that are motivated by fear. In the wild they are ever vigilant and any novel sight or sound is perceived as a possible danger. Their ears are more sensitive to high pitched noise than human ears and their wide angle vision enables them to scan the horizon for predators while they are grazing.

1. **Fear of Novelty** - Cattle will often balk and refuse to walk over a shadow, puddle, or change in flooring surface. They are wary of abrupt changes in color and high contrast. A coffee cup on the floor of a single file race or a small chain that jiggles on a fence will make them stop. If cattle balk and refuse to move through a facility one needs to get down in the race and pens and see what the cattle are seeing. Some of the most common things which will make cattle stop are: jiggling objects, a coat on a fence, reflections off puddles and seeing people moving up ahead. Calm cattle will look right at the things that they are scared of. If the cattle become excited it becomes impossible to determine why they refuse to walk down a race.

Novelty can be both fear inducing and attractive. Calm cattle in a corral will approach and sniff a paper cup on the ground, but that same cup will cause them to balk and turn back if one attempts to force the animals to walk over it. Cattle are most likely to panic when they are suddenly confronted with a novel sight or sound.

Cattle can be trained to tolerate novelty and changes in their routine. Cattle in the Philippines are not afraid of cars and motorcycles because they have seen them since birth while
grazing along the roads. The vehicles are no longer novel. Cattle that have never seen horses may become agitated when they are first moved with horses and be calm when moved by handlers on foot. However, animals accustomed to handlers on horseback may panic if suddenly confronted with people on foot. If new handling procedures are introduced slowly the animals can be trained to accept them. When a new procedure or a new facility is first introduced to the cattle their first experience with the new people and equipment should be relatively pleasant. If the animal's first experience is painful or scary the cattle will have a permanent strong fear memory. It is advisable to train cattle by walking them through new yards, races and chutes prior to any painful procedures.

Fear is a very strong stressor. For wild, extensively reared cattle, being restrained in a squeeze chute (crush) can be almost as stressful as branding. In tame dairy cattle, branding is much more stressful than restraint. The highly variable results in many handling and transport studies in likely to be due to different levels of fear stress in cattle with differing degrees of tameness.

There is an old saying, "You can tell what kind of a stockman a person is by looking at his cattle." A good stockman who handles cattle calmly will have calmer animals than a bad stockman who gets them excited. Livestock have excellent memories and if they are mistreated they will remember it. Handlers should spend time walking quietly among their cattle to get them accustomed to people moving among them. The person should become a neutral entity who is not associated with either food or going to the corrals. This will make it easier to move cows and calves to a new pasture at a slow walk. Moving cows slowly will prevent small calves from being separated from the cows when the animals are moved. When cows are fed from a vehicle it is
best to train them to come when the horn is blown. Otherwise they will chase the vehicle when you drive around to look at them. They should associate being fed with the horn instead of the vehicle.

2. **Flight Zone** - People working with cattle need to understand the flight zone. The flight zone is the animal's personal space. When a handler enters the flight zone the animals will move away. The size of the flight zone depends on how wild or tame the cattle are. Wild cattle will have a larger flight zone than tame cattle. Cattle that have been handled quietly will have a smaller flight zone than cattle which have been handled roughly. A tame high producing dairy cow may have no flight zone and she will allow people to touch her, but a wild cow that seldom sees people may have a flight zone of many meters. Flight zone size is determined by three factors: amount of contact with people, quality of the contact (quiet vs rough) and genetics. When a person enters a pasture the cattle will turn and face him, as long as he stays outside their flight zone. This is a predator avoidance behavior. Cattle turn and face potential danger and keep a safe distance. When the handler walks inside the flight zone the animals will turn away. Excited cattle will have a larger flight zone than calm cattle and if cattle become excited it takes 20 to 30 minutes for them to calm back down.

To move cattle quietly the handler should walk on the edge of the flight zone. The handler penetrates the flight zone to make the cattle move and backs away to stop movement. The principle is to alternately enter and withdraw from the flight zone. When the cow moves, the handler should reward her by retreating from her flight zone. The flight zone is larger when an animal is approached head on and smaller when she passes by a person. In confined areas such as an alley, handlers must be careful to avoid cornering an animal and deeply invading the flight zone.
Cattle sometimes turn back and run over people because they want to get the person out of their flight zone. If cattle in a confined space become agitated, turn back or rear up, the handler should immediately back up and retreat from their flight zone. Everybody who handles cattle also needs to understand the point of balance at the shoulder. To move an animal forward the handler must be behind the point of balance and to make the animal back up the handler must be in front of the shoulder.

3. **Effect of Genetics** - Genetic factors will also affect how cattle will react to handling. Cattle with an excitable temperament are more likely to panic and become agitated when they are suddenly confronted with novelty. In North America the author has observed increasing problems with European Continental cross cattle that have no tolerance for novelty. If they are handled quietly on their familiar home ranch or farm they will be quiet and easy to handle. But they become highly agitated when confronted with the novelty and noise of an auction market or slaughter plant. These animals are more likely to injure themselves or handlers when suddenly confronted with novelty. Excitable cattle have a temperament that is more like a horse's temperament. They have a greater tendency to panic. Cattle are herd animals. Animals isolated by themselves are likely to become highly agitated because they want to rejoin their herdmates. Animals with an excitable temperament become more agitated when separated from the group than animals with a calm temperament.

Problems with excessive excitability in European Continental cattle appears to be related to the increasing emphasis on breeding lean animals. The cattle with the worst temperament are the fine boned slender lean animals. Cattle bred for leanness with large bulging muscles often have a calmer temperament.
Research by the author has revealed that temperament must be evaluated more than once to get a really accurate evaluation. In one study 9% of the bulls become highly agitated in the squeeze chute every time they were handled and half the bulls remained calm. The animals were handled four times at 30 day intervals. There was also a large group of animals that were sometimes agitated and sometimes calm. To identify the really bad animals temperament must be evaluated more than once to avoid culling animals that may have become agitated because an animal next to them became excited. To rate temperament during restraint in a squeeze chute a simple scoring system can be used.

1. Calm - stands still
2. Slightly restless
3. Very restless
4. Vigorously shakes the chute and attempts to escape

Temperament ratings while restrained in a squeeze chute are also highly correlated with the position of the spiral round hair whorls on an animal’s forehead. Cattle with spiral hair whorls on the forehead above the top of the eyes become more excited and agitated while held in a squeeze chute than cattle with spiral hair whorls below the eyes. This effect is most likely to be observed in extensively reared cattle that are not completely tame. Hair whorl position is also correlated with flight zone distance. In groups of cattle with identical previous handling experiences, the animals with hair whorls high on the forehead were more likely to have a large flight zone.
It is important for producers to select for temperament. Cattle that become highly agitated at auctions and slaughter plants are dangerous for people to handle and they are more likely to have dark cutting meat. In the U. S. the incidence of dark cutters has more than doubled partly due to genetic lines of cattle with an excitable temperament. A recent study we conducted showed that cattle which went beserk in the squeeze chute (temperament rating of 5) had more dark cutters. Cattle with an excitable temperament also had lower weight gains in the feedlot.

4. **Principles of Restraint** - Since cattle have good memories it is important to make restraint for veterinary procedures as pleasant as possible. To hold the head for blood testing or IVs use a halter instead of nose tongs. Nose tongs hurt and cattle remember it.

Cattle that are extensively raised and not accustomed to close contact with people will often become highly agitated when they are held in a squeeze chute for veterinary treatment. One reason why the cattle become so excited is because they can see people deep in their flight zone through the open barred sides of the chute. Covering the sides of the squeeze chute to prevent the animals from seeing people standing close to them will make them calmer. Installing solid sides on the restraining chute will also prevent the cattle from lunging and bashing into the head stanchion as they enter the squeeze chute. If you do not believe that solid sides on squeeze chutes work, try installing some temporary solid sides made from cardboard.

Many cattle are injured when they hit the head stanchion too hard. Cattle movement into the head stanchion can be slowed down by installing a solid sliding gate 1.2m (4 ft) in front of the head stanchion. As the animal enters the squeeze chute the solid sides prevent it from seeing people. The only thing the animal should be able to see is a lighted opening to put its head through. If the animals are handled inside a building it may be necessary to install an overhead
light in between the solid sliding door and the head stanchion so that the animals will see a lighted opening to put their head through. The light must be positioned so that it illuminates the stanchion, but it must never be pointed directly into the eyes of approaching cattle.

Since the solid sides and front sliding door prevent the animals from seeing people and a pathway of escape most animals will quietly enter. A solid barrier in between them and people makes them feel safe. Since the animal enters at a slow walk the head stanchion and squeeze sides can be closed with a steady smooth motion. Sudden jerky motion of the apparatus excites and slow steady motion is calming. There is also an optimum pressure for holding an animal. The chute must apply enough pressure to make the animal "feel held" but excessive pressure which would cause pain must be avoided. Many people make the mistake of squeezing the animal tighter if it struggles. It is important that the restraining chute holds the animal firmly. If the squeeze sides jiggle and rattle when the animal struggles it is more likely to fight restraint.

Below is a list of the principles of low stress restraint for wild extensively reared cattle:

1. Block vision to prevent the animals from seeing people deep in their flight zone.

2. Block vision of an escape route, but cattle entering a restraining apparatus must see a lighted area. They will not walk into a dark space.

3. Slow steady pressure applied by a restraint device is calming and sudden jerky motion causes excitement and agitation.

4. Optimum pressure - a restraint device must apply sufficient pressure to provide the feeling of being held but excessive pressure that causes pain must be avoided.

5. Cattle will stand more quietly and remain calmer if they can see another animal within 1m (3 ft) of them but they may lunge and become excited if they see
herdmates many meters away. They become excited because they want to rejoin their herdmates.

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Behavioral Principles of Livestock Handling

TEMPLE GRANDIN

Summary

Reducing stress during handling will improve productivity and prevent physiological changes that could confound research results or lower productivity. Handling stresses lower conception rates and reduces both immune and rumen function. Handlers who understand livestock behavior can reduce stress. Livestock have wide angle vision and they are easily frightened by shadows or moving distractions outside of chutes. Solid sides on chutes will reduce agitation and excitement. Noise should be kept to a minimum because animals have sensitive hearing. When wild cattle or sheep are handled the handler should work on the edge of the flight zone to avoid agitation. Cattle, pigs, and sheep are herd animals and isolation of a single individual should be avoided. An animal's previous experience with handling will affect its reaction to handling in the future. Animals which have had frequent gentle contact with people will be less stressed during handling than animals which have had previous aversive treatment. Livestock can be trained to voluntarily enter a restraining device. The restraint device should be gradually introduced and should not cause pain. Feed rewards will facilitate training. Training animals to voluntarily submit to handling procedures would be especially useful for valuable breeding animals and animals used for research.

Introduction

An understanding of the behavior of livestock will facilitate handling, reduce stress, and improve both handler safety and animal welfare. Large animals can seriously injure handlers and/or themselves if they become excited or agitated. Reducing stress on animals has been demonstrated to improve productivity and prevent physiological changes that could confound research results. Recent studies have shown the adverse effects of stress on animals. Restraint, electric prods and other handling stresses lowered conception rates (44, 84, 85). Transportation and restraint stress reduced the immune function in cattle and pigs (4, 53, 65). Rumen function was impaired by transit stress (20). In the studies conducted by Galyean et al. (20), Kelley et al. (53), and Blecha et al. (4), the stress imposed by transit had a greater detrimental effect on the animal's physiology than the stress of feed and water deprivation for the same length of time. Handling sheep with dogs and transport and sorting two to three weeks after mating caused early embryonic losses (12). The purpose of this review is to provide practical livestock handling information. It will cover various factors which affect stress levels in livestock.

Vision and Livestock Motion

Livestock have wide angle vision. Cattle and pigs have a visual field in excess of 300 degrees (75). In sheep, the visual field ranges from 191 to 306 degrees depending on the amount of wool on the head. Loading ramps and handling chutes should have solid side walls to prevent animals from seeing distractions outside the chute with their wide-angle vision (22, 24, 79). Moving objects and people seen through the sides of a chute can cause balking or frighten livestock. Solid side walls are especially important if animals are not completely tame or they are unaccustomed to the facility. Blocking vision will stop escape attempts. This is why a solid portable panel is so effective for handling pigs. Sight restriction will lower stress levels...
The wildest cow will remain calm in a darkened artificial insemination box which completely blocks vision (70, 86). Even though ruminant animals have depth perception, their ability to perceive depth at ground level while moving with their heads up is probably poor (59). Hutson (50) suggests that there may be an extensive blind area at ground level and moving livestock may not be able to use motion parallax or retinal disparity cues to perceive depth. To see depth on the ground, the animal would have to stop and lower its head. This may explain why livestock often lower their heads and stop to look at strange things on the ground. Cattle, pigs, sheep and horses will often balk and refuse to walk over a drain grate, hose, puddle, shadow or change in flooring surface or texture (22, 24, 62). In areas where animals are handled, illumination should be uniform and diffuse. Shadows and bright spots should be minimized. Slats on the floor of shearing sheds and other animal facilities, should be oriented so animals walk across the slats (48). Flapping objects or a coat hung on a chute fence may stop animal movement.

Pigs, sheep, and cattle have a tendency to move from a dimly illuminated area to a more brightly illuminated area, provided the light is not glaring in their eyes (22, 62, 90). A spot light directed onto a ramp or other apparatus will often facilitate entry. The light must not shine directly into the eyes of approaching animals. Recent research by Phillips et al. (74) indicated that pigs reared indoors preferred to walk up a ramp illuminated at 80 lux which was similar to the illumination of their living quarters. A dimly illuminated ramp with less than 5 lux was avoided. There was also a tendency to avoid an excessively bright ramp illuminated with 1200 lux.

Moving or flapping objects can also disrupt handling. Fan blades or a flapping cloth can cause balking. Animals may refuse to walk through a chute if they can see motion up ahead (31).

Livestock have color perception. Numerous investigators have now confirmed that cattle, pigs, sheep and goats all possess color vision (9, 10, 19, 40, 58, 68). Handling facilities should be painted one uniform color. All species of livestock are more likely to balk at a sudden change in color or texture.

**Hearing**

Cattle and sheep are more sensitive than people to high frequency noises (2, 56). The auditory sensitivity of cattle is greatest at 8000 hz and sheep at 7000 hz (1). The human ear is most sensitive at 1000 to 3000 hz. Unexpected loud or novel noises can be highly stressful to livestock. Sheep exposed to exploding firecrackers or noise in a slaughter plant had increased thyroid hormone levels and elevated cortisol (16, 72). A loud ringing bell from an outdoor telephone will raise a calf's heart rate 50 to 70 beats per minute (T. Camp USDA Experimental Station, College Station, TX, personal communication). Physiological changes induced by sudden noises could alter the results of experiments. Animals will readily adapt to reasonable levels of continuous sound, such as white noise, instrumental music, and miscellaneous sounds. Continuous exposure to sounds over 100 dB reduced daily weight gain in sheep (1). However, continuous background sound can actually improve weight gain in some cases. Ames (1) found that sheep exposed to 75 dB of miscellaneous sounds (roller coasters, trains, horns, etc.), white noise, or instrumental music gained weight faster than controls without continuous background sound.

Livestock producers and researchers have learned from practical experience that continuous playing of a radio with a variety of talk and music will reduce the reaction of pigs to sudden noises. Providing controlled amounts of continuous but varying background sound may help prevent weight gain losses caused by unexpected noises.

In facilities where livestock are handled, loud or novel noises should be avoided because they distress livestock (31). It may be advisable to have the same radio station or background sound that is provided in the living quarters. Research is needed to determine if exposing animals to sounds such as truck noise would help reduce stress.

The sound of banging metal can cause balking and agitation (31). Rubber stops on gates and squeeze chutes will help reduce noise (26). The pump and motor on a hydraulic squeeze chute should be located away from the squeeze. Exhausts on pneumatic powered equipment should be piped away from the handling area. Small amounts of noise can be used to move livestock.
Cattle and sheep will move away from a rustling piece of plastic. If sheep become excited they will not respond to this stimulus (87).

Flight Zone

An important concept of livestock handling is flight zone. The flight zone is the animal’s “personal space”. When a person enters the flight zone the animals will move away (22, 31). Understanding of the flight zone can reduce stress and help prevent accidents to handlers. The size of the flight zone varies depending on the tameness or wildness of the livestock (22). The flight zone of extensively raised cows may be as much as 50m (164 ft) whereas the flight zone of feedlot cattle may be 2m (6 ft) to 8m (26 ft) (22). The size of the flight zone will slowly diminish when animals receive frequent gentle handling.

The edge of the flight zone can be determined by slowing walking up to the animals. The circle in Figure 1 represents the edge of the flight zone (22). Extremely tame livestock are often difficult to drive because they no longer have a flight zone. These animals should be led with a feed bucket or halter. The size of the enclosure the livestock are confined in may affect flight zone size. Sheep experiments indicated that animals confined in a narrow alley had a smaller flight zone compared to animals confined in a wider alley (49). Approaching an animal head on will increase flight zone size (Bud Williams, personal communication).

When a person enters an animal’s flight zone it will move away. If the handler penetrates the flight zone too deeply, the animal will either bolt and run away, or turn back and run past the person. When the flight zone of a group of bulls was invaded by a mechanical trolley, the bulls moved away and maintained a constant distance between themselves and the trolley (54). The best place for the person to work is on the edge of the flight zone (22). This will cause the animals to move away in an orderly manner. The animals will stop moving when the handler retreats from the flight zone. To make an animal move forward, the handler should stand in the shaded area marked A and B (Figure 1) (22). To cause the animal to back up, the handler should stand in front of the point of balance (57). A flag on the end of a stick can be used to sort cattle by moving it back and forth across the point of balance (57).

Many people make the mistake of deeply invading the flight zone when cattle are being driven down an alley or into an enclosed area such as a crowd pen. If the handler deeply penetrates the flight zone, the cattle may turn back and run over him (3). If the cattle attempt to turn back, the person should back up and retreat from inside the flight zone. The reason why the livestock attempt to turn back is because they are trying to escape from the person who is deep inside their flight zone. Cattle sometimes rear up and become agitated while waiting in a single file chute. A common cause of this problem is a person leaning over the chute and deeply penetrating the flight zone (25). The animal will usually settle back down if the person backs up and retreats from the flight zone. Inexperienced handlers sometimes make the mistake of attempting to push a rearing animal back down into a chute. The animal will often react to this by becoming increasingly agitated. Both the handler and the animal have a greater likelihood of being injured.

This also explains why livestock will balk if they see people standing in front of the squeeze chute. The provision of shields for handlers to stand behind will improve animal movement (17, 54).
Herd Animals

All livestock are herd animals, and they are likely to become highly agitated and stressed when they are separated from their herd mates. Physiological changes which occur during isolation may affect productivity or research results.

Isolation is a strong stresser. Restraint and isolation in a small box reduced immune response in pigs (65). In sheep and cattle isolation was highly stressful (15, 55, 80). A dairy cow left alone in a stanchion had increased leucocytes in her milk (62).

During handling, isolated large animals that become agitated and excited are likely to injure handlers. Many serious cattle handling accidents have been caused by isolated frantic cattle (Grandin, 1987). If an isolated animal becomes agitated, other animals should be put in with it.

