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Domestogenic Diseases

Michael W. Fox, Editor-in-Chief

The term 'iatrogenic disease' refers to a variety of disease states which may result from a certain course of treatment. Iatrogenic diseases have important legal and ethical implications. Their identification has done much to further the recognition by the medical profession of the patient's right to informed consent. For example, the iatrogenic effects of cancer chemotherapy or of some new surgical or medical procedure may cause considerable physical and psychological suffering. Certain drug combinations or idiosyncratic patient reactions may have serious iatrogenic consequences, and under most circumstances, the patient should be warned if such sequelae might occur.

The concept of iatrogenic disease needs further expansion and refinement in relation to animals and their welfare. Steen Bech-Nielson (JAVMA 175:1304-1307, 1979) has discussed the significance of nosocomial disease, those hospital-acquired ailments associated with veterinary care. Another category, which might be termed 'domestogenic animal diseases' exists, and their recognition has considerable relevance to animal welfare. As the term 'iatrogenic' conveys the clinical treatment-induced nature of the problem, the term 'domestogenic' similarly implies that there are variables in animal husbandry which act as agents in the etiology of disease states or disease susceptibility, and that animal care technologies may exacerbate certain of these disorders.

A great range of inherited anomalies such as hip dysplasia in German shepherds, achondroplasia in Bassett hounds, strabismus in Siamese cats, unstable temperament in purebred dogs, flightiness in poultry and the porcine stress syndrome are essentially breeder-created or environmentally influenced.

Such anomalies are either absent or occur at an extremely low frequency in wild species, most probably due to a combination of factors such as hybrid vigor and rigorous natural selection. When these factors are attenuated or eliminated through selective breeding, genetically anomalous and phenodeviant forms appear with increasing frequency, either inadvertently or through deliberate selection for reasons of taste or utility. Hip dysplasia is an inadvertent consequence of selecting for sloping hindquarters in German shepherds. The metabolic and neuro-endocrine disorders of certain lines of dairy cattle (termed 'production diseases' by Professor David Sainsbury) are associated with exceptionally high milk yield.

Some of these genetically based anomalies may be either buffered or aggravated by the way the animal is raised, handled, housed and fed. For example, while the porcine stress syndrome is absent in some breeds of pig, it is present in others such as the Pietrain and may be intensified by infrequent handling and total confinement housing. As Sir Kenneth Blaxter has shown (Vet Rec 103:323-324, 1978), extremely complex disease states can be created by a combination of factors in the technology of animal care and production such as genetic lineage, the presence or absence of antibiotics or essential nutrients in the feed, feed contaminants such as aflatoxins and enterobactins, and the husbandry system under which the animals are kept (e.g., stocking density, humidity and ventilation).
Recognition of domestogenic diseases could do much to improve the welfare of farm and companion animals. The concept not only provides a holistic view of many animal diseases and structural/functional disorders, it also focuses greater responsibility for care on the pet owner, breeder and livestock manager by emphasizing that few diseases have a simple, specific cause which can be corrected either with surgery or with drugs, both of which can have additional untoward iatrogenic consequences.

The Benefits of Tender Loving Care

Walter B. Gross, Editorial Advisory Board

Tender loving care (TLC) as a disease control measure is sometimes considered a relic of the days before the advent of wonder drugs. In fact, TLC is still a very important feature in disease control and treatment. As applied to animals, TLC infers gentle, compassionate care. Not only is the animal unafraid of the handler, it also welcomes the handler’s presence.

The majority of people oppose inconsiderate handling of animals on moral and ethical grounds. This opposition is easier to maintain when one is well-fed and remote from animals or interacts with only a few animals. On the other hand, it becomes more difficult when one works with large numbers of animals and is under increased pressure to get the work done. When an animal does something which irritates the handler, such as moving at a critical moment, it is easy to react violently toward the animal as a means of discouraging such actions, or relieving frustrations. Following such treatment, the animal becomes fearful of the handler and thus even more difficult to handle. If one does not understand their behavior and appreciate their social needs, one can easily adopt the view that animals are unfeeling creatures.

Millions of animals are employed annually in research projects and testing programs. Often, their caretakers have little real interest in the results. To them, it is a job to be done as quickly and as easily as possible. Furthermore, researchers and directors of testing programs gain little or no prestige from the time spent working directly with animals. Their administrative requirements and laboratory duties may leave little time for developing a relationship with the animals. It is thus understandable how laboratory animals can be reduced to things to be utilized as required. Humane societies have helped the welfare of animals by promoting standards for space, ventilation, sanitation and nutrition. However, they have also encouraged the “thing” attitude by focusing attention on physical requirements.

Recently, Drs. Cornhill, Nerem and Levesque (Ohio State University) reported that rabbits which were given TLC had from 1/3 to 1/2 the amount of atherosclerosis while being fed a high level of cholesterol than unhandled rabbits on the same regimen. They suggested that TLC, or the lack of it, could alter the results of other experiments.

Our research has shown that chickens which are frequently gently handled before and during experiments are superior experimental animals. Their
responses are more consistent, and they are easier to handle. Their immunological response to antigens (vaccines), blood protein levels, and abilities to convert feed into growth and to resist stresses are all increased. Some differences between experimental groups can only be demonstrated with birds which have been handled with TLC. Genetic selection for many factors can only be done with chickens receiving TLC and ideal physical environments. When chickens are not well cared for, environmental effects tend to mask their genetic potential.

To summarize, experimental animals which are exposed to TLC under good environmental circumstances are truly superior. In addition, they experience less trauma, and fewer are needed to obtain better quality results.

Animals employed in agriculture have similar problems to those used in labs. Back in the days when poultry flocks were small, their environmental and disease stresses were high. However, many of the flock owners had a real feeling for the birds and understood their behavior. As flocks became larger, the environmental and disease stresses were reduced. Administrators became more and more remote from the birds and tended to think more about their physical needs than about their social ones. As the size of flocks increased, even those in direct contact with the birds had less time to be cognizant of their social needs, much less to satisfy them. Furthermore, the competitive process in the marketplace which resulted in increased quality of products at decreased cost to the consumer tended to relegate animals to the status of things. However, this feeling is far from universal. Many people who work with poultry today have developed an understanding of their behavioral and social needs and therefore treat them gently and with compassion. The birds perform better, and the caring people make more profits than the uncaring. Similarly, dairy cattle and other domestic animals which are exposed to TLC are easier to work with, more productive and of course more profitable. Again, as in the case of laboratory animals, TLC is indirectly beneficial to humans.

TLC is known to be an important aid in training animals. The most impressive trainers are those who are able to obtain superb cooperation and responses from animals without uttering harsh words or inflicting pain.

TLC is an attitude and as such cannot be put into force through legislation. What is needed to foster a caring attitude is more widespread knowledge about animal behavior and appreciation of the animals' needs by those who work with them. Toward this aim, humane societies should increase their educational efforts directed at those who use animals as pets, in research, in testing and in agriculture. Greater understanding of an animal's behavior results in respect for and compassion toward animals in general. With tender loving care, the animal's life is made more pleasant and the human's endeavors are more satisfactory.

Humane societies should also promote research on animal behavior, particularly of animals that are closely associated with man. Moreover, they should encourage colleges and universities to require courses in animal behavior for all students who might work with animals after graduation. Among these students are those studying biology, psychology, animal agriculture and veterinary and human medicine. These people are especially important because they are likely to have future decision-making power. Their actions and attitudes toward animals will influence those with whom they work. They should be strong advocates of TLC.
TLC is *not* a relic of the past. Those who are presently obtaining the best results from their work with animals are using it right now.

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**The “Reasonable Ground” as a Problem of the German Animal Protection Act**

Gotthard M. Teutsch, Editorial Advisory Board

The German Animal Protection Act has been widely praised for its high ethical aims. Indeed, the law’s intentions as well as its specific prohibitions should help to ensure a remarkably advanced stage of animal protection in the Federal Republic of Germany. However, laws can provide only a degree of deterrence. Humane conduct depends more on moral consciousness than on the fear of penalty.

**How Effective is the Law?**

One measure of the efficiency of a law is the associated number of sentenced violations. Other valid criteria for judgment exist, but it is difficult to ignore the fact that the number of sentences has been steadily decreasing since the animal protection law went into effect in 1972. According to an estimate by K.D. Wiegand (1979), only one out of every 5000 (unnotified as well as notified) offenses in the Federal Republic of Germany result in prosecution and sentencing.

The interpretive freedom allowed by the German Animal Protection Act is a major source of its ineffectiveness in that it leaves the judge with no objective criteria on which to base a decision. This uncertainty stems in part from the newly-introduced phrase, “reasonable ground,” a term assumed to be helpful in evaluating judicial arguments. In reading the term “reasonable ground,” the philosophical and ethical meaning of the word “reason” cannot be overlooked. Obviously, not every intellectually understandable cause can be accepted as a “reasonable ground” (von Loeper, 1979). Hence the uncertainty.

**Commentaries on the Meaning of “Reasonable Grounds”**

Paragraph 1 of the German Animal Protection Act states the law’s fundamental aim and gives the general directive under which exceptions can be made: “This act serves the protection and well-being of animals. No one may be permitted to inflict pain, suffering or damage upon an animal without reasonable grounds” (emphasis added). Although no formal explanation of the term “reasonable ground” is offered, one can assume that a) all actions explicitly permitted by the Act are justified as being based on “reasonable grounds,” and that b) all actions explicitly prohibited by the Act are unjustifiable because they evidently lack “reasonable grounds.”

When situations arise which are not expressly discussed in the Act, the judge must make his or her own decision as to what constitutes “reasonable grounds” for exempting a particular action from the proscriptions of the law. The latitude
involved in making a judgement is a general problem of jurisdiction and can be found in connection with animal welfare legislation of other countries. Various commentators on the German Animal Protection Act have explored this problem and attempted to delineate categories of justifiable versus unjustifiable actions.

According to A. Lorz (1979), “reasonable grounds” for the killing or ill-treatment of animals do not include: annoyance, antipathy, disgust, aversion, boredom, ‘devilry’, whim, indolence, lust for hunting, planning or veiling a criminal offense, rage, vengeance, firearm training, sensationalism, vandalism, wantonness, weariness or working off emotional excitement.

Professor H. Kraft (1972), one of the experts who participated in the deliberations which preceded the final drafting of the German Animal Protection Act, tried to develop a system superior, or equivalent to animal uses. Among those uses considered inferior are any of those connected with the fashion world, personal hobbies, sports or the arts if these uses inflict animal pain, suffering, damage or death.

Another attempt to define the difference between “reasonable” and “unreasonable” grounds has been undertaken by E. Kadlec (1976). He concedes that man is entitled to make use of animals or plants in order to satisfy his vital needs. On the other hand, he rejects any misuse of animals or plants for the fulfillment of unrestrained wants. In distinguishing between needs and wants, Paragraph 9/1 of the Act acquires great importance. According to the regulation in this part of the Act, experimentation on living animals is not allowed if there is any possibility of attaining the desired result by a sound alternative method. The underlying principle of this regulation is that a “reasonable ground” exists only as long as the intended purpose cannot be achieved except through the use of animals. This principle can be generalized to other areas of animal exploitation. For example, the manufacture of fur coats may have been tolerable in former times, but it can no longer be justified in an age of mass production of textiles and fur substitutes which serve the same intended purposes.

**A New Definition**

I would like to present my own scheme for what constitutes “reasonable grounds,” based on a combination of the attempts outlined above and proceeding from the assumption that purposes which are deemed justifiable entail the minimal necessary degree of pain, suffering or damage to the animal.

Reasonable grounds for inflicting pain, suffering or damage upon an animal exist if:

1. A person’s life is being threatened by an attacking animal. (This does not include bullfighting or any other situation in which humans intentionally endanger themselves by inciting animals to attack.)
2. Animal products are to be used for food.
3. Animal products, special organs or substances (e.g., sera) are to be used to preserve human life and health.
4. Animals are to be used in experiments necessary to the preservation of human life and health, provided that there is no alternative method of experimentation.
5. Goods necessary to human life are being imperiled by animals.

Obviously, adherence to this code means that some of our traditional customs and patterns of behavior must be changed. In particular, the following practices would have to be discontinued:

1. Any killing of animals which does not fulfill vital human needs or which is carried out under painful conditions. (This includes the renunciation of any killing in order to obtain inessential products such as fur, etc.)
2. Painful experiments on and with living animals for nonvital purposes as well as any experimental procedure which could be replaced by another method.
3. The keeping of animals of whatever kind for whatever purpose under conditions which disregard their well-being and natural behavior.
4. Sport hunting. (Hunting is tolerated only as an aid to wildlife management or as a means of human survival.)
5. Fishing and harpooning as a sport or hobby.
6. Animal fighting or human-animal fighting which has been arranged for human entertainment and/or profit.
7. Exhibition of animals under conditions which disregard their well-being and natural behavior. This particularly concerns any form of inadequate living conditions in zoos as well as inhumane treatment in circuses and rodeos.

I realize that any attempt to define a legal term which possesses strong moral and philosophical overtones is bound to meet with some dissatisfaction. I myself cannot concede that the above formulations, though legally sound, are all totally justifiable from an ethical point of view. Some may find these definitions too radical, others may find them not radical enough. However, more radical definitions, which are not possible under the present law, would require a respective change in the ethical convictions of our society.

References

COMPANION ANIMALS

Trap Injuries to Pets

A questionnaire circulated by the Tompkins County (NY) Society for the Prevention of Cruelty to Animals to a total of ten veterinarians and veterinary clinics revealed that 66 dogs and 93 cats received examination and treatment for trap injuries between July 1, 1979 and January 1, 1980. Thirty-two animals required lifesaving limb amputation, while another eight had to be euthanized due to the severity of the injury.

The SPCA of Tompkins County, concerned by the high number of companion animal trap injuries yielded by the short-term survey, urged pet owners and trappers to find a cooperative solution to the problem by observing local leash and trapping laws. (Tompkins County SPCA Tailbearer, March, 1980, p. 3). Leash laws and the prohibition of trapping on private lands without the permission of the owner are in part designed to prevent these occurrences. However, rising fur prices have attracted more trappers and thus increased the possibility of careless placement of traps and failure to check the traps every 24 hours as required by law. On the other hand, pet owners who allow their dogs and cats (the latter are not covered by leash laws) to roam freely, often believing that such 'freedom' is vital to the animals' health and well-being, may in fact be creating the chance for a pet to wander into a trap and incur a serious injury.

U.S. Dog and Cat Ownership Estimates

An updated estimate of dog and cat ownership in the United States has been published by National Family Opinion (NFO), a consumer panel research service headquartered in Toledo, Ohio. In September, 1979, National Family Opinion published a booklet, NFO Consumer Family Sample 1979-1980, based on demographic profiles made in 1978 of 100,000 families which are represented in a controlled survey panel balanced in accordance with household characteristics reported by the U.S. Bureau of the Census.

The report indicates that 51% of U.S. families owned a dog during 1978, while 30.6% of all families owned a cat. These statistics reflect a 1.5% average annual increase in dog ownership since a 1976 NFO survey was conducted for the Upjohn Company. Data on cats was not included in that survey; however, a 1975 study conducted by National Analysts for the Pet Food Institute can be used as a basis for comparison. The two surveys indicate an average annual increase of 2.86% in the number of families owning cats.

