CANINE RESEARCH
ENVIRONMENT

From a conference held by the Scientists Center for Animal Welfare in Bethesda, Maryland on June 22, 1989

Edited by
Joy A. Mench, D.Phil.
and Lee Krulisch

Scientists Center for Animal Welfare
4805 St. Elmo Avenue
Bethesda, MD 20814
(301) 654-6390

January 1990
The material in this volume is based on tape recordings of proceedings from the conference, "Canine Research Environment", held in Bethesda, Maryland on June 22, 1989. Some speakers have provided additional references.

The opinions expressed in this publication are those of the individual authors. They do not necessarily represent the views of the Scientists Center for Animal Welfare.

Published by the Scientists Center for Animal Welfare, January 1990.

Library of Congress Catalog Card Number: 89-062910
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Acknowledgments</th>
<th>iv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information on the Scientists Center for Animal Welfare</td>
<td>v</td>
</tr>
<tr>
<td>Faculty</td>
<td>vi</td>
</tr>
</tbody>
</table>

## Regulatory Issues

| Regulatory Requirements for Exercise of Dogs                                    | 3   |
| Dale F. Schwindaman, DVM                                                       |     |
| **Question and Answer Session**                                                |     |

| Regulations for Canine Well-being in Canada                                     | 11  |
| H.C. Rowsell, DVM, PhD                                                         |     |

## Environment Enrichment

| Canine Behavior                                                                 | 21  |
| Michael W. Fox, DSc, PhD, B.Vet., Med., MRCVS                                  |     |
| **Question and Answer Session**                                                |     |

| Socialization and Management of Purpose-Bred Dogs                              | 33  |
| Thomas Carroll, DVM, David A. Valerio, DVM and George Pucak, DVM               |     |
| **Question and Answer Session**                                                |     |

## Management

| Policy, Program and People: The Three P’s to Well-being                         | 41  |
| Thomas L. Wolfle, DVM, PhD                                                     |     |

| Caging Systems for Dogs Under the New Standards of the Animal Welfare Act      | 48  |
| William E. Britz, Jr., DVM                                                      |     |
| **Question and Answer Session**                                                |     |

| Environmental Variables and Animal Care                                        | 53  |
| Emerson L. Besch, PhD                                                          |     |

## Effects of Exercise Programs

| Research Studies in Exercise and Behavior of Dogs                               | 61  |
| J. Derrell Clark, DVM                                                          |     |
| **Question and Answer Session**                                                |     |

| Effects of Primary Enclosure Size and Human Contact                            | 66  |
| Howard C. Hughes, DVM and Sarah Campbell, BS                                   |     |
| **Question and Answer Session**                                                |     |

| Effects of Exercise Programs on Serum Biochemical Stress Indicators in Purpose-Bred Beagle Dogs | 77  |
| Sarah A. Campbell, BS                                                          |     |
| **Question and Answer Session**                                                |     |

| Caging Systems for Dogs Under the New Standards of the Animal Welfare Act      | 48  |
| William E. Britz, Jr., DVM                                                      |     |
| **Question and Answer Session**                                                |     |
ACKNOWLEDGMENTS

The Scientists Center for Animal Welfare (SCAW) thanks the Faculty who contributed so much to make this conference a success. The publication of the proceedings of the conference, entitled Canine Research Environment, is due in part to the efforts of Jane Rogers, Managing Editor, Ann McAuley, Coordinator of Distributions, and the staff at Daystar Press.
The Scientists Center for Animal Welfare (SCAW), founded in 1978, is a unique non-profit association of persons and institutions who study, or are concerned about their responsibilities to, laboratory and all animals.

Through educational activities and scientific scholarship, SCAW promotes responsible treatment of laboratory, farm, and wild animals involved in research, strongly discourages redundant research that employs animals, and encourages development and use of alternatives to animal use. SCAW helps define policy for animal use as well as accountability and responsibility of persons who use animals.

SCAW serves as a forum, through workshops, conferences, publications, and contact with scientists and the general public, where current issues pertaining to animal well-being can be discussed. SCAW’s approach is objective and based on the presentation of scientific and empirical evidence to optimize animal well-being.

Concerned scientists from academe and industry, students, and members of the public are invited to join SCAW, participate in its activities, and support its educational programs.
FACULTY

Co-Chairs

Howard C. Hughes, VMD
Group Director (Worldwide)
Department of Laboratory Animal Science
Research and Development Division
Smith Kline & French Laboratories

Andrew N. Rowan, PhD (VP, SCAW)
Assistant Dean of New Programs
School of Veterinary Medicine
Tufts University

Faculty

Emerson L. Besch, PhD
Associate Dean and Professor
College of Veterinary Medicine
University of Florida

William E. Britz, Jr., DVM
Vice President
Research Equipment Company, Inc.

Sarah Campbell, BS
Associate Scientist
Department of Laboratory Animal Science
Research and Development Division
Smith Kline & French Laboratories

Thomas A. Carroll, DVM
Hazleton Research Products, Inc.

J. Derrell Clark, DVM
Director, Animal Resources
College of Veterinary Medicine
University of Georgia

Michael W. Fox, DSc, PhD, BVetMed, DVM, MRCVS
Vice President of Bioethics and
Farm Animals
Humane Society of the United States

George Pucak, DVM
Director of Veterinary Medicine
Hazleton Research Products, Inc.

Harry C. Rowsell, DVM, PhD
Executive Director
Canadian Council on Animal Care

Dale F. Schwindaman, DVM
Assistant Deputy Administrator for
Regulatory Enforcement
Animal and Plant Health Inspection
Service
U.S. Department of Agriculture

David A. Valerio, DVM
President
Hazleton Research Products, Inc.

Thomas L. Wolfe, DVM, PhD
Director, ILAR
National Research Council
National Academy of Science
REGULATORY ISSUES
Good morning. I am pleased to be here and I want to thank the Scientists Center for Animal Welfare (SCAW) for having these conferences, not only the one today on dog exercise, but also the one tomorrow. I will be here tomorrow morning also to discuss what is being proposed by the U.S. Department of Agriculture (USDA) as it relates to the well-being of primates in research.

I want to give you some background on what has occurred as far as the proposed rule-making by USDA since the 1985 Amendments to the Animal Welfare Act that have really caused concern both on the part of the public and the scientific community. I would like to bring you up-to-date on where we are at the present time in the rule-making process and then go into what was proposed by the USDA in the Federal Register of March 15, 1989.

In reviewing the rule-making process, most of you are aware that the first proposed rule-making as it relates to Parts One and Part Two (Part One being definitions; Part Two, regulations of the USDA requirements that are in Title of the Code of Federal Regulations) was initially published in March of 1987 with a public comment period. That public comment period was extended twice. By the close of the public comment period we had received just under 8,000 comments. This created a tremendous staff workload in analyzing these comments and determining what was relevant, i.e., what was appropriate, in our opinion, for final rule-making. The document was prepared and sent along with the Part Three proposed rule-making, which are the standards, through the clearance process to the Office of Management and Budget (OMB). It was at that time, of course, that it was determined that this was a major rule. A major rule under Executive Order 12291 is that if the potential cost to the regulated users of animals is going to exceed 100 million, then there has to be a regulatory impact analysis conducted. This was done by the Animal and Plant Health Inspection Service (APHIS), and accompanied the documents to the Office of Management and Budget. Of course the figure, as most of you know, was close to plus or minus a billion dollars.