Cattle and sheep are motivated to maintain visual contact with each other (14, 95). Animals will readily follow the leader. Skillful handlers allow livestock to follow the leader and do not rush them. If animals bunch up, handlers should concentrate on moving the leaders instead of pushing a group of animals from the rear. Trained sheep can be used to lead sheep through a handling facility (5). Groups of animals that have body contact remain calmer (15). A tame pacifier cow will keep a wild cow calm during artificial insemination. The wild cow will stand quietly while maintaining tactile contact with the tame cow (31). A loading ramp for pigs or sheep that has a “see through” center partition (Figure 2) (31) takes advantage of natural following behavior. As the animals walk up the twin single file chutes, they can see each other through the center partition. Solid outer walls block outside distractions.

Genetic Differences

Genetic factors affect an animal’s reaction to handling. Brahman and Brahman cross cattle are more excitable and hard to handle than English breeds. Angus cattle are more excitable than Herefords, and Holsteins move more slowly than Angus or Herefords (89). When Brahman or Brahman cross cattle become excited they are more difficult to block at fences (89). Visually substantial fences built with planks or a wide belly rail should be used with these breeds (31). Brahman cattle will seldom run into a fence that appears to be a solid barrier. Highly excited Brahman cattle may lie down and become immobile if they are repeatedly prodded with an electric prod. Continuous electric prodding of Brahman or Brahman cross cattle can result in death (31). If the animal is left alone for a few minutes, it will usually get up. English or European cattle such as Charolais will seldom become immobile.

In pigs, Yorkshires move more slowly during loading than Pietrians (63). Observations at farms and slaughter plants by the author indicate that certain types of hybrid pigs are difficult to drive. They have extreme shelter seeking behavior (flocking together) and they refuse to move forward up a chute. They are also very excitable. This problem is most evident in some hybrid lines of pigs selected for high productivity. Pig breeders should select for temperament to avoid serious meat quality and animal welfare problems at the slaughter plant.

Different breeds of sheep also react differently to handling (82, 95). Rambouillet tend to flock tightly together and remain in the group. Cheviots are more independent than other breeds.

Handler Dominance

Handlers can often control animals more efficiently if they exert dominance over an animal.

Figure 2. Pig loading ramp with solid sides and a “see through” center divider.
Exerting dominance is not beating an animal into submission. It is using the animal's natural behavior to exert dominance and the handler becomes the "Boss animal". Nomadic tribesmen in Africa control their cattle by entering the dominance hierarchy and becoming the dominant herd member (60).

The author has successfully achieved dominance over a group of pigs. Slapping the dominant pig when it bit the author had little effect on its behavior. The aggressive behavior was stopped by shoving the pig against the fence with a board pushed against its neck (31). The board against the neck simulated another pig pushing and biting. Pigs exert dominance over each other by biting and pushing against the neck (45). It is often advisable to handle the dominant pig first (P. Dziuk, 1983 personal communication). The odor of the dominant pig on the handler may make the other pigs more submissive. More research is needed to develop simple methods of exerting dominance which will enable handlers to control boars and other large animals with a minimum of force and greater safety.

Effect of Environment and Experience

The previous experiences of an animal will affect how it will react to handling (27). An animal's stress reaction to a handling procedure such as transportation or restraint, depends on three important factors. These are as follows: genetics, individual differences, and previous experiences (11, 52, 61, 63, 77, 87). Facility design can have strong influence on previous experiences. Poor design will increase stress.

Sheep raised in a barn in close contact with people had a less intense physiological response to handling than sheep raised on pasture (78). Hails (38) reported that calves lost less weight the second time they were transported. Hens which were not accustomed to being caught and handled had lowered egg production. Egg production, however, was not affected in hens accustomed to frequent handling (46). Piglets accustomed to repeated gentle handling by people approached a strange person readily at 24 months of age (42).

Environmental Stimulation

Providing additional environmental stimulation will reduce excitability. Pigs raised in a windowless building with hanging rubber hose toys and weekly petting were less excitable compared to pigs raised with no extra environmental stimulation (31, 32). Pigs raised outdoors with a variety of playthings and daily petting were more willing to approach a strange man and walk through a narrow chute compared to pigs raised indoors in small, barren pens with minimal contact with people (29, 32).

Loading pigs into a vehicle was more difficult when confinement reared pigs were handled. Pigs reared outdoors were easier to load (93).

Our experiments also illustrate the different effects of environmental stimulation under different conditions. In the first trial, environmental stimulation for pigs housed in a windowless building consisted of hanging rubber hoses and weekly petting. The stimulation made the animals easier to drive through a chute and less prodding was required (29, 31, 32). In the second trial, the animals were initially very tame and both the control and extra stimulation pens were washed twice weekly with a hose. There was a tendency for the controls to be easier to drive because the petted pigs approached people for petting. Frequent pen washing provided environmental stimulation and may have helped to calm the controls. Tame animals should be led with a feed bucket or lead rope.

Previous Experiences

Animals remember painful or frightening experiences. Research by Hutson (51) and Pascoe (71) indicated that cattle and sheep could remember an aversive experience for many months. Sheep which had been inverted in a sheep handling machine were more difficult to move through the corrals the following year. Many months later, cattle which had experienced electro-immobilization had elevated heart rates when they approached the place where the shock had occurred. Animals can readily discriminate and make a choice between the less aversive of two different handling treatments (36, 80). Livestock which have had previous experiences with gentle handling will be less stressed when they are handled in the future.
Calves accustomed to regular gentle handling had fewer injuries during marketing because they were accustomed to handling (96). Excitable cattle had lower weight gains (64). Dogs can be highly aversive to sheep (55). The use of dogs in a confined space where animals are unable to move away should be avoided. Electric prods should be used sparingly on cattle and never used on breeding pigs (31). Additional gentle methods for moving livestock are reviewed in Kilgour and Dalton (57). Cattle will be easier to handle in the future if they are not allowed to rush out of corrals back to pasture. Cattle should become accustomed to walking slowly past a handler when they exit the corrals (Bud Williams, personal communication).

Cattle handled roughly in poorly designed facilities had higher heart rates compared to cattle handled calmly in well designed facilities (83). Chickens handled gently had lower plasma corticosterone levels compared to chickens handled roughly (8).

**Animals Feel Threatened**

If an animal perceives a handling procedure or contact with a person as a threat, stress may increase. Sows that withdrew from a person's hand farrowed fewer piglets than sows which readily approached a person's hand (41). When extra human contact is provided to reduce excitability the handler must be careful not to intimidate the animals. He should squat down in the pen and allow the animals to approach (29). He must never chase them. In our experiments, weight gains were not adversely affected by petting pigs in the pens or a weekly walk in the aisles. However, if the pigs feel threatened or are hurt, weight gains will be reduced. Gonyou et al. (21) found that a looming, threatening person approaching the animals reduced gains. Animals can readily adapt to handling, such as daily weighing with no effect on weight gains (73). Pumfrey (76) reported that calves accustomed to daily handling by people on horses had no difference in weight gain compared to unhandled controls during cool weather. During warm weather, heat stress which occurred due to physical exertion lowered weight gains. Apparently, the animals knew the routine and did not feel threatened.

If a person shocked pigs every few days a chronic stress state was created (21). Inconsistent handling will cause stress. If a handler occasionally mistreats an animal, the animal is liable to be stressed every time the person approaches. An occasional aversive treatment lowered weight gain and increased corticosteroid levels even though the handler was gentle with the pigs most of the time (43). The pigs had learned the handler could not be trusted.

Novelty can be a strong stressor. Animals that have been raised in a variable environment are less likely to be stressed when confronted with novelty. In one study veal calves were raised in indoor stalls or in outdoor group pens (R. Dantzer, personal communication, 1983). When the calves reached market weight, both groups were exposed to a new indoor and outdoor environment. Calves raised indoors had higher serum glucocorticoid values when they were put in an outdoor arena. Calves raised outdoors were more highly stressed when they were put in an indoor arena. Both of the new locations were stressful to all calves, but their reactions were influenced to the greatest extent by variance from the type of environment in which they had been reared. Animals can be trained to accept irregularity in management (78). Pigs exposed to a variety of objects approached a novel object more quickly than animals raised in a barren environment (32). However, pigs which had grown accustomed to the same routine of blood pressure testing, responded to a change in routine with increased blood pressure (67).

In our previously described handling experiment, the pigs initially became highly agitated during the novel experience of pen washing (32). When they become accustomed to pen washing they walked up to be sprayed. The experience of pen washing was initially stressful but it soon became a pleasant experience that the animals actively sought.

**New Restraint Concept**

The idea of training an animal to voluntarily accept restraint is a new concept to some people. Animals that are handled gently can be trained to voluntarily accept restraint in a comfortable device (29, 33, 69). Training valuable breeding animals or animals used in long-term research studies to vol-
untarily enter a restraining device has many advantages. Stress on both animals and people will be reduced. Large animals that are trained to walk into a restraint device can easily be handled by one person. Cooperative large animals are less likely to injure people or themselves. Feed rewards can be used to facilitate animal movement through a facility (51).

The author has trained sheep to voluntarily enter a squeeze tilt table for a grain reward (33). Some sheep were squeezed and tilted to a horizontal position nine times in one day. After being released from the squeeze tilt table, the animals rapidly ran into the crowd pen and lined up in the chute (33).

To train the animals to voluntarily accept restraint, the restraint device must be introduced gradually and gently with feed rewards (33). At first, the animal is allowed to walk through the restrainer several times. The next step is to allow the animal to stand in the restrainer without being squeezed. On the fourth to fifth pass through, the squeeze is applied gently. During each step the animal is given a food reward of palatable feed. A relatively tame animal can be trained to voluntarily enter a restrainer in less than an hour.

Training animals to voluntarily enter a restraint device is easier and less stressful if the animal is tame and has little or no flight zone. If a wild animal is being trained, it is important to catch it correctly on the first attempt. Fumbling and failing to restrain an animal on the first attempt will result in increased excitement (15). If an animal resists and struggles, it must not be released until it stops struggling, otherwise it will be rewarded for resisting (29). Animals that are released while resisting are more likely to resist in the future (29). The animal should be stroked and talked to gently until it calms down.

Animals will not voluntarily accept restraint if the restraint device causes pain. Selection of the right type of squeeze chute and headgate to fit the specific handling requirements is important (23). The use of new designs for restraint devices should be investigated. Double rail (Figure 3) and V restrainers that are used in meat packing plants may provide less stressful restraint for veterinary and husbandry procedures (18, 34, 81). Pigs will readily relax and fall asleep when restrained upright in a padded V restrainer. Pressure applied to the flanks will induce relaxation (37). Sheep and calves held on a double rail restrainer had low stress levels (94). The author has observed that cattle restrained with nose tongs become more difficult to restrain in the future. Further observations by the author indicated that when a halter is used to hold the animal's head for blood testing, restraining the head becomes easier with successive tests. Cattle blood-tested with halter head restraint will learn to turn their head and expose their jugular. Cattle that have had experience with nose tongs will often fling their head about to avoid attachment of the tongs.
Handling Facility Layout

Handling facilities that utilize behavioral principles will make handling easier. Sheep research has shown that corrals are more efficient if the animals follow the same route for procedures such as dipping and sorting (3, 47). Orienting the exit end of a sorting chute, dip vat or squeeze chute towards the "home" pasture or pen will facilitate movement (6).

Curved Chutes and Solid Fences

Curved single file chutes are especially recommended for moving cattle onto a truck or squeeze chute (Figure 4) (22, 79). A curved chute is more efficient for two reasons. First, it prevents the animal from seeing what is at the other end of the chute until it is almost there. Second, it takes advantage of the natural tendency to circle around a handler moving along the inner radius. A curved chute provides the greatest benefit when animals have to wait in line for vaccinations or other procedures. A curved chute with an inside radius 3.5m (12 ft) to 5m (16 ft) will work well for handling cattle (22). The curve must be laid out as shown in Figure 4. If the chute is bent too sharply at the junction between the single file chute and the crowd pen, it will appear as a dead end. This will cause livestock to balk (31). If space is restricted, short 1.5m (5 ft) bends can be used (28). If bends with a radius smaller than 3.5m (12 ft) are used, there must be a 3m (10 ft) section of straight single file at the junction between the crowd pen and chute to prevent the chute from appearing to be a dead end. Handler walkways should run alongside the chute and crowd pen (31). The use of overhead walkways should be avoided. Livestock will often balk when they have to move from an outdoor pen into a building which contains the squeeze chute. Animals will enter a building more easily if they are lined up in a single file chute before they enter the building (22). Conversely, pigs reared indoors are often reluctant to move out into bright daylight. A pig loading ramp should be designed so that the pigs are lined up in single file, where they cannot turn around before they leave the building.

For all species, solid sides are recommended on both the chute and the crowd pen which leads to a squeeze chute or leading ramp (7, 22, 24, 79). For operator safety, mangates must be constructed so that people can escape charging cattle. The crowd gate should also be solid to prevent animals from turning back (31). Wild animals tend to be calmer in facilities with solid sides. In holding pens, solid pen gates along the main drive alley facilitate animal movement (Figure 2).

Crowd Pen Design

The crowd pen used to direct animals into a single file or double file chute must never be built on the ramp. A sloped crowd pen will cause livestock to pile up against the crowd gate (26). Round crowd pens shown in Figures 4 and 5 are very efficient for all species. In cattle facilities, a circular crowd pen and a curved chute reduced time moving cattle by up to 50 percent (92). Practical experience has shown that the recommended radius for round crowd pens is 3.5m (12 ft) for cattle, 1.83m for pigs (6 ft) and 2.4m (8 ft) for sheep.

Cattle and sheep crowd pens should have one straight fence, and the other fence should be on a 30 degree angle (66). This layout should not be used with pigs. They will jam at the chute entrance. Jamming is very stressful for pigs (90). A single, offset step equal to the width of one pig should be used to prevent jamming at the entrance of a single file ramp (24, 31). (Figure 5). Jamming can be further prevented by installing an entrance restric­ter at single file race entrances. The entrance of

Figure 4. Layout of curved cattle handling facility with curved gutter and slab for easy wash down.
prove weight gain, reproductive performance and animal health. Livestock should be handled gently with a minimum of noise. To avoid agitation the handler should work on the edge of the flight zone. Animals which have been handled gently will be less stressed by handling in the future. Restraint devices should be designed so that they do not cause pain. In certain research situations animals can be easily trained to voluntarily enter a restraint device. This practice will help reduce stress. All areas where animals are crowded such as chutes and crowd pens, should have solid sides and diffuse lighting with a minimum of shadows.

Ramp Steepness and Flooring

Excessively steep ramps may injure animals. The maximum recommended steepness for a stationary cattle or pig ramp is 20 degrees for market weight animals (26). If space permits a 15 degree slope is recommended for pigs (91). Stairsteps are recommended on concrete ramps because they still provide good footing when dirty or worn (31).

Conclusions

The use of behavioral principles should improve efficiency of livestock handling and reduce stress on animals. Reducing stress also should help im-

Figure 5. Layout of pig loading ramp with a single offset step to prevent jamming.

the single file chute should provide only 1/2 cm on each side of each pig. More detailed information on facility layout can be found in Grandin (22, 24, 25, 28, 30).

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LIVESTOCK HANDLING


INTRODUCTION

An understanding of cattle psychology combined with well designed facilities will reduce stress on both you and your cattle. Reducing stress is important because stress reduces the ability to fight disease and weight gain. It also increases weight loss, damages rumen function, and can interfere with reproduction. An animal's previous experiences will affect its stress reaction to handling. Cattle have long memories. Animals which have been handled roughly will be more stressed and difficult to handle in the future. Animals which are handled gently and have become accustomed to handling procedures will have very little stress when handled. The basic principle is to prevent cattle from becoming excited. Cattle can become excited in just a few seconds, but it takes 20 to 30 minutes for the heart rate to return to normal in severely agitated cattle.

There is an old saying "You can tell what kind of a stock man a person is by looking at the behavior of his cattle." In one feedyard survey, cattle feed yards which had a reputation for rough handling were wilder and more difficult to handle at the packer. They also had more bruises. The degree of stress which will be induced by handling and restraint can vary from almost no stress in a tame show animal to very severe stress in a wild range cow. The degree of stress is determined by three major factors -- 1) amount of contact with people, 2) quality of handling (rough vs. gentle) and 3) genetics. Frequent, gentle handling will reduce stress. Genetics is also an important factor. Some genetic lines of cattle are calmer and less wild than others. Cattle with an excitable temperament will take longer to respond positively to gentle handling than cattle with a calm temperament. Most cattle will become less stressed and settle down when they are handled gently. However, there are a few individuals with a bad temperament that may never settle down and are dangerous to restrain and handle. Culling them is often advisable.

Although painful procedures cannot be avoided, a reduction of agitation and excitement will still reduce stress. Cattle remember painful restraint methods such as nose tongs. Handling will be easier in the future if you use a halter to hold the heads and keep electric prod usage to an absolute minimum. If tail twisting is used to move a cow up a chute, let go of the tail when the cow moves to reward her for moving. Breeding cattle will quickly learn to move when their tail is touched.
Cattle have wide angle vision, they can see behind themselves without turning their heads. However, there is a small blind spot behind their rear (Diagram 1). When a group of cattle move, the animals maintain visual contact with each other. This enables the herd to stay together. An animal following another animal will tend to stay in Positions A and B on Diagram 1. Moving together as a herd helps protect cattle from predators. The strongest dominant animals will be in the middle of the herd and the subordinate, weaker animals will be on the outside. Since cattle are a prey species they are ever vigilant and fear novelty. For example, cattle moved to a new pasture may be fearful of cars passing by on the highway, but soon they learn to ignore them.

Understanding the flight zone is the key to easy, quiet handling. The flight zone is the cow's personal space. When you penetrate the flight zone the animals will move, and when you retreat from the flight zone the animals will stop moving. The size of the flight zone is determined by several factors, such as wildness or tameness, and the angle of the handler's approach. The flight zone will be larger when a handler approaches head on, and it will become smaller when the animal is confined inside a single file chute. A barrier in between the handler and the cattle reduces the flight distance. A cow passing by you will have a smaller flight zone than a cow coming directly at you. If a cow becomes excited the flight zone will increase. Cattle can be easily moved by working on the edge of the flight zone (Diagram 1). The handler must be close enough to the animal to make it move, but not so close as to cause it to panic and flee. If the cattle start moving too fast, you must back off and get out of the flight zone.

If cows on pasture turn and look at you, you are outside the flight zone. You need to approach and put pressure on the edge of the flight zone. To keep the animals moving you alternately enter and retreat from the flight zone. When an animal moves for you, you reward her by relieving pressure on her flight zone, but in a few seconds you will invade her flight zone again to keep her going.

When cattle are worked in an enclosed space such as an alley or crowd pen, great care must be taken to avoid deeply penetrating the flight zone. This can result in panic, jumped fences and cattle turning back on the handler. If cattle in an alley start to turn back you must back up and get out of the flight zone. When an animal rears up in a chute, retreat from its flight zone; nine times out of ten, it will settle back down.