Guy R. Hodge
HSUS Director of Research and Data

LABORATORY ANIMALS

Effects of Caging in Animal Studies

A review article by L.L. Lewis in Lab Animal (9:53-58, 1980) provides a useful update of literature citations concerning the microenvironment (as opposed to the more often explored
room-level macroenvironment) of laboratory animals. Factors such as cage dimensions, air exchange and humidity, and related secondary diseases, notably mycoplasma, can be significant experimental variables if not controlled, and also jeopardize the animal's welfare. The review cites many references on the design of rodent cages and the build-up of potentially harmful metabolites, particularly ammonia. The point is also made that heat dissipation rates in dogs are greater in animals kept in isolation in an environmentally-controlled chamber, which may be a stress-response to social isolation.

As the reviewer states, there is an "...infinite number of environmental factors which can alter the homeostatic state of the animal. Such variables compound and confuse experimental results." The review contains only a few references on the influence of noise, lighting and social structure, indicating that more research is needed in these areas, especially in the realm of laboratory animal ethology.

Export Embargo

According to an Indonesian newspaper, the Indonesian government has temporarily suspended all trade in primates beginning 3 February 1980. Certain species were already protected, but this suspension includes the crab-eating macaque (Macaca fascicularis) which has taken the place of the rhesus macaque as the leading exported monkey for laboratory research. Other species involved in the suspension include the pigtail macaque and the silver-leaf monkey.

This embargo reduces still further the number of habitat countries which export large numbers of primates mainly for biomedical research. India and Bangladesh introduced embargoes in the last few years, followed by Malaysia. After the Indian ban, the number of monkeys exported from Malaysia increased rapidly, and concern over this increased demand was partly responsible for the Malaysian action. After Malaysia introduced its embargo, dealers turned to Indonesia.

FARM ANIMALS

Farm Animal Welfare Concerns Recognized

The major national U.S. agricultural weekly, Feedstuffs (P.O. Box 67, Minneapolis, MN 55440), published several articles on farm animal welfare in the March 24, 1980 edition.

The articles emphasized that producers must begin to take the concept of farm animal welfare seriously and examine current practices in relation to welfare questions. The recommendations of the Brambell Committee in the U.K. and the subsequent welfare codes that have been established under the British Ministry of Agriculture, Fisheries and Food are noted, and the European Convention on the Protection of Animals Kept for Farming Purposes duly recognized.

These articles represent the first major effort in the United States by an official agricultural-industrial publication to bring matters of farm animal welfare to the attention of livestock and poultry producers.

Malignant Hyperthermia and PSE Meat

A condition known as malignant hyperthermia may provide a key to understanding why certain breeds of pig are more apt to produce pale, soft, exudative meat (PSE meat) upon slaughter. Both malignant hyperthermia, which occurs in humans as well as in swine, and pre-slaughter stress, which seems to be the precipitating factor in the production of PSE meat, involve rapid manufacture of lactic acid caused by intense anaerobic muscle activity. In malignant hyperthermia, the stepped-up muscle me-
metabolism is coupled with large increases in body temperature. In pigs with a high susceptibility to stress, glycogen breakdown continues even after slaughter, and lactic acid, which in the living animal would be removed to the liver via the bloodstream, swiftly accumulates in the muscles. This combination of acidity and still warm tissue produces aesthetically displeasing and commercially unsuitable meat.

As selection for lean breeds of pigs has improved, the incidence of PSE meat and the concomitant economic losses to the pork industry have increased. Although the connection between stress and PSE meat is well-established, researchers have not completely understood why lean pigs succumb to stress more readily than other breeds. However, a recent report by Monica Winstanley of the Meat Research Institute in England (New Scientist 84:594-596, 1979) posits that pigs which are highly susceptible to stress (and subsequently produce PSE meat) are also prone to malignant hyperthermia, and that the two conditions share a common origin.

An environmental trigger such as stress or the anesthetic Halothane, plus a genetic predisposition are necessary to induce malignant hyperthermia. The condition is self-perpetuating; unlike the processes of normal anaerobic metabolism which cease when the muscle stimulus is removed, the deranged muscle metabolism associated with malignant hyperthermia cannot "switch off." Scientists at the Meat Research Institute suspect that the abnormality has to do with faulty calcium ion feedback between cell mitochondria and muscle cytoplasm which prevents muscles from relaxing after the stimulus has been removed. Stress causes oxygen deficiency, which in turn stimulates the anaerobic metabolic processes of glycogen breakdown and lactic acid production, the same process which can go awry and result in malignant hyperthermia.

There may also be another damaging feedback mechanism in stressed pigs relating to adrenalin output. Stress increases adrenalin production, which stimulates muscle activity. The lactic acid byproduct of this activity also stimulates production of adrenalin, and the cycle begins anew.

Porcine malignant hyperthermia is presently treated with Dantrolene, a muscle relaxant. In the case of PSE meat, however, the emphasis must be on prevention rather than on treatment. The destructive effects of stress can range from poor post-slaughter meat quality in pigs to 100% mortality rates in wild animals that succumb to capture myopathy, characterized by severe acidemia often leading to heart failure, after a brief, extremely intense chase (A.M. Harthoorn, The Chemical Capture of Animals, Bailiere Tindal, London, U.K., 1976, p. 103).

Dr. Winstanley suggests concentrating on stress-resistant breeds, or alternatively, directing efforts toward following established guidelines to minimize stress in animals that are genetically predisposed to failure in coping with stress.

Porcine Aggression: Measurement and Effects of Crowding and Fasting

Studies were conducted to determine the effects of restricted space allowance, fasting and straw bedding on porcine agonistic behavior in growing-finishing pigs (Kelly, K.W., McGlone, J.J. and Gaskins, C.T., J Anim Sci 50:336, 1980). Fasting increased agonistic behavior while straw bedding did not reduce biting among growing pigs fed ad libitum, but tended to reduce agonistic behavior among fasted pigs. It was concluded that adding straw bedding when pigs are mixed does not reduce aggressive behavior when they are fed ad libitum.
WILD ANIMALS

Missing Lynx

Results of a study of demographic changes in the Alberta, Canada lynx population during the winters of 1971-72 through 1975-76 show that continuous trapping can threaten local survival of the species (J Wildl Manage 43(4):827-849, 1979).

The primary food source of lynx in these regions is the snowshoe hare. Thus, a decline in the hare population corresponds to a decline in the lynx population, a natural cyclical occurrence. The demographic study was geared toward understanding the impact of human intervention through trapping on an already reduced lynx population during a period of snowshoe hare scarcity.

Researchers collected 1,108 lynx carcasses from trappers in Alberta and from this sample examined the diet, physical condition, reproductive performance, sex, age and mortality of the regional lynx population. Analysis of the food recovered from remains in the gastrointestinal tract of the dead lynx as well as a visual appraisal of the amount of renal and subcutaneous fat on the carcasses revealed that although lynx turned to alternative sources of prey during hare scarcity, they suffered an overall reduction in daily food consumption of 37%. This nutritional lack in turn affected reproductive performance: counts of corpora lutea and placentals scars indicated decreases in ovulation and pregnancy rates, and litter sizes. Age analysis of trapping samples (determined by developmental features of the dentition) showed a decline in the kitten population from 66% during the years of hare abundance to 3% during the years of hare scarcity.

The study concludes that the immediate cause of lynx population reduction is postpartum mortality of kittens due primarily to inadequate nutrition. However, increasing fur prices ($38 per pelt in 1971-72 to $216 in 1975-76) have heightened trapping activity during this naturally occurring cyclic decline, causing further decreases in lynx numbers. Indeed, starving lynx may be even more susceptible to death by trapping because of more frequent food searches and a consequently greater chance of encountering baited sets.

Since mortality due to natural factors and trapping mortality have an additive effect, the authors of the study recommend cessation of trapping for 3-4 years after the second year of peak kills in order to lessen the severity of the inevitable reduction in the lynx population due to snowshoe hare scarcity. If this practice or some refinement thereof is not adopted, "...intensive trapping could result in local extirpation of lynx during years when recruitment [influx of viable new members into a population] is absent" (p. 827).

Note: The lynx faced a similar fate in France not long ago, but the species is now being reintroduced into the forested mountains of that country. The predatory habits of the lynx include a preference for weak or sick members of abundant species. French officials hope that the lynx will prey on fox cubs, which are often infected with rabies virus, and thus contribute to a reduction in the incidence of the disease (Uniterra 4:7, 1979).

Endangered Reptiles

The U. S. Fish and Wildlife Service added five reptile species to its List of Endangered and Threatened Wildlife and Plants: the San Esteban Island chuckwalla of Mexico, the Fiji Island banded iguana, the Fiji Island crested iguana, and two species of Round Island boas. Commercial exploitation and habitat destruction have contributed to their endangerment. These reptiles do enjoy degrees of protection in their native countries, but the "endangered status" will tighten U.S. importation restrictions and allow U.S. funds to aid conservation programs in the species' countries of origin.
The Involvement of the Farm Animal Veterinarian in Animal Welfare

David G. Llewellyn

The following is excerpted from a paper presented by Mr. Llewellyn, BSc MRCVS at the British Veterinary Association Annual Congress, September 9-14, 1979, Aberdeen, Scotland.

The farm animal practitioner has always played a dual role. The primary role is humanitarian, concerned with the well-being of the livestock, and the secondary role relates to the economics of the enterprise.

With the control of the major endemic diseases (tuberculosis, brucellosis, bacillary white diarrhea and swine fever) in the 1950's, came economic and political pressure for capital-intensive land use to provide an adequate supply of food. This involved the keeping of groups of animals at much higher stocking rates. Cows left the cowshed for the yard and parlor and animals were confined—birds in cages, sows in stalls. These arrangements ensured that individuals could feed and rest relatively free from competition from their fellows. When the group was relatively large, certain automatic equipment was installed to reduce labor costs, and if the animals were dependent on this system for their well-being, the system was described as 'intensive.' The old endemic diseases were being replaced by man-made environmental diseases, and our basic husbandry methods faced a new challenge. The practitioner had to learn a new terminology—response, interaction, dominance—as many of the troubles now encountered had their etiology and control in the behavioral response of the animals to their environment. To the old concepts of cruelty and neglect were added stress, distress, understress, discomfort and pain. The practitioner's deficiencies in knowledge were remedied by the voluminous literature published by ethology specialists, and indeed to a considerable extent by students when they visited us to 'see practice' during their vacations. Conditions like tail biting, bowel edema and cannibalism could be attributed to the new situations in which the animals had been placed. Although the veterinarian had always been able to recognize good and bad husbandry, there now arose situations in which apparently good husbandry could be associated with behavior problems due to the environment; thus the term 'welfare' began to be used in conjunction with the description of husbandry practices. The practitioner is in a unique position to evaluate welfare standards, as he or she knows the capabilities of the stockman, the supply of food and the aims of management. In addition, through periodic visits to the farm, the practitioner can quickly recognize any deterioration in welfare and thus prevent unnecessary suffering. In my experience, disease is by
for the commonest and the most important cause of discomfort, pain and suffering in our livestock.

In 1965 the late Professor Rogers Brambell presented to the government the Report of his Committee of Enquiry into the Welfare of Animals. This Report emphasized the rapid changes that were taking place in animal production at that time, and it did indeed forecast many of the problems we are facing today. As a result of the Report’s recommendations, Parliament appointed the Farm Animal Welfare Advisory Committee, which was responsible for the publication of basic welfare requirements for food animals. Each Code states in its preface:

The basic requirements for the welfare of livestock are the provision of a husbandry system appropriate to the health and behavioral needs of the animals, including the provision of readily accessible fresh water and nutritionally adequate food as required, provision of ventilation and a suitable environmental temperature, adequate freedom of movement and ability to stretch the limbs, with sufficient light for the rapid diagnosis and treatment of injury and disease, emergency provision in the event of a breakdown of essential mechanical equipment, and flooring which neither harms nor causes undue strain, and the avoidance of unnecessary mutilation.

To achieve the recommendations contained in the preface requires highly skilled stockmanship. Animal welfare depends on the interaction of the stockman, his animals and the environment. This is the key not only to the welfare but also to the productivity of the unit. Although this interaction is the most important factor, in farm practice it is also the most variable. We can advise stockmen, but we have no control over the ability of an individual stockman to implement that advice. Thus we find variation in welfare standards from the excellent to the thoroughly unsatisfactory. The unit with frequent changes in staff and occasional incompatibility among workers can create unsatisfactory conditions which may have a deleterious effect on the well-being of the stock and present the practitioner with a serious ethical welfare problem. The large or extensive unit is not necessarily a welfare hazard in itself; indeed, we frequently find the biggest welfare problems in small units, some of which are associated with the new self-sufficiency ‘good life’ enthusiasts, or the weekend agriculturists who are often ignorant of the basic husbandry requirements of their stock, and who frequently have insufficient resources in land, housing and food. Losses from disease and malnutrition can be far greater in these holdings where the owners are not dependent on the unit for their livelihood.

Many practitioners will be familiar with the situation in which an outbreak of disease affects the majority of the animals in a group, and the stockman expects an instant cure out of the car boot. When it is pointed out to him that the prime etiological factor is environmental, he looks at you in disbelief. The response obtained to the advisory correction of the environmental errors is usually proportional to the size of the heap of carcasses on the floor.

If the demands of the Codes preface were met, a large number of the prob-
lems in the field of preventive medicine would disappear, resulting in considerable benefit to our livestock. I will now try and relate the demands of the preface to what we actually see in our evolving husbandry systems.

**Appropriate Husbandry Systems**

In agriculture, what is regarded as advanced or revolutionary in this decade often becomes conventional in the next. New systems or a change in system should be individually planned and researched. There is a tendency to copy existing systems without due regard to the resources available and to the capabilities of the stockmen. Emphasis seems to be concentrated on the return on capital rather than on the comfort and well-being of the livestock. There appears to be a neglect of fundamental research into alternative systems. Such research should be attached to university veterinary schools, where the multidisciplinary expertise is available.

