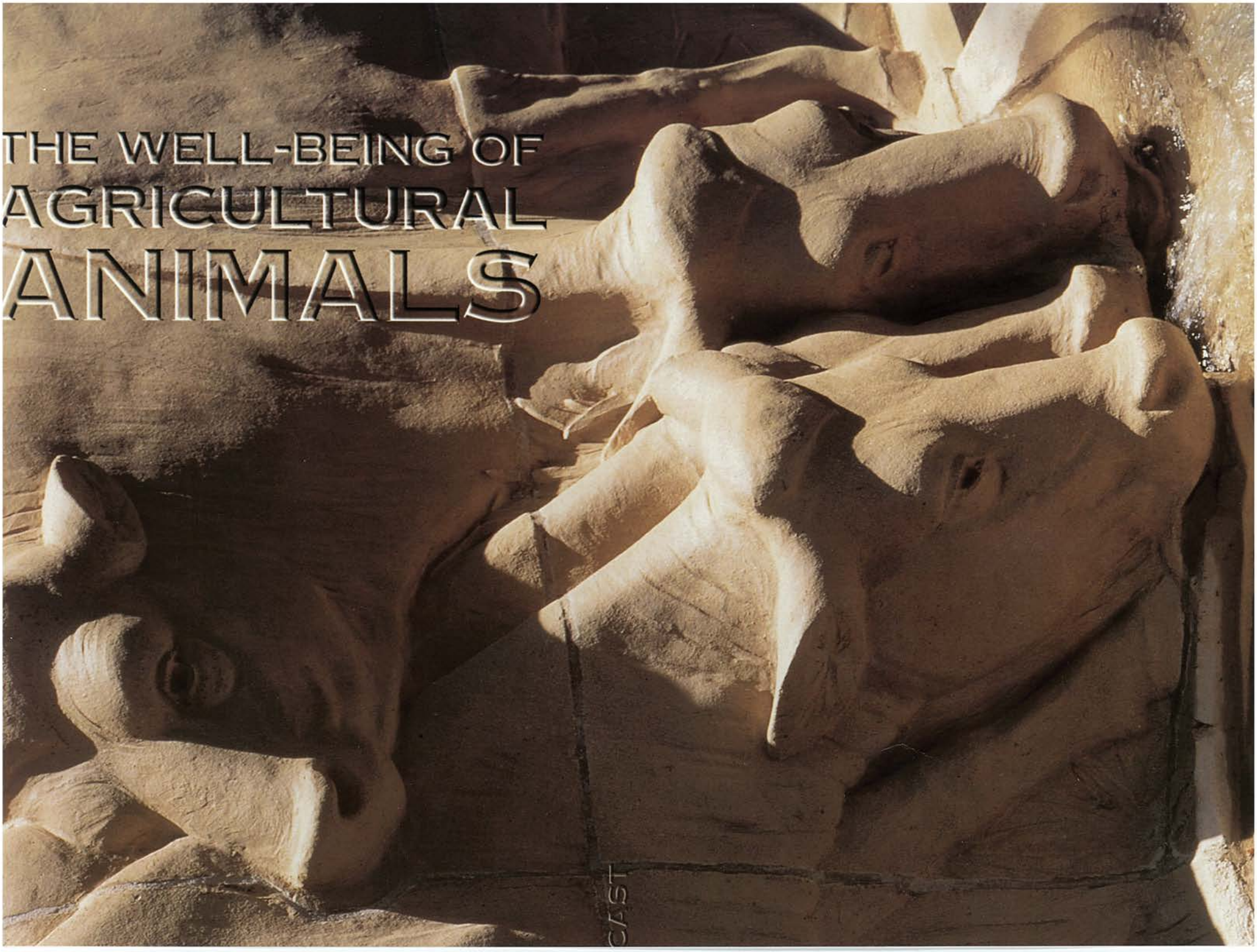
THE WELL-BEING OF
AGRICULTURAL
ANIMALS

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# The Well-Being of Agricultural Animals

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Task Force Report
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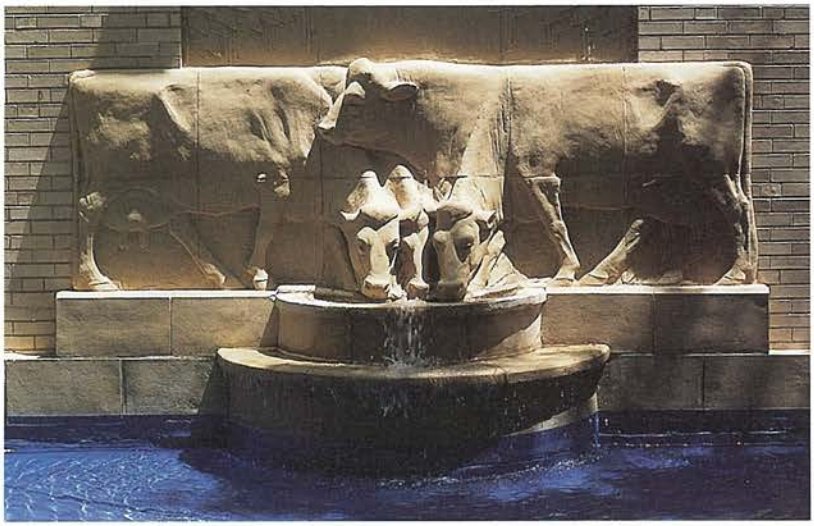
# Christian Petersen



Bob Elbert

The terra cotta bas relief (on the cover) at the former Dairy Industry Building, Iowa State University, Ames, Iowa was designed by Christian Petersen in collaboration with Paul E. Cox, head of the Ceramics Engineering Department. It is a part of the Art on Campus Collection, University Museums, Iowa State University, Ames, Iowa. Cover design by Lynn Ekblad, Different Angles, Ames, Iowa. Photographs by Bob Elbert, Iowa State University Photo Service, Ames, Iowa.

The story of Christian and Charlotte Petersen is a story of dedication. In 1928, Christian left commercial design work on the East Coast to dedicate his life to sculpture. He met Charlotte Garvey in Chicago where they married. He set up a studio in Belvidere, Illinois in 1932. Times were depressed, art work was slow, and the Petersens were penniless.

In December 1933, Grant Wood, famed Iowa painter, invited Christian to join the Federal Art Workshop in Iowa City. Christian and Charlotte were exultant: they borrowed money for gas and set off immediately for Iowa.

The Grant Wood funds were quickly used. But thanks to Raymond M. Hughes, president of Iowa State College, funds were found to bring Christian to the Ames campus to create terra cotta panels depicting the history of world and American dairy technology. Christian, the sculptor, Paul E. Cox, head of the Department of Ceramics Engineering, and a team of students combined efforts using the "Cox Kiln" to produce a series of terra cotta bas relief sculptures unlike anything created before—or since—in American art history. "No campus-produced sculpture of this medium, size, scope, and quality exists on any [other] campus in the United States," according to Patricia Lounsbury Bliss in *Christian Petersen Remembered.*

This premier project, located in the courtyard of the Dairy Industry Building (now part of the Department of Food Technology), recently was accepted into the National Register of Historic Places. That project was the beginning of more than 24 years of dedicated work at Iowa State University where Christian was the first sculptor-in-residence on any American campus. After creating the dairy bas relief, Christian went on to create 12 site-specific public art projects on the Iowa State University campus that have become symbols for colleges or departments. While at Iowa State University, he created more than 300 sculptures (hundreds of private portraits and studio pieces and 38 sculptures for the university).

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# Contents

# Foreword

Following a recommendation by the CAST National Concerns Committee, the CAST Board of Directors authorized preparation of a report on the well-being of agricultural animals in the United States.

Dr. Frank H. Baker, Winrock International, Morrilton, Arkansas, served as chair for the report until his untimely death. Dr. Stanley E. Curtis then agreed to serve as chair. Dr. Curtis set up a writing committee to condense the authors' contributions into a shorter report. A highly qualified group of scientists served as task force members and participated in the writing and review of the document. They include individuals with expertise in agricultural economics, animal science, dairy science, poultry science, law, and philosophy.

The task force met and prepared an initial draft of the report. They revised all subsequent drafts of the report and reviewed the proofs. The CAST Executive and Editorial Review committees reviewed the final draft. The CAST staff provided editorial and structural suggestions and published the report. The authors are responsible for the report's scientific content.

On behalf of CAST, we thank the chairs, writing committee, and authors who gave of their time and expertise to prepare this report as a contribution by the scientific community to public understanding of the issue. We also thank the employers of the scientists, who made the time of these individuals available at no cost to CAST. CAST recognizes and appreciates the financial support of the U.S. Department of Agriculture/Agricultural Research Service (USDA/ARS) to partially assist in the printing and distribution of this report. The members of CAST deserve special recognition because the unrestricted contributions that they have made in support of CAST also have financed the preparation and publication of this report.



Sue L. Sullivan
President

Richard E. Stuckey
Executive Vice President

Kayleen A. Niyo
Managing Scientific Editor

# Interpretive Summary

The purposes of this report are to outline philosophical, policy, and legal aspects of the public issues concerning the well-being of agricultural animals, to describe scientific approaches to assessing their well-being, and to identify areas in which additional scientific insight would help ensure that they experience well-being. Most of the U.S. public supports the agricultural use of animals and believes that they generally are treated humanely. But many citizens also support governmental regulation as a safeguard. The essential role of animals in the world food enterprise and the global catastrophe that would ensue if it were to cease, oblige stakeholders to continue seeking a thorough understanding of the well-being of agricultural animals and an inclusive resolution to farm animal welfare issues.

## Philosophical Aspects of the Debate

Welfare and rights can be opposing concepts in a variety of ethical, legal, and political controversies. The utilitarian strategy considers an action or a policy justified in light of its cumulative consequences to all affected parties whereas the rights strategy states that certain traits (rights) must be protected and the morality of an act judged according to whether it respects the rights of other individuals.

## Economic and Policy Aspects of the Debate

Extreme animal-rights advocates call for the end of raising animals for food and coproducts. Changes in how animals are treated could affect what is eaten and worn and what medicines remain available. Recent legislation in western Europe outlawed certain production systems and led to the collapse of affected agricultural sectors as well as to the importation of foods originating in production systems similar to those forbidden. Many of these laws since have been modified or rescinded as citizens have come to recognize domestic economic realities and the inevitability of undesirable events cascading from them. Judging from the western European experience, U.S. animal producers can expect ethical values to influence changes in animal care practices.

## Legal Aspects of the Debate

Concerns related to the ethical rights of agricultural animals generally have not been recognized as legal rights. In the United States, most states have anticruelty legislation to prohibit gross mistreatment of animals, but they often are criticized as ineffective, in part because of apathetic enforcement. Some state legislation excludes agricultural animals altogether whereas application of other statutes is limited to practices other than those customary in farming. Still other legislation applies only to unjustifiable actions or practices. No federal legislation exists related to the well-being of animals residing on farms.