To move an animal forward you must be behind the point of balance shown on Diagram 1. Moving in front of the point of balance at the shoulder will make the animal go backward. To start movement, approach just behind the point of balance and move back into Positions A and B. Avoid getting into the blind spot. Entering the blind spot will cause the cattle to stop and turn and look at you. They want to know where you are at all times. In close quarters you may get kicked if you get in a cow's blind spot.
BREAK OLD HABITS

You must break old habits to fully master quiet gathering of cattle from pasture. The first habit to break is whooping, hollering, and running. It will require some time and patience, but your cattle will become quieter and easier to handle as you work with them. The second bad habit is chasing cattle from the rear of the group like a predator. Positioning yourself behind the cattle, puts you in their blind spot. This will cause them to turn and look at you, unless they are scared and fleeing from you. Cattle movements should be under the handler’s control and the animals move at a slow walk. You have to concentrate on moving the leaders. You should spend time walking or riding among your cattle so they do not always associate you with either feeding or being taken to the corrals. The animals need to learn that you are neither predator or feed wagon. If cattle are fed from a truck, blow the horn as a signal for feeding. This will prevent the animals from chasing the truck every time you drive in the pasture. Cattle can be handled with horses, vehicle or people on foot. Since cattle are fearful of novelty, animals that have never seen a motorcycle will fear it. It is best to get cattle accustomed to different driving methods. Different vehicles and people should be used to train the animals to be less fearful of novelty.

A herd of cattle is like a car, before you can steer, the car must be moving. Herd movement must be started before you attempt to change direction. Diagram 2 shows the handler movement pattern which will keep a herd moving in an orderly manner. It will work both along a fence and in open pasture. If a single handler is moving the animals, use the Handler 2 Position of Diagram 2. As the herd moves, you walk forward at an angle which gradually relieves pressure on the herd’s collective flight zone. When the animals start to slow down, increase pressure on the flight zone by walking straight into the cattle. As they speed up, turn and walk back opposite the direction of travel. Walk at a slight angle to increase pressure on the flight zone. To maintain movement, keep repeating the pattern. It will require practice to determine the length of each movement pattern. It is important to use the pattern. If you just walk along parallel with the herd, the herd will tend to split.

When two people move a large herd of cattle, one person walks in the pattern shown on Diagram 2, Handler Position 2, and the other handler stays with the leader. The lead handler should stay just behind the leader’s point of balance. He should bear in and our of the flight zone in an alternating manner (Diagram 2, Position 1). The lead handler and the rear handler should stay as close together as possible. It is important to not allow cattle to escape between them. The following instinct of the cattle will pull the tail enders along even though the rear handler is somewhat ahead of the rear of the group.

If a few cattle break away and straggle to the rear, don’t go around behind them and chase them. Use the motion of the herd to draw them back as shown in Diagram 3. At a walk, approach the stragglers at an angle which gradually increases pressure on their flight zone. Approach just to one side of their heads and move just past the point of balance at the shoulder. Do not go all the way to Positions A and B on Diagram 1. As soon as the stragglers are attracted by the movement of the herd, start
repeating the Handler 2 pattern on Diagram 2. Be careful not to push the stragglers into the dominant cattle in the middle of the herd.

WORKING IN CORRALS

Applying and relieving pressure to the flight zone of the leaders will also make it easier to fill and empty corrals. Cattle movements are under your control at all times. It is important for your cattle to learn that you control their movements and they cannot escape from you. Never allow cattle to run wildly our of a corral. Make the animals walk past you at the exit gate. Wait for the cattle to turn and look at you before you walk away from the gate. When a new set of corrals is first used, avoid doing painful procedures. It is advisable to "train" the cattle to the new system and do non-aversive procedures such as weighing or sorting the first time corrals are used.

Cattle will also enter a corral in a more orderly manner if they have to walk by you as they enter. Diagram 4 illustrates the correct position for the lead handler as the cattle enter a corral. Do not move back and forth. Increase and decrease pressure on the flight zone by moving forward and back, straight into the herd. You must apply enough pressure to keep them form veering away from the fence but not so much as to cause panic.

When you move animals from a pen, do not let them race out. Work on the flight zone of the leaders. Diagram 5 show the movement pattern for emptying a pen and for sorting at a gate. To empty the pen in a controlled manner, move back and forth as shown in Diagram 5. To control the movement of the cattle out a gate, move to the sorting position shown on Diagram 5. To sort cattle, move forward and backward. Do not move sideways. If you move sideways they will get by you. By moving forward and backward you can easily separate cows from calves. You increase pressure on the flight zone of the animal you want to hold back and decrease pressure on the flight zone of the animals you wish to let go by. This method can be used either in an alley or in a gate. A handy tool for sorting is a stick with a flag or a paddle on the end. Blocking the animal’s vision on one side with paddle or flag will cause it to turn.

When cattle are being handled in a confined area such as a crowding pen or sorting alley, handle small groups. Bring eight or ten cattle into a crowding pen instead of twenty. Overloading the crown pen is a common handling mistake. The animals need room to turn. A stick or whip with plastic streamers or a garbage bag tied on the end is useful for turning cattle in the crow pen. Shake the streamers on the right side of the head to turn left and vice versa. Use the animal’s natural following behavior to assist with filling chutes. Wait until the single file to the squeeze is almost empty before refilling. Avoid the overuse of crowd gates. If the cattle are moving, do not shove the crowd gate up on them.

Problems with balking tend to come in bunches; when one animal balks, the tendency to balk seems to spread to the next animals in line. When an animal is being moved through a single-file chute, the animal must never be prodded until it has a place to go. Once it has balked, it will continue balking. The handler should wait until the tailgate on
the squeeze chute is open before prodding the next animal. If the cattle
come severely agitated due to excessive prodding, the agitation and
frenzy can spread to the other cattle. Severely agitated cattle may
secrete a "smell of fear" substance that can be detected by other cattle.

An animal left alone in the crowding pen after the other animals
have entered the single-file chute, may attempt to jump the fence to
rejoin its herdmates. A lone steer or cow may become agitated and charge
the handler. A large portion of the serious handler injuries occur when
a steer or cow, departed from its herdmates, refuses to walk up the
single-file chute. When a lone animal refuses to move, the handler
should release it from the crowding pen and bring it back with another
group of cattle.

VISION AND FACILITY DESIGN

Cattle have poor depth perception when they are moving with their
heads up. To see depth they have to stop and put their heads down. This
is why they balk at shadows and strange objects on the ground. A single
shadow that falls across a scale or loading chute can disrupt handling.
The lead animal will often balk and refuse to cross the shadow. If you
are having problems with animals balking at one place, a shadow is a
likely cause. Balking can also be caused by a small bright spot formed
by the sun's rays coming through a hole in a roof. Patching the hole
will often solve the problem. Shades constructed from snow fence should
not be used over working areas. The zebra stripe shadows can cause
balking.

Drain grates in the middle of the floor will make cattle balk. A
good drainage design is to slope the concrete floor in the squeeze chute
area toward an open drainage ditch located outside the fences. The open
drainage ditch outside the fences needs no cover and so it is easier to
clean. Animals will also balk if they see a moving or flapping object.
A coat flung over a chute fence or the shiny reflection off a car bumper
will cause balking. Dairy cows that move through a facility every day
will learn to walk over shadows and drains because they are no longer
novel. However, a dairy cow will balk if she sees a strange piece of paper
on the floor or a coat hung over a fence.

Cattle have a tendency to move toward the light. If you ever have
to load livestock at night, it is strongly recommended that frosted lamps
that do not glare in the animal's face be positioned inside of the truck.
However, loading chutes and squeeze chutes should face either north or
south; livestock will balk if they have to look directly into the sun.
Sometimes it is difficult to persuade cattle to enter a roofed working
area. Persuading the animals to enter a dark, single-file chute from an
outdoor crowding pen in bright sunlight is often difficult. Cattle are
more easily driven into a shaded area from an outdoor pen if they are
first lined up in single file.

Many people make the mistake of placing the single-file chute and
squeeze chute entirely inside a building and the crowding pen outside.
Balking will be reduced if the single-file chute is extended 10 to 15
feet outside the building. The animals will enter more easily if they are
lined up single file before they enter the dark building. The wall
of the building should NEVER be placed at the junction between the single-file chute and the crowding.

**DO NOT DEAD END YOUR CHUTE**

Livestock will balk if a chute appears to be a dead end. Sliding and one-way gates in the single-file chute must be constructed so that your animals can see through them, otherwise the animals will balk. This is especially important at the junction between the single-file chute and the crowd pen. The sides of the single-file chute and the crowding pen should be solid. The crowding pen gate also should be solid so that animals cannot see through and turn back towards herdmates they just left. Palpation gates, however, should be solid so that cattle do not see a person standing in the chute.

When a curved chute is used it must be laid out properly so that it does not appear to be a dead end. A cow standing in the crowd pen must be able to see a minimum of two body lengths up the chute. Cows will balk if the chute is bent too sharply at the junction between the crowd pen and the single-file chute. Diagram 6 illustrates an efficient curved facility that is easy to lay out. It consist of three half circles laid out along a layout line. The radius points of all three half circles are on the layout line. A 16 (4.8m) ft. inside radius for the curved single-file chute is recommended. A 12 (3.5m) ft. radius is the absolute minimum unless a straight section is installed at the junction between the crowd pen and the chute.

**WHY A CURVED CHUTE WORKS**

A curved chute works better than a straight chute for two reasons. First, it prevents the animal from seeing the truck, the squeeze chute, or people until it is almost in the truck or squeeze chute. Shields for handlers to hide behind and remote controlled gates can also be used to prevent cattle from seeing people up ahead. A curved chute also takes advantage of the animal’s natural tendency to circle around the handler. When you enter a pen of cattle or sheep you have probably noticed that the animals will turn and face you, but maintain a safe distance. As you move through the pen, the animals will keep looking at you and circle around you as you move. A curved chute takes advantage of this natural circling behavior.

A well-designed, curved single-file chute has a catwalk for the handler to use along the inner radius. The handler should always work along the inner radius. The curved chute forces the handler to stand at the best angle and lets the animals circle around him. The solid sides block our visual distractions except for the handler on the catwalk. The catwalk should run alongside of the chute and NEVER be placed overhead. The distance form the catwalk platform to the top of the chute fence should be 42 (100 cm) inches. This brings the top of the fence to belt-buckle height on the average person.

**DARK BOX AI CHUTE**

For improved conception rates, cows should be handled gently for AI and not allowed to become agitated or overheated. The chute used for AI should not be the same chute used for branding, dehorning, or injections.
The cow should not associate the AI chute with pain. Cows can be easily restrained for AI or pregnancy testing in a dark box chute that has no headgate or squeeze. Even the wildest cow can be restrained with a minimum of excitement. The dark box chute can be easily constructed with plywood or steel. It has solid sides, top and front. When the cow is inside the box, she is inside a quiet, snug, dark enclosure. A chain is latched behind her rump to keep her in. After insemination the cow is released through a gate in either the front or the side of the dark box. If wild cows are being handled, an extra long, dark box can be constructed. A tame cow that is not in heat is used as a pacifier and is placed in the chute in front of the cow to be bred. Even a wild cow will stand quietly and place her head on the pacifier cow's rump. After breeding, the cow is allowed to exit through a side gate, while the pacifier cow remains in the chute.

RESTRAINT PRINCIPLES

Cattle sometimes become severely stressed in a conventional squeeze chute. This is probably due to deep invasion of the animal’s flight zone by the operator and other people that can be seen through the open barred sides. Stress could be reduced by replacing the open barred sides with solid drop down panels for access to the animal. People that handle buffalo and deer have used solid sides on squeeze chutes for many years. They also use a solid gate located about 3 ft. (1m) to 4 ft. (1.2m) in front of the headgate. This gate prevents the cattle from attempting to run through the headgate. Many cattle sustain shoulder and neck injuries when they hit the headgate too hard. Even though a gate in front of the headgate would slow down cattle handling, it would probably pay for itself by reducing injuries and weight gain losses due to shoulder and neck pain. One large Colorado feedlot reported that sickness was greatly reduced when they handled animals more gently in the squeeze chute. Bruises and neck injuries also secrete "stress" substances onto the animal’s system.

Observations of cattle handling at meat packing plants indicates that squeeze chutes on ranches and feedlots need to be modified. Blocking the animal’s vision has a great calming effect. I spent 35 hours operating a restraining chute which is used for kosher slaughter. It consists of a box with completely solid sides and a small T shaped opening in the front for the animal’s head. When an animal enters the box it can not see people. After it sticks its head through the front opening a metal shield prevents it from seeing people. A light over the head hole entices the animal to stick its head through. Most cattle walk in quietly and seldom attempt to lunge at the head opening. The cattle at this packing plant were calmer than cattle entering a conventional squeeze chute with open bar sides.

Since the animals did not attempt to run through the chute, squeeze pressure could be applied slowly instead of suddenly. Slow steady motion had a calming effect. Sudden jerky motion or sudden bumping of the animal with the apparatus caused agitation and excitement. When the animal’s vision was blocked it would stand and allow its head and body to be positioned in the device. The cattle would seldom resist pressure from the apparatus if it was applied slowly and excessive pressure which would cause pain and discomfort was avoided. There is also the concept of optimum pressure. Sufficient pressure must be applied to make the
animal "feel restrained" but excessive pressure which would cause pain must be avoided. Many people make the mistake of applying more pressure when an animal struggles. The animal will often stop struggling if the pressure is reduced slightly. Excess pressure must be slowly backed. A sudden release of the pressure will cause the animal to become excited.

ADJUSTMENT OF SQUEEZE CHUTES

The use of a complete squeeze chute is strongly recommended for wild cattle that are not trained to head restraint. Restraint of the body will prevent the animal from fighting the headgate. On hydraulic chutes the pressure relief valve must be adjusted to prevent excessive squeeze pressure. Excessive pressure can cause severe injuries such as a ruptured diaphragm or broken bones. On most hydraulic chutes the proper setting is 500 PSI. The operator should be trained to slow the animal down in the squeeze before it reaches the headgate. To prevent shoulder and neck injuries, animals should enter the chute at a walk.

To prevent choking in a headgate with curved stanchion bars, the squeeze sides must be adjusted so that the V shape of the sides prevents the animal from lying down. Pressure exerted by the headgate on the carotid arteries can kill the animal. Some veterinarians prefer a chute which does not pinch the feet together at the bottom. If a squeeze chute with straight sides is used it must be equipped with a straight bar stanchion headgate to prevent choking. An animal can safely lie down in a straight bar stanchion. Care must be taken with self catching headgates. Cattle can by injured if they run into the self catcher at a high speed. Selfcatchers should not be used with wild horned cattle. It is also essential to adjust the self catcher for the size of the cattle. Severe injuries can occur if a self catcher is adjusted too wide and the animal's shoulder pass part way through the closed gate.

Latches and ratchet locks must be kept well maintained to prevent accidents to people. If a ratchet device becomes worn, replace it immediately. Friction type latches must never be oiled. Oiling will destroy the ability of a friction latch to hold. On self catching headgates the mechanism must be kept maintained to prevent an animal from getting stuck part way through a closed gate.

LOADING CHUTE DESIGN

Loading chutes should be equipped with telescoping side panels and a self-aligning dock bumper. These devices will help prevent foot and leg injuries caused by an animal stepping down between the truck and the chute. The side panels will prevent animals from jumping out the gap between the chute and the truck.

A well designed loading ramp has a level landing at the top. This provides the animals with a level surface to walk on when they first get off the truck. The landing should be at least 5 ft. (1.5m) wide for cattle. Many animals are injured on ramps that are too steep. The slope of a permanently installed cattle ramp should not exceed 20°. On concrete ramps, stairsteps are recommended because they are easier for cattle to walk on when they become dirty or worn. The recommended dimensions for stair steps are a 3 1/2 in. (10cm) rise and a 12 in. (30cm) to 18 in. (45cm) tread length.
Chutes for both loading and unloading cattle should have solid sides and a gradual curve. If the curve is too sharp, the chute will look like a dead end when the animals are being unloaded. A curved single-file chute is most efficient for forcing cattle to enter a truck or a squeeze chute. A chute used for loading and unloading cattle should have an inside radius of 12 ft. (3.5m) to 17 ft. (5m), the bigger radius is the best. A loading chute for cattle should be 30 in. (76cm) wide and no wider. The largest bulls will fit through a 30 in. wide chute.

CORRALS

A corral constructed with round holding pens, diagonal sorting pens, and curved drive lanes will enable you to handle cattle more efficiently because there is a minimum of square corners for the cattle to bunch up in. The principle of the corral layout in Diagram 7 is that the animals are gathered into the big round pen and then directed to the curved sorting reservoir lane for sorting and handling. The curved sorting lane serves two functions: it holds cattle which will be sorted back into diagonal pens and it holds cattle waiting to go to the squeeze chute, AI chute, or calf table. When cows and calves are being separated, the calves are held in the diagonal pens into the large post-working pen.

LARGE CORRAL

The corral shown in Diagram 7 is a general purpose system for shipping calves, working calves, sorting, pregnancy checking, and AI. It can handle 300 cow-calf pairs or 400 mature cows. For smaller ranches the large gathering and holding pens can be reduced in size. Gathering pen space can be figured at 20 sq. ft. (1.8 sq.m) per cow and 35 sq. ft. (3.3 sq.m) per cow and calf pair. Sorting pens should be designed to hold one truck load which works out to 840 sq. ft. (78 sq.m). If cattle will be held overnight in a sorting pen, increase the size to 900 sq. ft. (84 sq.m). This corral is equipped with a two-way sorting gate in front of the squeeze chute for separating the cows that are pregnant from cows that are open. Depending upon you needs, you can position either the squeeze chute, AI chute, or calf table at the sorting gate. If the cattle are watered in the large gathering pen, they will become accustomed to coming and going in and out of the trap gate. When you need to catch an animal, you merely shut the trap gate and direct her up the curved reservoir lane to the chutes. This is an especially handy feature for AI. If more than one corral is built on the same ranch, they should both be laid out in the same direction. The mirror image of the designs will work.

The curved sorting reservoir terminates in a round crowding pen and curved single-file chute. The crowding gate has a ratchet latch that locks automatically as the gate is advanced behind the cattle. To load low stock trailers, open an 8 ft. (2.5m) gate that is alongside the regular loading chute. This provides you with the advantage of the round crowding pen for stock trailers.

This design can also be modified for pasture rotation. The large gathering pens are eliminated and the main working parts of the corral such as the curved lane, curved chutes, and diagonal pens are retained.
CORRAL CONSTRUCTION TIPS

Five foot (1.5m) high fences are usually sufficient for cattle such as Hereford and Angus. For Brahman cross and exotics a 5 1/2 ft. (1.6m) to 6 ft. (1.8m) fence is recommended. Solid fencing should be used in the crowding pen, single-file chute, and loading chute. If your budget permits, solid fencing should be used in the curved reservoir lane. If solid fencing is too expensive, then a wide belly rail should be installed. This is especially important if the corral is constructed from sucker rod. An 18 in. (45cm) wide solid belly rail can also be installed on gates to prevent animals from hitting gates during sorting.

If a V-shaped chute is built, it should be 16 (41cm) to 18 (45cm) in. wide at the bottom and 32 (81cm) to 36 (90cm) in. wide at the top. The top measurement is taken at the 5 ft. level. If the single-file chute has straight sides it should be 26 (1.5m) in. wide for the cows and 18 (46cm) to 20 (51cm) in. wide for calves. When a funnel type crowding pen is built, make one side straight and the other side on a 30° angle. This design will prevent bunching and jamming. The crowding pen should be 10 (20 m) to 12 (3.5m) ft. wide. The recommended radius for a round crowd pen is 12 ft. (3.5m). Larger crowd pens are not recommended. The minimum radius is 10 ft. (3m). Recommended cattle alley dimensions are 10 ft. (3m) for people on foot, 12 ft. (3.5m) for people on foot and horses, and 14 ft. (4.2m) to 16 ft. (4.8m) for horses only.