The last twenty years have been a continuous series of trial and error to improve the environment for the benefit of workers and animals. The loose housing on straw yards was short lived, due to the straw demand and consequential increase in the price of straw. From this the cubicle evolved, in many ways the most tragic thing to hit the dairy cow. The design of a standard cubicle resulted in enlarged hocks and the bruising, sometimes extensive, of stifles, pin bones and thoracic walls. I believe that some of the severe mastitis cases seen in fresh-calved cows are the result of trauma and bruising by the cubicle, which is too small for some of our bigger cows. The lying area of the cubicle went through a grim evolution. Some areas were filled with earth (cheap) but soon this developed into mounds and hollows and proved so uncomfortable as a lying area that many cows rejected the cubicle. Then stone scalplings covered with cheap stone dust were tried. The stones progressively rose to the surface and resulted in a very high incidence of foot problems. In several herds over half the cattle were lame as the result of interdigital injury. Yet even when practitioners were aware of the problem and protested, we saw builders of new housing being advised to use stone. Frequently insufficient attention is paid to the heel stone, so vital to cow comfort and cleanliness. Design and construction faults result in cows rejecting the cubicle and lying in the slurry; 5% rejection is common and we have seen herds where the rejection was as high as 30%. Many of these problems could have been reduced if the practitioner had been consulted at the planning stage. Even today, cattle handling facilities are unsatisfactory on 70% of our farms, and in my opinion this is a major welfare matter. Poor handling facilities cause unnecessary pain and distress through the excessive use of sticks and goads and cause stress on the stockman as well. I am sorry to say that liaison on the farm between the land arm of the Ministry and the practitioner, in my experience, can only be described as poor and often nonexistent. The cowman, as many others, requires motivation which is encouraged by financial reward and job satisfaction. The good cowman should know the behavior of each cow and be able to recognize small deviations. Despite all the mechanization and gadgetry aimed at improving parlor throughput, a 'bionic cowman' has yet to be created. In some of our large dairy units, the anxiety and stress that some of our cowmen experience worries me. Indeed, I think the time has come for a serious reappraisal of this situation.
Adequate Supply of Clean Water

Bovines drink large quantities, and one would think that the provision of an ample supply of clean water in this country is no problem. Yet frequently I see a queue of cows waiting for water at empty tanks due to the bore of the pipe being too small, or the pressure inadequate. In this situation the lower members of the hierarchy go short and can be seen drinking stagnant water around the yard. Water bowls and troughs in cattle yards are often poorly situated, they are frozen in cold weather, heavily polluted with dung, and frequently they get broken by the stock, with the result that the bedding area becomes a sea of slurry. We see a similar result in sow houses. Bored sows are constantly playing with the water nipples, resulting in constant wet beds. These problems are beginning to receive attention, as evidenced by the installation of water straws to eliminate wet beds in swine houses.

Adequate Nutritious Food

Malnutrition continues to be an important welfare problem, particularly in young stock, although the technological improvement in grassland management and conservation has improved the situation. The ‘in’ method of grazing in the 1960’s was paddock grazing, which has now been abandoned and a return made to set stocking. One farmer described wire fence and paddock grazing as ‘controlled starvation.’ We are now seeing dissatisfaction with self feed silage so much advocated by advisers. Hence there is a move back to trough feeding although it involves more work and more capital. The farmer can see that nutritional adequacy is essential for optimum production. A considerable amount of practitioners’ time is spent in controlling and preventing the effects of nutritional change and deficiencies. Barley produces acidosis, laminitis and bloat. Kale produces anemia and bloat. The greater reliance on home grown crops has resulted in an increase in unthriftiness due to deficiencies of copper, selenium, magnesium and phosphorous. Half of our calf problems in the first month of life are nutritional. With the amalgamation of land, multicentered stock units have emerged. We have seen serious nutritional problems during the severe winters of ’78 and ’79 when it was not a question of the supply of food, but the inability to get to the stock. Here there is a clear need for farmers to arrange a ‘self help emergency service.’ In the West we saw an excellent example after the wet summer of ’74, when the cereal farmers of the East rescued the livestock of the West by massive straw movement into the famine areas. It is obvious that in these situations government contingency measures cannot be relied upon. In the interest of animal welfare, ‘self help’ planning on a regional basis by the livestock industry will be essential if major catastrophes are to be avoided.

Adequate Ventilation

The increase in the density of housed stock has resulted in many unsatisfactory air space situations. Ventilation is a complicated problem, and we find a tendency by advisory officers to generalize and oversimplify the answers. Dr. Dan Mitchell has emphasized the importance of considering the ventilation.
system as part of the complete design from the outset of building or conversion. When cow numbers more than doubled, extra accommodation had to be found to rear the replacements. The empty cowshed became the obvious choice; in my experience this was frequently a recipe for disaster. Respiratory disease is the major cause of discomfort and death in young stock from two to six months old.

**Suitable Environmental Temperature**

Cattle adapt readily to cold and can thrive at low temperatures. These traits can apply to quite young calves. The stockman tends to regulate the temperature in a building to a level acceptable to himself which often results in condensation with calves housed under a dripping roof. Once the coat is wet it has lost much of its insulation. There is also need for improvement in the provision of shelter for marginal and hill cattle during the winter. Wind seems to be an important cooling factor. This has been shown by the success of the topless cubicle, and yet many have been roofed, as the stockmen did not like to see their cattle with wet backs, and did not like to have wet backs themselves attending to them.

**Sufficient Light**

The situating of light points to permit satisfactory inspection is extremely important not only for welfare but for the safety at work of the attendants. There are very few units that come up to the recommended lux standards. In most of the purpose-built housing, it is possible to walk through and do a thorough inspection. Much conversion housing and indeed some kennel housing are dark dens where proper inspection or observation is impossible. Every advisory leaflet emphasizes the importance of the early recognition of deviations from normal in the individual animal, yet the whole productivity exercise is aiming at reducing the labor available. Many units in the future will rely on transponders and computers, to the detriment of the animals' well-being. Many units are now left at 6 pm and are not seen again until 7 am. The sight of impacted dystocias, cases of hypocalcaemia are regrettably familiar before-breakfast scenes for the practitioner. Much lip service is given to animal welfare by politicians, yet one of the most serious losses to the animal unit was the removal of the tied cottage where the stockman was on hand for inspection and in emergencies and not in a village or town often five or ten miles away. To offset losses, some farms pay a motivation bonus on live calves born and reared to ten days.

**Proper Flooring**

Satisfactory flooring is extremely difficult to achieve. That all is not well is revealed by the fact that we spend about a quarter of our professional time attending to lame cows. Lameness in the bovine is an extremely painful condition. Concrete seems to have an eroding effect on the sole which makes it vulnerable to flint puncture and abscess formation, and also to pressure necrosis with consequential ulceration of the sole. Many cubicle passages and yards become highly polished and perilous to man and beast. There is a considerable loss in cast
animals from injuries that occur due to incoordination in milk fever, mounting during oestrus, or simply hurrying on the insecure surface. Slatted floors are not new; indeed, centuries ago they were used in the form of split saplings covered with bracken to give a dry comfortable secure bed. Concrete slats of good quality and fitted properly work well. Cattle lying on slats appear happier than those standing or lying in a bed of straw slurry. There should, however, be a standard for concrete stall construction to eliminate erosion and slit fracture resulting in foot and leg injuries which have tended to bring slatted floors into disrepute. Brambell focused attention on the problem of the floor in pig housing. Although considerable work has been done in the past fifteen years, an enormous welfare problem remains in the flooring of farrowing houses. The solid floor is wet and dirty and is responsible for many enteric illnesses. On slats, young piglets injure their feet and fracture their legs. Metal slats and punched metal are too slippery and sows frequently fracture their pelvises. Woven wire is good on the feet but seems to cause hock damage in the sows. Expanded metal causes teat injuries and damage to piglet feet. When I advised a client to complain to the manufacturers, their advice was to get a file and remove all the sharp bits! Calves spend 80% of their time lying down; here we should give a positive direction on floor construction by requesting a fall in the floor to ensure a reasonably dry bed. Considerable research and appropriate financing are urgently needed to improve welfare and reduce losses from improper flooring.

Avoidance of Unnecessary Mutilation

Some unnecessary surgical interferences have been prohibited by ‘regulation,’ such as castration, pinioning and dewinging of poultry, and the docking of cattle. The majority of unnecessary surgical interferences will continue to be done in the foreseeable future for economic, practical and in a few cases, therapeutic purposes. In common with many other farm procedures, the role of the practitioner in this area has changed. In the 1950’s we did 90% of this work, in the 1960’s we did less than 50% and with the continued increase in size of the enterprises and the economic pressures, we had less than 20% to do in the 1970’s. Professor Brambell recognized this trend in 1965 when he stated he was not happy with the situation where stock attendants learned by ‘experience.’ Today animals are frequently not under the direct day-to-day control of the farmer, or even the senior stockman. In more and more cases, livestock are kept on premises which are geographically many miles away from the home farm and often tended by stockmen without the knowledge of and the expertise in the performance of a number of procedures which the farmer or senior stockman may possess.

There is a need for improvement in the training given to stockmen, which at present varies considerably in quantity and quality in various regions of the country. The profession must give a positive lead in conjunction with the Agricultural Training Board (ATB), and the Association of Agricultural Education Staff (AAES) to improve this situation. Here they will face many obstacles and difficulties such as feasibility, economic constraints, practicalities, and the discussion may get bogged down in controversial areas. The benefits of any difficulty should be given to the animal. One often sees a recommendation that a procedure should
be carried out by a competent person. Many of these procedures are not daily tasks, such as tusk removal in boars or ringing of bulls. On the horizon one sees many objectionable maimings such as amputation of the penis in vasectomized bulls to prevent intromission, amputation of the tongue in calves, and the possible insertion of electronic transponders in cattle. This is an area where we must not abdicate our responsibilities. The role of the practitioner must continue in the future to safeguard the well-being of our livestock by giving advice on care and the prevention of neglect, as well as therapy to the sick and injured.

Welfare is team work. The practitioners will do the forward work, the half back District Veterinary Offices will be at hand in any difficult situation, supported by the talents of Agricultural Development and Advisory Service (ADAS) in the center and the universities on the wings. Very few problems should ever reach the Minister of Agriculture at full back, but if one ever does let us hope he will not put it out of play into touch, but give us an ‘up and under’ so that we can all bring our expertise together to solve the problem.

Laboratory Animals and Alternatives in the 80’s

Andrew N. Rowan

Introduction

In 1969, Sir Peter Medewar, immunologist, Nobel prize-winner and philosopher of science, made the following statement at the Research Defence Society’s Annual Meeting:

The use of animals in laboratories to enlarge our understanding of nature is part of a far wider exploratory process, and one cannot assay its value in isolation — as if it were an activity which, if prohibited, would deprive us only of the material benefits that grow directly out of its own use. Any such prohibition of learning or confinement of the understanding would have widespread and damaging consequences; but this does not imply that we are forevermore, and in increasing numbers, to enlist animals in the scientific service of man. I think that the use of experimental animals on the present scale is a temporary episode in biological and medical history, and that its peak will be reached in ten years time, or perhaps even sooner. In the meantime, we must grapple with the paradox that nothing but research on animals will provide us with the knowledge that will make it possible for us, one day, to dispense with the use of them altogether (Medewar, 1972).
It is now just over ten years since Medewar made the prediction that the number of laboratory animals used every year would peak. Figures produced by the U.K. authorities indicate that he was more or less correct. Although the number of recorded animal experiments in the U.K. has stabilized around 5.4 million per annum and may even be falling, it is by no means clear whether this is due to reduced funding and the increasing expense of laboratory animals or to the development and adoption of alternatives (see Box). The most likely explanation is that this peaking is the result of a combination of these and related factors. Whatever the reason, we are entering the 80's amid a flurry of interest in and activity around the idea of "alternatives to laboratory animals."

In this discussion, an alternative is defined as any technique which could:

- **REPLACE** the use of animals altogether;
- **REDUCE** the numbers of animals required;
- reduce the amount of stress suffered by the animal by **REFINING** the techniques used.

At the same time, and this is most important, any alternative system must provide data which leads to the same ultimate conclusion with the same or greater degree of confidence as that obtained from the method being replaced.

A clear example of this concept is provided by the experience of an anti-viral screening program in a major pharmaceutical company (Bucknall, R.A., 1980, The use of cultured cells and tissues in the development of anti-viral drugs. In *The Use of Alternatives in Drug Research* [eds A.N. Rowan and C.J. Stratmann] MacMillan: London, pp. 15-27). Over a period of fifteen years (up to 1977), the introduction of cell and organ culture screening techniques reduced the number of mice required per annum from approximately 13,000 to about 2,000. At the same time, the company was able to increase the number of compounds screened for potential anti-viral properties from about 2,000 to about 24,000 per annum. There are a couple of instructive points in this example. First, the laboratory reduced rather than eliminated the use of mice. The cell and organ culture systems could not mimic mammalian metabolism completely and, therefore, the final screening tests still had to be conducted in the whole animal. Second, a great deal of time and money was saved by doing the initial screening of compounds with unknown potential in the faster and cheaper cell system. However, although the time and cost benefits of alternative systems are indisputable, scientists do not always agree that the conclusions derived from them are as valid as those derived from the animal system.

**Europe**

In Europe, the interest in alternatives has grown steadily ever since the Council of Europe adopted Recommendation 621 in 1971. (The Council of Europe is a loosely-knit treaty organization of 21 European countries). This Recommendation was a radical document which, *inter alia*, called for the drafting of international legislation to set out the conditions under which experiments on live ani-
mals may be authorized and, specifically, for the establishment of a major international clearinghouse on alternatives. At present, the Council of Europe’s expert committee is completing a draft treaty on laboratory animals which is considerably watered down from the original Recommendation. Interest in alternatives has, in the meantime, grown significantly, and several of the European nations have publicly supported the concept.

In Britain, Mr. Callaghan, as Prime Minister, issued the following answer to a question in Parliament about his Government’s intentions vis-à-vis alternatives:

I hope I have indicated that it would certainly be our policy and desire to move to alternatives to animal experiments as quickly as possible, and our efforts must be directed in that way (Hansard, 8 Dec 1977, Cols 1642-1644).

The Home Office (which administers The Cruelty to Animals Act, 1876) backed up the Prime Minister’s statement by sending out a letter exhorting all scientists in Britain who are licensed to perform experiments on living animals to “take every reasonable step to confirm, before using living animals, that their investigations” could not be effectively carried out by other means. The letter continued by urging the licensees “to give thought to the possibilities of developing new alternatives to the use of living animals and to publishing information about successful new methods.” According to reports, this letter caused some resentment among biomedical researchers, but it certainly demonstrated the Government’s public commitment to the idea.

In continental Europe, the Federal Republic of Germany included a section on alternatives in its Animal Protection Law of 1972 which stated that potentially injurious experimentation would only be authorized if the research could not be done on nonanimal systems or on phyletically lower animals. In Denmark, the 1953 law on experimental animals was amended on May 13, 1977 to forbid painful experiments in schools and to allow experiments on live animals only after due permission is obtained from a national committee composed of four scientists, a lawyer and three representatives from the Danish Society for the Prevention of Cruelty to Animals. Also in 1977, the Dutch Parliament enacted legislation which placed heavy emphasis on the requirement that those dealing with laboratory animals have adequate professional skill and that “no animal experiment shall be conducted for a purpose that, according to the consensus of opinion among experts, could equally well be achieved in some other way.” At last year’s (1979) meeting of the International Committee for Laboratory Animal Science in Utrecht, the Dutch Minister of Health and Enviromental Protection, Dr. Ginjaar, drew specific attention to this point and stated that “The Netherlands endorses a suggestion made in the Council of Europe’s Committee of Experts on the Protection of Animals that the matter of alternatives be promoted at the European level.”

Outside the European Economic Community (EEC), Sweden has recently established a governmental advisory Central Committee on Experimental Animals, one of whose responsibilities is the development and promotion of alternatives. Approximately $90,000 has been distributed to research projects dealing with alternatives, and a section on alternatives is to be included in a
course for veterinary students this year. Sweden also passed a law at the end of 1978 making reviews of animal experiments by ethical committees in government institutions mandatory. Elsewhere, the Swiss Federal Assembly passed a new animal welfare law in December 1978 which is expected to be put into force in mid-1980.