This caused a great deal of concern. Since that time there has been a lot of discussion back and forth between USDA, OMB and the other Federal agencies that are involved in biomedical research, primarily the Department of Health and Human Services (HHS).

These discussions were continuing at the time that there was legal action filed against the Secretary of Agriculture, the Secretary of HHS and the Director of OMB by the Animal Legal Defense Fund in the latter part of December 1988. It was actually served on the Secretary of Agriculture on the 19th of January, 1989. This action precipitated an attempt to develop a timetable and come to an agreement on what should be done with Parts One, Two and Three. The agreement with the court was that Parts One and Two would be published in the Federal Register along with what was being proposed for Part Three. Even though the document had been developed as a final rule for Parts One and Two, there was a decision to request public comment on the interrelationships between Parts One and Two and what was being proposed for Part Three. That comment period was for 60 days. The agreement with
the court was that at the end of 90 days from the date it was published in the Federal Register, USDA would make every attempt to have an analysis of the comments received and the final document possibly ready for publication as the final rule for Parts One and Two.

Even though the first publication in the Federal Register did mention 150 days, the comment period for Part Three was later amended to 120 days. The comment period for Parts One and Two closed on May 15 of this year. In order to try to meet the agreed upon deadline with the court, we had a task force of anywhere from three to four of our field veterinary medical officers and the necessary supporting clerical personnel open, analyze, photocopy and categorize the comments as they came in. This information was entered into a computer database system so that the comments could be rapidly analyzed. At the present time, the number of comments received on Parts One and Two with postmarks of May 15 totaled 7,103.

We received 1,599 comments from the public, 5,236 from the scientific community, 253 from animal dealers, 12 from exhibitors, and 3 from the transportation industry. We have finished opening all of the comments. Even with the task force it has taken a considerable amount of time. We have entered them into the computer and should complete the analysis, at least the initial cut at an analysis, by the middle of next week.

We don't know at this time what the final outcome will be with Parts One and Two.* There have been a number of discussions held at high levels within government between the Secretary of Agriculture, the Assistant Secretary of Agriculture, the Secretary and the Assistant Secretary of HHS. We do not have any decisions at this point from the policy makers on exactly what direction we should go with respect to Parts One and Two. So, unfortunately, I am unable to give you a complete update at this time. I might say that the comments from the scientific community did reflect a great deal of concern about the approach that was being proposed by the USDA as opposed to the approach that is used by HHS with the Public Health Service Policy. The difference being primarily that USDA, being a regulatory agency, has proposed what have been described as design-based standards rather than the performance-based standards which are the backbone of PHS Policy.

I am now going to set the stage for discussing the Part Three USDA proposal on exercise for dogs. The proposed rule-making that USDA had as it relates to Part Three was an effort to propose what we felt at the time was an interpretation of the 1985 Amendments and the resulting responsibilities placed on the Secretary of Agriculture. It was an attempt to provide wording for which the scientific community, the people that were going to be regulated under the rule-making, and the public would have an opportunity to provide input. We have received a lot of input from both sides and we appreciate that. It is now going to be our job to strike a balance and try to develop final rule-making that will in fact carry out the wishes of Congress, but at the same time be reasonable and objective for the users of the animals. We will make every attempt to do that. I have been fortunate in being able to attend a number of conferences dealing with the most controversial issues. I have appreciated hearing the concerns from both sides as it relates to what we feel we have to do.

The 1985 Amendments were a series of changes to the Animal Welfare Act that were, in many respects, quite specific, much more so than the general authorities that the Secretary of Agriculture had under the initial 1966 Act and the subsequent 1970 Amendments. The Secretary of Agriculture was required to establish standards for pre- and post-surgical care and inspection of research facilities. I will hastily add that it has been USDA's policy in the past not to make unannounced inspections of Federal research facilities. This will continue as our policy except upon request of the agency that would be involved.

The formation of an animal use committee, and the establishment of an information service at the National Agricultural Library, were mandatory. I am very pleased with the database that is being established at the National Agricultural Library, and I hope
that all of us will take advantage of this resource. The Amendments required the offering of annual training sessions for laboratory personnel and provisions for increased penalties for research facilities that violate the animal welfare standards. These are the main points, but let’s take a look at the additional standards that are being proposed in Part Three. Most of you have probably finished, and I am sure enjoyed, reading the proposed rule-making that was published in the Federal Register. It was directed primarily toward the exercise of dogs, the psychological well-being of primates, standards for research facilities and some additional amendments. The additional amendments were added because we felt through experience that there was a need to make some changes in Part Three. We knew that with the 1985 Amendments there was going to be a need for a wholesale revision, and so we waited and added other changes that were not part of the 1985 Amendments.

As you may know, any regulatory agency that receives direction from Congress for new regulatory measures needs to take a look at the actual wording of the law. In so doing we have interpreted the wording to mean that the methods and exemption to exercise dogs can essentially be determined by veterinarians, but the Secretary of Agriculture also should develop general standards that would be used by the attending veterinarian.

In addition, we look at the intent of Congress. With the 1985 Amendments there was very little discussion, and no hearings were actually held on the most controversial issues. With most laws, a conference report is developed when you have a Bill introduced on the Senate side and a companion Bill on the House side. If there are differences, of course, they go to conference and try to work out those differences and come up with a unified Bill. We always take a look at what is contained in that conference report because it will usually identify the intent of Congress. It is very short as it relates to the 1985 Amendments as published in the Congressional Record. But it did say that the intent of Congress was to offer a variety of motion for dogs, through the regular release of the animals from their primary enclosures—these are not the exact words—or through the use of runs, and that they should be assured of having ample space.

We also review statements made by sponsors of the Bill, and in this case Senator Dole, a co-sponsor on the Senate side, had made the statement that, in his opinion, he wanted to have the 1985 Amendments prevent the permanent caging of dogs without daily release and to offer a variety of motion.

Now I would like to give you a quick overview of what was proposed in Part Three by USDA as it relates to the exercise of dogs. First, there are a number of miscellaneous amendments that were also included in the proposed rule-making. Some of them related to dog and cat housing. There were proposed changes for the temperature range in which dogs are housed in various types of primary enclosures or housing units, and ventilation— we have included a proposal to have a humidity requirement for dogs in indoor housing. Anyplace where the environment can be controlled the humidity should be maintained in a range of 30 to 70 percent. For cats, we have proposed a change in the space requirements to conform with the NIH Guide for the Care and Use of Animals. We are proposing additional space requirements for female cats that have litters, and the same is true of nursing bitches. We know that to make any changes in your facilities to conform to whatever the final rule-making might be is going to be very difficult. If there are changes that are needed, you will have to have time. We understand that, and so we are proposing an opportunity for the granting of variances for up to a two-year period in order to comply with whatever the final rule-making may be.