To prevent animals from slipping in areas paved with concrete, the concrete should be scored with deep grooves. The grooves should be 1 in. (2.5cm) to 1 1/2 in. (3.8cm) in an 8 in. (20cm) diamond pattern. A diamond pattern should be used because it is easier to wash.

In areas with solid fence, small man-gates must be installed so that people can get away from charging cattle. The best type of man-gate is an 18 in. (46cm) wide, spring-loaded steel flap. The gate opens inward toward the cattle and is held shut by a spring. A person can quickly escape because there is no latch to fool with. The man-gates can be constructed from 10 gauge steel with a rim of 1/2 in. (1.3cm) rod.

Some of the information in this paper was obtained from:

Ron Kilgour, Ruakura, New Zealand
Bud Williams, Ranch Management Consultants, Albuquerque, New Mexico
1. Flight zone diagram.

2. Handler positions to move groups of cattle on pasture.
3. Handler positions to bring stragglers back into the herd.

4. Leader handler position for filling corral.
5. Handler positions for emptying a pen and sorting at a gate.
6. Basic curved handling facility.

7. Corral system for a large ranch.
Tips for Low Stress Cattle Handling

1. Slow is faster. When cattle become excited up to 30 minutes is required for their heart rate to return to normal. Animals should be moved at a slow walk and handlers should make slow deliberate movements. Sudden jerky movements by people excite cattle.

2. The round crowd pen shown in these drawings should be filled only three quarters full. Half full is even better. The cattle need room to turn. The crowd gate should not be pushed up tight against the animals.

3. If the lead animal balks and refuses to enter the single file chute you should look for visual distractions up ahead such as a chain hanging in the chute, seeing people up ahead, a coat on the fence, changes in flooring type or texture. The oneway gate which prevents cattle from backing out of the single file chute should be held open. Many feedlots and ranches have improved cattle movement into the single file chute by equipping the oneway gate with a remote control rope so that it can be held open for the cattle.

4. Lighting problems may make cattle balk. Animals often refuse to enter a dark place. If the facility is located inside a building the animals will often enter more easily if a door or skylight allows enough light in to illuminate the entrance to the single file chute. Cattle will often refuse to leave a brightly illuminated crowd pen and enter a dark single file chute.

5. To induce cattle to walk into the squeeze chute the handler should walk in the OPPOSITE direction of desired movement (See diagrams)

6. Reduce noise in every way possible. Cattle have more sensitive ears than people. Equip gates with rubber stops to stop clanging and banging. Reducing both equipment noise and yelling and whistling will keep the animals calmer and easier to move.

7. It will take about two weeks of effort to learn quiet handling methods. Electric prods should be replaced with other driving aids such plastic paddles and sticks with flags on them. Use these aids to turn the cattle.

8. Taking the time to learn quiet cattle handling will help improve profits. Excited stressed cattle gain less weight and are more likely to get sick. One large feedlot found that eliminating electric prods and using quiet handling enabled their cattle to get back on feed more quickly.
Handler Movement Pattern to Keep Cattle Moving Into a Squeeze Chute or Restrainer

Cattle will move forward when the handler passes the point of balance at the shoulder of each animal. The handler walks in the opposite direction along side the single file race.
Handler Movement Pattern to Keep Cattle Moving Into the Squeeze Chute in a Curved Chute System

Cattle will move forward when handler crosses the point of balance of each animal.
Bud Williams is a well known cattle handling expert from Alberta, Canada, who for many years has practiced and taught low stress methods for moving cattle. For those who know of Bud Williams and have watched him move cattle, or who have attended one of his many clinics held throughout Canada and the U.S., it is clear that these methods really work. What Bud does has been called magic. However, many people try these methods and become frustrated and give up because they can not make them work. It is our opinion that the problem results from instructions that are not clear.

It is the job of animal behaviorists to interpret animal behavior and translate in clear language the cause of behaviors and the underlying motivations for them. For years, we have been interested in the Bud Williams methods for moving cattle because low stress methods of handling cattle are known to improve both productivity and welfare. For example, in a cow-calf operation, when the animals are being moved from pastures into corrals, or in pasture rotation movements, cows that get excited and run wildly when being driven can lose their calves, or the calves can get stressed and will gain less weight. Wild, uncontrolled movement of cattle causes stress in the animals, wear and tear on equipment or fences, and a greater incidence of injuries to both handlers and cattle. Slow, calm movement of cattle in feedlots can also lower stress, reduce sickness, and enable cattle to get back on feed faster. Cattle that run wildly down alleys into the processing
area become stressed prior to the stress imposed by restraint for normal husbandry procedures. In order to lower stress and improve productivity, calm, quiet handling of cattle in all aspects of management is very important.

The Bud Williams methods of calm, slow movement of cattle on pastures can be defined as a stimulus-response relationship. The “stimulus” is a person who simulates predator “stalking behavior”, which elicits predatory “avoidance behavior” in the cattle. The “stalking” behavior simulated by the person is similar to the behavior of a predator such as a lion or a wolf. First, the predator locates the herd. Then it begins a slow survey of the herd by walking in a circular direction around the herd looking for weak or old animals. The behavior of the predator circling the herd causes anxiety in the animals. The cattle become uneasy over an impending attack by the predator and begin to loosely bunch together. This uneasiness and slight anxiety comes before the fear and flight elicited by an actual attack. It is important to remember before attempting to use these methods that it is anxiety that makes this technique work and not fear.

The methods used by Bud Williams to move herds of cattle on pastures or to move cattle in large feedlot pens are easy to learn if you have patience and take your time. The handler moves at a normal walking speed (as a stalking predator would) and there should be no noise such as whistling, yelling, or whip cracking. If the cattle start running, these methods will not work. This method only works on animals that are slightly anxious and not fearful to the point of flight and running to get away. If the animals become excited in your first attempt and start running, they must be allowed to calm down for at least 30 minutes before the next attempt is made. Handler movements must be steady and deliberate with no sudden jerky movements or arm waving.
These methods work best on cattle with a fairly large flight zone. We attempted to use these methods on a large group of tame feedlot cattle with no success. It is very difficult to elicit predatory avoidance behavior in tame cattle with extensive contact with people. Tame cattle can often be moved easily by leading them. There are also time of day effects that may aid handler movements. For example, cattle that are actively grazing a pasture tend to spread out, whereas cattle resting between grazing will bunch closer together. There are three steps in the process of moving cattle on large pastures:

1. Gathering and Loose Bunching: This is the most critical step. The majority of the herd must be loosely bunched before any attempt is made to move the herd. Depending on herd size, wildness of the cattle, and the terrain, it will usually take 5 to 20 minutes to induce the herd to form a loose bunch. This is accomplished by applying very light pressure on the edge of the collective flight zone to induce the animals to move into a loose bunch.

   The handler should locate the majority of the herd and start making a series of wide back and forth movements on the edge of the herd. You should move in the pattern of a giant windshield wiper (Figure 1). The handler can induce the rear animals to begin to move by giving them a “predatory” stare. This simulates the initial stalking behavior of a predator sizing up the herd. The handler should keep continuously moving back and forth. If you stop moving and linger too long in one animal’s blind spot it may turn back and look at you. On open pastures, it is important to take your time. Six to twenty wide back and forth movements of 100 meters or more may be required to move the herd into a loose bunch. Handler movement patterns on large pastures and other large spaces are much larger than
handler movement patterns in confined spaces such as alleys or feedlot pens. Animals spread out over large areas require larger movements than animals gathered together in smaller spaces. The handler should continuously walk back and forth and move enough to the side that the lead animals can see him. (Figure 1). Cattle that are off to one side of the pasture will be attracted as the herd moves into a loose bunch. Animals hidden in the brush or timber will be drawn out because they seek the safety of the herd. Do not chase stragglers.

It is very important that the handler resist the urge to press the cattle into loose bunching to quickly. Remember, in this step the handler is attempting to cause slight anxiety in the animals by simulating predator “stalking” behavior. Stalking behavior causes anxiety which makes the animals want to bunch together closely for safety. This anxiety comes before the fear and flight caused by an attack by the predator. Take your time to allow the animals to bunch together and to allow calves to find their mothers (Figure 1).

2. Initiating Movement. When the majority of the herd has come together into a loose bunch, increase pressure on the collective flight zone to initiate movement in the desired direction (Figure 2). The handler continues the back and forth movements but presses closer to the herd to induce movement. This will cause the herd to move forward and begin to string out.

Handlers need to differentiate between “good” and “bad” movement of the cattle. When cattle have “good” movement, they can easily be driven in the desired direction. When animals have good movement that are all headed in the same direction and moving smoothly. They will look like a group of animals walking to
water or making some other voluntary group movement on a large pasture. In a large group of animals, “good” movement starts with one animal and additional animals will gradually follow. “Good” movement entices the other animals to follow, and bad movements prevents other animals from following in an orderly manner. There are two types of “bad” movement; 1) running, cutting back, and other panic induced movements, 2) animals stop moving as an orderly stream in the desired direction. The first signs of bad movement are stopping, wavering towards motion or starting to turn away from the desired direction to look at the handler. The extreme form of type two movement is circular movement.

Good movement can be disrupted when the animals are attempting to locate the handler’s position. This is a natural anti-predator behavior of prey species. They want to know where the predator is and what its intentions are. Animals will turn and look at a person or a dog that is either in their blind spot behind their rear or is out side their flight zone. Handlers should not remain more than momentarily in any individual animal’s blind spot. Walking through the blind spot will not cause a problem.

To make the group move pressure has to be applied to both the collective flight zone and individual animals within the moving herd. When an animal or a group responds to the handler’s pressure on the flight zone, the handlers must IMMEDIATELY stop forward movement or change direction of movement to relieve pressure. This rewards the animal for moving in the desired direction and the animal is more likely to continue that movement. When the desired movement slows down, the handler must apply pressure again.
Every time you are working your animals you are training them. You can train them to be easy to handle and have good movement or you can train them to be difficult and have bad movement.

3. **Controlling Movement Direction:** Animals must all be walking in the same direction before any attempt is made to change the direction of movement. When good movement is initiated, the handler can control the direction of movement by moving to the left to make the cattle turn right and visa versa (Figure 3). A basic principle is to alternately penetrate and withdraw from the animal’s flight zone. Other movement patterns are shown on other parts of our web page, www.grandin.com.
Figure 1. Handler zig-zag movement pattern for use in open pastures to induce cattle to move into a loose bunch.

Direction of desired movement

Ignore stragglers

Starting Point

Ignore stragglers
Figure 2. Handler zig-zag movement pattern for use in open pastures - starting movement in the desired direction.

The handler must zig-zag back and forth to keep the herd going straight. Imagine that the leaders are the pivot point of a windshield wiper and the handler is out on the end of the blade sweeping back and forth. As the herd narrows and gets good forward movement, the width of the handler's zig-zag narrows.
Figure 3. Handler zig-zag movement pattern for continuing animal movement on open pastures.

When every animal is heading in the desired direction, the width of the zig-zag becomes very narrow and the handler can now use the T-square movement pattern.
Tips for Squeeze Chutes

1. Install solid sides on your squeeze chute. The cattle will enter more easily and impact on the headgate will be decreased. The animals will remain calmer and easier to work on. The most important part of the squeeze chute to cover is the back section closest to the tail gate. If you do not believe that solid sides really work you should experiment with cardboard. Solid sides can also be created by installing angled rubber louvres on the side bars.

2. The chute leading up to the squeeze chute should also have solid sides. Solid sides on the squeeze chute must be used in conjunction with solid sides on the leadup chute to get the maximum calming effect.

3. Cattle entering the squeeze should not be able to see the person standing next to the chute. However they must see light through the headgate opening. Cattle will enter more quietly if their vision through the headgate is restricted so that they can not see other cattle. If they see other cattle they are more likely to lunge at the headgate. A solid sorting gate in front of the headgate is ideal.

4. Use the concept of optimum pressure. A common mistake is to squeeze cattle too hard when they struggle. A squeeze chute must apply sufficient pressure to make the animal feel restrained, but excessive pressure which causes pain should be avoided. Less pressure will be required to hold an animal when solid sides are installed on the squeeze chute. Excessive pressure applied by a hydraulic chute can cause severe injuries. The chute should be adjusted so that the hydraulic system bypasses at approximately 500 psi. The correct pressure setting will vary depending on the mechanical linkage on the chute.

5. Cattle must have non-slip flooring. An animal which slips and feels like it is going to fall is more likely to struggle.

6. Reduce noise such as clanging and banging by installing rubber stops. Some new squeeze chutes are engineered to reduce noise. They are worth the extra money. The hydraulic system should be engineered to be quiet. High pitched noise is more stressful than low pitched noise. Cattle are most sensitive to 8000 hz.

7. When solid sides are installed the cattle will walk in calmly. This will make it possible to apply pressure to the animal with a slow steady motion. Sudden jerky motion of a restraint device agitates and excites the cattle.
Cortisol is a stress hormone which is secreted when animals are stressed. Stressed animals with high levels of cortisol are more likely to get sick and have poor growth. Quiet handling greatly reduces stress. The cortisol levels on this graph were obtained from a number of different articles in the scientific literature. Training animals to handling procedures such as restraint and moving through the corrals will further reduce stress. Trained animals are the least stressed because they are the least fearful. Fearful animals will have high levels of stress. Fear is a very strong stressor which will greatly raise cortisol levels.

The range of cortisol values for ruminant animals such as cattle, deer, and antelope are very similar so a comparison between different ruminants is valid. Pigs and chickens have a completely different range of cortisol values. The values on this graph must not be used with non-ruminants.
Solving livestock handling problems

Based on 20 years of personal experience, this author describes three steps for improving the handling of hogs and cattle: selecting animals with a calm temperament, correcting facility problems that impede livestock movement, and training handlers.

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TO SOLVE ANIMAL handling problems, veterinarians must determine if the difficulties arise from one or more of the following factors: 1) an animal temperament problem, 2) a facility problem, or 3) a personnel problem. During the past few years, I have observed an increasing number of handling problems caused by nervous, flighty, excitable hogs and cattle. Both producers and seedstock breeders should be encouraged to select animals with a calm temperament. Animals balking and refusing to move through a chute or other facility can also be caused by a wide array of facility defects, ranging from major mistakes in design to easily corrected problems such as inadequate lighting. The most common problems related to personnel are rough handling, excessive prodding, and overcrowding of animals in a crowd pen. Cattle and hogs remember bad experiences, and animals that have been handled roughly become more difficult to handle in the future. Successful identification and correction of factors that contribute to animal handling problems can help produce better-quality meat and provide a safer environment for both the animals and their handlers. Agitation and excitement during handling shortly before slaughter can increase the occurrence of meat-quality defects (pale soft exudative pork and dark cutting in beef). Both of these conditions reduce the quality and value of the meat.

Choosing less excitable genetic lines

One factor that contributes to handling problems is an excitable animal temperament. Hogs from excitable genetic lines are more difficult to drive through chutes because they tend to bunch together. Both hogs and cattle from excitable genetic lines are more likely to balk or back up when being moved through chutes or into a restraint device. Excitable animals appear to be more vigilant and wary of novelty (such as sounds they have not heard before) than are animals with a calmer temperament. I have observed excitable animals balk at small distractions, such as a shadow or a puddle, that a calmer animal would ignore. Cattle with an excitable temperament are more likely to become agitated and injure themselves when they experience something new such as handling at an auction. Excitable cattle that have
been handled gently may be quiet and calm when they are in familiar surroundings, but may become highly agitated at an auction or feedlot.

Nervous, excitable temperament appears to cause handling problems that are somewhat different from the agitated behavior caused by experiences with rough handling. When excitable cattle are restrained, their behavior appears to be similar to that of a frenzied horse that has caught its leg in a fence. Animals with an excitable temperament are more likely to vocalize or injure themselves during handling.

I recently observed a group of feedlot heifers that constantly bellowed while standing in the crowd pen at a packing plant. These cattle were very nervous, and they jumped and reared much more often than the other cattle processed that day. These heifers also had a masculine appearance, probably due to the excessive use of androgenic growth implants. On another day, I observed a second group of European-continental-cross heifers that constantly bellowed and kicked at handlers. Three animals arrived at the plant with severe hoof injuries. The cattle appeared otherwise normal. The injuries seemed to have occurred when the animals panicked after their feet had been caught in a truck ramp at the feedlot.

The increasing occurrence of flighty, excitable livestock coincides with the drive to produce leaner pork and beef. In my opinion, indiscriminate selection for rapid growth and leanness tends to produce animals with a more excitable temperament. My observations at packing plants indicate that increased excitability is causing serious handling problems. Some groups of hogs or cattle are easy to drive and others constantly balk and show signs of agitation. This not only can reduce the quality of the meat but causes an animal welfare problem because excitable animals that refuse to move through a handling facility are more likely to be handled in an abusive manner by frustrated handlers. Practical experience has shown that flighty, excitable animals are more likely to have meat-quality defects (e.g. pale soft exudative pork or dark cutting in beef).

In cattle, the most serious temperament problems tend to occur in European continental breeds. Cattle from some genetic lines of these breeds are excitable. The history of the continental breeds may explain why the British breeds are less likely to go into a frenzy in a squeeze chute. I speculate that breeds from countries such as France and Italy have more severe temperament problems than breeds from England because they have not been reared under extensive conditions on rangeland where they have little contact with people. For centuries, French beef cattle have been halter broken, milked, and tamed. Today in French packing plants, cattle are held in halter tie-up stalls similar to a livestock show. When cattle are completely tamed and acclimated to people, milking machines, and vehicles, excitable temperament traits may be masked. Therefore, producers have never had to cull animals for temperament problems. British producers, on the other hand, have reared cattle semi-extensively on pasture. Their animals were seldom halter broken.

Animals from excitable genetic lines would have been culled because handling them in primitive handling facilities is difficult and dangerous.

Practitioners should educate producers and breeders on choosing lean animals with calm temperaments. An easy method of scoring the temperament of breeding stock is to rank animals by temperament while each is held in a squeeze chute or a scale. Each animal needs to be rated individually because temperament differences are less apparent when animals are in a group. A simple ranking system is as follows:

1. Remains calm, stands still
2. Appears slightly restless
3. Appears very restless
4. Vigorously shakes the squeeze chute and attempts to escape

It is also essential that each animal's temperament be evaluated more than once. In one study, 9% of 53 bulls received a 4 or 5 ranking during four different handling sessions, and about 50% of the bulls were always calm, receiving a ranking of 1 or 2 each time. The rest of the animals had mixed ratings. Similar results were obtained when 102 steers were rated. Six percent of the steers became agitated every time they were handled, and 64% were always calm. This is why culling decisions should be based on two or three evaluations. Animals that consistently exhibit bad dispositions when handled are the ones that need to be culled. Culling based on one evaluation may remove a good animal that became excited only because another animal nearby
was excited. Excitement tends to spread through a group of cattle or hogs. One excited animal can excite other usually calm animals.