## Scientific Assessment of the Well-Being of Agricultural Animals

Although many of the issues of agricultural animal well-being probably will be resolved politically, for several reasons the scientific assessment of animal well-being is needed. Specific recommendations follow:

- Producers should continue to adopt scientifically based practices.
- Voluntary animal-care guidelines published by most producer organizations have been based on scientific assessment of husbandry practices and should be consulted.
- Education of the general citizenry should be based on scientific assessment of animal well-being.
- The Congress of the United States should continue to consider scientific assessment and opinion seriously when addressing specific issues.
- The public should consider requesting scientific assessments of (1) the actual need to alleviate an-

imal suffering and (2) the degree to which proposed alternative practices would alleviate any suffering.
- Future designs of animal accommodations and practices should reflect the results of scientific assessment.

## Approaches to Scientific Assessment

Several proposals for assessing animal well-being have emerged. The report of a special committee to the British Parliament in 1965 constitutes the first attempt at addressing the issue. That report stated (1) that *welfare* refers to "both physical and mental well-being,"(2) that its assessment must involve "scientific evidence available concerning the feelings of the animals that can be derived from their structure and functions and also from their behavior," and (3) that there are sound reasons for assuming that sensations and emotional states are substantial in animals and should not be disregarded.

The report also established "five freedoms": "An animal should at least be able without difficulty, to turn around, groom itself, get up, lie down and stretch its limbs." In the main, subsequent attempts to establish meaningful assessment of the overall well-being of individual animals have sprung from that framework.

## Needed Scientific Insight

Animal scientists and other agricultural stakeholders generally agree on the prioritization of researchable questions regarding animal well-being. Agreement has resulted from four consensus initiatives in recent years. The six research areas identified were (1) bioethics and conflict resolution, (2) responses of individual animals to the production environment, (3) stress, (4) social behavior and space requirements, (5) cognition, and (6) alternative production practices and systems.

## Recommended Approach in the Meantime

One rational approach to establishing provisional multifactorial indices of well-being in agricultural animals would involve (1) assembling a multidisciplinary team of several expert scientists; (2) asking the team to assemble a worldwide database of reliable information of all kinds bearing on matters of farm-animal well-being; and (3) asking the team to employ appropriate statistical analytical methods to elucidate and to determine the multifactorial indices of well-being in agricultural animals.

# Executive Summary

The purposes of this report are to outline philosophical, policy, and legal aspects of the public debate concerning the well-being of agricultural animals; to describe scientific approaches to assessing well-being in agricultural animals; and to identify areas in which additional scientific insight would help ensure that animals experience well-being in agricultural systems.

## Introduction

Discussion of complex public issues concerning the well-being of agricultural animals began in the 1960s and has not been resolved. It continues to engender debate between those with special sympathy for what animals experience and those with business, professional, or scholarly interests in animals. Most Americans support the agricultural use of animals and believe that such animals generally are treated humanely. But many also support governmental regulation as a safeguard. The essential role of animals in the world food enterprise and the global catastrophe that would ensue if it were to cease oblige stakeholders to continue seeking a thorough understanding of the well-being of agricultural animals and an inclusive resolution to farm animal welfare issues.

## Origins of the Debate

### Philosophical Aspects

#### Welfare and Rights

Many describe those advocating moderate change in agricultural systems as *animal-welfare advocates* and those advocating greater change as *animal-rights advocates*. Scholars use each of the terms differently.

In scholarly works, rights often are analyzed in terms of claims made by one party against another. There are informal, moral, and legal rights. Any rights claim depends on a context of validation. One intervening on behalf of a victimized animal makes (on behalf of the animal) a claim validated by custom, ethics, and probably law. This claim need not imply, however, either support for an animal's right not to be used for human food or validation of claims by animal-rights groups.

Rights also may assert priority of an individual interest over aggregate interests and even the common good. Political examination of trade-offs (costs and benefits) is constrained by rights. Trade-offs that would violate individual rights are "trumped" by valid rights claims. Contentious public policy issues often revolve around where the line between trade-offs and trumps should be drawn. Welfare and rights can be opposing concepts in a variety of ethical, legal, and political controversies.

#### Ethics and Morals

Two distinct rationales for showing how a rights claim might be validated stipulate different kinds of ethical principles. The utilitarian strategy considers an action or a policy justified in light of its cumulative consequences to all affected parties whereas the rights strategy states that individuals have certain traits (rights) that must be protected and the morality of an act judged according to whether it respects others' rights. Philosophical tension exists between utilitarian and rights philosophers. Major leaders of activist political organizations also differ over which philosophical principles best justify the initiatives, on which they agree.

#### Major Figures

Dozens of essays have been published on the ethical basis for reform of animal agriculture, as well as on the moral basis for relationships between humans and other animals generally. The works and opinions of three authors—Peter Singer, Tom Regan, and Bernard Rollin—are reviewed briefly in this publication.

### Economic and Policy Aspects

#### Further Examination

Certain intensive production methods have improved production efficiency, but at times have put egg, meat, and milk producers in defensive positions. Animal-welfare activists and other critics have brand-

ed certain methods as "factory farming." Yet in the opinion of some agriculturalists, the modifications called for would increase production cost while not necessarily improving animal well-being. Animal-rights advocates call for the end of raising animals for food and coproducts.

### Choices

From a policy perspective, there exist at least four alternative approaches to the animal well-being controversy: (1) pass laws requiring modifications in controversial production methods; (2) pass laws requiring modifications in production methods documented to cause animal suffering; (3) encourage food-animal production systems that are intensive and at the same time engender animal well-being; or (4) allow consumers to choose among foods labeled as originating in animals kept in a range of intensive and extensive production systems.

Changes in how animals are treated could affect what is eaten and worn by humans and what medicines remain available. Recent legislation in Europe outlawed certain production systems and led to the collapse of affected agricultural sectors as well as to the importation of foods originating in production systems similar to those forbidden by law. Many of these laws since have been modified or rescinded, as citizens have come to recognize domestic economic realities and the inevitability of undesirable events cascading from the laws.

### Economics

Intensive production tends to have economic advantages, but evaluation must be made carefully, and generalizations are not possible. One threat to U.S. animal agriculture would be requirements that animal products in international trade be produced under conditions specified by laws based on the standards of certain animal-protection groups. If animal agriculture were partly or wholly discontinued, thousands of farm families and communities worldwide would be devastated.

### Countermeasures

Animal agriculture is resisting the efforts of activists that would restrict or destroy the industries and institutions dependent on the traditional uses of animals. The animal industries have major political advantages over organizations and philosophies that would disrupt the national economic base and living standard.

### Trends

Power clusters within food and agriculture as well as elsewhere provide public support and facilitate legislative action to maintain and to protect various animal sectors in the American economy. How animals are treated in the future will depend on changing public attitudes and ethical and social values. Will producers of animals sense increasing personal responsibility for humane care and shift their actions closer to the positions of reformists? Public pressure for increased regulation will persist, but placing animal issues in the forefront for legislative action will be a formidable task. Still, judging from the European experience, U.S. animal producers can expect ethical values to influence change in animal care practices.

## Legal Aspects

### Existing Framework

Existing legislation in the United States deals little with the treatment of livestock and poultry. Concerns related to the ethical rights of agricultural animals generally have not been recognized as legal rights.

### Production Practices

Public calls for regulation of agricultural-animal care practices have been more successful in Europe than in the United States although standards differ markedly among nations and trans-European legislation has been slow.

In the United States, most states have anticruelty legislation to prohibit gross mistreatment of animals, but they often are criticized as ineffective, in part because of apathetic enforcement. Some state legislation excludes agricultural animals altogether whereas application of other statutes is limited to practices other than those customary in farming. Still other legislation applies only to unjustifiable actions or practices. At the federal level, only limited legislation exists related to the humane treatment of animals, and there is none related to animals residing on-farm.

# Scientific Assessment of the Well-Being of Agricultural Animals

## Needs for Scientific Assessment

Although the issue of agricultural animal well-being probably will be resolved politically, for several reasons the scientific assessment of animal well-be-

ing is needed. Specific recommendations follow:

- Producers should adopt scientifically based practices.
- Voluntary animal-care guidelines published by most producer organizations have been based on scientific assessment of husbandry practices and should be consulted.
- Education of the general citizenry should be based on scientific assessment.
- The Congress of the United States should continue to consider scientific assessment and opinion seriously when addressing specific issues.
- The public should consider requesting scientific assessments of (1) the actual need to alleviate animal suffering and (2) the degree to which proposed alternative practices would alleviate any suffering.
- Future designs of animal accommodations and practices should reflect the results of scientific assessment.

## Approaches to Scientific Assessment

### Underlying Assumptions

Farm-animal ecologists and ethologists have some common assumptions about animal well-being that are based on science. Following are some of the points about agricultural animals that are emerging:

- Humans have the right to use animals in agricultural production and are obligated to treat them appropriately.
- The undomesticated progenitors of agricultural animals were unusual creatures.
- Agricultural animals have been molded by genetic selection, and so have specific environmental sensitivities and tolerances.
- They can experience cruelty of two fundamental kinds—abuse and neglect—and perhaps a third—deprivation of opportunities to express internally motivated behaviors; yet it is difficult to enforce well-being regulations except to minimize gross abuse.
- Their productive and reproductive functions are sensitive to stressors, which can diminish performance.
- Production systems unsupportive of animals have resulted from careless design.
- Agricultural animals are confronted by stress ranging from eustress to distress; their well-being still is difficult if not impossible to define precisely in practical terms; and, like any creatures, they should not be expected to experience well-being continuously.
- They are endowed with a variety of useful adaptive traits.
- Physiological changes in response to stressors may indicate that they have reached a prepathological state.
- Agricultural animals probably have internally motivated behaviors, which should be considered behavioral needs to be accommodated by the environment.
- Their immune systems are influenced by stressors (often negatively), and they in turn influence other responses to stressors.
- They perceive various physical and psychological stressors consciously although little is known about any feelings connected with these perceptions.
- They can experience diminished well-being due to either acute or chronic stressors.
- Residing in a range of conditions provided by a variety of agricultural systems, they can experience an ethically acceptable level of well-being.

### Defining *Well-Being*

No scientific consensus has emerged yet regarding the definition of *well-being* in agricultural animals. Until there is convergence in this respect, the sort of strides called for by some in ensuring well-being are unlikely. Yet, according to experts, *well-being* always will be difficult if not impossible to define precisely.

### Proposals for Assessing Well-Being

Perhaps the difficulty in assessing well-being has mostly to do with its complexity than with anything else. In turn, this complexity may have more to do with the current level of scientific ignorance. Agreement on approaches to scientifically assessing the well-being of animals in agricultural settings is wanting; neither is there consensus as to meaningful indicators of well-being, which are essential for making prudent change. Nevertheless, several proposals have emerged. Although they differ in emphasis, they are not mutually exclusive.