A few additional miscellaneous requirements. We have proposed a requirement for surface transportation. When we implemented the final rule-making under the 1976 Amendments which dealt with common carriers and transportation, we failed at that time to put in anything relating to surface transportation. So we have inserted that, and also there are proposed changes relating to air transportation. As for guinea pigs, hamsters, and rabbits, we are proposing a change in the
Regulatory Issues

space requirements for these species to conform with the Guide and, although the Guide does not require it, we are proposing some additional space for breeding animals.

Even though we are proposing a change in the cat space requirements to conform with the Guide, we have retained the same minimum floor space requirements for dogs. As all of you know, this uses a formula of measuring the dog from the tip of its nose to the base of its tail, adding six inches, squaring that number and dividing by 144 to get the required square footage. I mentioned previously that nursing bitches with litters would require an additional five percent of the dam's required floor space for each nursing puppy. The interior height for the primary enclosure must exceed the dog's height by six inches.

As an example, if we were to use a 28-inch beagle (one that measures 28 inches from the tip of its nose to the base of its tail), we would find that it requires about eight square feet for its primary enclosure. If you were to put additional animals of the same size in that primary enclosure for socialization and exercise, we are proposing 150 percent of the required floor space, or a basic minimum of 80 square feet. If there were six beagles of the same size, using the 150 percent rule, we find that these six animals then would require 72 square feet. However, since that is less than the 80 square foot minimum, they would have to be placed either permanently or for exercise purposes in an enclosure that met the 80 square foot requirement.

For bitches with three nursing pups, again using the same formula, we would find that five percent/pup of the eight square feet required for the dam would require a total of 9.2 square feet of floor space.

In looking at the proposed exercise and socialization requirements, and it may very well turn out to be that socialization is more important as far as dogs are concerned, we are proposing that dogs be given opportunities for socialization. This could be social contact either with other dogs, or with humans in the case of singly-housed animals. They should be maintained in compatible groups.

The law stated that the attending veterinarian could make some decisions about the general standards that would be proposed or that the USDA would have guidelines. The attending veterinarian could make some professional decisions on exactly what would be needed in their particular facility as far as exercise and socialization were concerned. The only exemption, as proposed, would be if the Institutional Animal Care and Use Committee (IACUC) approved an exemption because of the type of research with the required justification in the research protocol or the animal care and use procedures. In addition to being maintained in compatible groups, we are proposing that dogs be able to see and hear other dogs. Singly-housed animals would receive positive physical contact, probably with the caretakers or with other humans. As far as exercise is concerned, we are proposing that animals that are housed in less than what is required for permanent housing be released for exercise at least once daily for a period of thirty minutes. With individually-housed animals, they would have to be released if they are in spaces less than four times what is required using the formula that we currently use for primary enclosures and if there is no visual or physical contact with other dogs. In the case of group-housed animals, if they are in primary enclosures that are less than 80 square feet or less than 150 percent of the now-required space, then they would have to be released for exercise once daily for a period of thirty minutes.

We had proposed other mechanisms or ways of providing exercise, but the methods of exercise could be determined by the attending veterinarian. The attending veterinarian, depending on whether the animal is a random-source or purpose-bred animal, can use any combination of leash walking, release into a room or aisle space, release into a run or pen of at least 80 square feet, or any other similar arrangement. However, we would propose that the veterinarian must maintain a record of this release for enforcement purposes. The attending veterinarian can exempt or restrict the exercise for individual animals, but it must be justified and reviewed every 30 days.

I want to re-emphasize that in the proposal there is an opportunity to get a variance for
compliance on the part of the individual institution, but the institution must apply for this within 60 days after the effective date of any final rule-making. So if, for example, it is published in the Federal Register of March 15, 1990 with May 15 as the effective date, then the registrant must submit a written application for the variance by July 15. The administrator of APHIS may grant this variance for a period of up to two years with a possible one year extension.

Those are the basics of the proposed rule-making we had published in the Federal Register as it relates to exercise for dogs. Again, I want to emphasize that the USDA is very open to comments. The enforcement philosophy that APHIS is taking with the formation of the new unit on regulatory enforcement and animal care is that we want to have full-time, well-trained individuals making inspections. Whatever the final rule-making may be, we will be making quality inspections to identify non-compliance items. We want to gain compliance through education and working with the institutions or the licensees and registrants. However, if we do not get compliance, as a last resort we will then take legal action.

So that gives you a brief overview of the USDA's requirements. Again, we appreciate the Scientists Center putting on these two one-day conferences. I am sure that USDA and I myself will benefit a great deal more from the discussions that you are going to have than from what you will get from my presentation this morning.

Question and Answer Session

Q. I have one question. You alluded to the fact that for Part One and Part Two the comments are being looked at. Can you speculate as to the possible scenarios that might result out of the review of our comments?

A. There are several scenarios, of course, that can result and that are being considered. One scenario is to assess the comments, go ahead and have final rule-making.

Another scenario is to take a look at the PHS policy to try to harmonize the policy just as closely as we can, within the legal requirements, with what USDA will have as rule-making. In so doing, if these changes are substantive enough, two things may happen. If they are substantive changes and the public has not had an opportunity to comment on them, the rule-making would have to be re-published as a proposal for public comment. If it turns out that they are not substantive enough, and depending upon what the assessment of the comments are, it is possible that with reformatting there would be final rule-making; again, attempting to harmonize as much as possible. The reformatting would be to take everything that USDA has in Parts One and Two that relates to research facilities and place it into a separate subpart. Research facilities would no longer be included along with dealers, common carriers, or the operators of auction sales. Instead, everything would be separate and apart for research facilities in a subpart.

Q. You talked about daily exercise. Is that five days a week or seven days a week?

A. That's a good question. I have not looked at the comments myself, but I think there have been quite a large number of comments on this. We need to identify what constitutes daily, whether it would involve five days a week with provisions for emergency care and observation on the weekends. There are a number of things that can be included in such a provision. I can't answer your question specifically, but as it is presently written, the interpretation would be seven days a week.

Q. Do you anticipate we will ever see regulations for the exercise of cats?

A. I really don't know. What USDA does, of course, is to respond in the best way possible to Congressional direction and to public feelings. That comes through Congress, and I don't think you would ever find that USDA would ask for that kind of authority.

Q. In an indoor/outdoor run situation, how do you apply 80 square feet or four times the minimum? Can you include both indoor and outdoor portions of the run?

A. If that animal has access to both inside and outside, both of them would be included in the minimum required floor space.

Q. Since behavioral requirements differ a fair amount from the Guide, what was the basis for USDA making the proposals that they did on space requirement?

A. I don't know the exact answer to that. I have asked staff the same thing since I was not involved at that time. The response was that when USDA published in the Federal
Register their intent for proposed rule-making, not the proposed rules themselves, that this was the only actual space requirement or space recommendation that was received. And so that was used in order to have something definite for public comment.

Q. If that was the basis for the rule, it seems it would require some modification, if it is not based on anything more substantive. Some sort of scientific or other type of evidence should be used.