Troubleshooting problems with facilities
The first step in troubleshooting facility problems is to distinguish between major design mistakes and easily corrected faults. The most serious layout mistake is dead-ending a single-file chute that leads up to a squeeze chute. The single-file chute must not be bent sharply at the junction between the chute and the crowd pen. A facility with a dead-ended chute works very poorly because animals will refuse to enter the chute. To induce them to enter, cattle and hogs standing in a crowd pen must be able to see at least two body lengths ahead in a single-file chute. For cattle, a curved chute is more efficient because it prevents them from seeing people up ahead. Figure 1 shows a curved handling facility I designed.

Hogs will refuse to leave their building during truck loading when it is either cold or very bright outside. Enclosing the loading facilities usually will improve the hogs’ movement. Animals also often refuse to enter a dark place. When single-file chutes are used to direct cattle to a squeeze chute, a wall of the building should never fall at the junction between the crowd pen and the single-file chute because the wall makes the entrance look dark. Cattle move more readily if they are lined up in the single-file chute before they pass through an entrance in the wall of a building. Therefore, the single-file chute should extend two or more body lengths from a wall.

Both cattle and hogs have wide-angle vision. Many chutes and loading ramps can be greatly improved by adding solid sides to block the animal’s peripheral vision. Solid sides on single-file chutes, crowd pens, and loading ramps will facilitate animal movement (Figure 1). Crowd gates on crowd pens should also be solid to keep animals from trying to turn back.

Another common mistake is building chutes that are too wide. It is impossible to move animals quietly through a chute if they become jammed side by side. Single-file chutes for market-weight hogs should be 41 cm wide, and cattle chutes should be 66 to 71 cm wide for cows and 76 cm wide for market-weight feedlot cattle. Single-file chutes should be sized so that the largest animal has only 1 or 2 cm of clearance on each side.

Non-slip flooring is absolutely essential for safe, humane livestock handling. It is impossible to handle animals calmly and quiet if they are constantly slipping or falling down. Falling on scales and in front of the squeeze chute can be prevented by installing a floor grating constructed from 1-in. steel rods placed on 12-in. centers.

I have learned of an increasing number of injuries to cattle caused by headgates. The problem may partially be due to more excitable cattle, but many of these injuries are caused by failure to slow the animal down in the squeeze chute before it hits the headgate. Excessive use of electric prods also contributes to injuries because excited cattle hit the headgate too hard. Flighty cattle remain calmer if the standard open-barred sides of a squeeze chute are covered. Simple, solid, drop-down panels can be constructed to allow access to the animal.

For hydraulic squeeze chutes, the pressure relief valve must be set properly to prevent excessive pressure from injuring the animals. Some examples of injuries caused by excessive pressure are broken ribs, a ruptured diaphragm, or a fractured pelvis. When the squeeze control lever is pressed all the way down, the relief valve must automatically bypass to the hydraulic reservoir to prevent excessive pressure on the animal. Animals must be held snugly to provide the feeling of being held, but excessive pressure causes pain and animals will fight restraint. If the squeeze chute is too tight, the pressure should be reduced slowly; a sudden or jerky motion causes excitement, but a slow, steady motion is calming.

Simple improvements in facilities
Some excitability problems in hogs are caused by a lack of environmental stimulation in indoor growing and finishing buildings. Playing a radio in the finishing building can help prevent an excessive startle reaction to a sudden noise, such as a door slamming shut. Providing finishing hogs with hanging rubber hose toys to chew and ensuring weekly contact with people in their pens will produce calmer animals that are easier to handle. The animals do distinguish between interacting with people in their pens and seeing people in the aisles, so it is important to have personnel actually enter each pen. If people remain only in the aisles, the animals are more likely to be
fearful when a person enters their pen for truck loading.

Distractions that appear to be insignificant, such as a wiggling chain in a chute, and lighting mistakes, such as a chute entrance that looks like a black cave to the animal, can ruin the efficiency of the best chutes and crowd pens. Simple changes in lighting can improve animal movement. At night, lamps can be used to attract animals to trucks, and, in indoor facilities, chutes must be illuminated so animals can see where they are going. Both cattle and hogs tend to move from darker places to brighter areas. To attract the animals, the lamps must be aimed toward the place the animals are entering. A good example is using a spotlight to encourage animals to move into a chute. The lamp must not shine into the eyes of approaching animals because glaring, blinding light impedes movement.

Both cattle and hogs will balk if they see a sparkling reflection in a puddle or a moving reflection on a sheet of metal. To locate these problems, someone must get into the empty chute and see what the animal is seeing. Moving a lamp away from the center line of a chute can eliminate a reflection on a wet floor. Any object on a fence or in a chute that appears novel also causes balking. A piece of paper lying in an alley causes both cattle and hogs to stop. A hat or coat hanging on a fence causes balking. I have seen cattle balk at a small chain hanging down in a single-file chute. In one location, the leader of an approaching group of cattle stopped to watch a small, jiggling chain. In another facility, hogs balked when they had to pass by a jiggling gate. Some of these distractions are subtle and require careful observation for people to detect them. To determine if small distractions are causing the balking, the animals have to be calm. It is almost impossible to determine the cause of balking when cattle or hogs are excited. Calm animals will stop and look directly at what is distracting them.

Both cattle and hogs are sensitive to changes in the color and texture of floors and fences. Animals tend to balk when moving between areas with different types of fences. Painting facilities a single color improves movement. Most colors work well, but light colors should be used in warmer areas of the country to keep the facility cooler. Contrary to popular belief, cattle and hogs do see color. Drain grates and metal plates on the floor also cause balking when animals are driven over them. In beef facilities, drains should be located outside of main drive alleys, chutes, and crowd pens. A dairy cow that walks over a grate every day learns to ignore it, but an animal that has just arrived at the dairy will balk at the grate for several days. In swine confinement facilities, hogs will balk at white plastic strips used as door thresholds. Figure 2 shows a plastic threshold that hogs refused to walk over. Grower, finishing, or nursery pigs that have never walked on concrete floors often refuse to move on such a surface. Pigs raised on metal mesh or plastic floors walk more readily on concrete if they are allowed to explore a concrete floor for 30 to 60 minutes before driving or other handling is attempted.

Animals may also refuse to move if they can see people ahead. Practitioners need to look up the chutes to determine if the animals can see other people ahead. Installing shields to prevent animals from seeing people farther ahead often facilitates movement. Gates can also be rigged with remote controls so that they can be opened by a handler standing behind the cattle (Figure 3).

Noise reduction in facilities

High-frequency sounds or loud intermittent noises are likely to cause animals to balk. Although no studies are available on sound sensitivity in hogs, cattle and sheep are more sensitive to high-pitched sounds than people are. The high-pitched whine from a hydraulic pump on a squeeze chute may increase balking in cattle. The pump and motor should be moved off the squeeze chute or a low-noise pump and motor must be purchased. At packing plants, I have seen cattle balk at a high-pitched noise, such as the whine of undersized hydraulic plumbing, but ignore a low-frequency sound, such as the rumbling of a chain conveyor. Cattle voluntarily entered chutes near equipment that made a low-frequency rumbling. The sound of metal clanging and banging causes a startle reaction, but I have seen an even greater startle reaction to air exhausts that hissed. Hissing air exhausts should be piped outside or quieted with mufflers that can be purchased from an industrial supplier.

Perfecting handling procedures

Quiet, calm handling of animals is impossible in facilities where animals constantly balk or stop. However, once problems with the facili-
1. A curved processing facility designed by the author for handling feedlot cattle. To facilitate the movement of cattle, the single-file chute, the crowd pen, and the curved approach alley all have solid sides. Curves improve cattle flow because the animals cannot see people standing by the squeeze chute. The chute must be designed so that cattle standing in the crowd pen can see two body lengths into the chute entrance. 2. Hogs refused to cross this threshold. Removal of the thresholds will improve hog movement. 3. At this facility, a rope is used to open a gate from behind a group of cattle. Standing in front of the animals to open the gate would cause balking. Both hogs and cattle are reluctant to approach a person they see ahead. 4. A stick with a plastic streamer on the end is a useful tool for moving cattle out of a crowd pen and into the single-file chute. The streamer is waved beside an animal's head to turn it.

If policies are fixed, the next step is to perfect calm, quiet handling methods. Handlers need to be trained in the basic principles of livestock behavior. The most important principles relate to the animal's flight zone and point of balance. The point of balance is located at the animal's shoulder. To make an animal move forward, the handler must be positioned behind the point of balance. To make an animal move backward, the handler must stand in front of the point of balance. Handlers often make the mistake of standing in front of an animal while
attempting to move it forward. Handlers must also learn to position themselves on the edge of the animal's flight zone. The flight zone is the animal's personal space, and its size is determined by the wildness or tameness of the animal. When a person enters the flight zone, the animal will move away. The size of the flight zone varies from 0 m for tame, halter-broken cattle, to 2 to 5 m for feedlot cattle, to 5 to 20 m for range cattle. Cattle that have been treated roughly have a larger flight zone. The animal's experiences have a tremendous effect on its current behavior and response to stress.\textsuperscript{1,3}

One of the most common handling mistakes is placing too many animals in a crowd pen. A crowd pen should never be more than three-quarters full. Livestock will move into a chute more efficiently if handlers wait until the chute is half empty before bringing another group into the crowd pen. This provides sufficient chute space so that several animals can follow a leader into it.

Overuse of electric prods is another frequent handling problem. The prod should be used only if an animal refuses to enter a squeeze chute or truck. Cattle must never be prodded when there is no place to go. Electric prods should never be used on breeding swine, and should be used sparingly when loading market hogs. The use of electric prods on breeding swine may cause them to fear people. Australian research has shown thatows that are fearful of people will farrow fewer piglets.\textsuperscript{11} Cows will learn to move promptly to avoid electric prodding, and may even learn to move when they simply hear the buzz of an electric prod.

If tail twisting is used to move cattle, the handler must release the tail when the animal moves forward. This rewards the animal for moving. The next time, the animal will move when the handler touches its tail. Many handlers make the mistake of continuously twisting the tail.

Both cattle and hogs can be moved and turned in a crowd pen by using a stick with either plastic streamers or a plastic garbage bag tied on the end (Figure 4). The plastic is used to block the animal's vision on one side and make it turn. Cattle can be easily turned and guided with the plastic streamers.

I have observed that many handling problems related to personnel have resulted from poor management or a lack of employee training. On many large operations, I have seen handling practices either improve or become rougher when a new manager is hired. From 20 years of experience, I have concluded that management's attitude is the single most important determinant of how animals are treated. The best facilities in the world are worthless unless they are managed well.

In conclusion, the three steps to improving livestock handling are selecting animals with a calm temperament, correcting problems in the facility that impede livestock movement, and training handlers.

\textbf{REFERENCES}
\begin{enumerate}
  \item Grandin, T.: \textit{Environmental and Genetic Factors Which Contribute to Handling Problems in Pigs}. Live-
Feedlot Cattle with Calm Temperaments Have Higher Average Daily Gains Than Cattle with Excitable Temperaments

B. D. Voisinet, T. Grandin, J. D. Tatum, S. F. O'Connor, and J. J. Struthers

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ABSTRACT: This study was conducted to assess the effect of temperament on the average daily gains of feedlot cattle. Cattle (292 steers and 144 heifers) were transported to Colorado feedlot facilities. Breeds studied included Braford (n = 177), Simmental x Red Angus (n = 92), Red Brangus (n = 70), Simbrah (n = 65), Angus (n = 18), and Tarentaise x Angus (n = 14). Cattle were temperament rated on a numerical scale (chute score) during routine weighing and processing. Data were separated into two groups based on breed, Brahman cross (> 25% Brahman) and non-Brahman breeding. Animals that had Brahman breeding had a higher mean temperament rating (3.45 ± .09) or were more excitable than animals that had no Brahman influence (1.80 ± .10); (P < .001). These data also show that heifers have a higher mean temperament rating than steers (P < .05). Temperament scores evaluated for each breed group also showed that increased temperament score resulted in decreased average daily gains (P < .05). These data show that cattle that were quieter and calmer during handling had greater average daily gains than cattle that became agitated during routine handling.

Key Words: Beef Cattle, Temperament, Weight Gain, Breeds, Sex Differences


Introduction

"No one likes wild cattle, so why raise them?" This quote, from The Lasater Philosophy of Cattle Raising (Lasater, 1972), seems obvious due to animal and handler safety concerns. Some beef producers do, in fact, consider temperament to be an important trait when selecting cattle for purchase (Elder et al., 1980). Often, however, the economic implications of livestock temperament have been unrecognized. Reports of very excitable cattle that become highly agitated and excited when restrained or handled are increasing (Grandin, 1994). This trend could possibly be counterproductive for the beef industry.

Few experiments have attempted to identify links between temperament and various measures of productivity. One study reported that cows with calm temperaments had a 25 to 30% increase in milk production (Drugociu et al., 1977). Observations tend to show that more excitable cattle with higher temperament scores have lower live weights and(or) weight gains (Tulloh, 1961; Fordyce and Goddard, 1984), though few data have been presented. The present study was conducted to identify the relationship between temperament and productivity as measured by daily weight gain.

Materials and Methods

Cattle. Four hundred thirty-six cattle (7 to 11 months old), 292 steers and 144 heifers, were transported to feedlot facilities near Fort Collins, Colorado, for finishing. Breeds studied included Braford (3/8 Brahman × 5/8 Hereford or 1/2 Brahman × 1/2 Hereford), Simmental × Red Angus, Red Brangus (3/8 Brahman × 5/8 Red Angus or 1/4 Brahman × 3/4 Red Angus), Simbrah (3/8 Brahman × 5/8 Simmental), Angus, and Tarentaise × Angus. Braford, Red Brangus, and Simbrah cattle will be referred to as Bos indicus-cross; Simmental × Red Angus, Angus, and Tarentaise × Angus cattle will be referred to as Bos taurus.

All cattle were received at the feedlot from October through December 1994 and acclimated to feedlot conditions for 2 to 3 wk before the start of the trial. The B. indicus-cross cattle were obtained from Florida, Simmental × Red Angus were obtained from Nebraska, and Angus and Tarentaise × Angus cattle...
were obtained from Wyoming. All cattle, regardless of origin, were produced on extensive operations with minimal human interaction. While in the feedlot, cattle were housed in groups of approximately 20 to 50 cattle, with group allotments determined by ranch and thus breed, sex, and weight. Cattle were fed to acquire a constant subcutaneous fat thickness of 9 to 13 mm (target = 11 mm) over the 12th rib, as determined by visual indices and ultrasound measurements.

All cattle received a diet consisting primarily of whole corn and corn silage. For the complete diet, see O’Connor et al. (1997). Growth implants were administered at the start of the finishing period and after approximately 120 d on feed. Implant protocols were as follows: steers were given an initial implant of Synovex-S (Syntex Animal Health, St. Louis, MO, 1994) and a second implant of Revalor-S (Hoechst Roussel Agri-Vet, Somerville, NJ); heifers received Finaflex-H (Hoechst Roussel Agri-Vet) for the initial and the second implants. Each heifer received .4 mg/d of melengestrol acetate (MGA) for the entire feeding period.

Experimental Procedure. Approximately every 28 d, weight gain assessment and ultrasound determination of subcutaneous fat thickness data were recorded for all cattle. During processing, two independent observers assessed the temperament of each animal. A single temperament rating was recorded for each animal by each observer. The number of cattle prohibited temperament observations for all cattle from being completed on a single day. Observer 1 scored cattle after they had four to eight previous experiences with the handling facility at the feedyards. Observer 2 scored cattle during the animals first encounter with the handling facilities. Observers temperament-scored the same cattle using slightly different methods. Observer 1 rated 436 B. indicus-cross and B. taurus cattle via a temperament rating system similar to that used in Grandin (1993), assigning scores of 1 through 5. Each animal’s temperament was assessed while the animal was in a nonrestraining single-animal scale crate. Observer 2 assigned scores of 1 through 4 for handling device (squeeze chute or scale); 4: continuous vigorous movement and shaking of device; 5(4): rearing, twisting, or violently struggling.

Restraint of animals in a hydraulic squeeze chute reduces the range of movement and therefore reduces the resolution of discrimination between categories on a rating scale; thus a four-point scale was used. No interobserver comparison can be made because of the differences in animal movement between the squeeze chute and scale and because of numerical differences in temperament rating scale. Due to these differences in method, the data sets have been analyzed separately and presented as two independent experiments. Experiments 1 and 2 will refer to data collected by observers 1 and 2, respectively.

Statistical Analysis. Data were analyzed using the SAS GLM procedure (SAS, 1985). Average daily gain was analyzed with a model that included breed, sex (where appropriate), temperament, sire(breed) (as a random effect), and fat thickness. Temperament was analyzed using a model that included breed, sex (where appropriate), sire(breed), and fat thickness.

Pairwise comparisons were conducted between the means of each level of temperament score, breed, and sex.

Results and Discussion

Table 1 lists the unshrunk on-test and off-test least squares mean weights, days on feed, and average daily gains for animals in the study.

Analysis of Breed Differences in Temperament

Experiment 1. Observer 1 collected data on the Bos indicus and Bos taurus cattle. Our analyses showed that temperament score differed between breed groups. No significant temperament score differences existed within B. indicus-cross cattle with respect to differing percentages of Brahman influence (1/4, 3/8, 5/8).

<table>
<thead>
<tr>
<th>Breed</th>
<th>n</th>
<th>On-test wt. kg</th>
<th>Off-test wt. kg</th>
<th>Days on feed</th>
<th>Avg daily gain ± SE kg/d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Braford</td>
<td>177</td>
<td>290</td>
<td>468</td>
<td>201</td>
<td>.95 ± .03</td>
</tr>
<tr>
<td>Red Brangus</td>
<td>70</td>
<td>305</td>
<td>507</td>
<td>206</td>
<td>.98 ± .04</td>
</tr>
<tr>
<td>Simbrah</td>
<td>65</td>
<td>320</td>
<td>552</td>
<td>212</td>
<td>1.10 ± .04</td>
</tr>
<tr>
<td>Angus</td>
<td>18</td>
<td>305</td>
<td>543</td>
<td>194</td>
<td>1.24 ± .06</td>
</tr>
<tr>
<td>Simmental/Red Angus</td>
<td>92</td>
<td>264</td>
<td>569</td>
<td>213</td>
<td>1.44 ± .02</td>
</tr>
<tr>
<td>Tarentaise/Angus</td>
<td>14</td>
<td>301</td>
<td>550</td>
<td>207</td>
<td>1.21 ± .09</td>
</tr>
</tbody>
</table>

aData listed are for all animals temperament scored by Observer 1.

bTraits are adjusted to a constant fat thickness of 11 mm using analysis of covariance techniques. The model included breed, sex (Brahman-cross only), sire(breed), and fat thickness.

cValues are means ± SE. The error term for analysis of breed differences = sire(breed) (df = 73, df = 64).
Braford Red Brangus Simbrah

Bos indicus-cross

Tarentaise × Angus

violently struggling.

Simmental × Red Angus

movement and shaking of restraint device: 5

individual breeds = 75: df
Bos taurus

cattle were higher (for

for

for

al., 1980; Hearnshaw and Morris, 1984; Fordyce et al.,

Accurate representation of mean temperament score

breed are presented in Table 2. Differences were

analyzed separately. Mean temperament scores by

1988 L Because of these differences, weight gain data

present within the

for individual

.05)

excitable temperaments than Simbrah cattle.