### The First Attempt to Assess Well-Being

The report of a special committee to the British Parliament in 1965 constitutes the first attempt at addressing these matters. The report states (1) that *welfare* refers to "both physical and mental well-being," (2) that its assessment must involve "scientific evidence available concerning the feelings of the animals that can be derived from their structure and

functions and also from their behavior," and (3) that there are sound reasons for assuming that sensations and emotional states are substantial in animals and should not be disregarded.

The report also established "five freedoms": "An animal should at least be able without difficulty, to turn around, groom itself, get up, lie down and stretch its limbs." In the main, subsequent attempts to establish meaningful assessment of the overall well-being of individual animals have sprung from that framework.

### Other Proposals for Assessing Well-Being

Numerous approaches to assessing the well-being of agricultural animals have since been proposed. These approaches have emphasized one or more of the following: behavioral and cognitive indicators; anatomical, physiological, and immunological indicators; fitness and agricultural-performance indicators; and multiple indicators. Each of these approaches has merit, and may serve as a basis for consensus. As a group, the approaches recognize (1) that there are differences between acute and chronic incidents of anxiety, frustration, discomfort, and pain and (2) that the well-being of an animal involves biological systems that may change over the life of the individual as well as over the natural history of the population. Moreover, the approaches generally advocate multiple categories of indicators of well-being, demonstrate awareness of the human-animal interface, and acknowledge the ongoing nature of domestication.

### Off-Farm Experiences

The well-being of animals may be compromised more in their off-farm than in their on-farm experiences. One of the most important determinants of an animals' off-farm experience is the attitude of management personnel in the succession of firms typically responsible for animal care and handling prior to slaughter. This report focuses on the well-being of animals during handling and transportation and during stunning before slaughter as well as during their residence on farms and ranches.

## Scientific Assessment of the Current Status of Animal Well-Being

### Overview

Designers and operators of animal-agricultural systems are constrained by insufficient knowledge. Small design differences can cause major differences in how effectively animal needs are fulfilled. An animal accommodation (1) may be designed and operated well, evidently supporting an ethically adequate degree of animal well-being; (2) may be designed well but operated incompetently or apathetically—hence not supporting adequate animal well-being; or (3) may be designed so poorly that deficiencies are insurmountable regardless of the ethical concern or technical competence of personnel.

In animal agriculture in the United States, business priorities still often prevail over emerging ethical considerations. In view of the nature of our economic systems, politics, and governance, this probably will be the case so long as assessment of animal well-being is based on no science, inadequate science, or lack of interest. Today, the problem is primarily that of inadequate science. The current situation of business priorities receiving more weight than ethical considerations will remain the norm until meaningful scientific assessment of animal well-being is possible.

### Needed Scientific Insight

Animal scientists and other agricultural stakeholders generally agree on the prioritization of researchable questions regarding these matters. Agreement has resulted from four consensus initiatives in recent years. Members of this CAST task force generally subscribe to this emerging consensus, which is summarized next.

### General Research Areas Identified by Discussants in the Food Animal Integrated Research (FAIR) '95 Process

The six research areas identified were (1) bioethics and conflict resolution, (2) responses of individual animals to the production environment, (3) stress, (4) social behavior and space requirements, (5) cognition, and (6) alternative production practices and systems.

### Overall Research Objectives on Which Consensus Emerged in the FAIR '95 Process

Two of the research objectives identified during the 1992 deliberations of the FAIR '95 consensus committee were (1) to determine scientific measures of well-being in food-producing animals and (2) to develop short-term production practices and long-term management systems based on scientific research findings about animal well-being.

### Contributions by the Workgroup at the 1993 Purdue University/USDA Food Animal Well-Being Conference and Workshop

To develop measures of the well-being of agricultural animals, three priority research areas were identified: (1) adaptations and adaptiveness, (2) social behavior and space requirements, and (3) cognition and motivation.

## Interim Recommended Approach

Taking advantage of the multitude of approaches and disciplines now involved seems most reasonable at present. Decades will be required for adequate scientific data to be generated, however. In the meantime, one rational approach to establishing provisional multifactorial indices of well-being in agricultural animals would involve (1) assembling a multidisciplinary team of several scientists specifically knowledgeable and experienced, (2) asking the team to assemble a worldwide database of reliable information of all kinds bearing on matters of farm-animal well-being, and (3) asking the team to employ appropriate multivariate parametric and nonparametric statistical analytical methods to elucidate and to determine the multifactorial indices of well-being in agricultural animals.

# 1 Introduction

Since Ruth Harrison wrote *Animal Machines* (1964), which criticized "factory farming" methods as cruel to animals, the well-being of agricultural animals has been prominent on public agendas across North America, western Europe, Australia, and New Zealand. The farm-animal-welfare issue emerged in the United States during the late 1970s. Specific areas of concern are essentially the same now as they were then (Fox, 1980, 1984; Mason and Singer, 1980, 1990; Rollin, 1995a; Rowan, 1993). This complex issue continues to engender debate between members of a pluralistic society who have special sympathy for the degree of well-being that animals experience and members who have—through agriculture, biology, economics, philosophy, the law, public policy, or politics—a business, professional, or scholarly interest in animals. According to surveys conducted in the mid-1980s by several agricultural organizations, most Americans and some animal-protection groups support the agricultural use of animals and believe that farmers generally treat animals humanely. Nevertheless, many individuals also support governmental regulation to ensure humane treatment of animals in production agriculture (Becker, 1992).

Debate around the world has not resolved the issue. Although several European nations, commissions, and councils have attempted to deal with the farm-animal-welfare issue for more than three decades, it remains at the forefront of public agendas in western Europe, as in North America (Albright, 1983; Baumgartner, 1993; Fraser, 1995; Guither and Curtis, 1983; Hardy, 1990; Schmidt and Schmidt, 1995; Spedding, 1993). During this period, producer groups in the United States have become better informed and have developed voluntary guidelines for individual species; yet the issue remains unresolved, and the debate continues. The essential role of animals in the world food-production enterprise (Bowman, 1977) and the global catastrophe that would ensue if that role were to cease (McDowell, 1991) obliges stakeholders to continue searching for thorough understanding of the well-being of agricultural animals and an inclusive resolution to farm animal welfare issues.

The purpose of this report is threefold:

1. to outline ethical, moral, economic, legal, and policy aspects of the public issues concerning the well-being of agricultural animals both on and off farms and ranches;
2. to describe scientific approaches to assessing well-being in agricultural animals; and
3. to identify areas in which additional scientific insight would help ensure that animals experience well-being in agricultural production systems.

# 2 Origins of the Public Debate Concerning the Well-Being of Agricultural Animals

## Philosophical Aspects

### Welfare and Rights: The Distinction

Discussion of the care and the use of agricultural animals usually assumes a distinction between animal welfare and animal rights. But there is considerable confusion over definitions and uses of terms. Many in agriculture describe those individuals advocating moderate change as *animal-welfare activists* and those advocating more sweeping action as *animal-rights activists*. Those who take a scholarly approach use the terms *welfare* and *rights* in various specific ways having applications for economics, ethics, law, and political theory. Although *welfare* usually means *well-being*, it also may indicate entitlement programs benefiting the disadvantaged.

Measurement of well-being for animals as well as for human beings is a contentious issue. If and when a meaningful measure of animal well-being has been achieved, the goal will be to identify the options maximizing or at least optimizing overall well-being. Insofar as this can scarcely happen without cost, a key consideration in fulfilling welfare objectives is the benefit:cost ratio (efficiency) of policy. Criteria for efficiency become vexed when costs to one group are weighed against benefits to another. In the animal well-being debate, further difficulties arise when the animals, nonhumans, are considered a group across which costs and benefits are distributed.

Multiple uses of the term *rights* create the most confusion. The core meaning of *rights* has been analyzed in terms of claims that can be made by or on behalf of one party against another (Feinberg, 1970). Criteria for validating such claims depend on frame of reference. If a claim can be validated through actions in a court of law, it represents a *legal* right; if by general principles of ethics and morality, it represents a *moral* right. There also can be *informal* rights, which are validated by custom or etiquette. Although areas of overlap among custom, ethics, and law occur, existence of a right in one context does not guarantee that the right exists in another. In some instances, having a right becomes meaningful only when a series of additional rights are granted, but it is not part of the concept of rights that supporting rights are implied.

Any rights claim is contingent on a context of validation. Whether a legal right protecting animal interests exists will be determined by the courts. Some who have made rights claims on behalf of farm animals argue that they are validated by custom (Rollin, 1995a). A majority of Americans agree that animals should not be subjected to intentionally cruel treatment (Kellert, 1989). A person intervening on behalf of a cruelly victimized animal makes on behalf of the animal a claim validated by custom, ethics, and probably law. When this claim is indeed supported customarily or recognized by the courts, it is correct to say that the animal has a right not to be so mistreated. Yet this right need not imply supporting rights, e.g., the right not to be used for human food, and does not, in itself, validate claims made by so-called animal-rights groups. One may grant animals certain limited rights without implying commitment to all the extensive changes sought by activists.

The concept of rights also may be used to assert the priority of an individual interest over aggregate or powerful interests and even the common good. In recent American politics, this use of the term *rights* signals rejection of an evaluation process emphasizing trade-offs, i.e., optimizing the benefit:cost ratio. Dworkin (1977) introduced the concept of "trumps" to explain this aspect of rights. The process of examining trade-offs—costs and benefits—is constrained by rights. Trades that would violate individual rights are trumped by valid rights claims. Contentious policy issues such as the well-being of agricultural animals often revolve around where the line between trades and trumps should be drawn.

The contrast between trades and trumps illustrates how welfare and rights can be opposing concepts in a variety of ethical, legal, and political controversies. With respect to food animals, those who feel that lowering animal-origin food prices for consumers or raising profits for producers is more important than certain perceived animals interests would be inclined to emphasize an aggregate or common good. In contrast,

those who feel that important animal interests are about to be sacrificed would attempt to trump the efficiency argument by claiming that an animal's rights have been violated.

## Ethics and Morals

Moral rights are validated with respect to subjectively held philosophical beliefs and are established through arguments appealing to widely held philosophical beliefs, in the hopes of inducing people to change custom and law. There are two strategies for making such an argument.

The best ultimate consequences may be brought about by the recognition of certain claims made on behalf of an individual even if it would be inefficient to do so in the short run or in the immediate case. Rights claims produce a social agreement that determines the rules of the game. Having a stable set of rules can decrease long-run costs. One can make plans with the knowledge that certain claims made against others must be recognized and that one may make claims against others. It would be costly, too, to calculate costs and benefits for each social transaction. A good set of rules—some stated as rights—therefore will promote efficiency, appealing to either the long-run good or some sophisticated notion of social efficiency. According to this strategy, rights are simply rules of the game that are justified by the consequences they produce.