A. I can understand that. For scientists or people involved in biomedical research that does strike you as very ridiculous. All I can say is that when we are given this responsibility, if there really is not any scientific data available upon which to base proposed requirements or standards, then we have to take an amalgamation of what the public's and scientists' concerns are and try to come up with something that is best for the animals. Because that is our primary responsibility. We have an individual or maybe a couple of individuals in the room who were involved during the 1966 initial act writing of the proposed standards for the six involved species at that time. We contracted with ILAR to write a draft of the proposed standards. That was when I was first brought in from the field to work with them on the standards and the regulations. But there was not any real scientific data available at that time. So it was primarily based on empirical evidence, experiences of the experts that were put together by ILAR constituting the committees and subcommittees for the respective species. The USDA then went through and modified it to reflect what we felt were minimum requirements, which was our charge at that time. What I am saying is that when we are charged to do something and the information is not available, then we have to use either empirical evidence or the best information we can get as it relates to that particular subject area. I might say that one thing that I see that has really come out of the 1985 Amendments is that it has stimulated a lot of interest, a lot of work, and a lot of information that, to the best of my knowledge, was not available before. I think that is a tremendous thing.

Q. Don't you believe that for all practical purposes caging of dogs would be a thing of the past under the current proposed rule except for those exceptions?

A. The answer would have to be yes. Under the proposed rules, except for the exemptions or the exceptions, cages as we know them at the present time would probably be a thing of the past. The conformation of cages and adaptability are going to be design features that would be innovative and necessary under what is being proposed.

Q. I have a question relative to the welfare of animals, whether we are talking about dogs or whether we are talking about monkeys. It would appear that our concern about space is for the animals' welfare. In the issue of physical health the Animal Welfare Act is rather broad. Why can't regulations be written only to assure that the space available to meet the animals' needs is adequate? And in essence, when a USDA inspector comes to our facilities they look at the animals and determine whether or not the animals are healthy, both from a physical and a behavioral standpoint. I think it is possible to determine from the literature what constitutes abnormal behavior in dogs and nonhuman primates. Let that be the guide, instead of specifying requirements.

A. I would say that what you have described, of course, is the difference between performance-based requirements as opposed to engineering, design-based requirements. These are the options that are being considered.

Q. Can you clarify the relation between the minimum square foot housing requirement and the exercise period for a beagle?

A. With individually-housed animals, a beagle that required a minimum of 8 square feet would then have to be housed in a primary enclosure of 32 square feet, at least four times the square footage of the minimum
Regulatory Issues

required. If it was housed in a primary enclosure of less than 32 square feet, then it would have to be released daily for the 30 minute exercise period.

Q. Since the history of the 1985 Amendments is rather unusual, is there any possibility that Congress could clarify their intent, so that we don't have to rely on statements by Senators Dole and Melcher as to what was really intended to be regulated?

A. At my level that is not a question to answer. I really don't know. It has been my experience that once Congress passes something they don't go back, except in 1970, to clarify their intent. In 1970 it was done almost immediately after the President signed the Bill and made it law. The dog fanciers recognized that the way it was worded under the 1970 Amendments it could very well include all of the pure-bred breeders. They came in, started a nationwide campaign with telephone calls, telegrams, and visits. It was clarified then in the Congressional Record. That's the only experience I have had of any additional clarification except in the budget (appropriations) language, after the law has been passed and signed by the President. In appropriations bills quite often they will specify the amount and clarify how this should be used or what additional measures the regulatory agency should take. This quite often gives direction to a program.

Q. When do you feel the proposed regulations will become finalized?

A. I believe that Parts One and Two are going to be finalized this calendar year. It will depend on the policy makers' decisions. Part Three, I have no idea. I think that Part Three will be re-published as proposed rule-making, but in what format or with what proposals I don't know at this time. It is very possible that it could be re-published more than once as proposed rule-making before it becomes final rule-making. So I have no idea. I would even hate to "guesstimate" on it.

Q. Can you explain the time frame when the new rules are implemented? Will the budget for inspections be increased?

A. Are you talking about the additional time that it would take to make inspections? I might just briefly mention that under the reorganization and restructuring within APHIS by the formation of this new unit, regulatory enforcement in animal care, we have actually gained staff years in the field within the same budgetary limitation that we have had in the past. The impact is that our inspectors are spending more time at the research facilities. But I don't think it is going to have a negative impact on the frequency of inspections, for example. To more directly answer your question, the impact is going to be whatever the budget allows. At this point, if we had the same budget, I don't see any negative impact. If budgets for whatever reason are increased, it would be a positive impact. So as far as USDA/APHIS is concerned, it is not going to have a negative impact.
Although the title of this presentation suggests that my remarks are going to be concerned only with Canadian regulations, it is possible that we may gain insight into this subject by looking briefly at the international scene and the approach of some countries to the subject of canine well-being.

The International Guiding Principles for Biomedical Research Involving Animals, prepared by the Council for International Organizations of Medical Sciences (CIOMS, 1985), includes in its basic principles the statement that: "Investigators and other personnel should never fail to treat animals as sentient beings, and should regard their proper care and use and the minimization of discomfort, distress or pain as ethical imperatives... The best possible living conditions should be maintained for animals kept for biomedical purposes. Normally the care of animals should be under the supervision of veterinarians having experience in laboratory animal science. In any case, veterinary care should be available as required."

On the subject of acquisition, although not specifically referring to dogs, the document states: "Specialized breeding establishments are the best source for the most commonly-used experimental animals. Non-specifically bred animals may be used only if they meet the research requirements, particularly for health and quality, and their acquisition is not in contradiction with national legislation and conservation policies."

If we examine the situation in a number of countries, we see that in England legislation prohibits the use of stray dogs in research. However, there exist dealers who may supply random-source dogs; sometimes there are questions relating to the source of such dogs. In the Royal Society and the Universities Federation for Animal Welfare (UFAW) Guidelines on the Care of Laboratory Animals and Their Use for Scientific Purposes (1987), the section on housing and care states that "the minimum floor area for a dog pen should be 4.5 sq. m. Two dogs or more may be housed in this area depending on weight. Where one dog is confined in part of this area it should not be confined for longer than the overnight period. There is always the need for dogs to have regular human contact. Compatible dogs may be kept in pairs. Where they cannot be kept in pairs, their pens should be so placed that they can see each other, but it should be possible to prevent this when required for procedural reasons. Whenever possible, all dogs should have access to exercise areas."

Conversely, in Japan, stray dogs are readily available from pounds for use in research. Although many purpose-bred dogs are also used in specific studies, the random-source dog is the most common choice. Animal technicians do provide human contact as proposed in the Royal Society/UFAW guidelines. Even in the poorest conditions, dogs can be well looked after by caring attendants. A recent visit to Japan demonstrated significant improvements in the care and management of their dogs even when the facilities were old. Human contact is a guiding principle in these enlightened facilities.

Animal protection legislation, including the use of research animals, has existed in Japan since 1974; however, it has not been
Regulatory Issues

applied. The Ministry of Education and the Science Council of Japan are presently developing policy with respect to the use of animals in research; this policy appears at present to be leaning towards a voluntary control program supported by scientists and some members of the animal welfare groups.

In China, there is no indication that legislation governing the use of animals in research would ever be considered. At the Shanghai University, a medical university, they breed beagles for use in research; many of these animals are shipped to Japan. Caging in the Shanghai facility is either in rooms or in large cages. At the same Shanghai institution, random-source dogs are housed in large pens. In Beijing, at the Academy of Military Medicine, beagles are the common dog maintained in pens.