Red Brangus, 3.78: Simbrah, 2.89) and the

cross breed group

 exceed.

Based differences in temperament due to confounding

by geographic origin. As was discussed in the Materi­

als and Methods section, all B. indicus-cross breeds

were obtained from a single location. Angus and

Tarentaise × Angus cattle were obtained from a second

location, and Simmental × Red Angus cattle were

taken from a third location.

Experiment 2. No difference (P < .4) in tempera­

ment existed among any of the B. indicus breeds

observed in the squeeze chute. Braford cattle had an

average temperament score of 2.0 ± .12. Red Brangus
cattle had a score of 2.18 ± .17, and Simbrah cattle
	had a score of 2.11 ± .14, on the 1 to 4 rating system.

No B. taurus cattle were included in this experiment
(data not shown).

Analyses of Weight Gain Differences

Experiment 1. Our results show a significant effect

of temperament ranking on average daily gain in B.

indicus-cross and B. taurus cattle (Table 3). The B.
taurus steers with the calmest temperaments had .19

kg/d greater (P < .05) mean average daily gain than

the steers with the highest temperament scores or

most excitable temperaments. With the exception of B.

indicus-cross steers and heifers that had a tempera­

ment score of 1, average daily gains in both breed

groups decreased as temperament scores increased.

The B. indicus cattle with calm temperaments (scores

of 1) do not fit with this pattern, because they had the

lowest average daily gains (.75 kg/d). We speculate,

however, that the small number of animals (n = 4)

and large standard error may have contributed to this

apparently contradictory result.

Experiment 2. Observer 2 temperament ranked 304

B. indicus-cross cattle on the four-point system

or 1/2 Brahman). Mean temperament scores of B.

indicus-cross cattle were higher (P < .001) than those

for B. taurus steers. This agrees with research that

has shown that B. indicus cattle are more tempera­

mental or excitable than B. taurus cattle (Elder et al.,

1980; Hearnshaw and Morris, 1984; Fordyce et al.,

1988). Because of these differences, weight gain data

for B. indicus-cross and B. taurus breed groups were

analyzed separately. Mean temperament scores by

breed are presented in Table 2. Differences were

present within the B. indicus-cross breed group. with

the Braford and Red Brangus cattle having more (P <

.05) excitable temperaments than Simbrah cattle.

Accurate representation of mean temperament score

for individual B. indicus-cross breeds (Braford, 3.62;

Red Brangus, 3.78; Simbrah, 2.89) and the B. indicus-
cross breed group (3.46) necessitated that heifers be

omitted from this analysis because only steers were

present in the B. taurus breeds.

Even though breed group differences were statisti­

cally significant, they may not represent true breed-

based differences in temperament due to confounding

of geographic origin. As was discussed in the Materi­

als and Methods section, all B. indicus-cross breeds

were obtained from a single location. Angus and

Tarentaise × Angus cattle were obtained from a second

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and large standard error may have contributed to this

apparently contradictory result.

Experiment 2. Observer 2 temperament ranked 304

B. indicus-cross cattle on the four-point system

Table 2. Least squares means for temperament score by breed, steers only (Experiment 1)

Breed* | Mean temperament rankingabc
---|---
Braford | 3.62 ± .15d
Red Brangus | 3.78 ± .22d
Simbrah | 2.89 ± .22
Bos indicus-cross | 3.46 ± .08d
Angus | 1.70 ± .19d
Simment al × Red Angus | 1.77 ± .07d
Tarentaise × Angus | 2.36 ± .31d
Bos taurus | 1.80 ± .10d

*Model included breed, sire(breed), and fat thickness. The error term for analysis of breed differences = sire(breed) (df = 75; df = all breed means = 123). b = calm no movement: 2 = restless shifting: 3 = squirming. occasional shaking of restraint device: 4 = continuous vigorous movement and shaking of restraint device: 5 = rearing, twisting or violently struggling.

Table 3. Least squares means for average daily gain for animals temperament-ranked for Experiment 1

<table>
<thead>
<tr>
<th>Temperament rankinga,b</th>
<th>Bos taurusc</th>
<th>Bos indicus-crossd</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Avg daily gainkg/d</td>
</tr>
<tr>
<td>1</td>
<td>37</td>
<td>1.38 ± .05</td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>1.29 ± .04</td>
</tr>
<tr>
<td>3</td>
<td>17</td>
<td>1.19 ± .06</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>—</td>
</tr>
</tbody>
</table>

aModel included temperament, breed, sex (B indicus-cross only), sire(breed), and fat thickness. The error term for analysis of temperament differences = residual (df = Bos indicus-cross = 274; df = Bos taurus = 84). b = calm, no movement; 2 = restless shifting; 3 = squirming, occasional shaking of restraint device; 4 = continuous vigorous movement and shaking of restraint device; 5 = rearing, twisting or violently struggling.

cSteers only.

dSteers and heifers.

fValues are means ± SE.
Temperament ranking was a significant source of variation in average daily gain. Animals with temperament scores of 1 or 2 had higher average daily gains than animals with temperament scores of 3.

The use of two observers and different experimental methods attests to the robustness of our results and the strength of the temperament effect on weight gain. Due to the lack of body restraint in the scale there was an increased ability for animal movement. As a result, observer 1 assigned more scores of 4 (25.9%) or 5 (14.0%) than observer 2 assigned scores of 4 (6.6%).

Despite those differences, the results derived from the study remain consistent. We conclude from these results that the driving force behind average daily gain differences was primarily a product of calm temperaments, as opposed to excitable temperaments.

Stated another way, calm cattle had increased average daily gains rather than excitable cattle having decreased average daily gains. More research, however, is necessary to confidently establish this.

**Analysis of Sex Differences**

Because heifers were present in Bos indicus-cross groups only, sex analyses were limited to the B. indicus-cross breed group. Sex was a significant source of variation, not only in average daily gain, as would be expected, but also in average temperament scores. Regardless of observer or temperament ranking system, heifers consistently had higher temperament scores than their male contemporaries (Table 5). In Experiment 1, heifers had a mean temperament score of 3.72, and steers had a mean temperament score of 3.39. In Experiment 2, the mean temperament score of heifers was 2.23 and that of steers was 1.97.

Similar sex differences in temperament have been found in British and European Continental (exotic) cattle (Stricklin et al., 1980). Other research, which focused on B. taurus breeds, found similar trends, but no significant differences in temperament due to sex were detected (Tulloh, 1961; Shrode and Hammack, 1971). We hypothesize that sex differences may be evident only in certain breeds. For example, due to calmer temperaments among B. taurus breeds, sex differences may not be as pronounced as the sex differences in B. indicus or B. indicus-cross breeds (Elder et al., 1980; Fordyce et al., 1988).

Studies with rodents, which typically exhibit fear or anxiety (typically considered to be synonymous), have shown common, though inconsistent, sex differences in behavior (Gray, 1987; Johnston and File, 1991). Studies of fear may contribute to our knowledge of temperament by considering that fear, as a physiological state of the nervous system, ultimately results in certain behaviors (Gray, 1987). Additionally, Boissy (1995) defined fearfulness as a trait that determines the extent to which an individual becomes frightened in alarming situations.

The evolutionary and(or) adaptive mechanisms underlying sex differences in temperament are not fully understood. Practical experience on ranches has shown that heifers are more temperamental than cows. The fact that this calming of their disposition occurs just after parturition is verified by rodent experiments. Just after parturition and during lactation, rats exhibit a decrease in emotional reactivity or fearfulness (Härd and Hansen, 1985). Nulliparous rats were more fearful than parturient females in a variety of tests, including those that measured emergence latencies from a box into an open field test arena and the inclination to flee from an intruder (Fleming and Luebke, 1981). Reduced fearfulness of parturient female rats is most likely hormonally mediated (Fleming and Luebke, 1981).

In addition to genetically based differences in temperament, the possibility also exists for temperament to be influenced by growth-promotant implant protocols, which are completely confounded by sex; however, we found no research to support or refute this possibility in heifers. Two studies using steers and bulls have been conducted to examine behavioral effects of zeranol implants. Neither study showed a significant effect of implantation on agitation scores (Vanderwerf et al., 1985; Baker and Gonyou, 1986).

### Table 4. Least squares means for average daily gain for animals temperament-ranked for Experiment 2

<table>
<thead>
<tr>
<th>Temperament ranking</th>
<th>n</th>
<th>Avg daily gain (kg/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>89</td>
<td>1.04 ± .03</td>
</tr>
<tr>
<td>2</td>
<td>119</td>
<td>1.05 ± .03</td>
</tr>
<tr>
<td>3</td>
<td>76</td>
<td>.95 ± .03d</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>.94 ± .06d</td>
</tr>
</tbody>
</table>

*Model included temperament, breed, sire/breed, and fat thickness. The error term for analysis of temperament differences = residual (df = 267). Values are means ± SE.

Means with different superscripts differ (P < .05).

### Table 5. Sex differences in mean temperament score in Bos indicus-cross cattle

<table>
<thead>
<tr>
<th>Sex</th>
<th>Experiment 1</th>
<th>Experiment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heifers</td>
<td>3.72 ± .11c</td>
<td>2.23 ± 10d</td>
</tr>
<tr>
<td>Steers</td>
<td>3.39 ± .11c</td>
<td>1.97 ± 10d</td>
</tr>
</tbody>
</table>

*Model included breed, sex, sire/breed, and fat thickness. The error term for analysis of gender differences = residual (df = 278: df = 270).

Values are means ± SE.

*Means differ (P < .01).

*Means differ (P < .05).
Experience also affects reactions to handling and restraint. Crookshank et al. (1979) showed that agitation and cortisol levels in cattle were decreased over multiple handling experiences. Gentling of animals is at least somewhat successful at reducing aversion to restraint and handling, although not enough to overcome the effects of highly aversive procedures (Hargreaves and Hutson, 1990). European Continental cattle that were worked through a squeeze chute repeatedly in a single day became increasingly agitated (Grandin, 1993). Calm Angus bulls, however, did not become agitated with additional passes through working facilities (B. D. Voisin et al., unpublished data). Other research, however, has shown that if given the opportunity to avoid highly aversive handling procedures, such as electroimmobilisation, sheep will do so consistently over many trials (Grandin et al., 1986). Differences in the results between studies is likely due to differing levels of fear and how the animal perceives the aversiveness of a procedure. Animals are able to discriminate between different kinds of human interaction, aversive or nonaversive (Gonyou et al., 1986) and also between different areas of a restraint system where highly aversive events occurred (Rushen, 1986). The levels of aversion expressed by an individual animal, however, are relatively persistent across multiple handling experiences (Fordyce and Goddard, 1984; Lyons, 1989; Grandin, 1993). Because of this and regardless of whether agitation in response to a particular handling event increases or decreases over time, one should expect agitation levels or temperament for an individual animal to remain relatively consistent with respect to its contemporaries. Heritability estimates of cattle temperament show that it is a moderately heritable trait (Shrode and Hammack, 1971; Stricklin et al., 1980; Fordyce et al., 1988).

Even though an economic analysis has not been completed at this time, the benefits of selecting for calmer or more docile animals may be more than enhanced animals and handler safety and decreased facility wear. Another advantage of selecting cattle with calmer temperaments would be increased welfare because injuries to the animal would be reduced. Research is needed to determine the physiological mechanisms underlying the effect of temperament on average daily gain.

Implications

Selection for calm temperaments may become a key factor in maximizing production efficiency of cattle weight gains in feedlots. Cattle temperament is heritable, and temperament differences persist when animals are rated over a period of time. These two factors, considered together, imply that careful selection for a calm temperament may not only improve animal and handler safety but also increase economic returns via improved average daily gains.

Literature Cited


Assessment of Stress During Handling and Transport

T. Grandin
Department of Animal Sciences, Colorado State University, Fort Collins 80523

ABSTRACT: Fear is a very strong stressor, and the highly variable results of handling and transportation studies are likely to be due to different levels of psychological stress. Psychological stress is fear stress. Some examples are restraint, contact with people, or exposure to novelty. In many different animals, stimulation of the amygdala with an implanted electrode triggers a complex pattern of behavior and autonomic responses that resemble fear in humans. Both previous experience and genetic factors affecting temperament will interact in complex ways to determine how fearful an animal may become when it is handled or transported. Cattle trained and habituated to a squeeze chute may have baseline cortisol levels and be behaviorally calm, whereas extensively reared animals may have elevated cortisol levels in the same squeeze chute. The squeeze chute is perceived as neutral and non-threatening to one animal; to another animal, the novelty of it may trigger intense fear. Novelty is a strong stressor when an animal is suddenly confronted with it. To accurately assess an animal's reaction, a combination of behavioral and physiological measurements will provide the best overall measurement of animal discomfort.

Key Words: Handling, Restraint, Welfare, Anxiety, Stress, Slaughter

Introduction

Studies to determine the amount of stress on farm animals during routine handling and transport often have highly variable results and are difficult to interpret from an animal welfare standpoint. This paper will cover some of the factors that influence how an animal may react during handling. Much of the variability between handling studies is likely to be due to different levels of psychological stress. Animals can be stressed by either psychological stress (restraint, handling, or novelty) or physical stresses (hunger, thirst, fatigue, injury, or thermal extremes). Procedures such as restraint in a squeeze chute do not usually cause significant pain, but fear may be a major psychological stressor in extensively raised cattle. Many apparently conflicting results of different studies may be explained if the varying amounts of psychological stress and physical stress within each study are considered. Fear responses in a particular situation are difficult to predict because they depend on how the animal perceives the handling or transport experience. The animal's reactions will be governed by a complex interaction of genetic factors and previous experiences. For example, animals with previous experiences with rough handling will remember it and may become more stressed when handled in the future than animals that have had previous experiences with gentle handling. Previous handling experiences may interact with genetic factors. Rough handling may be more detrimental and stressful to animals with an excitable temperament compared to animals with a more placid temperament. For example, Brahman-cross cattle had higher cortisol levels when restrained in a squeeze chute than English crosses (Zavy et al., 1992). An animal's social rank within the group can also affect stress levels. McGlone et al. (1993) found that subordinate submissive pigs were more stressed by 4 h of transport than dominant pigs. This paper will only address short-term stressors such as handling and transport. The measurement of chronic stress imposed by the environment or different housing systems is much more complex.

Importance of Fear and Effects of Novelty

Fear is a universal emotion in the animal kingdom and motivates animals to avoid predators. All vertebrates can be fear-conditioned (LeDoux, 1994). The amygdala in the brain is probably the central fear system that is involved in both fear behavior and the acquisition of conditioned fear (Davis, 1992).
(1992) cited over 20 animal studies from many different laboratories that showed that electrical stimulation of the amygdala with an implanted electrode triggers a complex pattern of behaviors and changes in autonomic responses that resembles fear in humans. In humans, electrical stimulation of the amygdala elicits feelings of fear (Gloor et al., 1981). Studies have also shown that electrical stimulation of the amygdala will increase plasma corticosterone in cats (Setzkleiv et al., 1961; Matheson et al., 1971) and in rats (Redgate and Fahringer, 1973). Lesioning of the amygdala will block both unconditioned and conditioned fear responses (Davis, 1992). Large lesions in the amygdala will reduce emotionality in wild rats as measured by flight distance (Kemble et al., 1984). Kemble et al. (1984) also noted that lesioning of the amygdala had a taming effect on wild rats. LeDoux (1994) explains that fear conditioning takes place in a subcortical pathway and that extinguishing a conditioned fear response is difficult because it requires the animal to suppress the fear memory via an active learning process. A single, very aversive event can produce a strong conditioned fear response, but extinguishing this fear response is much more difficult.

Observations by the author on cattle ranches have shown that to prevent cattle and sheep from becoming averse and fearful of a new squeeze chute or corral system, painful or highly aversive procedures should be avoided the first time the animals enter the facility. The same principle also applies to rats. Rats that receive a strong electrical shock the first time they enter a novel alley will refuse to enter it again (Miller, 1960). However, if the rat is subjected to a series of shocks of gradually increasing intensity, it will continue to enter the alley to get a food reward. Therefore, Hutson (1993) recommends that stress in sheep during routine handling could be reduced if the animals were conditioned gradually to handling procedures. Less severe procedures should be done first (Stephens and Toner, 1975; Dantzer and Mormede, 1983).

Novelty is a very strong stressor (Stephens and Toner, 1975; Moberg and Wood, 1982; Dantzer and Mormede, 1983). This is especially true when an animal is suddenly confronted with it. In the wild, novelty and strange sights or sounds are often a sign of danger (Grandin, 1993a). Cattle will balk at shadows or differences in flooring during movement through handling facilities (Grandin, 1980). Pigs that have been trained to laboratory procedures will respond to deviations in their daily routine with a rise in blood pressure (Miller and Twohill, 1983). Reid and Mills (1962) have suggested that livestock can be trained to accept changes in management routines that would cause a significant increase in physiological measurements in animals that had not been trained. Gradual exposure of animals to novel experiences enables them to become accustomed to nonpainful stimuli that had previously evoked a flight reaction. Grandin et al. (1995b) reported that training nyala antelope to cooperate during blood sampling had to be done very slowly to avoid triggering a massive flight reaction. The animals are very vigilant and will react to any unfamiliar sights and sounds.

There are some situations in which novelty is attractive to animals. Cattle and pigs often approach and manipulate a piece of paper dropped on the ground. The author has observed that the same piece of paper will cause animals to balk and jump away if they are being forced to walk toward it. Therefore, the paper may be perceived as threatening in one situation and non-threatening in another. The author has observed that cattle in the Philippines seldom react to cars, trucks, and other distractions when they graze on the highway median strip. Cars and trucks are no longer novel because they have been seen them since birth. In the nyala antelope, animals born after the adults had been trained to blood sampling procedures learned to cooperate more quickly (Grandin et al., 1995b).

Cattle can become accustomed to repeated non-aversive procedures such as weighing or drawing blood through an indwelling catheter (Peischel et al., 1980; Alam and Dobson, 1986). Sheep, pigs, and giraffes have been trained to voluntarily enter a restraint device (Panepinto, 1983; Wienker, 1986; Grandin, 1989).

However, animals do not habituate to procedures that are very aversive (Hargreaves and Hutson, 1990a). A procedure can be highly aversive without being painful. Full inversion to an upside-down position is extremely aversive to sheep. The time required to drive sheep down a race into a restraint device that inverted them increased the following year (Hutson, 1985). Cortisol levels did not decrease with experience when cattle were subjected to repeated truck trips during which they fell down (Fell and Shutt, 1986). Hargreaves and Hutson (1990a) found that repeated trials of a sham shearing procedure failed to reduce the stress response. Sheep also did not habituate to 6 h of restraint with their legs tied (Coppinger et al., 1991).

Apple et al. (1995) found that in sheep, 6 h of restraint stress caused dark cutting meat and very high (> 110 ng/mL) levels of cortisol. Epidural blockage with lidocaine, which prevents the animals from contracting their muscles and straining against the restraint, failed to inhibit glycogen metabolism. This experiment indicates that psychological stress was probably a significant factor.

Cattle are very sensitive to the relative aversiveness of different parts of handling procedures. When they were handled every 30 d in a squeeze chute and a single animal scale, balking at the scale decreased with successive experience and balking at the squeeze chute increased slightly (Grandin, 1992). The animals learned that the scale never caused discomfort. Cattle that had been mishandled in a squeeze
chute and struck hard on the head by the headgate were more likely to resist entry into the chute in the future (Grandin et al., 1994) compared with cattle that had never been hit with the headgate.