Another rationale emphasizes the absolute moral importance of the individual. Here, individuals are understood to be the focus of morality, and it is one's respect for another individual's autonomy that is promoted as the central idea in ethical action. Ethically deep traits of individuals must be respected if fundamental terms of ethics are to be met. At least some of these are rights, e.g., natural, human, or metaphysical rights. One's responsibility as an individual is to respect other's rights, and society's responsibility is to adopt codes supporting morality by extending legal protection to these crucial rights. Some individuals base their vision of the religious and philosophical rationales supporting this way of understanding rights on theology or on rationality. Others base their vision on assumptions implied by the coherence of moral language and political rights (Harris, 1997).

The two distinct rationales—utilitarianism and rights—for showing how a rights claim might be validated stipulate different kinds of ethical principles.

The **utilitarian strategy** considers an action or a policy justified in light of the consequences it produces. Philosophers such as Bentham (1789) and Mill (1861) argued that all ethical principles ultimately are reducible to a principle called the utilitarian maxim: act so as to produce the greatest good for the greatest number of parties. Also, right actions are those producing the greatest possible balance of happiness over unhappiness, with each party's happiness counted as equally important (Rachels, 1993).

The **rights strategy** has deep roots and clearly inspired framers of the U.S. Constitution to include a Bill of Rights. Recent advocates include Gewirth (1982) and Rawls (1971). The rights view states that certain traits—viz., rights—must be protected and that the morality of an act should be judged according to whether it successfully respects the rights of others.

At least two points must be made about ethics and the treatment of agricultural animals. (1) The two strategies—utilitarianism and rights—extend the distinction between welfare and rights into deeper levels of philosophy. But correspondence is not necessary between philosophical commitments to welfare or rights and practical commitments to the assertion or denial of specific rights claims. And neither is correspondence necessary between either utilitarianism or rights and the political commitment to groups organized around animal-protection objectives. (2) Major figures in radical political organizations differ over which philosophical principles best justify their initiatives (on which they agree).

Of course, an act that utilitarians judge moral by virtue of its producing the greatest good may at times be judged immoral by rights theorists when individual rights are sacrificed. And some acts that clearly are inefficient when judged by the utilitarian standard are consistent fully with the terms of morality laid down by rights theory. Thus, philosophical tension exists between utilitarian philosophers and those constructing moral theories based on a concept of rights.

## Principal Figures in the Animal Welfare/ Animal Rights Debate

Dozens of philosophers, theologians, journalists, social scientists, and concerned citizens have published essays on the ethical basis for reform of animal agriculture, as well as on the moral basis for relationships between humans and other animals generally. Theologian Andrew Linzey (1976, 1995) has been a vocal exponent of animal rights. Philosopher Mary Midgley's work (1984) has been particularly influential in English-speaking countries outside the United States. Many of her views have focused on the use of animals in biomedical research (Rowan, 1993) rath-

er than in agriculture.

Although a number of scholars have published critical responses to the advocates of animal interests (Lehman, 1995; McCloskey, 1965), probably only R. G. Frey has developed a significant reputation for defending status quo attitudes toward animals (1980, 1983), and even he has been somewhat critical of recent trends in animal agriculture (Frey, 1995). Future work on the moral status of animals and on the ethics of production methods in agriculture undoubtedly will integrate ethical theory with scientific approaches to the study of animal behavior and cognition (Allen and Bekoff, 1997). For the present, the contributions of two philosophers provide the main framework for the American debate on ethics and agricultural animals, and a third philosopher has been prominent in these discussions.

Peter Singer, an Oxford-educated Australian, is one of the world's leading figures applying philosophy to questions of practical importance. His early publications on world hunger (Singer, 1972) and animal welfare (Singer, 1973) established his basic approach, an extension of the utilitarian philosophy. In both publications, Singer argued that the common practice of limiting the evaluation of the consequences of one's actions to the effect on people nearby in space and time is morally arbitrary and should be abandoned in favor of a more comprehensive assessment. With respect to world hunger, this entailed a consideration of the potential harms and benefits of alternative courses of action to far-off starving people. With respect to animal welfare, it entailed his critique of speciesism—that is, of arbitrarily favoring the interests of human beings over those of animals (Singer, 1975).

Singer's thinking on animals was extended in his book *Animal Liberation* (1975), now in its second edition (1990). This work laid the foundation both for much of the political movement on behalf of sweeping reform in the use of animals and for sentience views in the debate over animal welfare and animal rights. Such viewpoints hold that the sentient experience of pain and suffering forms the basis for extending moral consideration to an entity or organism. One can harm an individual animal or a group of animals, but one cannot harm a species or a nonsentient organism in a morally significant way (Sagoff, 1984).

Timberlake (1980) claims that a fundamental problem with Singer's work is the lack of an adequate definition of *suffering*. Though a central aim of the animal welfare movement is to decrease or to eliminate suffering in animals, Singer has presented only the most tentative grounds for discovering and analyzing suffering. *Animal suffering* has become a term so emotionally charged that attempts to analyze it critically have been rejected in favor of immediate action to stop it, whatever it may be.

Singer applied a strict rule of trades reasoning in his moral philosophy. If animal suffering was compensated for sufficiently in terms of its benefit to humans, a given practice could be considered justified (though, for Singer, the converse also is justified). Singer's writings thus do not necessitate vegetarianism and open the door for carefully regulated production of animals for food (Singer, 1980).

Tom Regan, an American philosopher, became a well-known philosophical exponent of animal rights with his 1983 book, *The Case for Animal Rights*. Regan accepts the sentience criterion proposed by Singer, but argues that any organism possessing consciousness is "the subject of a life," and as such is entitled to the strong protection of its individual interests associated with a trumps view. Regan's basic position thus is a general rejection of the utilitarian trades view, which he argues entails a strong constraint on interference in any subject's capacity to live its life (Regan, 1985). Because he includes animals among morally relevant subjects, Regan requires morally based vegetarianism for humans and radical changes not only in animal production but also in the very use of animals by humans.

Most philosophically trained readers of *The Case for Animal Rights* found Regan's argument for the trumps view less innovative than his approach to resolving conflict between the rights claims of two competing groups. When it is impossible to chart a course of action that does not violate some individual rights, Regan offers two principles that, when satisfied, will prescribe the proper choice.

The miniride principle states that, when one must choose between overriding the rights of the many who are innocent or the rights of the few who are innocent, choose to override the rights of the few. Exceptions to this rule are specified by the worse-off principle, which states that when the harm faced by the few would make them worse off than any of the many would be if another option were chosen, choose to override the rights of the many (Regan, 1983). It is Regan's use of the worse-off principle that produces the case for moral vegetarianism.

A third philosopher, Bernard Rollin, holds an appointment in an American veterinary college, has collaborated with animal scientists, and has spoken before agricultural audiences more often than either Singer or Regan. In his 1981 book, *Animal Rights and Human Morality*, Rollin presented the argument that

people, including ranchers, already do implicitly recognize animal rights in their speech and conduct, e.g., when they stand willing to lower profits in order to act on behalf of their animals. In recent work, Rollin (1995a) argued that the implicit social consensus on the moral standing of animals requires more explicit and diligent attention to how animals fare in production, transport, and slaughter situations. Further, the new social ethic for animals mandates both research on animal well-being, including studies utilizing cognitive approaches, and common sense reform of production practices (Rollin, 1989).

# Economic and Policy Aspects

## Examining the Issue Further

Although intensive confinement methods, which use more capital and less labor than traditional methods do, have improved production efficiency, they have at times put egg, meat, and milk producers in defensive positions because animal activists have branded certain current methods as "factory farming." Producers adopted "high technology," intensive production systems because it allowed them to produce more product by substituting capital for labor and to achieve lower cost per unit of product. Critics, however, see intensive production animal agriculture differently because their views are based variously on philosophical thinking, feelings, or opinions, often with little exposure to or understanding of the economics, the science, or the actual practice of food-animal production.

Most animal-rights activists call for the end of all food-animal production. Many animal activists also advocate a vegetarian diet, the replacement of leather in shoes and other products, with canvas and plastic, and the replacement of wool and silk in clothing with cotton and synthetic textiles. Production method modifications that the more moderate reformists advocate would, according to some agriculturists, increase the cost of production while not necessarily improving animal well-being.

## Choices

From a policy perspective, there exist at least four alternative approaches to the food animal well-being controversy. One or more of the approaches could be adopted.

1. Pass laws requiring modifications in the production methods that some individuals believe to cause animal suffering.
2. Pass laws requiring modifications in production methods documented to cause such suffering.
3. Because consumers worldwide are increasing their demand for foods of animal origin, encourage food-animal production systems that are intensive and at the same time engender animal well-being, as efficient production systems will be needed to supply this demand.
4. Allow consumers to choose between foods labeled as originating in animals in intensive production systems or in extensive production systems.

Changes in how animals are treated, particularly those changes required by law, could affect what is eaten and what is worn by humans and what medicines and treatments for diseases remain available (Dawkins, 1980). Legislation prescribing animal production systems that recently has been passed in some countries, such as that pertaining to the banning of cages for laying hens in Sweden, has been modified or rescinded, for citizens have come to recognize either domestic economic realities or the hypocrisy of common events cascading from these laws. Production systems have been outlawed (e.g., crates for veal calves in the United Kingdom); affected sectors of animal agriculture have collapsed; and foods originating in animals residing in production systems similar to those forbidden by law have been imported.

## Economics

Intensive production has economic advantages. The economic benefits of caged layers, for instance, provide the strongest reasons for continuing the system, although modifications are possible. Housing and equipment costs per hen in a caged unit are higher than those per hen in a litter-floor unit. Operating and labor costs, however, are considerably lower (Appleby et al., 1992). The most viable change in keeping with the betterment of animal existence seems to be that of decreasing the number of hens per cage although costs per hen will rise. In a British analysis, relative to the cost of producing eggs in caged housing ( = 100), those produced in an indoor litter-floor system cost 118; in a deep litter system, 122; and free range or outdoors, 199 (Ministry of Agriculture, Fisheries, and Food, 1980). Similarly, Elson (1985) estimated the costs of alternative systems relative to the cost of a conventional cage system ( = 100): aviary cost was 115; deep litter, 118; straw yard, 130; and free range, 150 (or 170). In The Netherlands, the cost of

producing veal calves averaged, in U.S. dollar equivalents, about $25 per calf more in free stalls than in individual stalls (Guither and Curtis, 1983). Generalizations are not possible, however. For example, in some climates, the cost of producing pigs outdoors can be lower than that indoors (McGlone, 1996; Nicholson et al., 1995).

Obviously, the economic disruption if animal agriculture were discontinued would devastate many farm families and communities. And the protein and other nutrients traditionally available from animal-based food products no longer would be available to consumers. From a risk-management perspective, food animals (especially ruminant species) represent a short-term reserve food supply in case of widespread crop failures, which otherwise could result in severe famine. At a time when global markets for agricultural products are expanding, certain interests are working to restrict expansion of international trade. One threat for U.S. food animal producers would be requirements that animal products in international trade be produced under humane conditions as defined by the standards of certain animal rights groups. Other efforts to restrict trade usually originate with groups wanting to protect their domestic market regardless of consumer needs, and such efforts usually are unrelated to animal welfare concerns.