In South Africa, dogs receive priority treatment in research centers and purpose-bred beagles are commonly used. However, the most common species are the baboon and the vervet monkey.

In discussing the use of dogs in research, we must understand that this involves both research and testing. In Canada, less than one percent of all animals used by medical schools are used in teaching laboratories.

It appears that historically we have had greater interest in the use of dogs and cats than the commonest laboratory animal, the rodent species. A recent New York Times article (August, 1988) indicates that "the influence of pets reaches a new high--pets are part of the extended family. Ninety percent of pet owners talk to their pets." Animal rights advocates prefer to call their pets "companion animals." In Blacksburg, Virginia, the veterinary clinic now calls itself a "companion animal clinic."

In discussing the importance of pets to older people, there would be an affirmative reply by over 95 percent to the following questions: Do you consider your pet a friend? Do you talk to your pet? Does owning a pet add to your happiness? Interestingly, 91 percent of the respondents considered that the pet knew how they felt.

The interest in animals has increased significantly in the last 20 years, with the emergence of many human/animal bond associations such as the Delta Foundation and the Human/Animal Bond Association of Canada.

Donald Griffin has written two books on the question of animal awareness. Questions which we previously did not ask concerning the wisdom of animals are now being asked in the laboratory and in the field. There is growing evidence from such studies that they know more than we think.

The welfare of animals is promoted by veterinary associations. For example, the holding of Animal Health Week is an annual undertaking by the Canadian Veterinary Medical Association (CVMA); it also provides publications such as A Commonsense Guide to Feeding the Dog and Cat.

We concur in Canada that all animals in research must be healthy and behaviorally normal. In the 1920's, when Best and Banting were doing their work, as recorded by Michael Bliss in "The Discovery of Insulin," the studies that ended in failure were numerous. Even the source of their dogs was questionable. Today, Best and Banting would be unlikely to have their protocol approved by an Animal Care Committee. We recognize, however, that the use of dogs derived from pounds has played an integral part in these and other advances.

The Canadian Council on Animal Care (CCAC) is responsible, on a national basis, for the care and use of animals in research. In its publication, "Guide to the Care and Use of Experimental Animals," Volumes 1 and 2, the section on conditioning states: "Similarly, dogs (usually beagles) obtained from reputable breeding laboratories will have complete health profiles and will have received specific prophylactic inoculations. Animals that are legally procured as strays or are donated (mostly dogs and cats) and feral animals such as non-human primates that have been acquired from nature should be subjected to a period of conditioning following their reception at the facility."

Although we suggest that beagles be acquired from reputable breeding laboratories, we rarely define the requirements for a reputable facility. In the
1960's in Canada we used to state that all animals should be obtained from reputable dealers, although at that time no licensing or inspection system existed. It is also interesting to note that in our guidelines we simply state that animals should be legally procured; however, in most provinces there is no legislation.

CCAC's Guide also states in the section on exercise that "experts disagree about the need for exercise in laboratory animals (particularly dogs). A decision in such cases must be made by the person responsible for the animal facility in consultation with the investigator. Judgment should be based on the animal's breed, temperament, physical condition, the conditions under which it has been previously kept and the length of time it is to be confined. Several studies suggest that there are no beneficial effects on behavior, health, or in enhancement of voluntary activity in the laboratory-bred beagle from increasing the cage dimensions." The section concludes: "Animal cages must, however, be large enough to allow the innate normal behavioral and postural adjustments."

"Most research dogs are" the Guide continues, "acquired from random sources, usually municipal pounds. Such dogs have completely unknown genotypes, behavioral experiences and disease exposure profiles. Their use should be limited to those studies in which a defined animal is not a requirement.

"Dogs from random sources (pounds) have often been discarded by their owners and turned lose to fend for themselves; thus, nutritional disease problems will be frequently encountered in these animals.

"Some few of the random-source (pound dogs) that are legally acquired by a research institute will nonetheless inevitably be lost pets. The research institution should, if requested, ensure that owners have the opportunity and, in fact, are encouraged to examine random dogs suspected of being lost. Identifications and retrievals of this sort should be done during the quarantine and conditioning period. If the owner is not interested in retrieving a pet, it should be utilized for an acute non-survival study, as should a pet dog donated for research, unless the owner specifically requests that it be used for chronic studies. In the latter situation, the nature of the study should be explained, and a written statement describing the animal and donating it to research should be signed by the donor."

Under the section under housing in Volume 2, Social Interactions and Exercise are discussed. It states:

The dog is a highly social animal which, if permitted, will spend most of its time with other dogs, is generally well-adapted for running and has a strong sense of territory. Dogs have come, through domestication, to accept humans as an integral part of their social order usually occupying the top or alpha position.

The above characteristics are probably the most important, among the basic factors to be considered in providing satisfactory housing and caging for dogs in scientific institutions. Certainly, they should be taken into consideration in the initial design of facilities where possible and in the organization and type of accommodation provided for the research animal.

Under Cages, Volume 2 states:

Cage dimensions will vary greatly with the breed, but should always be sufficient to readily permit the animal to stand, stretch fully (both horizontally and vertically), turn around and lie down fully extended.

Although we accept that there is evidence for purpose-bred laboratory beagles that increasing cage space does not result in altered behavioral patterns where individual dog cages are in use, it is strongly recommended that the animals be released for exercise at least once and preferably twice daily into the largest available space.

The CCAC Committee on Social and Behavioural Requirements of Experimental Animals recently developed the following draft position statement which was accepted in principle by the Council July 5, 1989:

Well-being in animals has two components: physical and behavioral.
Regulatory Issues

Physical well-being is manifested by a state of clinical health. Behavioral well-being is manifested by behavior considered to be normal for that species and strain, together with the absence of significantly abnormal behavior. Behavioral well-being is considered to reflect psychological well-being, and to that extent, the terms are considered to be synonymous in our usage.

In the interest of well-being, a social environment is desired for each animal which will allow basic social contacts and positive social relationships. Social behavior assists animals to cope with certain circumstances of confinement.

Chronic isolation as a method of accommodation, should not occur unless there is scientific justification. However, in exceptional circumstances some animals are better kept alone. Positive interactions with human beings are very important in all circumstances, and particularly in conditions of social isolation. It is also necessary to recognize the natural affiliations which commonly occur within and between species.

Canadian Legislation

Although not specified in any documentation or legislation, in the 1960's at the Ontario Veterinary College Research Station, dogs were maintained in communal groups in pens and outside runs. However, it was common at that time to also confine dogs from random sources in cages.

Legislation in Canada includes several provincial Acts regulating the acquisition of unclaimed pound dogs. In Alberta, the Universities Act, Section 50, Regulation 333/72, prohibits the acquisition of dogs from sources other than pounds; therefore, if purpose-bred dogs are required, permission must be obtained from the Alberta Government. The Act states:

The university, upon acquisition of an unclaimed dog or dogs, shall at its own expense cause such dog or dogs to be transported to the university under conditions compatible with humane sanitary practice. Quarters or cages shall be of such a size that each dog may stand, sit, lie in a normal position and turn around with ease. Each caged dog shall be provided with daily exercise outside of the cage. Exceptions to this are permissible only when provisions for the exercise would defeat the object of the experiment and then only with the approval of the Animal Welfare Committee.