Effects of Adaptation to Handling on Stress

Tame animals that are accustomed to frequent handling and close contact with people are usually less stressed by restraint and handling than animals that seldom see people. Binstead (1977), Fordyce et al. (1985), and Fordyce (1987) report that training weanling heifer calves produced calmer adult animals that were easier to handle. Training these extensively raised calves involved walking quietly among them, teaching them to follow a lead horseman and quiet walking through chutes. How an animal is handled early in life will have an effect on its physiological response to stressors later in life. Calves on a university experiment station that had become accustomed to petting by visitors had lower cortisol levels after restraint than calves that had less frequent contact with people (Boandle et al., 1989). Lay et al. (1992a) found that restraint in a squeeze chute was almost as stressful as hot-iron branding for extensively reared beef cattle. In hand-reared dairy cows, branding was much more stressful than restraint (Lay et al., 1992b).

Taming may reduce the physiological reactivity of the nervous system. Hastings et al. (1992) found that hand-reared deer had lower cortisol levels after restraint compared with free-ranging deer. Even though the physiological response to restraint was lower in the tame animals, hand-reared deer struggled just as violently as free-range deer (Hastings et al., 1992). Associations that animals make seem to be highly specific. Mateo et al. (1991) found that tame sheep approached a person more quickly, but behavioral measurements of struggling indicated that taming did not generalize to other procedures. Similar findings by Hargreaves and Hutson (1990a,b) showed that gentling and reduction of the sheep's flight zone failed to reduce aversion to shearing. Tame animals can sometimes have an extreme flight reaction when suddenly confronted with novelty that is perceived as a threat. Reports from ranchers and horse trainers indicate that horses and cattle that are calm and easy to handle at their home farm sometimes become extremely agitated when confronted with the novelty of a livestock show or auction. The animal's behavioral reaction seems to be less likely to generalize to other procedures than its physiological reaction. Moberg and Wood (1982) found that experiences during rearing greatly affected behavior in an open field test but had little effect on adrenocortical response of lambs. Exposing piglets to novel noises for 20 min increases both heart rate and motor activity. Heart rate habituated to a recording of abattoir sounds more quickly than motor activity (Spensley et al., 1995).

The effects of previous experience on an animal's fear response may provide one explanation for the often variable results in handling and transport studies. For example, extensively raised animals may have more psychological or fear stress during loading and unloading for transport compared to more intensively reared animals. British researchers have found that loading and unloading of sheep and calves was the most stressful part of the journey (Trunkfield and Broom, 1990; Knowles, 1995). Kenney and Tarrant (1987) reported that for Irish cattle, the actual journey was more stressful than loading and unloading. The physical stresses of the trip, such as jiggling, were more stressful than the psychological stresses of loading or unloading. A possible explanation for this discrepancy between these two studies may be the amount of contact the animals had with people. There may be a big difference in the degree of fear stress between U.S. cattle reared on rangeland where they seldom see people and European pasture-reared cattle. Differences in the degree of psychological stress may explain why too many rest stops during long-distance transport is detrimental to the health of weaner calves raised under U.S. conditions. Cattle feeders have learned from practical experience that 200- to 300-kg calves shipped from the southeast to Texas will have fewer health problems if they are transported non-stop for the entire 32-hour trip. For these extensively reared calves, rest stops may possibly turn into stress stops. Research is needed to conclusively determine what factors cause the rest stops to be stressful. Legislating too many rest stops may be detrimental to welfare. One possibility is fear stress during loading and unloading at rest stops and the second possibility is that the calves become infected with diseases at the rest stop. Many of the calves shipped on these trips are not properly vaccinated. There may be an interaction between rest stops and disease. Frequent rest stops may be more beneficial to fully vaccinated calves.

Genetics

Genetic factors such as temperament interact in complex ways with an animal's previous handling experiences and learning to determine how it will react during a particular handling procedure. Wild species are usually more reactive to novel stimuli than domesticated animals. Price (1984) maintains that the domestic phenotype have reduced responses to changes in the environment. Domesticated animals are more stress-resistant because they have been selected for a calm attitude toward people (Parsons, 1988). When deer or antelope are tamed, the flighty temperament is masked until they are confronted with a novel stimulus that is perceived as threatening. A
tame deer or antelope can have an explosive reaction to a novel event. A wild species has a more intense flight response because this enables it to flee from predators.

Temperament in cattle is a heritable trait that may affect the animal’s reaction to handling (Le Neindre et al., 1995). There are differences in temperament both between and within cattle breeds. Within the Brahman breed, temperament is heritable (Hearnshaw et al., 1979; Fordyce et al., 1988). Temperament differences between breeds have also been reported by Stricklin et al. (1980) and Tulloh (1961). Genetics also affects an animal’s response to stress. Brahman-cross cattle had higher cortisol levels while restrained in a squeeze chute compared to English crosses (Zavy et al., 1992). Recent research by Grandin et al. (1995a) and replicated by H. Randle (1995, personal communication. University of Plymouth, U.K.) indicated that the spiral hair whorl on a bovine’s forehead is an indicator of temperament. Cattle with spiral hair whorls above the eyes became more agitated while restrained than animals with hair whorls below the eyes.

Temperament may be under genetic control in many different animals. Research with rats has shown that they can be selected for either high or low emotionality (Fujita et al., 1994) or for reduced fear-induced aggressiveness toward humans (Popova et al., 1993). Phenotypic characteristics are also related to temperament. Interestingly, it seems that different genetic factors control fear-induced aggression and intermale aggression. Selection for reduced fear-induced aggression had no effect on aggressive behavior toward other male rats.

Temperament is a trait that seems to be stable over time. In European Continental-cross cattle, certain individuals became extremely agitated every time they were handled in a squeeze chute and others were always calm (Grandin, 1992). The agitated animals failed to adapt to being held in the squeeze chute during four handling sessions spaced 30 d apart. Cattle with a very excitable temperament may have greater difficulty adapting to repeated nonpainful handling procedures than cattle with a calmer temperament. The two types of animals may have differing physiological and behavioral reactions to the same procedure. Animals with a calm temperament may adapt more easily and become less stressed with repeated handling treatments and animals with a very excitable temperament may become increasingly stressed with each repeated handling treatment. Lamier et al. (1995) found that some pigs habituated to a swimming task and maintained near baseline levels of epinephrine and norepinephrine and other animals failed to habituate and never adapted.

At five slaughter plants in the United States, Holland, and Ireland, the author has observed increasing problems with very excitable pigs and cattle from certain genetic lines that become highly agitated. It is almost impossible to drive them quietly through a high-speed slaughter line. These animals seem to have a much stronger startle reaction to novelty, are more likely to balk at small distractions such as shadows or reflections in the race, and are more likely to bunch together. Observations at slaughter plants and reports from ranchers also indicate that excitable cattle are more likely to injure themselves when they are confronted with the novel, unfamiliar surroundings of an auction market or slaughter plant. The appearance of greater numbers of more excitable pigs and cattle may possibly be related to the increasing emphasis of the livestock industry on lean beef and pork. In both cattle and pigs, the author has observed that excessive excitability occurs most often in animals bred for leanness that have a slender body shape and fine bones. Cattle and pigs bred for large. bulging lean muscles usually have a calmer temperament. This is an area that needs to be researched. Practical experience indicates that the excitable animal problem needs to be corrected because excessive excitability creates serious animal welfare problems during handling at auction markets and slaughter plants.

Cattle and pig producers need to select animals with a calm temperament. But care must be taken not to over-select for any one particular trait. A good example of overselection for a single trait is the halothane gene in pigs. Pigs with this gene have increased meat production, but the price for this increased production is poor meat quality (Pommier and Houde, 1993). Over-selection for calm temperament may possibly have detrimental effects on economically important traits, such as maternal ability. Researchers in Russia found that selecting foxes for calmness over 80 yr produced animals that lost their seasonal breeding pattern and had strange piebald black and white colored coats (Belyaev, 1979; Belyaev and Borodin, 1982). The foxes turned into animals that acted and looked like Border collies.

Fear Pheromones

Another factor that could confound handling stress studies is fear pheromones. Vieville-Thomas and Signoret (1992) found that urine from a stressed gilt caused other gilts to avoid a feed dispenser and urine from an unstressed animal had no effect. Both the results of this experiment and observations by the author indicate that it takes 10 to 15 min for the fear pheromone to be secreted. Observations by the author indicate that cattle will voluntarily walk into a restraining chute that is covered with blood, but if an animal becomes extremely agitated for several minutes, the other animals refused to enter (Grandin, 1993b). In a laboratory setting pigs witnessing slaughter had no increases in either beta endorphins or cortisol. These were calm animals fitted with jugular catheters (Anil et al., 1995). Eibl-Eibesfeldt
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(1970) observed that if a rat is instantly killed by a trap, the trap will remain effective and can be used again. Rats will avoid a trap that failed to instantly kill. Research with rats indicates that blood may contain a fear pheromone (Stevens and Gerzog-Thomas, 1977). Stevens and Saplikoski (1973) found that blood and muscle tissue from stressed rats was avoided in a choice test, whereas brain tissue and water had no effect. Blood from guinea pigs and people also had little effect (Hornbuckle and Beall, 1974).

**Short-Term Stress Measurements**

This discussion will be limited to measuring short-term stress induced by handling procedures such as being held in a squeeze chute. Assessment of stress and discomfort should contain both behavioral and physiological measures. Behavioral indicators of discomfort are attempting to escape, vocalization, kicking, or struggling. Other behavioral measures of how an animal perceives a handling procedure are choice tests and aversion tests. Common physiological measures of stress are cortisol, beta endorphin, and heart rate. Cortisol is a useful indicator of short-term stresses from handling or husbandry procedures such as castration. Researchers must remember that cortisol is a time-dependent measure that takes 10 to 20 min to reach peak values (Lay et al., 1992a).

A review of many studies indicates that cortisol levels in cattle fall into three categories: 1) baseline, 2) levels that occur during restraint in a headgate, and 3) extreme stress (Table 1). Cortisol levels are highly variable and absolute comparisons should not be made between studies, but the figures on Tables 1 and 2 would make it possible to determine whether a handling or slaughter procedure was either very low stress or very high stress. One could tentatively conclude that a mean value of >70 ng/mL in either steers or cows would possibly be an indicator of either rough handling or poor equipment, and low values close to the baseline values would indicate that a procedure was either low stress or was very quick. Quick procedures would be completed before cortisol levels could rise. Restraint in a headgate for blood sampling and slaughter produced similar values (Tables 1 and 2). Sexually mature bulls have much lower cortisol levels than steers, cows, or heifers (Tennesen et al., 1984). In one study, there was an extreme mean of 93 ng/mL for inverting cattle on their backs for 103 s (Dunn, 1990). This very high figure is not due to differences in assay methods because this same researcher obtained more reasonable values of 45 ng/mL for upright restraint. Properly performed cattle slaughter seems to be no more stressful than farm restraint (Tables 1 and 2).

Less clear cut ranges have been obtained in sheep. Pearson et al. (1977) found that slaughter in a quiet research abattoir produced lower cortisol levels than slaughter in a noisy commercial plant. The values were 40 vs 61 ng/mL. Values for shearing and other on-farm handling procedures were 73 ng/mL (Hargreaves and Hutson, 1990c,d) and 72 ng/mL (Kilgour and De Langen, 1970). Prolonged restraint and isolation for 2 h increased cortisol levels up to 100 ng/mL (Apple et al., 1993).

Creatine phosphokinase (CPK) and lactate seem to be useful measures for assessing handling stresses in pigs (Warris et al., 1994). Warris et al. (1994) found that the sound level of squealing pigs in a

<table>
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<th>Cortisol level, ng/mL</th>
<th>Breed or Species</th>
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<td>Baseline</td>
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<td>Hull-calves</td>
<td>Tennesen et al., 1984</td>
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<td>Restraint in headgate</td>
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<td>Brahman - Herford - Afrikander</td>
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Table 1. Mean cortisol values in cattle during handling
commercial abattoir was highly correlated with CPK measurements. White et al. (1995) also reported that vocalizations in pigs were indicative of stress and were correlated with other measures of acute stress, such as heart rate. Cattle that become behaviorally agitated have higher cortisol levels (Stahringer et al., 1989). Heart rate in cattle during restraint in a squeeze chute was highly correlated with cortisol levels (Lay et al., 1992a,b). Stermer et al. (1981) found that rough handling in poorly designed facilities resulted in greater heart rates than quiet handling in well-designed facilities.

Isolation is also a factor in handling stress. During restraint for routine husbandry procedures, animals are often separated from their conspecifics. Stookey et al. (1994) found that cattle became less behaviorally agitated during weighing on a single animal scale if they could see another animal in the chute less than 1 m away in front of the scale. Agitation was measured electronically by measuring movement and jiggling via the scale load cell system. Numerous studies have shown that isolation from conspecifics will raise cortisol and other physiological measures (Kilgour and deLangen, 1970; Whittlestone et al., 1970; Arave et al., 1974).

**Aversion Tests**

Aversion to a handling procedure can be measured by either choice testing or measuring aversion. One measure of aversion is the time required to induce an animal to re-enter a chute where it was previously handled (Rushen, 1986a,b 1995). In a choice test, the animals are allowed to choose between two different chutes that lead to different procedures (Grandin et al., 1986; Rushen and Congdon, 1986a,b). Another useful measure is the degree of force required to induce an animal to move through a race. In some cases, measuring the degree of force provides a more accurate assessment of aversion than time. Examples of force are the number of pats on the rump or number of electrical prods. Experience and genetic factors can confound aversion tests. Rushen (1996) warns that to accurately measure aversion in a race, the animal must experience the aversive procedure more than once. Observations by the author indicate that excitable cattle sometimes run through a single file chute quickly in an attempt to escape. Research (in progress by Bridgette Voisinet and the author) reveals that bulls trained to move through a race to a squeeze chute exhibit no aversion in the race after a single noxious treatment. After one aversive treatment, they continued to voluntarily walk through the race into the squeeze chute, but balking and turning back in the crowd pen at the entrance to the race greatly increased. At this point, the animals may perceive that they may be able to avoid re-entering the race. In aversion studies, balking and other behaviors indicative of aversion must be measured in both the single file race and in the pens and alleys that lead up to the entrance of the single file race. This is especially important if the aversive procedure is performed only once. After the animal is forced to enter the chute that leads to the squeeze, it may perceive that it may be able to escape by running quickly through it toward the squeeze chute. Under certain conditions, choice tests may be unreliable for measuring choices between mildly aversive procedures. Research conducted by Grandin et al. (1994) showed that cattle are reluctant to change a previously learned choice if the two choices in a choice test are only mildly aversive. Other research showed that sheep immediately switched sides to avoid highly aversive electroimmobilization (Grandin et al., 1986).

**Implications**

Both researchers and people making decisions about animal welfare must understand that fear during non-painful routine handling and transport can
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vary greatly. Fear is a very strong stressor. Cattle that have been trained and habituated to a handling procedure may be completely calm and have baseline cortisol and heart rate measurements during handling and restraint. Extensively reared cattle with an excitable disposition may have very high cortisol levels and show extreme behavioral agitation during the same procedure. For one animal, a squeeze chute may be perceived as neutral and non-threatening, but to another it may trigger an extreme fear response. The animal’s response will be determined by a complex interaction of genetics and previous experience. Studies to assess animal welfare during handling and transport should contain both behavioral and physiological measurements.

Literature Cited


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Practical tips on why some handling systems work better than others.

Good Design Principles
1. Cattle in crowd pen can see a minimum of 2 body lengths up the chute.
2. Cattle make a 180° turn through the crowd pen and think they are going back to where they came from.

Figure 1. A well-designed round crowd pen takes advantage of the tendency of cattle to go back in the direction they came from.

By Temple Grandin

Some cattle handling systems work like well-oiled machines, while others bog down with cattle that constantly balk and turn around.

Fixing crowded, poorly designed systems isn't impossible. In fact, there are usually three basic causes of problems in crowd pens and chutes:

• Distractions, such as a chain hanging down in the chute entrance, that cause balking,
• Poor handling methods, like over-loading the crowd pen with too many cattle, and
• Layout mistakes in the crowd pen and chute.

Curved vs. Straight

Round crowd pens and curved single file chutes work better than straight ones, but they must be laid out correctly.

A curved chute works more efficiently than a straight one because it prevents cattle from seeing people and other activities at the end of the chute.

A round crowd pen will work better than a straight crowd pen because, as cattle go around a 180° turn, they think they're going back to where they came from (see Figures 1 and 2). Round crowd pens should be laid out so cattle make a 180° turn as they move through the crowd pen.

The most common mistake is the straight-through layout shown in Figure 3. The advantage of a round crowd pen is lost when cattle move straight through it. When cattle go around the bend as shown in Figures 1 and 2, it takes advantage of their natural behavior. Cattle want to go back to where they came from.

The design in Figure 3 can be improved by changing the angle of the entrance. The dotted line shows how
Figure 3. The straight-through round crowd pen and dead-end chute is poorly designed.

A system that is designed perfectly to improve the layout. In places where a 180° turn is not possible, use a 90° or greater turn. Crowd pens where cattle make a 90° turn work better than a straight-through design.

The most common design mistake is dead-ending the curved single file chute. This occurs when the chute is bent too sharply where it joins the crowd pen. An animal standing in the crowd pen must be able to see a minimum of two body lengths up the chute before it turns.

Figures 1 and 2 show good layouts, and Figure 3 shows a dead-end layout. The dotted line on Figure 3 shows how to correct the problem. Cattle movement in Figure 3 can be greatly improved by adding a 10-ft. straight section of single file chute. This will enable cattle standing in the crowd pen to see two to three body lengths up the chute before it turns.

Why is it so important for an animal to be able to see up the chute? Cattle will refuse to go somewhere unless they can see a place to go. The principle of a well-designed, curved single file chute is to show the animal there is a place to go and then take him around the curve.

Another common mistake is making a crowd pen either too big or too small. The ideal radius for a round crowd pen is 12 ft. If a crowd gate longer than 12 ft. is used, the pen will be too big. An 8-ft. gate is too small. Cattle in a crowd pen need room to turn.

The crowd pen and curved chute systems shown in Figures 1 and 2 should be built as shown. Many producers think that efficiency will be improved if the crowd pen is designed so the crowd gate can squeeze the cattle all the way into the chute.

If an animal is turned around, handling will become more difficult if you attempt to squeeze the crowd pen space down to nothing.

A system that is designed perfectly...
Photo 1. When the crowd pen shown in Figure 1. is operated correctly, the crowd gate is not pushed tightly against the cattle.

will not work if the chute entrance is too dark or the system contains distractions that cause balking. Recently, I visited many feedlots and worked with employees to improve handling. In half of the lots, cattle balked at dangling loose chain ends hanging down in the entrance of the single file chute.

In many feedlots, good cattle movement was impossible until I tied open the anti-backup gate at the entrance of the chute. Anti-backup gates can also be equipped with a remote control rope. Cattle entering the chute will enter more easily if the gate is held open. After they enter, the gate can be closed.

A handling facility in a dark building will also cause balking. Cattle often move more easily in buildings equipped with translucent skylights or translucent panels in the walls. The panels provide bright lighting that is free of shadows.