### Countermeasures

Although targeted and strongly criticized, animal owners and users are resisting encroachment of activism that would restrict or destroy the industries and institutions thriving on the traditional uses of animals. These defensive countermeasures include educational programs; advertisements; informational materials for schools, civic, and community organizations; tours of farms; orientation of producers and users of animals to dealing with public demonstrators; and publicizing the accomplishments of scientific research and product testing. The animal industry's strong public support, the close ties between trade associations and government agencies, and the historic rapport between producers and state legislators and members of the U.S. Congress provide major advantages over organizations and individuals' philosophies that would disrupt the national economic base and living standard.

### Trends

Power clusters within food and agriculture, biomedical research and medicine, sportspeople, hunters and trappers, and owners of companion animals provide public support and facilitate legislative action to maintain and to protect food-, research-, and pleasure-animal sectors. How animals are treated and used in the future will depend on public attitudes and changing ethical and social values. If a majority of citizens accept change, they can influence change in public policy and governmental regulation. The crucial question is this: Will owners and users of animals sense increasing personal responsibility for humane care and treatment, which will shift their actions closer to the positions of reformist animal-activist philosophies?

If the European experience provides any guide to the future in the United States, then owners and users of animals can expect that, step by step, ethical values will influence change in animal production, marketing, processing, research, and entertainment practices. As more U.S. consumers seek assurance that animals are being raised and handled under humane conditions, the pressure for increased regulation and new public policies will persist. But insofar as the federal executive and legislative branches are preoccupied with the federal budget deficit, tax reform, political fundraising, health care, and education, placing animal issues in the forefront, for new legislative action, will be a formidable task.

## Legal Aspects

### Existing Legal Framework

The legal framework regarding animals in the United States has focused, to this point, on concerns that they be treated humanely. Existing legislation deals with the care and the use of laboratory animals in biomedical research and, to a much less comprehensive extent, with the treatment of livestock and poultry. Concerns related to the ethical rights of animals generally have not been recognized as legal rights although many animal-rights advocates believe that such legal protection should be extended. Such legal rights would include the right not to be used for human purposes, a concept running counter to the long Western tradition of absolute human dominion over nonhuman animals (Allen, 1983; Dresser, 1985).

### Production Practices

Calls for regulation of agricultural-animal care practices have been more successful in western Europe than in the United States (Baumgartner, 1993; Frank, 1979; Wise, 1986; Wolfson, 1996). Some Euro-

pean nations have set legal standards for animal husbandry on farms, although these standards differ markedly among nations. Trans-European legislation has been slow (Baumgartner, 1993; Guither and Curtis, 1983; Schmidt and Schmidt, 1995).

In the United States, most states have anticruelty legislation designed to prohibit gross mistreatment of animals (Animal Welfare Institute, 1990; McCarthy and Bennett, 1986; Wolfson, 1996). Abandonment, abuse, neglect, overwork, injury, and torture typically are defined as violations of such statutes. Specific uses of animals, such as for cock- and dog-fighting, are frequently but not universally banned. State anticruelty statutes often are criticized as ineffective except in the most blatant cases, in part because of apathetic enforcement (Wolfson, 1996). Some state legislation excludes agricultural animals altogether whereas the application of other statutes is limited to practices other than those standard or customary in farming. Still other legislation applies only to unnecessary or unjustifiable actions or practices.

At the federal level, only limited legislation exists related to the humane treatment of animals, and none related to animals residing on farms. The oldest is the Livestock Transportation Act ("The 28-hour Law of 1906"), which dates back to 1873. The act, recently revised, applies to transport of animals by "rail carrier, express carrier, or common carrier" and requires a respite period unless the vehicle itself provides food, water, and space (49 United States Code § 80502 [1995]). Additional federal legislation includes the Humane Slaughter Act of 1958 as amended in 1978 (7 United States Code § 1901–1906 [1995]), which requires humane livestock-slaughter methods to prevent "needless suffering," and the Horse Protection Act of 1970 (15 United States Code § 1821–1831 [1995]), which restricts the practice of soring horses (especially Tennessee Walking Horses) for exhibition or sale.

## Scientific Experimentation and Manipulation

In the United States, regulations promulgated under the Animal Welfare Act of 1966 (AWA) as amended in 1970 and 1976 and by the Improved Standards for Laboratory Animals Act of 1985 (7 United States Code § 2131–2159 [1995]) are enforced by the U.S. Department of Agriculture (USDA). They provide legal standards for animal handling and holding in research facilities, among other venues, and require registration of such facilities; compliance with standards for environment, nutrition, and veterinary care; and specific oversight of any scientific use of animals. Animal-protection groups criticize the AWA as merely sanctioning "abuse and destruction" of animals used in laboratory experiments (Hoch, 1987). One challenge to animal experimentation under the AWA is that farm animals are excluded specifically from the statutory definition of *animal*. For promulgation purposes, the USDA has defined *animal* to include warm-blooded animals except birds, rats, mice, and farm animals being used in food and fiber research.

Animal activists contend that more recent experimentation involving biotechnological manipulation raises questions beyond well-being as such, e.g., the contention that genetic manipulation poses risks to human health, environmental integrity, and socioeconomic dislocation and upheaval. Moreover, some experimentation is objected to on ethical grounds as "tampering with nature" and violating species integrity (Kimbrell and Rifkin, 1987; Rollin, 1995b; Sears, 1981).

# 3 Scientific Assessment of the Well-Being of Agricultural Animals

## Needs for Scientific Assessment

The issue of agricultural animal well-being probably will be resolved politically more on the primary basis of perceptions, attitudes, beliefs, and values of citizens than on the basis of biological or economic evaluation. Still, the scientific assessment of animal well-being is needed. Moreover, much already known about animal well-being is not being applied fully in agricultural production systems, especially off-farm (Grandin, 1997). Specific recommendations follow.

- Successful producers of food animals should adopt scientifically based practices. Those who have raised farm-animal well-being issues have succeeded in increasing farmers' attention to animal well-being per se, so calls have increased for scientific assessment to ensure the humaneness of animal-care practices and regulations proposed by activists.
- The voluntary guidelines for sound animal care that have been published by national producer organizations, e.g., the American Veal Association (1994), the National Milk Producers Federation (1994), the National Pork Producers Council (1996), and the National Turkey Federation (1997), have been based on then-current scientific assessment of pertinent aspects of husbandry and should be consulted.
- Education of a generally uninformed or misinformed citizenry with respect to the well-being of agricultural animals should be based on scientific assessment.
- When subcommittees of the U.S. Congress address specific issues of farm-animal well-being, e.g., Joint Hearings on the Veal Calf Protection Act (1989) and Public Hearings on the Downed Animal Protection Act (1994), they should continue to consider seriously scientific assessment and outside opinion.
- In view of the expected rise in retail prices of animal-origin foods as a result of the adoption of specific proposed alternative practices (§II.2.3), before requiring adoption of such alternatives by animal producers, the public—through its elected legislative representatives—should consider documenting via scientific assessment both (1) the actual need (which may differ from the perceived need) to alleviate animal suffering and (2) the degree to which the proposed alternative practices actually would alleviate any suffering that might exist.
- Future designs of animal-production equipment, facilities, and practices should reflect the results of scientific assessment for humaneness.

## Approaches to the Scientific Assessment of Animal Well-Being

### Underlying Assumptions

Among scientists, those most involved in developing the scientific knowledge regarding agricultural animal well-being are the applied environmental physiologists (applied ecologists) and the applied behavioral scientists (applied ethologists) concerned with agricultural animal behavior, genetics, health, nutrition, physiology, and production practices. Although, as in any science, understanding is based on a central dogma comprised of generally accepted scientific data, laws, and theories, these scientists have individual perceptions and opinions. They bring to their respective approaches perceptions and concepts of animal nature derivative from their unique educational backgrounds and experiences with animals. Differences of opinion lead to continual challenges to specific parts of the central dogma itself, as well as to each new bit of data nominated to become part of that amalgam. The new data often are soon forgotten, and sometimes part of existing dogma is abandoned and replaced by stronger evidence. The knowledge base grows, evolves, and approaches more closely an accurate understanding of the operative phenomena.

At the base of farm-animal ecologists' and ethologists' central dogma are products of the specific scientific disciplines, as well as of the animal sciences in general. Many of these givens are relevant to ques-

tions that have been raised by the public regarding the well-being of agricultural animals. Some important examples follow.

Agricultural animals are domestic animals of which the following statements are true:

- Humans have the right to use agricultural animals, which should as a common-sense rule be kept as calm, comfortable, and healthy as possible and should be handled and transported, euthanized, and slaughtered by appropriate ways and means (American Veterinary Medicine Association, 1993; Grandin, 1993; Guide, 1997; Universities Federation for Animal Welfare, 1987).
- Agricultural animals evolved from unusual creatures with catholic food preferences, short flight distances, agreeable temperaments, weak mate bonds, precocious neonates, amenability to living in groups, distinct social orders, ready adaptability to new environments, and so on—all traits favoring domestication (Budiansky, 1992; Craig and Swanson, 1994; Hale, 1969).
- They have been molded through artificial selection and crossing to fulfill agricultural goals, so they have specific environmental sensitivities and tolerances (Curtis, 1983; Wathes and Charles, 1994) and protocols for their care must be based on their unique needs, not on those of their progenitors or of humans (Craig, 1981; Craig and Swanson, 1994; Price, 1984, 1985; Siegel, 1989, 1993, 1995).
- They can experience cruelty in two categories and perhaps three: abuse, neglect, and perhaps deprivation of opportunities to express internally motivated behaviors (Curtis, 1987; Ewbank, 1985); yet it is difficult to enforce well-being regulations except to minimize gross abuse (Kilgour, 1976).
- They show maximal individual performance—growth, egg or milk yield, reproduction, and so on—under conditions to which they can adapt readily; their productive and reproductive functions are sensitive to stressors, which for any of several reasons can diminish performance (Curtis, 1983; Johnson, 1997; McFarlane et al., 1989; Moberg, 1985).
- It is important to design production systems for them carefully so as to simulate naturalistic settings; situations not in their best interests have resulted from careless approaches (Edwards, 1995; Tauson, 1995).
- They are confronted by many stressors (Curtis, 1983; Ewbank, 1985; Wiepkema, 1987); they experience stress ranging from *eustress* (good stress, i.e., stress that is positively rewarding) through (normal) physiological stress to distress (extreme stress) (Ewbank, 1985; Zulkifli and Siegel, 1995); their well-being is a discontinuous and variable state, still impossible to define precisely in practical terms (Mench, 1993a, 1993b); and they should not be expected to experience well-being continuously (Wiepkema, 1987).
- They are endowed with a variety of adaptive activities, functions, and structures that have served and continue to serve their wild progenitors and feral relatives well, which typically experience stressors more often, ordinarily involving a different complement of factors (Siegel, 1995).
- They invoke many general and specific physiological changes in homeokinetic response to specific stressors; although these changes alone may reveal little about the degree to which they are consciously experiencing well-being (Dantzer et al., 1983; Duncan and Dawkins, 1983), physiological changes nevertheless may indicate that they have reached a prepathological state (McGlone, 1993; Moberg, 1985).
- They probably have internally motivated behavior patterns that therefore should be considered behavioral needs to be accommodated by the environment (Hughes, 1980); they are aware of what is going on around them and perhaps even of themselves (Dawkins, 1993; Griffin, 1976, 1984, 1992).
- Their immune systems not only are influenced (often negatively) by stressors (Kelley, 1985; Siegel, 1987), but also influence, in turn, other responses to stressors (Arkins et al., 1996; Husband, 1995).
- They consciously perceive various physical and psychological stressors, although the quality and precise limits of experiences that engender in them the emotions of pleasure or displeasure, comfort or discomfort, anxiety or contentment remain enigmatic; and they perceive those stressors to degrees seeming to depend not only on stressor intensity and duration but also on their current psychological and physiological states, previous experiences, and age (Broom and Johnson, 1993; Curtis, 1983; Houpt, 1991; Jones, 1987; Keele and Smith, 1962; Kitchell and Erickson, 1983; Kitchell and Johnson, 1985; Rose and Adams, 1989; Zuklifli et al., 1995).
- They can experience diminished well-being due to either an *acute stressor*, e.g., husbandry practices such as beak-trimming, castration, and dehorning, or a *chronic stressor*, e.g., production systems