In the Province of Ontario, the Animals for Research Act was promulgated in 1970 and revised in 1980. The passage of this Act brought more correspondence to the province's then Minister of Agriculture and Food, the Honourable William Stewart, than any other topic. This Act (Section 14) stated:

No persons shall purchase or otherwise acquire an animal from any person in Ontario for use in a research facility except from, a) the operator of a registered research facility, b) the operator of a pound under section 20, c) the operator of a supply facility who is the holder of a license as an operator of a supply facility or exempt under this Act or the Regulations.

This Act required that every registered research facility establish an Animal Care Committee, one of the members of which was to be a veterinarian. Every Animal Care Committee established would be responsible for coordinating and reviewing a) the activities and procedures relating to the care of animals, b) the standard of care and facilities for the animals, c) the training and qualifications of personnel that are engaged in the care of animals, and d) procedures for the prevention of unnecessary pain, including the use of anesthetics and analgesics.

There have been two amendments proposed to the Act. One of these, in 1987, would have given pounds the freedom of choice in whether or not they turn over animals on requisition by registered animal research facilities. This received a second reading in the Ontario Legislature, but died on the Order Paper at the end of the legislative sitting, and has not been reintroduced.
The University of Ottawa, where I served as a Professor in the Department of Pathology and as Chairman of the Animal Care Committee, made an agreement with the pound operated by the Humane Society of Ottawa–Carleton to acquire dogs for acute non-survival studies. This has been in operation for the past 19 years. The procurement of dogs from this source fulfills a position I took in a paper presented to a symposium on "The Future of Animals, Cells, Models and Systems in Research, Development, Education, and Testing" (National Academy of Sciences, Washington, D.C. 1977). In this paper, entitled "The Ethics of Biomedical Experimentation," it was recorded that it had been recognized that "dogs and cats obtained from random sources can provide useful information in certain studies. Many are available due to the irresponsibility of pet owners who fail to provide proper care for their companion animals. There is, without question, greater cruelty in the streets where unwanted strays are abandoned, than in the laboratory to which they may be taken. Nevertheless, the concern and sensitivities of the general public regarding the use of these pet species must be appreciated by the scientific community."

It has been claimed that humane societies and animal welfare agencies ignore the benefits of research or the improvement of human health and welfare if they refuse to release their unwanted and unclaimed dogs and cats for research purposes.

There should be no justifiable objection by animal welfare agencies to providing scientists with dogs which will be anesthetized and not allowed to recover, if safeguards are provided that satisfy the requirements of the humane societies. Such stringent safeguards should include "open door" policies, for there must be no element of doubt concerning either humane treatment or humane destruction of such animals. Thus, it should be difficult to criticize the scientists who request that pounds operated by humane societies provide animals for acute, non-survival studies if such animals are to be killed because no home can be found for them. Release of dogs for such studies is practiced in many Canadian communities.

Having supported acquisition of acute, non-survival dogs from pounds operated by humane societies, accepting that this reduces the need to kill a second dog required for the experiment, there remains a need to find an answer concerning the release of dogs for use in long-term or chronic studies. This is an area in which it is important that the scientific community understand clearly the objectives of the humane societies.

Although it might appear paradoxical, it would be considered improper to release dogs from pounds operated by humane societies for use in long-term or chronic research studies, even though the release of dogs for acute non-survival studies has been condoned. However, it must be accepted that, during a chronic study, a painful situation might develop despite all safeguards and controls, because of human failure.

Unfortunately, we have not found a way to absolutely "idiot proof" our care and handling of experimental animals. Therefore, we should not ask the humane societies to accept the risk of suffering which is possible in a chronic or long-term investigation. A humane society should not be asked to compromise this principle of prevention of pain and distress when members of the scientific community are not willing to sacrifice their principles concerning the need for the use of animals in research.

The foregoing represents the position that the Canadian Council on Animal Care (CCAC) secretariat has taken on the release of dogs for acute, non-survival studies only, from pounds operated by humane societies.

In the Province of Saskatchewan, section 117 of the Urban Municipalities Act permits the disposal of unclaimed and unwanted dogs at the discretion of the pound operator, which allows the dogs to be turned over for research. The Act has been changed in the past two years, for previously the release was at the request of the chairman of the Department of Physiology of the University of Saskatchewan.

In 1988, the Law Reform Commission of Canada submitted to the Canadian Department of Justice a document which
Regulatory Issues

included legal provisions and policy alternatives involving animal experimentation in Canada. This constituted an amendment or revision to the Criminal Code of Canada. The present Criminal Code conveys a very confused and misleading message about the status of animals and fails to recognize them as living, sentient creatures directly deserving protection. For the purpose of the Code, the Commission revision defined animal as "any living non-human vertebrate." The proposed offenses under the Code were: unnecessarily causing injury or serious pain to an animal; organizing cruel sports or exhibitions; and failing to take reasonable steps to provide the necessities to an animal in one's care.

In the section on Experimentation it is noted that: "The Commission proposes an explicit standard for scientific experiments which allows a limited exception to the offence of causing injury or serious pain. The exception incorporates the proportionality test used in current case law: the pain and injury caused must be justifiable in terms of the objectives pursued. Where a significant scientific or medical benefit is sought, considerable pain may be justified; where the research is pointless or trivial, very little is justified and the exemption may be lost. The animal experimentation must also be a 'reasonably necessary means', that is to say, it must be reasonably unavoidable because no alternative research technique is possible. Where animal experimentation is required or authorized by statute (as in the case of some product testing), a further defence is afforded in clause 3(13) of the General Part."

Canadian Program

The Canadian Council on Animal Care's voluntary control program has led to the establishment of animal care committees at all research institutions across Canada. Assessments are carried out of more than 160 research institutions including universities, government laboratories, pharmaceutical industry and commercial testing laboratories. A key to the operation of the CCAC is the assessment program. In-depth site visits are conducted at least every three years, plus additional more frequent (often announced) visits. Assessments are based on the CCAC's two volume Guide to the Care and Use of Experimental Animals, as well as the Ethics of Animal Experimentation and other related CCAC documentation.

Assessment panels are comprised of members of the scientific community experienced in the care and use of animals in research of differing disciplines, as well as a representative appointed by the Canadian Federation of Humane Societies (CFHS). Each panelist has the right to agree or disagree with the findings of the assessment panel, which are contained in a final report to the institution. All assessment reports are considered confidential.

The penalties for continued non-compliance with CCAC's requirements are imposed by Canada's major granting agencies, the Medical Research Council (MRC) and the Natural Sciences and Engineering Research Council (NSERC), (both of which provide funding for the CCAC operation), and could lead to loss of all funding for research from both agencies.

The result has been an improvement in the care and use of animals which initially began in 1968 with the examination of the physical facilities for the care of animals and the competence of the technical staff. Progress regarding animal facilities has been made so that, today, greater emphasis is being placed on how the animals are being used in scientific investigations, in teaching programs and in testing. The influence of the CCAC, with the support of the scientific community, has for the most part eliminated the use of traditional cages for dogs, although some cages still exist. There is a requirement that dogs be removed from existing cages to provide for their behavioral needs. It is considered that random-source dogs which have been accustomed to a "free existence" possibly require the release from cages more than purpose-bred beagles which may be accustomed to the containment and confinement of the cages.