Cattle often move more easily if the crowd pen and most of the single file chute is located outside the building. Cattle will often balk if the wall of the building is placed at the junction between the crowd pen and the single file chute. A building either has to cover the entire crowd pen and single file chute, or you need a minimum of two body lengths of single file chute protruding outside the building.

It's important that a crowd pen have solid sides and a solid crowd gate. A solid crowd gate is important to prevent cattle from attempting to turn back to where they came from. Man gates must be installed to allow people to escape from charging cattle.

Improve Handling

When cattle enter the crowd pen, they should move easily into the single file chute. If the animals balk, either eliminate distractions (such as a closed one-way anti-backup gate) or change where people stand.

The No. 1 rule is never overload the crowd pen. Cattle need room to turn. Fill the crowd pen less than ¼ full.

Photo 1 shows a round crowd pen that is similar to Figure 1. In this photo, the pen is being used properly. Note that the crowd gate is not pushed up against the cattle. The crowd gate should be used the same way the emergency brake is used in the car: you should almost never have to use it.

The crowd gate in Photo 1 has been left on the first notch and it stays there. If cattle are walking into the chute, don't push them with the crowd gate. The crowd gate should only be used if there are one or two stubborn cattle. Pushing the crowd gate tightly against the cattle makes handling more difficult because animals cannot turn.

The handlers in Photo 1 are using sticks with plastic flags on them to move cattle. The man in the dark shirt has his flag on the ground so cattle don't see it. He's also standing back far enough so cattle move easily. Cattle sometimes move more easily into the single file chute if the handler works fairly close to the chute entrance.

Photo 2 shows a person moving cattle into the single file chute by moving on the catwalk. He walks forward to reduce jamming at the entrance and moves backwards, away from the entrance, to speed up the cattle. The handler should not move into this position until cattle have started to enter the single file chute. Cattle may refuse to approach the chute entrance if a person is standing near it.

Cattle movement into the single file chute will be more efficient if handlers wait until the chute is partially empty before attempting to fill it. This takes advantage of natural following behavior. If there is space, cattle can walk directly into the chute. Also, if the chute is full, cattle in the crowd pen are more likely to turn around. The crowd pen should be used as a pass-through pen to induce cattle to enter the chute.

Photo 2. Cattle entry from a crowd pen into the single file chute can be controlled by a person moving forward and backward along the catwalk.
DIAGRAMS/LAYOUTS
BASIC CATTLE LAYOUT

- Crush Squeeze
- Handler Walkway
- Round Forcing Pen
- Mangate
- Forcing Gate
- Curved Race Chute
- Loading Ramp
- Curved Lane
- Diagonal Pens
- (14 ft) 4.1
- (3 ft) 4.1
- (2 ft) 3.5
- (12 ft) 3.5
- (25 ft) to (35 ft) 9.6
WASHABLE WORK AREA FOR BEEF CATTLE

DITCH TO SUMP

DRAIN PIT UNDER SQUEEZE

OPEN SLOT

2FT. WIDE CURBED WASH GUTTER

TEMPLE GRANDIN 1988

ALTERNATE ENTRANCE
NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE AND SINGLE FILE CHUTES ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID

CURVED, SINGLE FILE CHUTE LAYOUTS (TYPICAL RADIUS)

UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES with [Millimeters] in brackets.
NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE, SINGLE FILE CHUTE AND LOADING RAMPS ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID.
FEEDLOT SHIPPING FACILITY

LEVEL DOCK

SELF ALIGNING BUMPER

WALKWAY

ROUND CROWD PEN

TRAILER GRANDIN 1979

HOLDING PEN

14 ft.

4.2

3.5 m 12 ft.

3.5 m 12 ft.

5 m 16 ft.

25 m

90°
This is a general purpose corral system for shipping, branding, sorting, and A.I. It can handle 300 cow-calf pairs or 400 mature cows. Its capacity can be increased to 1000 pairs by adding more diagonal pens and holding pen space.
USES PRE-FAB CROWD TUB

LAYOUT INSTRUCTIONS

1. Make layout line thru string.
2. Locate prefab crowd part 1/2 way
   of the layout line.
3. Lay out prefabricated frame,
   parallel to layout line.
4. Lay out wildlife sorting pens 1/4 A.
   Angle of facing.
5. Layout working facilities 11/2 to 2
   out last dimension.
7. Layout remaining pens and gates.

SUPPLIES: PERMANENT TYPE
- 60% HARDWOOD, REMAIN, WEB
- TREATED EUROPEAN HICKORY, OK
- FOR KERRY, KANSAS
- PORTABLE BATTLE CROWD
  PEN WITH 5' RADIUS W/L
- IN LAYOUT NEAR WORKING
  PENS SLIGHTLY.
DOUBLE CHUTE SYSTEM

FOR HIGH SPEED CATTLE HANDLING FEATURES A REMOVABLE SELECTOR GATE. WITH GATE REMOVED THE CATTLE CAN ENTER BOTH CHUTES SIMULTANEOUSLY TO PROMOTE FOLLOWING BEHAVIOR. THIS LAYOUT CAN BE USED WITH OTHER CORRAL DESIGNS.
DRAWING SCALE

RANCH SORTING PEN SYSTEM
- WITH SINGLE SQUEEZE CHUTE SYSTEM.
- NO ELECTRONIC SORTATION AREA.

UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES with [Millimeters] in brackets.

NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE & SINGLE FILE CHUTE ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID.

SEE SHEET DRAW-1 FOR DETAILS
Lay Out Line

Existing Corral will be used to hold cattle after they have been worked.

118' (36 m)

98' (29.9 m)

Gathering Pen
Capacity 300 pairs

Dirt Working
150 head capacity

Entrance gate

Rear work gate

Existing frame

Corral for Long Narrow Site
300 pair working e as corral

Additional access gates for pens & vehicles. They were left off the drawing in order to make the drawing less confusing.

You may wish to add some posts & center in pens & lanes

Posts 8' on center in pens & lanes

6' on center, round crowns & single file chutes

Corral layout for livestock systems.
3100 Silver Plume Dr. # C3
P. Collins, CO. 80526

Grandin livestock systems
Easy to build corral for 125-225 or less with lots of sorting capacity utilizes standard pre-fab tub and curved alley.

The wide curved lane also serves as a reservoir for cattle that are being sorted back into other pens.

Gathering pen may be omitted and existing pen can be attached to the pasture entrance.

Obtain varies at 2-3 depending on design of the pre-fab.
METRIC CONVERSIONS
3m = 10ft, 3.5m = 12ft
5m = 16 ft, 7.6 = 25ft,
4.2m = 14ft.

AUSTRALIAN STYLE
CATTLE CORRAL
CORRAL FOR 25 COWS
CONSTRUCTION RECOMMENDATIONS

1. Use 5' high fence for finish doors, 6' high for Barman Cross.
2. Use solid fencing in single file chute, loading chute, and crowding pen. Black gate and crowd gate should be solid.
3. All gate dimensions are actual length of gate. The width of the 12' lanes may be adjusted a few inches to fit gates.
5. Straight sides 24' inside for cows. 18' bottom will fit 18' inside measure.
6. Recommended to use a substantial fence such as planks.
7. All measurements for post location are center to center.
8. Tie bars are used adjustment must be made, no adjustment needed for steel posts.

LAYOUT DIRECTIONS

1. Locate point A first, and draw the two concentric circles which will form the sorting reservoir and chute.
2. Locate radius 1 and draw circle. Locate alley using radius 2 and placing the outer radius at 3' spacing.
3. Locate radius point B. The radius may be adjusted slightly to remove a small overlap of the inner circle.

Remember! Location circles around radius 1 first! After the circles around 1, 2, 3, and the alley are marked, line the gates and corners can be easily located.
CAPACITY 250 COWS  200 PAIRS
LAYOUT DIRECTIONS:

1. Lay out the Farmer and 110' side lines.
2. Lay out the centerline of the pasture.
3. Cut corners off the inner 110' side.
4. Cut corners off the outer 110' side.
5. Mark 5' side lane.
7. Lay out layout line for corners using a string.
8. Lay out curved lane, it is a 90° half circle.
9. Be sure to mark the layout line.
10. Lay out centerline, mark both lanes.
11. Lay out centerline.
12. Layout everything before building anything to avoid layout mistakes. Make sure both lanes so you can see the system design on the drawing.

UTILIZES PREFERENCES WORK AREA

BILL HUFFMAN MAJOR ROTATION LAYOUT
EASTLAND, TEXAS

GRANDIN LIVESTOCK HANDLING SYSTEMS INC.
SOUTH MAJOR CENTER, IDAHO FALLS, ID
877-JEFF-9778...
If a 17' (5.1m) wide alley is used, install 14' (4.1m) gates on the sorting pens & intersections.

FEEDLOT WORKING AREA
GRANDIN LIVESTOCK SYSTEMS
BASIC RANCH & FEEDLOT
SHIPPING & SORTING PENS LAYOUT

- FOR USE BY PEOPLE ON FOOT OR HORSEBACK
- 12'-0" [3657.61] wide, MAIN WIDE LANES with
  14'-0" [4267.21] PEN/DIVERT GATES.

NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE,
AND SINGLE FILE LOADING CHUTE ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID

UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES
with [Millimeters] in brackets.

DRAWING: PEN-02
DETAIL FOR WASHABLE CHUTE

OVERALL LAYOUT

AUX INTERSECTION, N. FEEDLOT
ACCORDING TO C, GO IN
DIFFERENT DIRECTIONS
WORKS FOR BOTH, 3 WAY AND 4 WAY

ALLEY CAN BE LENGTIENED TO ADD SCALE

WASHING FACILITIES

ST. SHE LLC SHIIPING AREA HAS TO BE MODIFIED TO FIT SITE, MOVE THIS 14' SECTION AS A UNIT. DO NOT ABLE OF BASIC LAYOUT TO THE CURVED WASHING FACILITIES
NOTE:
ALL FENCING ON FORCING PEN, CURVED WIDE LANE & SINGLE FILE CHUTE ARE SOLID.
ALL GATES IN FORCING PEN ARE SOLID

CURVED, DUAL SINGLE FILE CHUTES (TYPICAL RADIUS)

SEE SHEET DBLSQ-1 FOR DETAILS

SEE SHEET 3-14-15 FOR DETAILS

FEEDLOT PROCESSING, and SORTING PEN SYSTEM for CATTLE
- WITH DUAL SINGLE FILE & DUAL SQUEEZE CHUTE SYSTEM.
- WITHOUT ELECTRONIC SORTATION AREA.

UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES with [Millimeters] in brackets.

DRAWING: PEN-04
Feedlot Sorting Layout

Space is provided for electronic sorting, ultra-sound, grubacide dispenser, and other equipment.
Layout that provides space for electronic sorting and individual animal evaluation.
COMPACT FEEDLOT
SHIPPING, LOADING, AND
PROCESSING FACILITY
Diagram 7.
Diagonal Auction Yard Layout
CONTINUOUSLY REVOLVING CROWD GATES

HOLDING LANE CAPACITY 300 SHEEP

LOADING RAMP

DRENCHING RACE

SORT 1

SORT 2

SORT 3

FOOT BATH OR OTHER EQUIPMENT

GATE INTERSECTION

ENTRANCE FROM GATHERING PEN

SHEEP CORRAL

TEMPLE GRANDIN 1988
HOG LOADING RAMP

- LEVEL DOCK
- TEMPLE GRANDIN
- SOLID FENCE
- SEE THROUGH FENCE
- LEVEL 3 ft. 1 m
- 5' 1.5 m
- ENTRANCE RESTRICTOR
- OFFSET STEP PREVENTS JAMMING
- MANGATE
- ROUND CROWD PEN

ROUND CROWD PEN
METRIC CONVERSIONS

3m = 10ft, 3.5m = 12ft, 4.2m = 14ft
9m = 30ft, 13m = 75ft.

BEEF STOCKYARD FOR PACKING PLANT
Serpentine layout for a beef packing plant with restricted space.

Metric conversions:
- 3m = 10ft.
- 3.5m = 12ft.
- 15.24m = 50ft
- 30.50m = 100ft.
GATE SHOULD BE COUNTER BALANCED. IF THE GATE IS HARD TO PUSH OPEN, FILL COUNTER WEIGHT WITH CONCRETE.

USE 2 CHAINS, ONE ATTACHED TO EACH SIDE OF THE GATE

GATE ADJUSTED FOR CALVES

CHAIN HOOKED IN SLOT OF 1/4" (7mm) PLATE

60" (152cm)

GATE ADJUSTED FOR COWS

62" (157cm) WIDTH OF 10 GA PLUS 2" (5cm) GAP

42" (107cm) CATWALK HEIGHT

60" (152cm) 10 GA WIDTH

86" (218cm) POST LENGTH

2 3/8" OR 2" (5cm) OD TOP RAIL

2" (5cm) CLEAN OUT GAP

SIDE VIEW OF CHUTE WITH ONEWAY GATE

2000 PSI DEEPLY SCORED 2" (5cm) DEEP REINFORCE FLOOR WITH EITHER WIRE MESH OR REBAR. ADVISABLE TO PUT IN 3" (7cm) OF ABC BEFORE POURING FLOOR.
THE LARGEST ANIMAL TO BE HANDLED SHOULD RUB THE CHUTE SIDES

COY-CALF
BRAHMAN CROSS:
16' [4.88 m] BOTTOM
32' [9.14 m] TOP

ENGLISH BREEDS:
16' [4.88 m] BOTTOM
36' [10.97 m] TOP

BULLS
18' [5.49 m] TO 20' [6.09 m] BOTTOM
32' [9.14 m] TOP

FROM FLOOR TO TOP OF 5' [1.52 m] PIECE OF 10 GA STEEL LEAVE A 2' [0.61 m] GAP FOR CLEAN OUT

NOTE:

BASIC SPECIFICATIONS
FENCE POST 2 7/8" OD 4' [1.22 m] OC IN SOLID FENCE AREAS. GATE POSTS AND GATE STRIKE POSTS 4 1/2" OD 36' [9.14 m] IN GROUND. SOLID FENCES 10 GA STEEL.
CONCRETE 2000 PSI POST HOLES. 2500 PSI FLATWORK.
PIPE DIMENSIONS ARE FOR OIL FIELD SURPLUS PIPE SCHEDULE 80.
**CRITICAL DIMENSIONS:**

The largest animal to be handled should rub sides of chute.

- **V-Chute must be 32" [812.80] wide, inside, at the 5'-0" [1524.00] mark.** Height is 16" [406.40] at the concrete floor level. At bottom of chute. These measurements are very critical. For over 1000 lb. cows, widen bottom of chute to 18" [457.20] at floor level. If a 6'-0" [1828.80] V-Chute fence is needed for wild cattle, maintain 32" [812.80] wide at the 5'-0" [1524.00] high mark. If cattle are over 1500 lbs., widen V-Chute to 36" [914.40] at 5'-0" [1524.00] height.

- **V-Chute "inside" dimensions:**
  - (calves) 32" top, 5'-0" above ground [812.80] [1524.00]
  - 16" bottom, at concrete level [457.20]
  - (large cattle) 36" top, 5'-0" above ground [914.40] [1524.00]
  - 18" bottom, at concrete level [457.20]

**BASIC SPECIFICATIONS:**

- **Fence Posts 2 3/8" [60.33] O.D., 4'-0" [1219.20] O.C., in solid fence areas.**
- **Gate Posts and Gage Strike Posts: 4 1/2" [114.30] O.D., 36" [914.40] in ground.**
- Solid fences 10 gauge steel.

**Pipe Dimensions:**

- For oil field surplus pipe, schedule 80.

**NOTE:**

- For details of one-way backup gate, see drawing number VCHT-05A.

**HANDRAIL WARNING:**

- Any walkways mounted 36" [914.40] or higher, must have 42" [1066.80] high handrail.

**POST LAYOUT PLAN**

**END VIEW**

- **V-Chute and One-Way Gate - Cross Section**

**DO NOT USE THIS DRAWING DESIGN FOR:**

- Mature dairy cows or slaughter plants.

**UNLESS OTHERWISE SPECIFIED:**

- All dimensions are in feet & inches with [Millimeters] in brackets.

**DRAWING:** VCHT-05A
Cross Section Truck Loading Ramp
BASIC 3-WAY GATE SYSTEM
- FOR USE BY PEOPLE ON FOOT OR HORSEBACK
- 10'-0" [3048.00] MAIN WIDE LANE WITH 12'-0" [3657.61] BLOCK GATE
- 12'-0" [3657.61] MAIN WIDE LANE WITH 14'-0" [4267.21] BLOCK GATE

UNLESS OTHERWISE SPECIFIED:
ALL Dimensions are in FEET & INCHES
with [Millimeters] in brackets.

DRAWING: 3_12_14
STANDARD FENCE TYPICAL
WITH BELLY RAIL
24" WIDE
USE IN HIGH USE SORTING
ALLEYS AND WORKING PENS

SIDE VIEW ROD ATTACHMENT
3/4" ROD
3/8" HOT ROLL ROD
2 7/8" POST

CAP
3/8" HOT ROLL ROD
WELD 3/4" ROD STAY TO ROD RAILS
2 7/8"
3/4" RODS

18 GA
12 GA
12 GA
12 GA
12 GA

30"
30"

CONCRETE

TRIM STAY
SO FLUSH
WITH TOP & BOTTOM ROD

8'
ON CENTER
OR LESS

FIBERGLASS WRAP PER WRITTEN SPECS

GRANDIN LIVESTOCK HANDLING SYSTEMS INC
GATE WITH BELLY RAIL FOR HIGH USE AREAS

CHANNEL IRON
HORSE FENCE
SEE LARGE DETAIL SHEET

RAILS 2" X 2" OD
ROUND OR SQUARE

FRAME 2 1/4" X 2 1/4"
SQUARE TUBE
OR ROUND

6 1/2" OD
HEAVY WALL ROUND

PIPE NIPPLE
WELDED TO CHANNEL IRON INSERTED IN BACK OF GATE

GATE MAY BE WIDENED TO 60" FOR A 6' HIGH FENCE... DO NOT RAISE THE HEIGHT OF THE BELLY RAIL... IT MUST BE AT A LOW EYE LEVEL
HORSEBACK LATCH

GATE LATCH FOR USE ON ALL GATE EXCEPT MANGATE AND DOUBLE OVERLAPPING GATES

METAL TAB 2.50 cm x 3.14 x 0.49 cm
WELDED TO PLUNGER

PLUNGER 2.50 cm (1"

ROD 8.50 cm (1"

TAB MUST BE ATTACHED TO THE ROD SO THAT THE PLUNGER WILL REMAIN COMPLETELY RETRACTED WHEN THE PLUNGER IS TWISTED. PLUNGER EXTENDS 11.50 cm PAST THE END OF THE GATE WHEN IT IS EXTENDED

LENGTH STRAIGHT PORTION OF PLUNGER (30") 0.91 m
BARREL 2.50 cm OD (2") 15 cm TILT 15 cm
15 cm

2.50 cm BENT ROD
LATCH KEEPER

WELD LATCH KEEPER TO POST SQ PLUNGER IS AT TOP TO ALLOW FOR SAGGING

8.50 cm ROD (1"

(1"
(1 1/2") (3/16")
Layout that provides space for electronic sorting and individual animal evaluation