featuring overcrowding, excessive mud, or lack of shade.
- They can experience an ethically acceptable level of well-being residing in a range of conditions provided by a variety of agricultural production systems—well-run small, diverse, extensive farms as well as well-run large, specialized, intensive ones (Curtis, 1983, 1986/1987, 1987, 1993), but across the gamut, because of benefit:cost ratio trade-offs, they may be kept in environments meeting only marginally acceptable standards in terms of well-being (Duncan, 1978; Hardwick, 1978).

## Proposed Approaches to the Assessment of Animal Well-Being

Relative to the traditional study areas of the animal sciences, the scientific study of agricultural-animal well-being is fledgling. Although much is known about the environmental needs and behaviors of farm animals, unanswered fundamental questions relevant to an animal's state of being also abound. Only since around 1990 has attention sufficient to promote consensus been accorded these questions.

### Defining *Well-Being*

No scientific consensus has emerged yet regarding the definition of the *well-being* of agricultural animals (Broom and Johnson, 1993; Hurnik et al., 1995). Mench (1993a) observed the following:

> Ultimately, any measures or indicators [of farm-animal well-being] will need to be placed within the framework of a definition of well-being. A number of scientists have attempted to devise workable definitions . . . [ranging] from [those] that emphasize the need for the animal to maintain some type of behavioral or psychological stasis (Moberg, 1987; Fraser, 1989) or to cope (Broom, 1991) or be in harmony (Hurnik, 1988; Wiepkema, 1985) with its environment, to those that state that the animal's "feelings" are of primary importance (Dawkins, 1990; Duncan and Petherick, 1991).

Unless and until there is more convergence with respect to defining agricultural-animal well-being in practical terms, the sort of strides in ensuring such well-being that are being called for by some citizens are unlikely to occur. And according to Duncan and Dawkins (1983), "the terms 'well-being' and 'suffering' . . . will be very difficult, if not impossible to give . . . precise definitions."

### Assessing Well-Being

Perhaps the difficulty in assessing animal well-being has as much to do with its complexity as with anything else. In turn, this seeming complexity may have as much to do with the current level of scientific ignorance. Agreement on the approach to be taken in scientifically assessing the well-being of animals in agricultural settings is wanting; neither is there a consensus as to meaningful indicators of well-being, which are essential for making prudent changes in agricultural systems. Nevertheless, several prominent proposals have emerged. Although some differ from others in emphasis, none is mutually exclusive of any other.

### The First Attempt at Assessing Well-Being

The report of a special committee to the British Parliament (Brambell, 1965) constitutes the first attempt at addressing these matters. The report

- includes conscious feelings as well as structural and physiological conditions in considerations of animal well-being, stating that *welfare* refers to "both physical and mental well-being";
- states that assessment of well-being must involve "scientific evidence available concerning the feelings of the animals that can be derived from their structure and functions and also from their behaviour"; and
- accepts that, although sensations and emotional states probably are not identical in animals and humans, there are sound reasons for assuming that they are substantial in animals and should not be disregarded.

The Brambell Committee also noted the importance to an animal of freedom of movement: "An animal should at least be able without difficulty, to turn around, groom itself, get up, lie down and stretch its limbs." These "five freedoms" recently were affirmed in slightly revised form in the United Kingdom (Farm Animal Welfare Council, 1993).

Most subsequent attempts by scientists in a variety of disciplines to establish meaningful ways and means of assessing the overall well-being of an individual agricultural animal have sprung from the framework established by the Brambell Committee. Approaches have ranged from virtual ignorance of an animal's physical and physiological conditions, with reliance on conscious feelings, to virtual ignorance of conscious feelings, with reliance on anatomical and

physiological conditions. Most approaches have been more moderate and inclusive than these extremes. Whole categories of indicators in addition to those originally proposed now are being considered.

### Approaches Emphasizing Behavioral and Cognitive Indicators

Most attempts to assess animal well-being in terms of behavioral indicators have fallen into five categories (Gonyou, 1994): (1) accommodating normal behavior, (2) identifying behavioral needs, (3) interpreting results of preference tests, (4) characterizing anomalous behaviors and indicators of ill-being, and (5) elucidating emotional states and cognitive abilities.

Behavioral assessment of an animal in a particular situation depends on sound knowledge of the animal's behavior in a variety of situations. An *ethogram*—a catalog of all behavior patterns occurring during the life cycle in an animal species—forms the basis of such evaluation. Frequencies, durations, and sequences of normal and evidently abnormal behavior patterns can be measured, analyzed, and interpreted by means of comparative studies in specific agricultural settings, to provide information about an animal's adaptabilities to particular environments (e.g., Banks, 1982; Duncan, 1978, 1987, 1991, 1995; Gonyou, 1994; Houpt, 1991; Kilgour, 1976, 1985/1986). The underlying assumption is that an animal's behavior while residing in a specific situation somehow reflects its feelings about that situation.

Here an animal's cognitive processes—e.g., thinking, feeling, remembering, abstract representation—enter into the discussion (Dawkins, 1980, 1990, 1993; Duncan, 1987, 1991, 1993; Duncan and Dawkins, 1983). Duncan (1995) stated the following:

> Welfare has all to do with what animals feel, with the absence of negative emotional states and, perhaps, with the presence of positive emotional states (Dawkins, 1990; Duncan and Petherick, 1991; Duncan, 1993). Animals' feelings are not directly accessible to scientific investigation; they are subjective; only the animal is aware of how it feels. However, it may be possible to gain some insight into the feelings of animals by observing their behavior in various circumstances.

Duncan (1995) listed four ways in which behavior can be used to elucidate an animal's feelings: (1) abnormal behavior in a particular setting suggests maladaptation, (2) presence of behavioral indicators of suffering indicates maladaptation, (3) preferences in careful choice tests may reflect choices resulting in less negative feelings or more positive feelings, and (4) relative importances of preferences previously ascertained may be determined by measuring how strongly motivated the animal is to make a particular choice as against another.

Another aspect of cognition has to do with that species-specific part of the environment to which a species has become adapted during evolution. In particular, it has to do with the stress that may occur when, in certain environments, an animal's expectations are not fulfilled, thus diminishing the predictability or controllability of important environmental features (Wiepkema, 1983, 1987). The amount of stress an animal experiences can be reflected by (1) changes in behavioral sequences; (2) in acute situations, emergence of conflict behavior patterns such as redirection or ambivalence; and (3) in chronic situations, emergence of disturbed behavior patterns such as stereotypies or vices.

One approach would be to examine respective selected subsets of environmental variables systematically and to determine how they combine to influence animal behavioral response (Mench, 1992, 1993a, 1993b). The extent to which an emotion, the fulfillment or frustration of a motivated behavior, or a particular sensation is perceived as positive or negative would depend partly on cognitive factors.

### Approaches Emphasizing Anatomical, Physiological, and Immunological Indicators

Some scientists have held that environmental effects on endocrine status, hormonal effects on psychological traits, and the role of lymphoid cells are important determinants of conscious emotional states, which in turn reflect an animal's state of being (Arkins et al., 1996; Dantzer and Kelley, 1989; Dantzer and Mormede, 1983; Kelley, 1980, 1985). Another approach (McGlone, 1993; Moberg, 1985) focuses on stress phenomena that put animals in a state of vulnerability. Stress responses were categorized as (1) recognizing threat to homeostasis, (2) responding per se, or (3) coping with the consequences of responding. Development of a prepathological state was taken to be the real threat to animal well-being, and identifying indicators of that state therefore should be crucial.

### Approaches Emphasizing Fitness and Agricultural-Performance Indicators

One approach (Broom, 1991; Broom and Johnson, 1993) is based on *coping*, or successfully achieving internal stability in the face of external stress. The

welfare of an animal is considered to be its state insofar as it attempts to cope with its environment. Failure to cope results in diminished fitness, and an environment is considered detrimental if it diminishes or if it seems likely to diminish fitness.

Yet another approach (Curtis, 1983, 1985, 1987; Curtis and Stricklin, 1991) involves environmental adaptability, agricultural productivity, and animal needs. It recognizes the sensitivity of health and productivity as indicators of animal adaptation and well-being. This approach holds that well-being depends on the degree to which animal needs are being satisfied, that the primary needs are physiological and safety needs (Maslow, 1970), and that behavioral needs probably exist but remain to be documented. The approach emphasizes that identifying behavioral needs and characterizing feelings such as comfort, fear, frustration, pain, and pleasure will depend on development of an understanding of the cognitive processes of animals.

Yet another approach emphasizing fitness and performance (Craig and Swanson, 1994) emphasizes the preadaptation of the progenitors of most domestic animals to domestication by virtue of their lack of specialized requirements and relatively great adaptability to production environments. It recognizes limits to adaptability as reflected by behavioral, immunological, physiological, and individual performance indicators; acknowledges the need for multiple indicators to evaluate production systems reliably; and suggests that the various respective space allowances adequate for individual animal well-being seem greater than those maximizing net profit by means of raising large groups of animals in agricultural operations.

### Approaches Emphasizing Multiple Indicators

For some time, four potential categories of biological indicators of well-being have been postulated, namely, agricultural, ethological, pathological, and physiological (Smidt, 1983). This view, which has emphasized the theoretical advantages of combining single criteria to form an integrated system of indicators, has taken into account the problems remaining in the gathering of necessary information, the interpretation of animal responses, and the correlation of potential indicators with objectively defined degrees of animal well-being.