Animal welfare and anti-vivisection societies in Europe are not only encouraged by recent government activity, but are themselves encouraging scientists to consider the concept of alternatives by making grant money available for research. One such organization in Britain, the Lord Dowding Fund for Humane Research, held a meeting in the last quarter of 1979 to discuss the results of research which it has been supporting (New Scientist 84:271-272, 1979). As is not uncommon in scientific progress, the results were rather mixed.

Dr. Derek Calam of the National Institute for Biological Standards and Control (London) has been working on a high-performance liquid chromatography (HPLC) method for assaying “biological medicines” such as insulin and oxytocin which are currently standardized in potency assays using animals. However, Calam is having difficulty obtaining reproducible results although the HPLC method is potentially sensitive enough (±3% accuracy) to meet the regulatory requirements of ±10% accuracy for oxytocin potency assays.

Dr. Peter Knox of St. George's Hospital Medical School (London) is studying the nutrient requirements of cells in culture. He argues that cell culture technology is still in its infancy and needs to be improved so that it may become a more useful alternative. The blood serum supplement, which normally is added to cell culture nutrient media, contains a large number of constituents, most of which are unidentified. It is not known which constituents, and in what combination, are essential to normal cell growth. Knox has been working on this very complex problem and has isolated two proteins which appear to play a role in cell adhesion to the petri dish, a vital step in the growth process, and is following up on this finding.

Research on these or similar techniques is, of course, being supported by establishment organizations. However, the animal welfare trusts serve to focus attention on the potential of these techniques as alternatives.

The United States—Arguing the “Alternatives” Concept

The idea of alternatives is coming of age in Europe, but progress in the United States is a little slower. There have been one or two meetings at which the subject has been addressed—notably the ConMed Symposium in Cincinnati last year organized by the Department of Laboratory Animal Medicine at the University of Cincinnati. The National Institutes of Health is also considering a proposal to hold a major conference on the topic.

Furthermore, following the success of the Lord Dowding Fund in Britain, an “alternatives” funding organization has been established in New York (American Fund for Alternatives to Animal Research [AFAAR], 175 West 12th Street, New York, NY 10011). On January 19, 1980, AFAAR organized a small meeting at which two scientists who have received funds for alternatives research described their work. Professor Oscar Frank of the New Jersey Medical School discussed his work on microbial vitamin and amino acid assays, their potential for studying
vitamin deficiency disorders, and the role played by drug anti-metabolites. One protozoan, *Tetrahymena pyriformis* has the same amino acid requirements as man and the rat (the usual laboratory animal for testing protein quality). Professor Frank and his group have developed a technique which allows them to use the protozoan rather than the rat as the test animal for protein quality, and AFAAR is funding research into other applications of the assay. Dr John Petricciani of the Food and Drug Administration's Bureau of Biologics and scientific advisor to AFAAR, described research in his laboratory to develop an organ culture assay (using chick embryonic skin) to measure the tumorigenic potential of cells. Usually, tumorigenic potential is assessed in an immunosuppressed animal or in the nude mouse, but Petricciani argues that the chick embryonic skin test is more sensitive, quicker and less expensive than the animal test. He also stated that there are other areas where animal models are still required; e.g., to assess the metastasis (spreading) potential of a tumor.

Despite these developments, many American research scientists still express some uneasiness about the concept of alternatives. A frequent argument is that one cannot predict the outcome of research and, therefore, allocating funds for the development of alternatives would be a mistake. This argument fails to take into account a number of features about research in general and the alternatives concept in particular. First, funds are allocated for particular areas of research in the hope that this will stimulate the generation of good ideas and research projects. Second, the development and application of new techniques is an important part of the research process and it frequently is possible to predict the benefits of better techniques. Conversely, the application of greater resources to a multifaceted research problem, in which not even the correct questions are known, can confound predictions. This is exemplified by the failure of the “war on cancer.”

The advance of biomedical knowledge depends on a number of factors including an adequate reserve of imagination and intuition and sufficient funds, equipment and manpower for the critical evaluation and testing of new ideas. Imagination and critical review are the basis of the hypothetico-deductive model of scientific advance, but two other factors must also be included: luck and technique development. The importance of technique development is attested to by the number of awards given to scientists who develop new methods for attacking old problems. For example, Dr. Rosalyn Yalow received a Nobel price in 1977 for her part in the development of the radio-immunooassay technique. This technique has been cited as an alternative because it allows a researcher to assay very small amounts of complex biological molecules which previously could only have been done (if, indeed, it was possible at all) by using living animals.

The alternative technique which has raised the highest hopes among animal welfare organizations is tissue culture. Bernard Dixon argues in his book, *What Is Science For* (Penguin, 1972, pg 31), that when medical researchers look back through the decades, they will select as one of the most important single developments in the 1960's the technical innovations leading to the growth and study of human cells in the laboratory. As stated earlier, the technique is still in its infancy. If more research resources were devoted to improving and developing cell culture techniques, the investigation of many research problems would be simplified. For example, an understanding of the complete growth requirements of
human cells would probably have a major impact on our understanding of differentiation and malignant growth.

The National Institutes of Health already recognizes the importance of supporting technical developments through its Biotechnology Resources program in the Division of Research Resources (DRR). The DRR provided $11.8 million in 1976 to assist in the support and acquisition of complex technological capabilities for qualified research scientists, but a 1976 report on the DRR mission (known as the Bolt, Beranek and Newman Report after the name of the consultancy organization which managed the review), had the following to say about the biotechnology program:

*The Panel finds this program to be substantially under-funded even for its current portfolio. Furthermore, the Biotechnology Resources Board should address the challenges inherent in biotechnology needs by adding activities in new directions. Specifically, support should be given to pre-resource development of biomedically-relevant technologies before they are mature enough to serve a user community.*

Therefore, the Bolt, Beranek and Newman report implicitly supports the idea of developing new techniques (which would include alternatives) and also argues that the DRR is not adequately fulfilling its function of conceiving and creating such new resources. The application of funds specifically to the development of cell culture technology, to the training of scientists in tissue culture techniques and to the dissemination of appropriate information on all research models (not just animal models as is currently the case) would definitely fall within the purview of the DRR.

The DRR currently provides approximately $14 million per annum to maintain seven primate centers around the country. It is arguable that, if these funds had been devoted specifically to the development and application of cell culture technology, the subsequent advances in biomedical knowledge would have been more significant than those emanating from the primate centers. Animal welfare groups believe that there is too little attention paid to in vitro versus animal research models and are therefore attempting to direct research funds to the development and application of alternative techniques via congressional action. As a result, three Bills have been introduced into the U.S. House of Representatives in 1979.

**The United States—Legislative Activity**

The first Bill, H.R. 282, was introduced by Congressman Drinan (D-MA). This Bill is relatively straightforward and uncontroversial. It calls upon Congress to allocate $12 million to the development of alternative techniques. Most animal welfare advocates consider that the bill is too modest. The second Bill, H.R. 4479, was introduced by Congressman Weiss (D-NY), and it mandates the establishment of a Commission to study alternative methods to the use of live animals in research and testing. The Bill requires that individuals appointed to the Commis-
sion should include representatives from animal welfare groups, biomedical research organizations and veterinarians. The Commission would have a maximum of five years for the investigation and an annual budget of not more than $750,000.

The third and most recent Bill, H.R. 4805, was introduced on July 16, 1979 and is sponsored by Congressmen Richmond (D-NY), Roe (D-NJ), Hollenbeck (R-NJ) and Wolff (D-NY). It is based on a draft bill drawn up by United Action for Animals. This Bill mandates the establishment of a National Center for Alternative Research to increase the use of existing alternatives, to encourage the development of more alternatives, to provide for the training of scientists in the use of such alternatives, to eliminate duplication and repetitive research on live animals, and to disseminate information on alternatives. The National Center, directed by representatives of all the federal agencies who fund animal research, would be required to publish an annual report of how the goals of the Bill are being met. Finally, the Bill mandates the re-allocation of 30-50% of all appropriations for live animal research and testing to the development of alternatives.

The presence of three bills in the House of Representatives promoting the idea of alternatives has generated widespread interest in the subject in the United States. For example, the General Accounting Office has been requested to investigate whether or not research would benefit from the allocation of funds specifically to the development of alternatives and the National Institutes of Health has been conducting its own in-house survey on the extent to which it currently funds research utilizing techniques which fall within the "alternatives" classification. However, scientific organizations are unenthusiastic about all of the Bills. Although the Drinan Bill (H.R. 282) is not controversial and would provide additional funding to scientists, an official letter from the Department of Health, Education and Welfare comments that, although the Department supports the purpose of this bill, it "questions the need for specific authorization." The National Institutes of Health and other scientific organizations are, not surprisingly, much more strongly opposed to the more radical and sweeping H.R. 4805.

A major attraction of H.R. 4805 to members of the present Congress is that the Bill does not require additional funding. However, biomedical research funding agencies are unhappy about the restraints that the bill would place on their activities, and many regard it as being anti-science. United Action for Animals has publicized the Bill widely, and it has vocal support among members of animal welfare organizations, and support from some establishment sources. For example, the Christian Science Monitor carried an editorial about the Bill on October 25, 1979 in which they stated that "such legislation would not inhibit any essential research but might help foster a moral climate in which greater emphasis is placed on humane consideration of the life of all living creatures. It deserves public support." There has been a mixed response from the animal welfare groups themselves. The Society for Animal Rights opposes the Bill because it "clearly implies that the vivisection of animals is acceptable and necessary until such time as alternatives are discovered and put into use" (SAR Report, December 1979). The Humane Society of the United States is committed to support for the principle of alternatives, but considers that H.R. 4805 will have to be modified if it is to have any chance of enactment against the opposition of the
very powerful research lobby.

H.R. 4805 and the other Bills are serving a useful purpose in raising the consciousness of the political public and in forcing scientific organizations to pay greater attention to the question of alternatives. It is not unlikely that some sort of "alternatives" bill could be passed in the next decade as the subject comes under closer and closer scrutiny. In order for such a bill to satisfy the animal welfare community, it would have to contain elements which provided substantial funding for the development of alternatives, which provided for the training of scientists and the dissemination of relevant information, and which tackled the problems of unscientific duplication and repetitive research. On the other hand, if such a bill is to be acceptable to a reasonable proportion of biomedical researchers, then it will have to be perceived as a constructive development. In fact, the research constituency is still apprehensive about the whole concept of alternatives and much groundwork is still required, employing technical and scholarly arguments, to persuade biomedical scientists that the concept is not only valid but that it can also be valuable.

At the very least, generation of a positive attitude toward alternatives should lead to better planning of research and to the use of the most appropriate research models. At the very most, the development of in vitro research models can lead to significant new research opportunities. According to Professor Sergey Federoff, past president of the Tissue Culture Association, "the application of tissue cultures to biomedical research is limited only by the imagination of the scientists employing them."

Dr. Rowan is the author of *Alternatives to Laboratory Animals*, which is a review of the scientific and technical aspects of alternatives and an examination of the potential and the limitations of the alternatives concept. The monograph contains detailed information on animal use in various types of biomedical research, a description of alternative techniques and their applicability to specific research areas, as well as extensive references and a selected bibliography covering the ethics, history and legal aspects of animal experimentation. *Alternatives to Laboratory Animals* is available at a cost of $2.00 from the Institute for the Study of Animal Problems, 2100 L St. NW, Washington, DC 20037, USA.
Bringing Nature into the Zoo: Inexpensive Solutions for Zoo Environments

David Hancocks*

Abstract

Animals in captivity have traditionally been kept in sterile and inappropriate environments. Typically this situation still prevails in zoos. Cages are designed only for restraint of the animals, expediency for the public, and convenient maintenance by keepers. The animals' behavioral needs are often ignored. By using nature as a norm, and by using natural materials, the spatial and temporal environment of a captive animal can be easily and greatly enriched. Several examples which have been used at Woodland Park Zoological Gardens are discussed. Their application and expansion are appropriate for most urban zoos.

Introduction

Most zoo visitors have seen animals engaged in stereotypic movements, aberrant sexual behavior, excessive inactivity, or abnormal maternal care. These are common problems for zoo animals (Morris, 1964). Inadequate and sterile environments have been a tradition in zoos. They create behavioral defects and physiological stress, which in turn can increase susceptibility to disease and parasitic infection, as well as have significant effects on reproductive success (Hediger, 1969).

Correction of these conditions requires an increase in complexity of the captive animal's environment. There must, however, be a guide as to what type and degree of complexity. The answers can be found in nature.

Nature is the Norm

For too long zoo administrators and designers have looked to other zoos for solutions. Mistakes from the past have thus been perpetuated. Instead, one should look to nature: the captive environments should duplicate as many as possible of the essential characteristics in the animal's natural physical and social environment.

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Organisms in nature may live in an environment of great complexity. They experience spatial variations created by soils, rocks, vegetation, water and so on. Temporal variation occurs through such factors as light, temperature, humidity, food availability and seasonal changes in vegetation. Other organisms in the community also add to environmental variation (Barash, 1977).

Typical zoo environments, in comparison, are very sterile. Perhaps the worst aspect of this sterility is the awful predictability of the zoo environment: nothing changes from day to day or year to year.

Wild animals have evolved complex behavioral repertoires which are flexible and extensive enough to cope with the diversity of their natural environments (Barash, 1977). It is therefore not surprising that predictable and inappropriate furnishings, in sterile cages, produce boredom which in turn creates behavioral problems. What is alarming is that such conditions are so often accepted by the public as "normal," and that so little has been attempted to solve these problems.

Facilities for zoo animals tend to enclose simple spaces, and cage furniture tends never to be changed. Worse, the furnishings rarely complement the animal's special behavioral and anatomical adaptations. Arboreal animals such as gibbons are often seen in enclosures no different from those provided for terrestrial species, such as baboons.

The potential effects of environmental sameness were highlighted in a situation where a tiger, born and raised in a zoo, was released into a large outdoor area at the World Wildlife Safari, Winston, Oregon. It began to stumble and walk so erratically that it was thought to be ill. In fact the tiger, which had known nothing but a flat concrete floor, was having great difficulty coping with a natural substrate which had some variation in terrain.

Space and Time

There are two essential and basic methods of increasing environmental complexity in the zoo: spatially, through the addition of furnishings, and temporally, through periodic changes in the environment (Hancocks et al., 1979). The use of natural materials to make a zoo enclosure more complex brings numerous benefits to the animal; moreover, the public is highly influenced by the aesthetics of an exhibit. If the zoo visitors see an animal in a naturalistic environment, they have a better chance to realize, if only subconsciously, that there is a link between animal and habitat, and furthermore, that the two are interdependent.

Mankind has destroyed great parts of this planet out of a loss of respect for nature. If wildlife rehabilitation and habitat reconstruction are to become realities, and not just idle dreams, we will need an enlightened, aware and sympathetic public which has learned to respect wild animals in their own right.