At the University of Ottawa, it has been the policy beginning in the late 50's and early 60's to provide dogs with complete freedom in
rooms or pens. Space was always provided for these dogs to run free in a contained area on the roof. When a new Health Sciences Building was developed in the early 80's, one of the prerequisites for the building was to have outside dog runs. This may be the only medical school in Canada to have required such a provision. It is interesting that in almost 10 years of operation, no faculty members or occupants of the surrounding hospitals have complained of excess noise caused by dogs barking in the outside runs.

Although it is not possible to get into the brain of an animal to know precisely what it is thinking or feeling, it is important that we consider what for dogs are their normal behavioral requirements, and attempt in today's research environment to provide for these needs. As George Bernard Shaw said: "The worst sins to our fellow creatures is not to hate them, but to be indifferent to them. That is the essence of inhumanity."

Despite the realization that animals are still needed for research, efforts should be made to find replacements for them. The fundamental philosophy of the CCAC has always been in support of the "three R" principle of Russell and Burch (1959) of reduction, replacement and refinement.

Although both Canadian and American polls support animal research, the public in general appears ill at ease with the reality that their health may be dependent on practices possibly causing death and suffering to non-consenting animals. This feeling is also shared by many in the research community. Experience has taught us that, whenever possible, scientists should replace animals with other methods, based on the acquisition of sound scientific knowledge.

It is important to note that cases of deliberate cruelty more often involve animals which are the victims of neglect and ignorance. Similarly, the CCAC found in its assessment program that many researchers did not clearly understand the animals they were using, and their needs. This produced the development of the Syllabus of the Basic Principles of Laboratory Animal Science by the CCAC. Portions of this Syllabus have been used across Canada in teaching programs for graduate students, investigators, and technicians. However, more has to be accomplished in this area.

The CCAC supports the 1986 report of the American Veterinary Medical Association (AVMA) Panel on Euthanasia. We consider that the most important humane consideration for a euthanasia method is that it have an initial depressive action on the central nervous system to ensure immediate insensitivity to pain.

As our previous position statement by the Committee on Social and Behavioural Requirements of Experimental Animals was being developed, we had some difficulty in defining psychological well-being or defining all the constituents of social and behavioural well-being. It is interesting to note that Dr. D. Broom, the Chair of Animal Welfare at Cambridge University, stated at the Bio-Ethics '87 meeting held in Montreal on August 15-16, 1987: "The welfare of an individual is its state with regard to its attempt to cope with its environment."

We have continued to state that there are dividends to science accruing from humane animal care. Improvements to the comfort and well-being of the animals used in research often lead to better science. For example, it has been shown in mice that the more handling and human contact that are provided, the larger the litters and the more offspring weaned. Similarly, we know that if rats are not handled on a regular basis, it becomes very difficult for the researcher or technician to handle them. There are also reports concerning the effect of isolation stress in the testing of drugs.

Although the divisions between the various animal welfare/animal rights groups are very diverse and wide, it is important that the middle ground positions that exist be clearly defined, for example, the fact that animal protection advocates and scientists share the goal of eventual elimination of all animal use in research.

Abolitionists demand that all animal research stop immediately. This is not reasonable or practical when there is continued pain, suffering, and disease amongst both the human and animal populations.
Regulatory Issues

Finally, it is important to note that, in evaluating public response, if a substantial portion of our adult population believes in astrology and the efficacy of pyramids in promoting health, why should we expect thoughtful analysis of the value of animals to research? Mark Twain has summarized the human position best: "In studying the traits and dispositions of the so-called lower animals, and contrasting them with man's, I find the result humiliating to me ... Man is the only animal that blushes, and the only one that needs to."
ENVIRONMENTAL ENRICHMENT
Canine Behavior

Michael W. Fox, DSc, PhD, B.Vet.Med., MRCVS

I had mixed feelings coming here because my own personal development and position is that I am fundamentally opposed to the use of animals in biomedical research for primarily human purposes. But aside from the ethics and morality of experimenting upon animals in order to find cures for so many self-induced diseases that afflict us today, so long as this medical paradigm persists as the norm, as the rationalized necessity, I feel it is our responsibility as veterinarians and concerned citizens to ensure that the animals are kept under conditions which are optimal for their physical and psychological well-being. I remember a few years ago when I served on one of the ILAR committees on ethological requirements for laboratory animals that one old veterinarian ridiculed the idea that primates have psychological and emotional needs. But I think we are coming a long way now from the old Cartesian view that animals are unfeeling, instinct-driven automatons.

Now to focus specifically on dogs. A few years ago I visited various animal research facilities and saw dogs under various conditions. I was impressed by many facilities where the dogs had plenty of human contact with the caretakers, the animal experimenters and the veterinarians in charge. Dogs need this. Studies have shown that rats will cross an electric grid to explore a novel environment or a maze and will do all kinds of things for food. The motivation is there. Motivation for a dog is such that dogs will go through very stressful situations just to receive a kind word or a pat from a human being. So it is almost like social human contact for a dog that is bonded to a human being to receive contact—physical contact, or a gentle voice, is probably as important psychically to that animal as some essential nutrient in the diet.

Now I think we have got our packaged Purina diets together pretty well for the laboratory dog. There are still some problem areas in the nutritional requirements of canines, but we are now looking more into the realm of the psychic or psychological needs, the behavioral requirements.

I was concerned when the idea of exercise was first broached as a behavioral requirement for laboratory dogs. I think it is rather an anthropocentric view. I would conclude from a strictly ethological viewpoint that dogs and other animals do not have a motivation to exercise. But rather that, in the process of satisfying their behavioral needs, they get exercise. It does bemuse me seeing compulsive joggers running down the street, indirectly helping to clean the air of Washington, D.C. and other environments, but their motivations again are not simply for physical exercise. Motivations are very complex.

The dog, in the course of satisfying such behavioral requirements or motivations, quests for novelty, varied experience, social interaction and play, and thus gets plenty of exercise. The flip side of this, of course, is deprivation of these behavioral requirements, motivational needs and the subjective, again anthropomorphic, notion of boredom. I do think the boredom syndrome is being increasingly recognized for highly social and socially-dependent animals that are deprived of contact with their own kind or with human beings when socialized to human beings. There is increasing literature on farm animals and captive zoo animals which shows that boredom, the lack of social and environmental
Environmental Enrichment

The kinds of facilities where dogs are kept in a metabolism cage might be justified under certain experimental situations, but again we need to question putting an animal in a cage like this in the first place (Figure 1). Not simply from the ethical point of view, but the animal has to adapt to this confined space. I think one of the first things to consider, other than exercise and environmental enrichment, is what we might loosely term lair-dwelling behavior. That within a given space, the dog has certain behavioral requirements. One of which, of course, is to have a comfortable place to sleep and another place where it can defecate and urinate, and ideally for the males, to engage in some kind of territorial marking. How is the dog in a small metabolism cage going to raise his leg and is he going to be sitting on top of his own excrement?