Another approach emphasizing multiple indicators (Albright, 1987, 1990, 1993) has listed various performance criteria for assessing animal well-being. These criteria include behavior, health, musculoskeletal soundness, productivity, biochemical and physiological traits, and reproductive efficiency. According to this approach, a working knowledge of proper care and husbandry, animal comfort, and normal behavior patterns provides an understanding of animals and results in husbandry achieving and maintaining both animal productivity and well-being. This approach also acknowledges that abnormal behavior has been observed in all kinds of agricultural animals residing in all kinds of production environments. Many cases have been resolved by appropriate changes in environment and husbandry practices.

Another multifactorial approach (Fraser, 1993) involves finding performance indicators of three broad criteria: a high level of biological functioning; the freedom from suffering, that is, from prolonged fear, pain, and other negative experiences; and the presence of positive experiences such as comfort and contentment. According to this approach, measures of productivity, although valid, need careful interpretation. Moreover, pathology identifies breakdowns in functioning whereas epidemiology identifies the circumstances under which such breakdowns likely will occur. Useful physiological approaches include prepathological states and corroborative measures of short-term negative experiences such as fear and pain. Useful behavioral criteria are thought to include abnormal patterns, emotions, environmental preferences, and motivational strength.

Another approach (Siegel, 1989, 1995, 1996) holds that the well-being of agricultural animals comprises more than health, vigor, and vitality. Productive performance plays a prominent role, too. Many other criteria are emerging, including behavioral, physiological, and immunological traits. But a multifactorial index is lacking. Generalizations should be tempered because animal sensations, perceptions, and their consequences are modified by, among many other factors, genotype, gender, age, experiences, and motivational state. Even when several concomitant responses are measured reliably, interpretation of their collective meaning remains elusive.

## Off-Farm Experiences

Rough handling and other abuses of agricultural animals still occur in a small fraction of the off-farm locations at which animals reside transiently. According to existing knowledge, many of these problems in handling, transporting, and slaughtering can be corrected readily. More knowledge is needed, however, with respect to the rest-stop needs of livestock being transported long distances, as well as with respect to the problems of highly excitable or difficult to handle animals (Grandin, 1994a, 1994c, 1996).

Perhaps one of the most important determinants of animal well-being off-farm is the attitude of management personnel in the succession of firms typically responsible for animal care and handling (Grandin, 1994b). In addition to being supervised closely, personnel handling and transporting livestock also should be trained in the pertinent principles of animal behavior and handling (Grandin, 1993, 1994c; Kilgour and Dalton, 1984).

### Moving

During the last decade, design and manufacture of equipment in use for handling and transporting livestock have improved, and cattle, sheep, and most hogs will move quietly through it. By employing sound behavioral principles, solid sides, curved walkways, and adequate ramps help keep animals calm (Grandin, 1993). Systems must be designed, manufactured, and installed properly to avoid impeding animal movement (Grandin, 1995, 1996).

### Stunning

Methods for making animals insensible to pain before slaughter have been extensively investigated. Captive-bolt or electrical stunning will render an animal insensible instantly (Blackmore, 1985; Daly and Whittington, 1989; Grandin, 1994c; Gregory, 1994; Gregory and Wotton, 1984; Hoenderken, 1983). Electrical stunning as employed in slaughter plants should not be confused with electrical immobilization, a highly aversive technique that paralyzes a conscious animal (Grandin et al., 1986; Lambooy, 1983; Pascoe, 1986; Rushen, 1986).

When an animal has to be restrained for some procedure, a well-designed restraint device, such as a squeeze chute, should be used. When ritual slaughter of an animal without stunning is evaluated from a well-being standpoint, the variable of stressfulness of restraint method should be considered apart from the act of slaughter of the conscious animal per se (Giger et al., 1997; Grandin, 1994a; Regenstein and Grandin, 1994).

## Forging Consensus

Each of the foregoing approaches to the assessment of animal well-being has merit, and although they differ they contain a basis for consensus. As a group, these approaches recognize (1) that there are differences between acute and chronic incidents of anxiety, frustration, discomfort, and pain; and (2) that the well-being of an animal involves biological systems that may change over the lifetime of the individual as well as over the natural history of the population. Moreover, the approaches generally advocate multiple categories of indicators of well-being, demonstrate awareness of the human-animal interface, and acknowledge that domestication of agricultural animals is ongoing.

# Scientific Assessment of Current Status

### Overview

Scientists discussing animal behavior as the basis for designing and operating livestock and poultry accommodations still must use words and phrases such

**Curved chute with solid sides for handling cattle on a ranch. Curves help keep cattle calmer because they are unable to see people up ahead. Photograph courtesy of Temple Grandin, Colorado State University, Fort Collins.**

**Cattle in a feedlot waiting to be moved through a curved lane that directs them into a single-file chute. Cattle will move more easily through a curved lane because it circles back in the same direction they came from. Photograph courtesy of Temple Grandin, Colorado State University, Fort Collins.**

as *hope that soon*, *possibilities*, *would be*, and *will be* (e.g., Northeast Regional Agricultural Engineering Service, 1995). Today's scientist-evaluators of animal well-being in agricultural production systems are constrained by insufficient knowledge of animal needs and the means of meeting them. Small design differences in animal equipment and facilities can cause major differences in how effectively animal needs are fulfilled (Grandin, 1995; Pedersen et al., 1995; Tauson, 1995; Taylor, 1995). Moreover, the competencies and personalities of managers and operators of animal-production systems can differ greatly, and with them the quality of life and productive performance of animals (Albright, 1993; Gross and Siegel, 1993; Hemsworth and Barnett, 1987; Hemsworth et al., 1993; Jones, 1994; Seabrook, 1972).

An animal-production system, facility, or piece of equipment may be

- designed and operated well, evidently supporting an ethically adequate degree of animal well-being;
- designed well but operated incompetently or unconcernedly—hence not supporting adequate animal well-being; or
- designed so poorly that deficiencies are insurmountable regardless of personnels' ethical concern or technical competence.

Critics sometimes indict entire categories of animal-production systems. Scientists tend to focus on specific design features of a system, facility, or piece of equipment and how it is being operated. In the opinions of most scientists specializing in agricultural animals, an acceptable level of well-being is being supported most of the time in most of the production systems on most American farms. Still, members of the general public and agricultural specialists alike recognize instances in which animals are not well, usually because of inadequate environmental design, incompetent caretakers, or unconcerned managers. For every category of agricultural production system, facility, and equipment, the quality of these factors varies.

Animals are known to have traits and experiences that result in certain needs, so there are predictable and therefore preventable misfits between certain production systems and certain animals. Why cannot *all* such misfits be predicted and prevented? In the event of inadequate design or operation, an unfavorable rate of morbidity, mortality, or productivity tends to decrease profitability and can lead to bankruptcy. Of course, on ethical grounds, the accomodation's failings should have been recognized and the accomodation abandoned some time before the point of business failure. Similarly, incompetent or inhumane caretakers should be terminated before poor financial returns necessitate drastic action. Business priorities often prevail, however. In view of the natures of our economic system, politics, and governance, this probably will be the case so long as assessment of animal well-being is based on no science, inadequate science, or lack of interest. Today, the problem is primarily that of inadequate science, and so this state of affairs will remain until meaningful scientific assessment of animal well-being is possible.

## Needed Additional Scientific Insight

An area in which consensus among animal scientists and other animal-agriculture stakeholders has emerged is that of the prioritization of important researchable questions regarding the well-being of agricultural animals. The report by Moberg and Mench (1993) resulted from four consensus initiatives:

1. prioritization of researchable questions by members of the North Central Region (NCR)-131 Committee on Animal Care and Behavior (all committee members are scientists) (Moberg and Mench, 1993);
2. six general research objectives formulated by the 12 discussion groups, representing various stakeholders in animal agriculture, including scientists, at the Food Animal Integrated Research (FAIR '95) Meeting in Saint Louis in October 1992, sponsored by the Federation of American Societies of Food Animal Sciences (FASFAS) (Federation of American Societies of Food Animal Sciences, 1993; Mench, 1993a).
3. two overall research objectives for animal well-being as delineated by the consensus committee following the FAIR '95 Meeting (Federation of American Societies of Food Animal Sciences, 1993; Mench, 1993a); and
4. prioritization of areas for scientific research on animal well-being by members of the work group on researchable problems and priorities at the Food Animal Well-Being Conference and Workshop in Indianapolis in April 1993, sponsored by Purdue University and the USDA (Moberg and Mench, 1993).

Members of this Council for Agricultural Science and Technology (CAST) task force on animal well-being generally subscribe to the consensus on this topic that has begun to emerge in recent years.

### General Research Areas Identified by Discussants in the FAIR '95 Process

The six general research areas identified in the FAIR '95 process were as follows:

1. **Bioethics and conflict resolution.** There is a need to characterize thoroughly public attitudes towards and opinions about the well-being of agricultural animals, as a prelude to improving communication and resolving conflicts among the various interested parties and organizations and educating the general public about agricultural practices and the well-being of agricultural animals.
2. **Responses of individual animals to the production environment.** Identifying meaningful indicators of well-being is critical. Research is needed to analyze the relationships among normal- and abnormal-behavioral, immunological, neuroendocrinological, health, and productive-performance indicators of well-being in agricultural animals.
3. **Stress.** *Stress* here is taken, in its broadest context, to include any practice of ethical concern with regard to discomfort or pain in an *individual* agricultural animal. Examples include *standard agricultural practices*, e.g., beak-trimming, dehorning, and castration without anesthesia; selection and biotechnological approaches to genetic alteration of animal populations focused on agricultural goals; handling; transporting; slaughtering; restricting feed or water intake; restraining bodily movement; and isolating socially.
4. **Social behavior and space requirements.** Because most agricultural animals reside in social groups, research is needed to characterize the effects of group size and composition and social behavior patterns, e.g., aggression and play, on space use by and well-being of agricultural animals.
5. **Cognition**. Research using objectively designed cognitive-psychological methods to characterize the emotions and feelings of agricultural animals is needed.
6. **Alternative production practices and systems.** Research is needed to facilitate adoption of findings under objectives 2 through 5 in the multidisciplinary design and practical operation of production systems for agricultural animals.

### Overall Research Objectives on Which Consensus Emerged in the FAIR '95 Process

Two of the overall research objectives that emerged during deliberation of the FAIR '95 consensus committee were

1. to determine scientific measures of well-being in food-producing animals and
2. to develop short-term production practices and long-term management systems based on scientific research findings about animal well-being.

### Contributions by the Workgroup at Food Animal Well-Being Conference and Workshop

From the report by Moberg and Mench (1993), a workgroup on researchable problems and priorities supported the two general research objectives resulting from the FAIR '95 process, as described earlier. The workgroup proceeded to assign top research priorities identified by the NCR-131 Committee to these two objectives. The remaining text of this CAST report constitutes extracts quoted nearly verbatim from the work group's report, to which the members of this CAST task force on animal well-being generally subscribe.