Hundreds of millions of people visit zoos each year, and many of their attitudes are fashioned by what they see at the zoo. Simulated natural environments can therefore have critical importance. At a cost per square foot ratio, naturalistic environments are also much less expensive than traditional zoo "houses." An 18,000 square foot naturalistic habitat for gorillas has recently been built at Woodland Park Zoological Gardens, at a cost of less than $500,000. A typical Ape House of comparable size would cost at least two to three times that amount and still not offer as much environmental complexity.
Using Natural Materials

It is quite inexpensive to modify existing enclosures with natural materials. Captive felids are typically housed in concrete and tile cages (Figure 1). This type of zoo cage was developed before the advent of antibiotics. Modern and sophisticated veterinary care has reduced the need for daily disinfecting of sterile enclosures (Hancocks et al., 1979). There is no justification for housing cats in that manner today, and recent improvements at Woodland Park Zoological Gardens demonstrate how simply and inexpensively the changes can be made.

An enclosure for caracals, for example, has been modified to resemble their desert habitat. Sand, gravel, volcanic rocks, weathered tree branches and dried sagebrush were collected by the keepers at no cost. For the first year the caracals had free access to an unmodified cage, next door, where they were fed. The animals chose to spend over 80 percent of their time in the naturalistic enclosure, and often carried their food into that area to eat (Crockett and Hutchins, 1978).

A similar approach has been made with sand cats, Pallas cats and ocelots. Again, all work was carried out by keepers, and it has been most encouraging to note the extent of their ingenuity, and their enthusiasm for maintaining this exhibit.

Only the ocelot enclosure (Figure 2) required expenditure of funds. About $200 was spent on house plants (palms, rubber plants, philodendron, dracaena, etc.), while mosses and ferns were gathered from nearby countryside. Now we
find that people are pleased to donate plants for the ocelots’ exhibit, and since damage by the animals is only slight, it is a simple matter to maintain a lush, green environment.

While none of these enclosures can be considered ideal, they do illustrate that quick and easy improvements can be made which provide significant benefits for the animals, and an enriched viewing experience for the public.

Other examples, perhaps even more simple, can be seen at Woodland Park’s antiquated Primate House. This is a very traditional zoo building, with wire mesh and concrete cages. (It is important to note that the number of species in this building has been reduced in favor of larger group sizes. This, combined with changes in the physical environment, has eradicated problems of extreme inactivity.)

A multi-dimensional network of arboreal pathways has been created for the primates using natural tree branches, which are available at no cost and easily replaced. This may seem simple and obvious, but why is it not done more often? Some of the cages in the Primate House were devoid of furnishings, except for one or two metal pipes, during the first 66 years of its existence. This situation still prevails in some zoos.

Hay is also piled thickly on the floors of the primate cages. Sunflower seeds and raisins (not inexpensive!) are scattered among the hay, and the animals spend
hours each day in activity similar to natural foraging behavior.

In some of the cages, long and slender branches were fastened to the ceiling in such a way that the joint was flexible. These became the focus of much play activity by infant monkeys. This development was an idea of one of the keepers, and it has become obvious that keepers are a great source of imagination, compassion and enthusiasm when given the opportunity to use their abilities. A similar inexpensive trick was devised by a keeper who hung a large, dead branch from a tree in the elk enclosure. The bull elk now has something worthy of his antler activity. He no longer damages the tree trunks by scraping, as in the past, and the awful possibility of cutting off his antlers, which still happens at some zoos, no longer even has to be considered.

Natural branches are a good and inexpensive addition to any area inhabited by ungulates. Several large piles of maple branches placed in a sika deer enclosure at Woodland Park soon became a focus of activity for the entire herd. Much time was spent in stripping the bark; newborn fawns bedded down in the brush piles; and the stag used them to remove velvet from his antlers (Crockett and Hutchins, 1978).

Similarly, larger boulders and dead trees are added (or removed) from time to time in the bear grottos. Rotting logs are given to several species, and generate much activity and interest. Such logs typically harbor many insects which are hunted by the zoo animals, and invariably almost the entire log is eventually destroyed, much of it ending up in the animals’ stomachs.

Rotting logs, therefore, can be seen as an important addition to the diet of captive animals. In fact, both the type and the availability of food are important factors in seeking naturalistic solutions to behavioral problems.

A Question of Food

That food is a vital concern to animals is obvious; its importance, however, is often magnified in captivity. Attempts are being made at Woodland Park to offer not only a nutritionally sound diet, but also one which replicates essential characteristics of a natural diet. Gorillas in zoos have traditionally received fruits as a major part of their diet. In common with many other zoos, Woodland Park now uses a diet composed principally of vegetables. But this change alone is not enough. The method and time of presentation is also of special value to the animal, and keepers are therefore encouraged to use ingenuity in making food available. Before the gorillas at Woodland Park were relocated to a large, naturalistic habitat (Figure 3), they were housed in a concrete Ape House. Keepers presented food in paper sacks or cardboard boxes on occasion, which prolonged the discovery and eating time for the gorillas. Peanut butter was sometimes smeared all over a metal grating, and the gorillas would spend hours cleaning it off. In their new area, food is periodically scattered around to give the animals an opportunity to forage among the tall grass and dense shrubs.

Major feedings for the gorillas occur in the early morning and late afternoon. This is not the best time as regards public visitation, since most people stick to the old custom of visiting the zoo at the worst time of day—between about noon and mid-afternoon. It is beneficial to the animal, however, if feeding patterns similar to its natural situation are followed. Thus scheduled feeding
times have been abolished at Woodland Park. They were, in any case, only
designated for the excitement and convenience of visitors who had little option
but to watch bored and inactive animals at all other times (Hutchins and Han-

The new naturalistic exhibits at Woodland Park have brought about some
unforeseen benefits. Monkeys will catch and eat insects attracted to flowering
vegetation in the enclosures, and dig up and consume other small creatures from
the soil. In other instances live prey is offered as a deliberate attempt to enrich
the animals' temporal existence. Moths released in the Nocturnal House generate
considerable excitement and activity for dourocoulis, greater and lesser galagos
and slow lorises (which are not necessarily always slow). Consumption of live
crickets is also important for a wide diversity of species and is thought to be a
critical factor in the successful breeding of some species, such as Hartlaub's
ducks. Live trout purchased from a fish farm are fed by the hundreds throughout
the year to bears, herons, penguins, sea lions and otters. The animals show great
enthusiasm in pursuing and eating live fish. Some of these fish are maintained in
areas such as the beaver pond and the water moats around primate exhibits,
which serve as "holding tanks" until the fish are larger. The animals thereby also
receive occasional changes in prey size.

In comparison with the behavioral benefits achieved, the cost of purchasing
live fish and insects (the moths are donated from the University of Washington) is
negligible. We anticipate that this program can be expanded and diversified.

Ironically, the public will accept live feeding of fish and insects—and it should be mentioned that such feeding would not be tolerated if their death were not instantaneous—but the attitude toward stimulating predators by feeding live mammals is not as clear-cut. Indeed, occasional complaints are received because some animals at Woodland Park receive whole carcasses of chickens, rabbits and sheep, and visitors often report, with much concern, that “the snowy owl is eating its mate” or “the snow leopard has caught a bunny rabbit.”

It seems that the public will accept that a human has killed an animal which is then offered for food, but cannot tolerate the idea of a tiger killing its own prey. The extent of this confused attitude even goes to the extreme of one zoo visitor who wrote a letter to a Seattle newspaper (which, mirabile dictu, actually printed it) complaining that whole chickens and rabbits were now being fed to the cats at the zoos, whereas in the old days they used to receive only “nice slabs of meat” (Seattle Post Intelligencer, April 21, 1977).

Natural foods undoubtedly offer significant benefits compared to total reliance on commercially prepared or pelleted food. At Woodland Park an adult ocelot had been plucking the hair from its own body, until whole bird carcasses were provided for him to pluck. A similar incident was reported by Desmond Morris at the London Zoo. The ocelot, when given a whole chicken for the first time, plucked off all the feathers and then began violently plucking the grass. Morris described the plucking behavior as “breaking like a dam” (Morris, 1964). Feeding whole sheep carcasses to snow leopards at Woodland Park also stimulates much activity. The cats spend much time playing with the carcass, pulling it apart, consuming it, and rolling in the skin afterwards. Even if live feedings are not possible, the occasional feeding of whole carcasses will provide the animals with an opportunity to engage in a wide variety of natural behaviors.

**People Problems**

An analysis of public objections to live feeding is useful, since we have found that some zoo visitors—though only a very small percentage—actually dislike the concept of naturalistic environments for animals, complaining that the animals can hide from view, take no interest in the observer, and are difficult to see among “all those plants.”

Several objections to live feeding could be caused by a variety of factors related to our material affluence. In several parts of the world cats and dogs are used as food, but in our society these animals enjoy high status. Affluence has also masked our own predatory large-scale food processing has divorced the act of killing from the eating of meat (Hutchins and Hancock, 1978-1979). Similarly, our view of wildlife is warped. Many people’s perceptions of wild animals are fashioned only, or at least mainly, from the zoo; this is now the only contact they have with nature. This fact alone should encourage all our efforts to improve the conditions in zoos, and to solve the behavioral problems of animals in captivity.

If, for instance, we cannot raise the consciousness of zoo visitors to accept the natural activities of predators, how will we be able to ensure these animals’ continued existence in the wild? And if, as many claim, zoos are to become
"genetic reservoirs" from which captive-bred animals will be reintroduced to rehabilitated habitats, how will they fare if they have never had the chance to learn any natural patterns of behavior in the zoo?

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References

Designs and Specifications for Livestock Handling Equipment in Slaughter Plants

Temple Grandin*

Abstract

Properly designed, maintained and operated livestock handling facilities are more humane and more efficient in ensuring a steady uninterrupted flow of livestock to the slaughter line, and will usually pay for themselves by reducing bruises, injuries and lost work time. Down time or lost work time in a large slaughter plant is expensive since a five minute delay can cost over $500 in lost meat production. Another benefit of good systems is increased safety for the employees; many serious accidents have occurred when agitated cattle turn and trample a handler.

Although specific recommendations vary for different species, certain general principles of equipment design should be observed in all cases. These include the provision of secure flooring and a smooth transition from yard to holding pen to restraint and stunning areas, as well as consideration of natural species behavior and the importance of minimizing stress when choosing a particular type of equipment.

The recommendations and information in this article are based on five years of observations and practical experience by the author in beef, pork and sheep slaughter plants, feedlots and ranches throughout the United States.

Cattle Facilities

Stockyard Layout

The stockyards at a beef slaughter plant should be able to hold the number of cattle which can be slaughtered on one 8-hour shift and should be designed so that all of the cattle traffic is one-way. A curved and diagonal stockyard layout will handle large numbers of cattle with a minimum of stress (Grandin, 1977).

The shape of the pen may be equally as important as the space allotted per animal (Grandin, 1978, 1980a; Strickland et al., 1979). The most efficient designs

FIGURE 1 — Diagonal layout for large beef stockyard. Each pen should hold one 50-head truckload of cattle and should not be longer than 80 ft (23.5 m). The drive alleys through which the cattle enter and exit should be 10-12 ft (3-3.5 m) wide. The pen gates should be 2 ft (0.6 m) longer than the drive alley width. The extended gate, when open at an angle, facilitates the flow of livestock. Both the entrance and exit gates on the diagonal pens should be constructed from solid materials to prevent the cattle from running into them.

utilize long, narrow pens which are constructed on a 60° angle (Grandin, 1977, 1979; McFarlane, 1976) [Figure 1]. In slaughter plants where area is limited or when a plant is being remodeled, the curved and diagonal layout may have to be modified. The pens may be laid out straight instead of on a diagonal, and although there will be a slight loss of efficiency, such a design is more efficient than a square pen stockyard. An existing square pen system may be improved by providing one gate for cattle to enter each pen and another gate through which the cattle exit. Another good design is the pie-shaped stockyard layout (Figure 2). The capacity of either layout can be increased or decreased by adding or subtracting pens. The diagonal layout will utilize the space inside a building more efficiently than a pie-shaped stockyard. The layout which will best fit the building site should be chosen.

Space allowances differ for steers which have been raised together in the same feedlot pen. For fed 1000-1200 lb (450-540 kg) steers, a minimum of 17 sq ft (1.6 sq m) is recommended for polled (Rider et al., 1974), and 20 sq ft (1.8 sq m) for horned steers (Grandin, 1979). Observations indicate that given these allowances, the animals do not appear stressed, and the incidence of dark cutting beef in the United States is only 0.5% in fed steers (Epley, 1975).

FIGURE 2—Round stockyard layout with pie-shaped pens. Each wedge-shaped pen will hold two truckloads (100 animals) in a space 80 ft (24 m) long, 28 ft (8.2 m) wide at the perimeter, and 14 ft (4.1 m) wide at the center. The animals enter through a drive alley along the perimeter and exit through a drive alley in the center which leads to the crowding pen and lead-up chute to the restrainer. If pens which will hold only one 50-head truckload are desired, each pen can be shortened to 50 ft (15.2 m).

(2.3-2.8 sq m) per animal, but a greater percentage of the animals are brought to the plant in small groups, and more space may be required if strange cattle are mixed. When new stockyards are being designed, the author recommends the English standards only for mature cows and bulls. Homogeneous groups of fed steers can be housed in a smaller space.

These pen space recommendations should serve only as a guide and should not be used as a basis for laws governing stockyard construction. Much more research needs to be conducted to determine the optimum space allowance for each animal, pen shape, pen size, and water trough locations to aid in minimizing stress to the animals.

After the cattle leave the diagonal pens, they pass into a curved holding alley (Figure 3) which holds one double deck truck load (50) 1000 lb (450 kg) steers. In plants slaughtering more than 80 cattle per hour, a curved holding lane with a capacity of at least 50 head of cattle is strongly recommended to ensure a steady supply of cattle to the crowding pen.

Crowding Pens

Cattle are moved out of the holding pens into a crowding pen before going into the slaughter plant. A crowding pen is a narrow pen which funnels into the lead-up chute. For cattle it is important that the transition between the crowding
The curved holding lane should have high solid fences, a handler catwalk along the inner radius, and block gates to keep different groups of cattle separated. The inner surface should be completely smooth to reduce or eliminate bruising. Small 18 in (45 cm) spring loaded mandoors should be located in areas with solid fences so that people can escape from the holding lane if the cattle chase them. Most animals can be moved by a handler working from the catwalk.

pen and the single file lead-up chute is gradual to prevent the animals from bunching and jamming. All crowding pens should have high solid sides, a solid crowding gate and be constructed from either concrete or steel so that they can be easily washed. A catwalk should be provided alongside the crowding pen and along the inner radius of the single file lead-up chute. Overhead catwalks should be avoided. The recommended catwalk dimensions are 42 in (100 cm) from the catwalk platform to the top of the fence (Figure 3). In plants where the single file chute is inside the building and the crowding pen is outside, the single file lead-up chute should extend at least 15 ft (4.5 m) past the beginning of the building since cattle will enter the building more readily if they are already lined up in single file.

The circular crowding pen (Figure 1) is usually more efficient than the funnel pen. The circular pen has a crowding gate which swings around a central post, and the gate is equipped with a ratchet latch mechanism. The crowding gate, which forms the radius of the pen, should not be shorter than 12 ft (3.5 m) nor longer than 14 ft (4.1 m) and for greater efficiency and increased safety for the drover, be equipped with a hydraulic drive unit to advance and open the gate. The crowding gate never should be used to push the cattle up the single file lead-up chute by force, and sufficient area should be provided for cattle to turn around. Funnel pens which are 10 ft (3m) wide are recommended for smaller
plants and plants where a circular crowding pen cannot be accommodated in a small restricted space. On a funnel crowding pen, one side of the funnel should be a straight continuation of the single file leadup. The other side of the funnel should be on a 155° angle in relation to the lead-up chute (Grandin, 1976a). This configuration should not be used for pigs — both sides should be angled.

**Lead-Up Chutes**

The most efficient single file lead-up chutes to the stunning pen are curved, with an ideal inside radius of the curve being 17 ft (5 m), but not tighter than 12 ft (3.5 m). The last 6-10 ft (1.8-3 m) of the curved chute (where it joins the stunning pen entrance) should be straight to orient the animal directly into the stunning pen or restrainer.

In plants which slaughter 175 cattle per hour or less, a curved single file chute is strongly recommended. In very high-speed plants which handle 175 to 300 cattle per hour, a straight single file chute can be used efficiently since the animals are always kept moving and their natural following behavior will facilitate the flow along the straight chute. If space permits, a gentle curve is recommended. For large steers (over 1000 lb; 450 kg), the sides of the chute should be vertical and spaced 30 in (75 cm) apart. "V"-shaped lead-up chutes are recommended in plants which handle a variety of different sized cattle weighing under 1000 lbs (450 kg). Recommended dimensions are 20 in (50 cm) bottom; 32 in (80 cm) top, with the top measurement taken at 5 ft (1.5 m) level (Grandin, 1979, 1977).

Slaughter plant designers should avoid constructing a single file lead-up chute which is too short. The chute should be long enough to take advantage of the animal's natural following behavior. Observations indicate that there is an optimum ratio between single file lead-up chute length and the number of cattle slaughtered per hour (Table 1). A plant will usually be more efficient and humane if these recommended lengths are adopted. In a 100-cattle per hour plant, a 100 ft (30 m) lead-up chute will hold 20 fed steers which will take 12 minutes to slaughter. If the drovers and handlers have a problem with balky cattle, they have

### TABLE 1 — Optimum Ratio between Single File Lead-Up Chute and Number of Cattle Slaughtered

<table>
<thead>
<tr>
<th>Number Cattle/Hr</th>
<th>Length of Chute*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 to 20</td>
<td>20 ft (6 m)</td>
</tr>
<tr>
<td>20 to 50</td>
<td>50 ft (15 m)</td>
</tr>
<tr>
<td>75</td>
<td>75 ft (22 m)</td>
</tr>
<tr>
<td>100</td>
<td>100 ft (30 m)</td>
</tr>
<tr>
<td>150</td>
<td>150 ft (45 m)</td>
</tr>
<tr>
<td>175</td>
<td>175 ft (52 m)</td>
</tr>
<tr>
<td>Over 200</td>
<td>200 ft (60 m)</td>
</tr>
</tbody>
</table>

* Length 100 ft (30 m) or over can be divided between two lead-up chutes.
sufficient time to correct the problem and prevent rought treatment of the animals.

In large plants where over 100 cattle are slaughtered per hour, the installation of two single file chutes side-by-side is recommended. If the animal lies down in one of the lead-up chutes, the plant can still continue to operate while the downed animal is being removed. A double lead-up chute in a high speed plant will help prevent the cruel practice of allowing cattle to walk over the top of a downed cripple.

To prevent the cattle from backing up in the lead-up chute, one-way gates should be installed (Figure 4). One-way gates are superior to vertical sliding gates since they reduce bruising, although a sliding gate is a necessity at the stunning pen entrance. Vertical sliding gates, counterweighted to prevent slamming cattle and padded on the bottom, are recommended over horizontal sliding gates, especially for fed steers to avoid bruises. Horizontal sliding gates which are easier to operate may be used in plants handling calves.

Flooring

In order to prevent the cattle from falling down and injuring themselves, concrete floors in stockyards, scales and crowding pens should be deeply scored to make them nonskid. The recommended groove pattern for new construction is a pattern of 8 in (20 m) diamonds with grooves 1-2 in (2.5-5 cm) deep. In existing stockyards, where the floors have been worn smooth by the animals, grooves can be chipped in the floor with a pneumatic hammer. If this is not possible, a grid of 1 in (2.5 cm) steel rods can be constructed instead, however smaller rods should not be used.

Restraining and Stunning of Cattle

In order to stun an animal humanely, it must be restrained in either a stunning pen or a restrainer which should not be located directly in the slaughtering room. The more the animal can be kept isolated from the noise and blood odors of the plant, the calmer it will remain.

Stunning pens: A common type of stunning pen for cattle consists of a narrow stall with solid sides where the stunner operator reaches over the top of the pen to stun the animal (Figure 5). Such a pen is humane as long as only one animal is placed in the pen at a time. There are several techniques which can be employed to help keep the animal still for accurate humane stunning. A light installed at the front of the stunning pen will cause the animal to look up whereby it can be easily stunned. A better technique is to cut a small 12 x 12 in (30 x 30 cm) window in the front wall and place a diffuse, nonglaring, light behind it. The bottom of the window should be 3 ft (0.9 m) from the floor. Most cattle will stand and look out the window, which makes the stunning easier and more efficient. The window will also entice the animals to enter the pen; however, the window should not look out into the slaughter room. Another method is to install either a neck stanchion to restrain the head or a movable squeeze side.

A multi-animal stunning pen is not recommended, and in the author's opinion, is not humane. In some of the larger plants in the United States two or three animals are placed together in a single long compartment. The economic loss
FIGURE 4—One-way gates. The gate is counter balanced, and the animal pushes it up and walks through; the gate will then close automatically behind the animal. One-way gates should be placed 18-20 ft (5.4-6 m) apart, the first located approximately 6-10 ft (1.8-3 m) beyond the entrance to the single file lead-up chute. A gate located at the transition point between the lead-up chute and the crowding pen may cause cattle to balk. The one-way gates should be constructed so that cattle can see through them.

caused by bruising and safety hazards to employees in this kind of system will usually enable a plant to replace the multi-animal stunning pen with a more humane system and pay for the new equipment within two years.

Conveyor Restrainer: In plants where 100 to 300 fed steers or mature cattle are slaughtered per hour, the system of choice in all new construction is the conveyor "V" restrainer system manufactured by Cincinnati Butcher's Supply Company [Helen and Blade Sts., Cincinnati, OH] (Figure 6). The first conveyor restrainer system for cattle was constructed at Armour & Company in Omaha, Nebraska (Edwards, 1971; Schmidt, 1972; Willems and Markey, 1972). It is one of
FIGURE 5—Beef stunning pen. The recommended dimensions (Hantover, 1975) are 8 ft (2.4 m) long for up to 1300 lb (585 kg) cattle and 10 ft (3 m) long for over 1500 lb (675 kg) bulls, and narrow enough to prevent the animal from jumping or turning around. The inside dimensions are 27 in (69 cm) wide at the bottom and 32 in (81 cm) at the 5 ft (1.5 m) level from the floor.
the most humane, efficient and safe systems and is recommended for all large plants which slaughter fed steers and mature cows and bulls. The system is not recommended for emaciated animals or for small thin calves.

The conveyor restrainer system is expensive, costing in excess of $100,000 to install, but in many over 100 head per hour slaughter plants, it can pay for itself in less than three years, and in some instances, in less than two years. Several conveyor restrainers have been installed in existing plants which were using multiple animal stunning pens. One plant which was slaughtering 165 fed steers per hour in a multiple animal stunning pen eliminated serious injuries to its employees after replacement of the pen with a conveyor restrainer, and the system also reduced bruise and trim losses.

Even though the major components of the system are commercially available, many critical parts of the system have to be constructed at the plant, and proper installation and construction is essential for a humane, safe and efficient system. A well designed approach chute with a ramp (not exceeding a 20° slope) and small stair steps provides the most positive footing for the cattle. The steps should have a 3.5-4 in (9-10 cm) rise and a 12 in (30 cm) tread width. The steps must be grooved to prevent slipping (Grandin, 1979). The point at which the single file lead-up chute joins the conveyor restrainer is critical. There should be a smooth and gradual transition between the vertical approach chute sides and the "V" shape of the conveyor restrainer. The approach chute should be tapered only on the bottom where it joins the conveyor restrainer and it should be level for at least 6 ft (1.8 m) and have a cleated nonskid floor. This enables the animal to be on a level surface when it enters the restrainer (Figure 6).

A hold down guard rack, which can be adjusted for different size cattle,
should be installed to prevent the cattle from jumping up on each other (Figure 7) [Grandin, 1976b]. The rack also forces the cattle to settle down into the conveyor.

If extremely fat cattle are being slaughtered, the floor of the restrainer entrance may have to be raised to enable the animal's briskets to clear the narrow "V" formed between the bottom of the conveyors. All restrainer systems should be equipped with a small declining entrance ramp (Figure 6) at the restrainer entrance. As the cattle walk into the conveyor restrainer, they walk down the declining ramp which is located in between the two conveyors which form the restrainers. This enables the conveyors to ease in the animals. The recommended angle for this ramp is 25-30° (Grandin, 1976b).

After stunning and shackling, the animal is discharged from the conveyor restrainer onto a downward sloping 'take away' conveyor (Figure 8). An inclined conveyor hoist then transports the animal to the bleeding area. The inclined hoist which conveys the stunned cattle to the bleed area should be angled over the moving conveyor instead of being located alongside it. This keeps the stunned animal centered on the moving conveyor and it helps to maintain tension on the leg chain. In order to avoid jamming where the shackle trolleys enter the base of the inclined conveyor hoist, it should operate at a higher speed than the conveyor restrainer.

Some large plants have eliminated the inclined hoist conveyor by building the conveyor restrainer at the same height as the bleeding rail. Even though this
FIGURE 8 — Stunned animal being discharged from the conveyor restrainer onto a downward sloping ‘take away’ conveyor. The slat conveyor or a belt conveyor of the same basic dimensions is the best type system. The moving conveyor should be 16 ft (4.7 m) for short shackle chains, at least 18 ft (5.15 m) for longer shackle chains, and 5 ft (1.5 m) wide. The angle of the conveyor must not exceed 15° to prevent a jerky operation.

FIGURE 9 — The diagram illustrates a kosher version of the restrainer with a chin lift. For nonkosher slaughter, the chin lift would be removed. The lifting chute restrainer consists of two solid stationary sides which form a “V” which is open on the bottom. After the animal enters, the entire restrainer lifts up and the animal is securely restrained with its feet hanging out through the bottom. The system does not contain conveyors and up to 100 animals could be stunned per hour with a captive bolt.
eliminates the inclined hoist conveyor, this type of system has many problems. A much longer ramp is required to get the cattle up to the 16-18 ft (4.7-5.15 m) bleed rail height, and this type of installation requires more floor space. Observations in plants with the high type restrainer system indicate that it has no advantages over the standard system using the inclined conveyor hoist. The high type system is not usually recommended for new installations.

**Lifting Chutes:** Plants which slaughter 30-100 fed steers or mature cattle per hour should consider using a nonkosher version of the lifting chute (Figure 9). A prototype version constructed by Cincinnati Butcher's Supply Company indicated that it provided many of the advantages of the larger, more expensive restrainer systems at a quarter of the cost for smaller plants. The design of the restrainer was further developed by the author to make the system practical. The lifting chute would also make the shackler's job much safer, and since the animal is securely held in the restrainer, the stunner operator can stun more accurately.

**Pig and Sheep Facilities**

**Stockyard Layouts**

The same basic layouts for cattle can also be used for sheep or pigs. However, there are two important differences: pork stockyards usually have to be under a roof to protect the animals from weather extremes, and they need to have facilities for waiting pens (Figure 10). When the pigs arrive at the plant, the smaller market pigs are often mixed with large sows and boars and must be sorted before the animals are weighed and marked to identify their owner. This process is time consuming. The waiting pens allow trucks to unload the pigs and thus prevent the animals from becoming overheated from standing in parked trucks. A sorting chute facilitates the separating of market pigs, sows and boars. All pork stockyards must be equipped with either sprinklers or foggers to keep the pigs cool during hot weather (Grandin, 1980b)

**Crowding pens**

A round crowding pen (Figure 11) is one of the most efficient ways to force either sheep or pigs into the single file lead-up chute. A jointed articulated gate is used to urge the animals toward the funnel entrance which leads to the single file chute. For sheep it is important that there be a gradual transition between the round crowding pen and the lead-up chute in order to avoid bunching and jamming. For pigs it is strongly recommended to have two or three lead-up chute entrances side-by-side to prevent the pigs from jamming and fighting over a single entrance. Research conducted in Europe indicated that when only one entrance is used, the pigs will enter more easily if the transition between the lead-up chute and the crowding pen has a stair-step shape. This forces one pig to wait while another enters (Hoenderken, 1976; W. Sybesma [Research Institute for Animal Husbandry, Netherlands] personal communication). Articulated gates should not be used with cattle due to the strength and size of these animals, but a jointed crowding gate is more efficient than a straight crowding gate for sheep and pigs. In plants where space is limited the funnel shaped crowding pen can be used for either pigs or sheep. However, it is recommended that the funnel crowding pen width be decreased to 8-10 ft (2.4-3 m).
FIGURE 10—Design for pork stockyard with one-way traffic and a diagonal (60° angle) layout which can be constructed in a rectangular building. The stockyard layout shown has an 1800 pig capacity based on 5 sq ft (0.46 sq m) per pig. In warm weather, when the temperature is over 80°, each pig should be allowed 7 sq ft (0.65 sq m). As discussed in the section on cattle, pen shape may be just as important as the square footage allotted per animal. The Meat and Livestock Commission in England (1974) recommends 6 sq ft (0.56 sq m) for market pigs weighing under 250 lbs; sows and boars should have 8 sq ft (0.74 sq m). The Meat and Livestock Commission (1974) recommends 6 sq ft (0.56 sq m) per animal for sheep in the holding pens. The drive alleys for driving groups of sheep or pigs should be 8-10 ft (2.4-3 m) wide.
Lead-Up Chutes

The dimensions of the single file lead-up chute for both sheep and pigs are basically the same, 18 in (46 cm) wide or a commercially available tapered chute. There are some important differences. For sheep, the single file lead-up to the stunning area definitely should be curved (Court, 1976). The recommended inside radius is 12-17 ft (3.5-5 m) for sheep, while for pigs the curve is not important. Another basic difference is that pigs can be handled more easily with a minimum of excitement in short (25-35 ft; 7.4-10.5 m) single file lead-up chutes as compared to longer (50 ft; 15 m) single file chutes for sheep. For pigs, two or three lead-up chutes side-by-side are recommended (Figure 11).

For both sheep and pigs the single file chute should have solid outer sides although where two single file chutes are located adjacent to each other, the common fence in between should permit the animals to see through so that when an animal moves up, the animal in the adjacent chute will also move up (Grandin, 1980a). All one-way gates, sliding gates and divider gates in the single file chute should be constructed so that the animals can see through them (Court, 1976). In pig single file chutes, one-way gates installed every 10 ft (3 m) will prevent the animals from backing up or bunching toward the rear of the chute.