### Determining Scientific Measures of Well-Being in Food-Producing Animals

Developing measures of well-being is the pivotal step in providing a scientific answer to what constitutes acceptable standards for agricultural animal use. As these measures are developed, it should be remembered that they must be not only acceptable scientifically but also relevant to the rest of society.

To achieve this objective of developing measures of well-being, the workgroup identified three general research areas that should receive priority: (1) the adaptation and adaptiveness of farm animals to their environments, (2) the social behavior and space requirements of domestic animals, and (3) the cognition and motivation of domestic animals.

**Adaptation and Adaptiveness**. Most food animals have been domesticated for thousands of years. Selection under intensive management conditions has occurred only recently, however, and has been oriented largely toward the improvement of production traits. Of concern is whether individual animals are able to adapt physiologically and behaviorally to such intensive conditions, given the adaptive constraints resulting from their genetic history. A goal of research in this area is to determine the relative roles that genetics and environment play in well-being. This infor-

mation can serve as the basis for either modifying management practices or developing genetic selection programs to improve the fit between animals and their environments, where necessary.

Research in this area involves the following activities:

- developing quantitative behavioral, physiological, immunological, and neurobiological measures of stress in food animals, and determining their relationships;
- characterizing genetic differences in these responses when food animals are exposed to various conditions; and
- determining the mechanisms by which genetics and environment influence both the development and the expression of response to stress.

**Social Behavior and Spacing**. With the intensification of animal agriculture, a major concern is whether restricted space affects animal well-being adversely. To answer this question, understanding of the social behavior of food animals needs to be improved, as does understanding of how the quality of space influences behavior, and the consequences that changes in social interaction and space utilization patterns have on well-being.

Research in this area involves the following activities:

- determining how the animal perceives and uses the quality and quantity of space provided, including factors such as pen configuration, vertical space, and perimeter areas;
- determining the physiological, behavioral, and immunological responses of animals to different qualities and quantities of space;
- studying the influences of group size, group composition, social interactions, and individual distances on well-being and determining how these factors affect space utilization; and
- using the information obtained to model the use of pen, feeder, and waterer space.

**Cognition and Motivation**. The subjective experiences, or "feelings," of animals are of major concern to the public. There currently is little scientific information, however, that can be used as a basis for addressing this concern. Studies need to be undertaken to determine what animals sense and perceive and what they can learn about their environments and the consequences of their own behaviors. It also is necessary to assess motivation to determine whether it is important for animals to be able to engage in certain behaviors in different environments.

Research in this area involves the following activities under various housing and management conditions:

- developing methods to quantify the subjective states of animals, such as contentment, pleasure, fear, and frustration; and
- evaluating the motivational states of animals, such as hunger, thirst, libido, and comfort needs.

### Developing Short-Term Production Practices and Long-Term Management Systems Based on Scientific Research Findings about Animal Well-Being

The goal of the previous research objectives is to provide analytical methods for evaluating animal well-being. These methods are necessary to determine the influence that current animal agricultural practices has on the well-being of farm animals and to assist the industry in developing management practices ensuring the well-being of farm animals. Two general areas of current practice require attention: (1) short-term production practices and (2) long-term management systems. These interrelated areas are separated here for the purpose of discussion.

**Short-Term Production Practices**. Short-term production practices such as transportation and slaughter and special agricultural practices such as beak-trimming, dehorning, and castration are important or necessary elements of animal management, but they also unquestionably affect the well-being of animals. These practices need to be addressed by research focused on specific circumstances and species considerations.

Research in this area involves the following activities:

- evaluating existing and alternative practices with regard to potential pain, stress, or discomfort;
- evaluating the efficacy of analgesics for decreasing the pain and discomfort associated with special agricultural practices; and
- developing new or alternative procedures producing less pain, stress, or discomfort than current procedures.

**Long-Term Management Systems**. Current long-term management systems must be evaluated for their effect on farm-animal well-being. Equally important, however, is an evaluation of the benefits, if any,

of the modification of these systems and of the development of novel management systems.

Research in this area involves the following activities:

- investigating the basic behavioral, immunological, and physiological responses of animals to management systems;
- using these responses to evaluate alternative or modified management systems and comparing them with conventional management systems; and
- capitalizing on this knowledge to devise new management systems when warranted and assessing the biological and economic viability of those systems.

An overall research need for both short-term practices and long-term systems is to determine the ethical and societal concerns that might be raised or allayed by changes in production practices and management systems.

## Recommended Approach in the Meantime

Taking advantage of the multitude of approaches and disciplines now involved seems most reasonable at present. Decades will be required for adequate scientific data to be generated, however. In the meantime, taking advantage of the multitude of approaches and disciplines now involved seems reasonable, if only as a hedge in view of the lack of certainty as to the "correct" subset of measures to use in determining well-being among agricultural animals. One rational approach to seeking consensus regarding the multifactorial indices of well-being in agricultural animals would include the following actions:

- assembling a multidisciplinary team including several scientists specializing in the well-being of agricultural animals, one (or more) theoretical statisticians(s) thoroughly familiar with multivariate analyses, and one (or more) applied statistician(s) knowledgeable about both multivariate analyses and agricultural animals;
- asking the team to assemble a worldwide database of reliable information of all kinds bearing on matters of farm-animal well-being; and
- asking the team to employ appropriate multivariate parametric and nonparametric statistical analytical methods such as Bayesian and mixed model methods, neural networks, critical path analyses, principal components analyses, and Eigenvectors (e.g., Gianola and Hammond, 1989; Krzanowski and Marriott, 1994, 1995; Rao, 1973) to elucidate and to determine the multifactorial indices of well-being in agricultural animals.

# Appendix A: Symbols and Abbreviations

| | |
|---|---|
| AWA | Animal Welfare Act |
| CAST | Council for Agricultural Science and Technology |
| FAIR | Food Animal Integrated Research |
| FASFAS | Federation of American Societies of Food Animal Sciences |
| USDA | U.S. Department of Agriculture |

# Appendix B: Glossary

**Abuse.** Obvious cruelty; willfully harming an animal or causing an animal to experience pain.

**Acute stressor.** A stressor that tends to be brief but intense.

**Animal-welfare activists.** Individuals advocating moderate change in the human use of animals.

**Animal-rights activists.** Individuals advocating more sweeping action in the human use of animals.

**Chronic stressor.** A stressor that tends to be sustained but moderate.

**Coping.** Successfully achieving internal stability in the face of external or internal stress.

**Cruelty.** Causing an animal to suffer; being insensitive or indifferent to an animal's suffering.

**Deprivation.** Denying an animal what it needs to experience total well-being.

**Ethogram.** The complete repertory of behavior patterns occurring during the life cycle in an animal species.

**Eustress.** Stressful experiences positively rewarding to the animal.

**Informal right.** Claim that can be validated by custom or etiquette.

**Legal right.** Claim that can be validated through actions in a court of law

**Moral right.** Claim that can be validated by general principles of ethics and morality.

**Neglect.** Denying a vital need (e.g., feed, water, or shelter) to an animal under one's care.

**Rights.** Claims that can be made by or on behalf of one party against another (Feinberg, 1970). Criteria for validating such claims depend on frame of reference.

**Stress.** Any internal or external stimulus to which or with which the animal cannot easily or readily adapt or cope.

**Suffer.** To undergo pain, trauma, or loss resulting in negative emotions and feelings.

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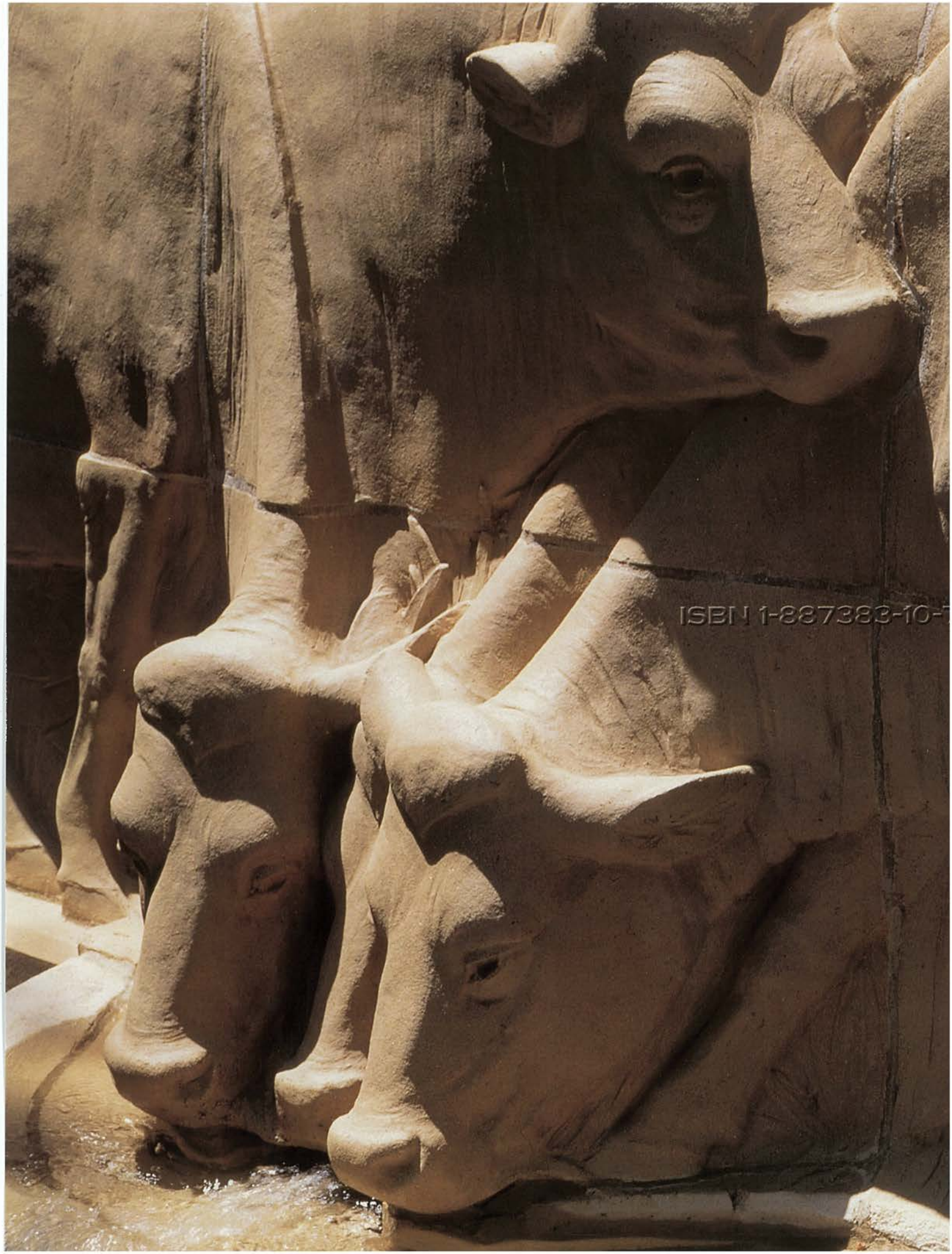
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