The movement of the animals through the single file chute can be highly automated. One of the best types of automatic systems for driving pigs through the single file chute is a series of electrified chains which are hung at 10 ft (3 m) intervals in between the one-way gates. The chains can be connected to a timing device which will electrify each chain for about 1 second in a sequential series. There are large differences in body resistance of pigs and their response to electric prods or chains; therefore, the charge on the chains should be set as slow as possible to make the pigs simply move away and not violently jolt the animal. This system is more humane as it reduces the number of handlers poking the pigs.

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**FIGURE 11**—Round crowding pen diagram. The recommended diameter for the round crowding pen for either pigs or sheep is 12-16 ft (3.5-4.7 m). The walls of the crowding pen should be at least 36 in (90 cm) high. If sows or boars, or rams will be handled the sides should be raised to 42 in (105 cm). In plants where pigs are skinned instead of being scalded, a shower pen is required to clean the animals prior to slaughter. When the shower pen is used in a cold climate, it must be in a fully enclosed, draft-free building to prevent the animals from becoming chilled.
with electric prods; however, the electrified chain system is not recommended for sheep.

**Flooring**

The flooring in a pork stockyard should be broom-finish concrete and not deeply scored; deep grooves in the floor will hurt the pigs’ feet. (A broom finish is made by brushing wet cement with a broom before the concrete sets.) A large majority of swine in the United States are raised in confinement and will move more easily on a concrete floor. Wood or metal should not be used on the floor in a pork stockyard as the animals tend to hesitate and slip on such surfaces. Drains should be located around the perimeter of the stockyards outside the alley and pen fences so that the animals do not have to cross over them.

In a sheep stockyard the floor should be grooved with a diamond pattern. The grooves should be 1/2 in (1.25 cm) in depth and spaced 4 in (10 cm) apart. A good method of grooving the floor is to push a grid made from 1/2 in (1.25 cm) rods into the wet cement to form the pattern.

**Restraining and Stunning for Pigs and Sheep**

**General:** The transition between the single file lead-up chute and the restrainer entrance should be smooth and gradual to prevent bruising and jamming. The sides of the single file chute should gradually slope to conform to the “V” shape of the conveyor restrainer, and the same basic design as the restrainer equipment for beef cattle can be used for pigs and sheep. The different types of equipment which can be used to restrain pigs and sheep for either electrical or captive bolt stunning are discussed.

Before the advent of stunning methods for pigs and sheep, these animals were herded into a shackling pen and hung by one rear leg on the shackles while they were still fully conscious. Shackling fully conscious animals and then hoisting them up in the air is both cruel and inefficient. Before the large plants in the United States started stunning pigs, many hams were ruined because struggling pigs jerked their joints apart (National Provisioner, 1956). However, some older slaughter plants still use the shackling pen, although they do apply an electric stunner to the animal before hoisting.*

It is nearly impossible to place the electrodes correctly on a pig’s head when the animal is running around in the shackling pen, and it is labor-inefficient. The excitement and commotion spreads to all the pigs in the shackling pen, which increases the chance of injury. It has been reported that, in large (5,000-16,000 pigs per week) pork slaughter plants in Germany using a restrainer, the animals had no shoulder fractures during electrical stunning while pigs electrically stunned without a restrainer had 1.5-2.2% shoulder fractures (Van der Wal, 1976; D. Arendale [Electronics Unlimited, Memphis, TN] personal communication).

Large slaughter plants which slaughter 100 or more sheep per hour should use the conveyor restrainer system for either captive bolt or electrical stunning. In small slaughter plants for sheep, the group stunning pen, used in conjunction with electrical stunning, appears to be a good method from a handling stand-

*Stunning methods will be presented in Int J Stud Anim Prob 1(4), 1980.
point. Sheep are gentle animals and do not jump around and fight as pigs do. The pen should have a crowding gate so that the sheep can be kept together and stunned without having to be chased. As the crowding gate is advanced, the sheep nearest the fence are stunned and then removed through a flexible flap, similar to the flap in a shearing shed. Group handling may be less stressful because the sheep can remain together as a flock (Kilgour, 1976 and 1978). If more than 30 sheep per hour are being stunned by captive bolt, a restrainer definitely should be used because accurate placement of the stunner is extremely difficult unless the animal is relatively still.

When a decision is being made concerning the most humane and efficient system, one must examine the whole system. The group stunning pen is a situation in which there is a trade off between electrical stunning accuracy and pre-stunning stress. It may be better to lose some stunning accuracy, but reduce the prestunning stress of being isolated. The humane stunning of sheep is a controversial subject and it will be discussed in issue No. 4 of this journal.

Conveyor systems: The best system for slaughter plants which slaughter more than 100 pigs or sheep per hour is the conveyor restrainer (Figure 12) which can be used with either electrical or captive bolt stunning. This system was first patented in 1936 by R.W. Regensburger of the American Institute of Meat Packers. In a pig or sheep conveyor restrainer system, the stunned animal is shackled after being ejected from the restrainer. There are three different types of shackling and bleeding systems which can be used with the conveyor restrainer (Table 2): 1) The animal can be shackled after stunning and ejection from the conveyor restrainer and then hung to bleed; 2) After ejection from the conveyor restrainer, the animal is bled on a long conveyorized table; 3) The stunned animal is ejected from the restrainer and is immediately bled while lying prone on a short moving slat conveyor and then shackled (Figure 13). The advantages and disadvantages of each system are given in Table 2.

When market pigs (200-250 lb; 90-110 kg) are being slaughtered, the hold down rack on the conveyor restrainer should be installed level, and there should be approximately 25 in (62 cm) from the underside of the hold down rack to the inside bottom edge of the conveyor restrainer flights. When the rack is in the full down position, it should be level. The rack should not be sloped like the one on the beef restrainer. The hold down rack should cover approximately three quarters of the length of the 14 ft (4.1 m) long conveyor restrainer. This will ensure that the pigs or sheep are settled down into the conveyor restrainer and thus be less likely to jump out. The hold down rack should be spring-loaded so that it will give when the animals push against it. This is especially important for pigs. When large sows and boars are being slaughtered, the hold down rack will need to be raised 6-8 in (15-20 cm).

For both pork and sheep slaughter operations, the conveyor restrainer should be equipped with a foot switch which will enable the stunner operator to stop, start and reverse the conveyors. The reverse feature will help prevent an unstunned animal from escaping. For electrical stunning of pigs, the restrainer should be electrically insulated from the ground. If the pigs are electrically grounded, current leakage to ground may make humane stunning impossible. The bolts in the wooden slats on a pig restrainer should be countersunk and
FIGURE 12—Conveyor restrainer for pigs. The conveyor restrainer is the best system for plants slaughtering 100 or more pigs or sheep per hour. A restrainer for pigs or sheep should be installed on a 10-15° upward angle from the restrainer entrance. This reduces the length of the lead-up ramp. A cattle restrainer, however, should be level.

plugged with a nonconductor. Other types of restrainers should be lined with rubber conveyor belts or plastic material. Small metal restrainers can be placed on insulated mounts. Insulating the restrainer is often not necessary for sheep because wool itself is an insulator. The area where the operator of the electric stunner stands should be kept dry and the surface insulated.
## TABLE 2 — Shackling and Bleeding Systems for Conveyor Restrainers for Pigs and Sheep

<table>
<thead>
<tr>
<th>System Type</th>
<th>Animal</th>
<th>Labor*</th>
<th>Layout and Cost</th>
<th>Meat Quality (Stress)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shackle first</td>
<td>Sheep</td>
<td>4—5</td>
<td>40 ft (12 m) lineal floor space. Can be either straight or L-shaped.</td>
<td>This system has the longest interval between stunning and bleeding, which is undesirable from a meat quality standpoint for pigs. If an animal is improperly stunned, it could be shackled while conscious. This system must be used if edible blood is collected. A good system for sheep stunned with captive bolt.</td>
</tr>
<tr>
<td>Bleed hanging</td>
<td>Pigs</td>
<td></td>
<td></td>
<td>For pigs the interval between stunning and bleeding is shortened which will help improve meat quality (Calkens et al., 1980; G.W. Davis [Univ Tenn] personal communication; Scheper, 1977; Van der Wal, 1978). No possibilities of a conscious pig being shackled and ham damage caused by jerking because the shackle is eliminated. Cannot be used if edible blood is collected, however, prone bleeding may enable more inedible blood collection.</td>
</tr>
<tr>
<td>Prone bleeding</td>
<td>Pigs (Only)</td>
<td>3-4</td>
<td>Requires over 100 ft (30 m) of lineal floor space. Costs two to three times as much as the other two systems.</td>
<td>This system is recommended for most pork plants. It has the benefits of a shortened interval between stunning and bleeding in a system which is less expensive. Cannot be used for edible blood collection. Not usually recommended for sheep because the larger throat incision can be contaminated on the moving conveyor.</td>
</tr>
<tr>
<td>No shackle (Only)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prone bleeding</td>
<td>Pigs (Mainly)</td>
<td>4-5</td>
<td>40 ft (12 m) lineal floor space. Can be either straight or L-shaped, although L-shape is best layout.</td>
<td></td>
</tr>
<tr>
<td>Then shackle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Under 300/hr use low figure; Over 300/hr use high figure; Labor for driving, stunning, shackling and bleeding.
In existing slaughter plants which slaughter more than 20 pigs per day it is strongly recommended that a pig restrainer be installed to individually restrain each animal. A pig restrainer is recommended for all new small plants. For slaughter plants handling up to 50 pigs per hour a rotating cradle type restrainer which is distributed by Alpha International Corp. [118 E. 28th St., New York, NY] can be used. The restrainer consists of two “V” shaped stationary sides. After the pig enters the restrainer the weight of the animal or the stunner operator tripping a lever causes the floor to drop away. The pig is now held in the “V” shape of the restrainer. After stunning, the pig is ejected by rotating the restrainer.

For plants slaughtering 30 to 100 pigs per hour a more automated version of the cradle type restrainer can be obtained from the Cincinnati Butcher’s Supply Company. After a pig enters this unit, the floor drops away. The stunned animal is then ejected by flipping the bottom of the restrainer. The Cincinnati restrainer can be automated with an air cylinder to roll out the animal. There should not be any set rules for determining which system should be used. Each individual plant should be individually evaluated. A system which is very stressful in the hands of one person may result in minimal stress in the hands of another person. It would be a grave mistake to attempt to legislate exact systems for handling sheep and pigs in small packing plants.

Another type of restrainer which can be used on either pigs or sheep is the squeeze box system. It was originally patented by Edgar E. Moss in 1962. This
system consists of a "V" shaped restrainer with padded sides. After the animal enters it is restrained by being squeezed by the side panels. The stunner operator trips the squeeze by releasing a foot switch.

The squeeze box system can handle 30 to 200 animals per hour. It is less expensive and requires less floor space than the conveyor restrainer system. It is recommended for medium sized plants which do not have enough floor space for a conveyor restrainer.

**General Requirements for Livestock**

**Unloading Chutes and Ramps**

Unloading chutes at a slaughter plant should be designed to accommodate double deck tractor trailer trucks which unload through either the rear or the side (Figures 14A and B). When a new unloading dock is being constructed, sufficient space should be provided for both rear unloading and side unloading trucks to maneuver (Stevens and Lyon, 1977).

![Image A](image1.png)

**FIGURES 14 A and B — A.** Wide straight chute for unloading only. **B.** Adjustable unloading ramp for hogs and sheep. The sides of all types of unloading chutes should be solid to prevent the animals from seeing out and becoming frightened or distracted by people and moving objects outside the chute. All structural members should be on the outside of the chute to prevent bruises; the inside is smooth metal or wood. All unloading chutes should be equipped with telescoping side panels or a wing gate to block the gap between the end of the chute and the vehicle to prevent any animal from trying to escape through the gap. A crossover bridge ("bull board") to block the floor gap will prevent serious leg injuries.
Since the unloading chute at a slaughter plant is used for unloading only, it should be wide and straight to allow the animals to see a clear path of escape in front of them. (A wide straight unloading chute must never be used for loading livestock into a truck with a narrow door.) The recommended width for permanent, nonadjustable unloading-only chutes at a slaughter plant for all species of livestock can vary from 6-10 ft (1.8-3 m).

For all species of livestock the unloading chute should have a flat landing at the top (Stevens and Lyon, 1977). This will provide the animals with a flat surface on which to walk when they first step out of the truck. This is especially important in a truck which unloads through the side because the animals have to turn a 90° corner inside the truck before exiting. For large cattle it is recommended that the flat landing at the top of the ramp be at least 5 ft (1.5 m). For all species of livestock, stairsteps are recommended. The steps should have a 3.5 in (9 cm) rise and a 12 in (30 cm) tread width. For pigs and sheep the minimum flat landing would be 3 ft (1 m), and unloading facilities must be available for unloading top decks of the trucks.

Slopes in Stockyards

For all species of livestock the crowding pen where the animals enter the single file lead-up chute must never be sloped. If the pen is sloped downward away from the entrance of the lead-up chute, the animals will tend to pile up against the back crowding gate. The crowding pen should be almost level except for a 1/4 in (0.6 cm) slope every 12 in (30 cm) for drainage. The drainage slope will not affect the handling of the animals in the crowding pen. If the crowding pen is sloped in an existing plant, the animals should be provided with a nonslip floor. Installation of a steel grid or chipping grooves in the concrete floor can help.

When a new plant is being designed, it is usually necessary to build a ramp from the level of the stockyard up to the level of the restrainer or stunning pen. All species will move very easily up a ramp in single file, and it is safe to leave the animals standing on a ramp when they are lined up in single file. The best location in the system for the ramp is in the single file lead-up chute; however, the angle should not exceed 20°. Stairsteps are recommended for an angle over 10°.

In some slaughter plants ramps have to be built in the drive alleys to transfer the animals from the stockyard area to a higher level. In these situations, it is not practical to line the animals up in single file to walk up the ramp. All species of livestock will walk readily up a wide ramp, but they will tend to bunch up and possibly fall down if they are left standing on a wide upward sloping ramp. The animals must be kept moving in an even, steady flow. If animals have to be left standing, they should be driven to a portion of the drive alley which is level.

Ante-Mortem Examination and Suspect Area

The U.S. Department of Agriculture (USDA, 1976) requires that a restraining device be installed so that the veterinary inspector can examine and take the temperature of sick animals. They also require a pen in which to put animals that are diseased or in poor health. This is called the “suspect” pen. In stockyards which are located outdoors, the examination area should be covered with a roof.

All slaughter plants for all species must be equipped with an easily accessible entrance where crippled animals can be brought in. In beef plants the cripple
door should be located in the shackling area and in pork and sheep plants it should be located by the shackling and bleeding station. In new plants the system should be designed so that the cripple door can be reached without having to walk up either a ramp or steps. Pigs and sheep can be brought to the cripple door in a wagon or a modified wheelbarrow. Cattle which are too severely injured to walk to the cripple door should be stunned in the stockyards or on the truck before being dragged to the cripple door.

References


Hoenderken, P. (1975) Revolving stunning pen door, Drawing No. 75123, Hantover Inc., Kansas City, MO.


New UK Proposal on Lab Animals

The Select Committee of British Parliament which has been reviewing Lord Halsbury’s Laboratory Animals Protection Bill [See Int J Stud Anim Prob 1 (1):54-56, 1980] is now examining a suggestion made by Professor Robert Hinde of the Association for the Study of Animal Behaviour to create two separate bills on laboratory animal use: one regulating scientific research and the other regulating product safety testing.

Jeremy Cherfas explained the rationale for such a division in a recent issue of New Scientist (85:634, 1980). According to Cherfas, fundamental differences in approach as well as in value and predictability of results mandate separate consideration and control of the use of animals in basic research, which can lead to new medical knowledge, and routine, bureaucratised product testing, which satisfies legislative imperatives without necessarily improving product safety. Indeed, the LD50 acute toxicity test and the Draize eye irritancy test, both of which use live animals, have been criticized in Britain and the United States for their often inconclusive results and thus questionable utility in determining the safety of products for human consumption.

Cherfas acknowledges that public demand for government involvement in product safety testing necessitates the death of a certain number of animals, but argues that new legislation could help ensure that the smallest number is used in procedures which, through review of existing regulations, can be streamlined to eliminate or reduce tests of dubious value.

Biomedical research, on the other hand, will do better under legislation which guarantees that the needs and rights of animals are considered by researchers who choose to use them, but also preserves the freedom to make that choice.

US Predator Control Policy

Secretary of the Interior Cecil Andrus has issued a document stating the goals of the United States Fish and Wildlife Service’s Predator Control Program as follows:

1. In the near term, preventative control should be limited to specific situations where acceptable high levels of losses have been documented during the preceding 12 months. In the long term, through additional research, our goal should be to minimize and phase out the use of lethal preventative controls, including creation of buffer zones;
2. Emphasize corrective control, utilizing nonlethal, noncapture methods and focusing on offending animals to the greatest degree possible;
3. Reduce conflicts between predators and livestock by encouraging the use of appropriate livestock husbandry techniques which decrease exposure of livestock to predators;
4. Expand the availability of extension services to ranchers;
5. Deploy resources to locations and in seasons of greatest need;
6. Redirect and refocus research efforts to support the above goals and to achieve the long-term objective of preventing predator damage rather than controlling predators.

In addition, Andrus placed the following restrictions on the use of certain techniques:

1. The practice of denning should be eliminated;
2. The use of aerial shooting, particularly in winter, should be tightly controlled to achieve policy goal (1) above;
3. All efforts will be made to utilize traps in the most selective and humane manner possible, through such practices as the use of tension devices, prohibition of bait sets, and frequent checks of traps;
4. There will be no further research or development of potential uses of Compound 1080. However, research may be continued on other toxicants that do not have secondary effects, are selective and humane.

Although denning (management jargon for the killing of cubs still in the den) is eliminated in these restrictions, no provision is made for the humane disposal of cubs if a lactating female is taken. This loophole introduces the possibility of continued de facto denning by local predator control personnel.

Andrus also called for a five-year research program on nonlethal control methods and animal husbandry techniques and practices.

(Abstracted from the *The Humane Society of the United States News* 25:19, 1980.)

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**MEETINGS and ANNOUNCEMENTS**

**FORTHCOMING MEETINGS**

**Ninth International Congress on Animal Reproduction and Artificial Insemination:** June 16-20, 1980, Madrid, Spain. Contact Dr. Tomas Perez Garcia, INIA, Crida 06, Departamento de Reproduccion Animal, Avda. de Puerta de Hierro s/n, Madrid-3, Spain.


**American Society of Animal Science:** Annual Conference, July 27-31, 1980, Cornell University, Ithaca, New York. Will include a symposium co-sponsored by the Institute for the Study of Animal Problems on "The Role of Animal Behavior in Agriculture." Contact Dr. Clifton A. Baile, University of Pennsylvania School of Veterinary Medicine, 382 West Street Road, Kennett Square, PA 19348, USA.

American Association for Laboratory Animal Science: 31st Annual Session, October 5-10, 1980, Indianapolis, Indiana. Contact Mr. Joseph J. Garvey, Exec. Secy., AALAS, 210 N. Hammes Ave., Suite 205, Joliet, IL 60435 USA.

Israel Association for Buiatrics: Eleventh International Congress on Diseases of Cattle, October 20-23, 1980, Tel Aviv, Israel. Contact Dr. E. Mayer, Congress Secretariat, P.O. Box 9610, Haifa, Israel.

MEETING REPORTS

BSAVA Symposium

The British Small Animal Veterinary Association (BSAVA) held a symposium on the Human-Companion Animal Bond in London on January 24-25, 1980. Long neglected or taken for granted, the human-animal bond was dissected and explored by over a dozen speakers whose backgrounds included veterinary medicine, psychiatry, anthropology, ecology and sociology.

The symposium opened with an historical review of the relationship between man and other animals by Michael W. Fox (Institute for the Study of Animal Problems). This paper emphasized how perceptions, attitudes and values influence the man-animal relationship, contemporary abuses, and societally condoned unethical animal exploitation. Following a cautionary note on misguided ‘naturalism’, he described what he terms ‘actualizing relationships’ and developed the concept of responsible humane stewardship.

Victoria Voith (University of Pennsylvania) discussed animal behavior problems that can arise from animal-human attachment and how to take preventive measures with animals that are used in pet facilitated therapy. She also noted that 90% of clients use parental expressions when addressing their animals, e.g., “Come to Daddy,” etc.

Giseler Guttman (University of Vienna) gave an intriguing review of his studies in Vienna of people’s attitudes toward pets. He reported four major characteristics of pet owners: they regard the companion animal as someone with whom to talk; they find it acceptable to keep the animal without the company of its own species; they enjoy providing the care involved in pet owning; and in contrast to non-pet owners, they would be less likely to keep a pet if friends did not approve. Non-pet owners were more concerned about disease hazards and loss of personal freedom, and they did not value an animal as someone with whom to talk.

Michael McCulloch (Oregon State University) gave a particularly stimulating paper on the benefits of pet ownership for chronically ill and depressed outpatients. He urged that more emphasis be given in veterinary and medical schools to the pet-owner bond. A veterinarian should have some knowledge of the pet’s family background and be more sensitized to the emotional impact of animal euthanasia. In this connection, Leo Bustad (Washington State University) presented guidelines for a veterinary school curriculum tailored to promote a greater understanding of the pet-owner relationship. Dr. McCulloch concluded that pets give joy, make people feel needed, improve morale, and help maintain a sense of humor in chronically ill and emotionally disturbed patients.

Jules Cass (Veterans Administration) gave an overview of pet facilitated therapy (PFT) in the Veterans Administration hospital setting. He
observed that PFT meets the requirements of being biologically safe (no harmful side effects), and that while more systematic research is needed, the lack of research to date should not slow down clinical application of PFT. Cass also stated that the Veterans Administration has charted comprehensive recommendations to encourage patient access to appropriate pets, and he mentioned the new Minnesota law permitting the keeping of pets under proper conditions for therapeutic purposes in hospitals and other institutions.

Samuel Corson (Ohio State University) gave an encouraging paper on companion animals as bonding catalysts in geriatric institutions. He summarized his observations on pet facilitated psychotherapy in an 800-bed nursing home for the mentally retarded of various ages. On the basis of his data, no nursing home should be without companion animals since their therapeutic role in improving the morale and sociability of patients has been conclusively established.

James VanLeeuwen (Hospital for Sick Children, Toronto) emphasized a possible link between child abuse and pet abuse and suggested that family therapy may be needed in situations where pets are abused. The increasing problem of dog bites may involve parental neglect (when a child is bitten) and perhaps should be reported to the appropriate authorities. Children’s abuse of animals may indicate immediate therapeutic intervention. Dr. VanLeeuwen also described how valuable it is as a potential diagnostic tool to have children draw a scene of their family with the pet included. Alistair McDonald (University of Dundee) described a study of interactions in the home between children and their dogs. He discovered a subgroup of children in his survey who perceived their dogs as understanding the emotional content of what they said; these children differed significantly in other aspects from the rest of the sample.

Eleanor Ryder and Ceile Washington (University of Pennsylvania) described the establishment of a social work service in the University of Pennsylvania School of Veterinary Medicine which is helping to improve the pet owning family-veterinarian relationship.

Alan Beck (University of Pennsylvania) gave an in-depth review of his experiences in creating guidelines for planning for pets in cities, a subject which has been seriously neglected by urban planners. Beck outlined the types of legislation and urban designs needed to accommodate pets for the benefit of all, including non-pet owners.

Anthropologist Constance Perin discussed dogs as symbols in human development. She suggested from her vantage point as a cultural anthropologist that the emotional dependence of owners on their pets is not based on the owners finding other people disappointing, but rather on the vitalizing effect of the animals. Human interest in another species is aroused by that species’ behavioral patterns of curiosity, exploration and play. Less because we feed them and more because they take an interest in what we are doing, dogs’ active responses keep us mutually involved.

Aaron Katcher (University of Pennsylvania) addressed the subject of the form and function of interaction between people and their pets. Studies of transactions between people and pets may be critical to the understanding of problems in human behavior. Following research which demonstrated improved probability of one year survival in heart attack victims who owned pets, Katcher’s laboratory identified seven functions of pets which would be expected to decrease the likelihood of illness or to reduce the death rate from a wide variety of physical diseases: companionship; someone to care for; someone to keep you busy; someone
to touch and fondle; someone to watch; someone to make you feel safe; and a stimulus for exercise. In addition to studying the health function of companion animals, his research team also investigated the ways in which people touch and talk to their pets. Ninety-four percent of the people surveyed talked to their pets as they would to a person and eighty-one percent think pets are sensitive to their owners’ feelings. While blood pressure increases when a person talks in an experimental setting (possibly related to evaluation anxiety), there is no such increase when the person talks to his or her pet in the same setting. In fact, a subject stroking a pet experiences a decrease in systolic blood pressure to below the resting rate. Thus, fondling or idle play with the pet is a kind of relaxing reverie state with distinct psychophysiological correlates. Dr. Katcher concluded that animal contact is not an inferior form of or substitute for human relationships, but supplements and augments those relationships.

The BSAVA is to be congratulated for organizing such an excellent symposium, which has been provisionally scheduled for publication as a book. For further details contact Dr. Bruce Fogle, British Small Animal Veterinary Association, 22 Seymour Street, Portman Square, London W1H 5WD, U.K.

Animal Welfare Curriculum

On February 7, 1980, a group of conservationists, animal welfare theorists and other academics met under the auspices of the Yale University School of Forestry and Environmental Studies (New Haven, Connecticut) and the Geraldine Rockefeller Dodge Foundation to consider the role of animal rights and welfare issues in a human/animal ecology graduate program. This conference was the last in a series of three, the earlier ones having dealt with the biopolitical implications of the Endangered Species Act and the vagaries of wildlife management programs. Compared to these two topics, animal welfare has suffered from a conspicuous lack of attention from academic institutions. Accordingly, meeting organizer Dr. Stephen Kellert stressed the need to examine the reasons for this lack of attention and to determine whether animal welfare issues could be usefully integrated into a university program on human/animal ecology.

Since a large number of the participants were associated with animal welfare organizations either directly or indirectly, it is perhaps not surprising that the general consensus was that animal welfare and animal rights issues do have a place in academic studies. Some interesting points were raised in the course of the general discussions indicating that there are, indeed, fruitful questions for academic inquiry, especially in an interdisciplinary graduate program.

Patricia Forkan (The Humane Society of the United States) highlighted the multi-faceted nature of the pet overpopulation issue, a thorough analysis of which would include: a) sound statistical techniques to determine which animals are turned loose or handed over to shelters and by whom; b) economic analyses of the relative costs of animal control programs versus other options; and c) sociological investigations of human/animal emotional needs and the possible impact of pet cotherapy.

Professor Tom Regan (North Carolina State University) projected that the ideal student graduating from an appropriate human/animal ecology program would have a solid knowledge of biological and behavioral sciences, a good sense of historical perspective and a firm grasp of political considerations. Such a student could then tackle some of the trans-scientific problems in the field of animal welfare. For example, ABC network broadcaster Roger Caras
raised the question of ownership of animals, and argued that this concept of ‘ownership’ is at the base of many animal welfare problems (e.g., the treatment of farm animals under different husbandry systems).

The conference was not designed to produce recommendations on the substantive issues that should (or could) be covered, on research needs and priorities, on the educational character and level of the program, or on the possible policy and management impact of the program. However, it was clear from the discussion that the participants foresaw the need for a program which would produce analytical, creative investigation leading to the breakdown of the myths currently plaguing animal welfare topics.

ANNOUNCEMENT

International Society for Animal-Assisted Therapy

The International Society for Animal-Assisted Therapy has been formed as a research center and information clearinghouse on the role of companion animals in reaching and treating institutionalized or otherwise isolated members of society. The Society plans to develop animal training centers and education programs in veterinary medicine and related professions, as well as foster research on pet facilitated therapy and support appropriate legislation.

General annual membership dues are $25.00, and $10.00 for shelters and individuals on fixed incomes. For further information, contact Dr. Bruce M. Feldmann, International Society for Animal-Assisted Therapy, 1042 Oxford St., Berkeley, CA 94707, USA.

BOOK REVIEW

THE ILLUSTRATED VETERINARY ENCYCLOPEDIA FOR HORSEMEN and VETERINARY TREATMENTS AND MEDICATIONS FOR HORSEMEN edited by Don M. Wagoner (Equine Research Publications, Dallas, TX, 1979, $46.95 and $38.95 respectively) are meant to bridge the gap in equine literature between the highly technical veterinary reference manuals and the less informative, nontechnical books commonly available to the layman. These books should be considered as companion volumes: the first deals primarily with the identification and explanation of equine disorders, while the latter explains common treatments and therapy that may be employed after the ailment has been diagnosed. Veterinary procedures are discussed in sufficient detail to provide a realistic understanding of the results which may be expected. In many cases, the efficacy of certain treatments is reviewed with particular attention to potential side effects and humane considerations.

Both volumes are easy to read and well illustrated. They do not avoid the use of medical terms since many horse maladies lack common names, and the texts are designed to facilitate communication between the practitioner and the client. For ease
in locating a particular subject, the reader can swiftly refer to an extensive color-coded glossary or index.

The major disadvantage of these books is their cost. While a ninety dollar price tag may not be especially prohibitive for the veterinarian, stable owner or professional horseman or woman, it is certain to deter the young novice who is perhaps most in need of this information. However, the fact that these volumes are of value to both the equine practitioner and the horse enthusiast makes them a worthwhile investment.

M.S. Paulhus


As indicated by the title, the potential of the placenta as an experimental research tool is far from being fully realized and yet readily available placental samples offer exciting opportunities to study human metabolism and physiological processes. For those interested in the concept of alternatives, these are vital considerations.

The human placenta possesses the unique property of differentiating and growing from embryonic tissue to maturity (and senescence?) in nine months. During this time, it passes through stages of graft acceptance, invasive growth and "rejection" while also maintaining a number of metabolic and immunological processes. This unusual diversity is discussed by major figures from each relevant field in individual chapters dealing with metabolism, cell replication, immunology and aging.

There is no chapter on ethical implications in the acquisition and use of human placentas. With the burgeoning bioethical debate on human research and abortion, among other concerns, it is unfortunate that this topic was not included as a postscript to the publication.

A.N. Rowan

BOOKS RECEIVED


GENETICS FOR DOG BREEDERS, Frederick B. Hutt (W.H. Freeman & Company, San Francisco, CA, 1979, $15.00).


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