We have a dog at home who, when he does have an accident in the house, runs into the other room, not out of fear of being punished, but just because he does not like to be around his excrement. A lot of animals that do spontaneously housebreak, like pigs for example, naturally avoid their own excrement. This and the other kinds of naturalistic wisdom that evolves in certain species might be a behavioral program to avoid infection. I think one significant aspect of environmental quality for our canines is not keeping them in close proximity to their own waste (Figure 2).

I would like to remind us again that even

enrichment, can be deleterious to the animal’s overall physical and psychological well-being.
though we are moving to improve the care and environment of laboratory animals, we need to always keep in mind the ethics of experimenting in the first place, and the final good that can arise. I think it could be very tragic for dedicated staff to raise quality dogs for research, and then have some idiot coming along and doing painful, meaningless experiments upon them.

Aside from these serious concerns we need to focus on the quality of the environment we give to dogs used in research. I just had a quick look at the video that Harry Rowsell has on the conference table here showing group housing, with sawdust or wood shavings on the floor. This was how we used to keep dogs and puppies for behavioral studies when I was at the Jackson Laboratory in Bar Harbor, Maine. There are all kinds of suitable bedding materials that can be used for social groups. The minimal provision, of course, is for some kind of resting palate, a comfortable area for the dog to sleep on (Figure 3). That is part of the lair-dwelling behavior.

Because they are highly social animals, I think dogs should ideally be kept in groups. For those animals which for reasons of medical, post-surgical or experimental procedure have to be kept in solitary confinement, I think it could be advantageous if they have some visual contact with each other and at least a schedule of more frequent human contact. You can see in this particular cage design that it has completely sealed walls (Figure 4a). The dog has no visual contact with cospecifics in contiguous compartments. This dog certainly looks depressed compared to a pair of pointers kept together. So I am very much the advocate for the group housing (Figures 4b).

One of the aspects of group housing is exemplified by a couple of village dogs in Kashmir that I photographed. The photograph shows a very sickly female dog and the male grooming the sores on her and snapping at flies around her head. Dogs engage in a lot of care-giving behavior with each other. There is a lot of nurturing and support that goes on. It is a part of pack behavior. And I think this is an aspect of the quality of life which we need to consider when we decide whether dogs should be housed together or singly.

One significant phenomenon when talking to a dog or stroking it is that the heart rate goes down in response to these human stimuli. The intense parasympathetic arousal that causes a reduction in the heart rate can be interpreted as one aspect of the relaxation response. This might well be a physiological indicator which helps us to understand why dogs enjoy physical contact and a gentle voice, regular grooming, petting, or whatever. Those animals that do engage in social grooming with each other, or even making certain vocalizations like purring, manifest this phenomenon. It is widespread in the animal kingdom. The slowing of the heart rate is an indicator of the relaxation response. For dogs that are housed separately (and I would say
Environmental Enrichment

that this is also true for primates because they engage in social grooming and you have the same decrease in heart rate and relaxation response, it is important to have a schedule of regular human contact in order to facilitate, I think, the emotional homeostatic functioning of the dog. We know from studies with zoo animals that captive primates and other species deprived of contact exhibit excessive self-grooming. This can lead to self-mutilation.

For example, a German Shepherd started self-mutilating (there was nothing physically wrong with the animal) while in a veterinary hospital. No arthritis, no pathology in the knee area where this self-comforting licking became self-mutilation within a very short period of time. The dog was lonely, depressed, anxious, frustrated, all of those subjective human labels which are appropriate because they are labels for the subjective state of limbic functioning, and we share the limbic system with dogs and other mammals.

When I worked at the Jackson Laboratory we had a fairly common behavior problem with dogs in isolation. A lot of these dogs in isolation developed stereotypic behavior, and one of the indicators of deprivation, boredom, isolation and stress is stereotypic behavior. Now, a lot of dogs will show this behavior out of excitement when there is a visitor. They will also show stereotypic behavior when there is simply nobody there at all. It is valuable in doing behavioral evaluations of animals under confinement conditions to use a video in the absence of a human observer, because the presence of a human observer has a significant effect on animal behavior.

The other week we had hearings on HR84 to give veal calves in narrow crates six inches more space so that they can turn around. One veterinarian who was speaking for the veal industry said that he recently went to a large veal farm where they had many hundreds of veal calves in these narrow crates. He said, "I didn't examine everyone clinically, but I had a very thorough walk-through and they all seemed fine to me." Well that is so ridiculous. You can't simply eyeball animals because your presence there is a stimulus, and it is going to provide a distraction for them and an enrichment which can completely mask behavioral anomalies.

So stereotypic behavior in the Jackson Laboratory dog colony was pretty common. Also, in the beagles that we kept in more solitary conditions, you saw shy behavior. We found that when they were kept in pairs or in groups of more than two, they were generally more sociable. So keeping them in groups tends to make them more sociable. Part of that dynamic we felt was that some dogs are a little on the timid side, especially this particular beagle strain. When housed with dogs that are more outgoing and more friendly towards people, they tend to follow those friendly, more outgoing dogs and in a sense come out of their shells, becoming easier to make contact with. This is very important when such dogs are going to be handled for experimental purposes. You don't want a dog that becomes catatonic or is a fear biter.

I want to emphasize one of the paradoxical aspects of stereotypic behavior. And this is a dissonance theory that I developed with a graduate student a few years ago when we were looking at this phenomenon. The incidence of stereotypy is high when there is low sensory input, and this is a means by which the animal can compensate for low sensory input in a deprived environment. It is trying to make its environment more enriched, so it engages in rhythmic activities which may have a self-comforting element as well.

When there is high sensory input, as when a stranger comes by, you see the dogs spinning in circles, chasing their tails and so on, engaging in stereotypic activity. That can be a self-comforting activity or a way of displacing the aroused motivational energies. Very similar behavioral correlations are seen in autistic children.

Another syndrome that psychologists have identified experimentally in caged animals is what we might call "learned helplessness" (Figure 5). Learned helplessness is a syndrome that develops when there is no escape possible in a given situation. Some of these experiments were pretty awful, involving putting dogs in harnesses and giving them inescapable shock. But they found some similarities to dogs put in these conditioning
Michael W. Fox, DSc, PhD, B.Vet., Med., MRCVS

'LEARNED' HELPLESSNESS

- No escape possible
- No control/competence
- Reduced adaptability
- Stress susceptibility
- Fear, anxiety, depression.

Figure 5. The syndrome of "learned" helplessness.

Harnesses and those that have been kept for a long period of time alone in cages. Again, there is no escape. They have no control over their immediate environment. This learned helplessness syndrome results in reduced adaptability, especially when the animals are placed in different situations, like going from a cage into the laboratory testing room. There is greater stress susceptibility and there are symptoms of fear, anxiety and depression. Indeed, this learned helplessness model, which is far too simplistic anyway, was initially developed as a biological model of depression in the human species. That does give us some insight about the syndrome when animals have no control in their immediate environment.

One way to give an animal a greater feeling of competence is to provide various operant devices within the environment that it can manipulate, ranging from play objects to a lever that provides food, and so on. A good deal of research in this area has been done by a French group looking at pigs. Pigs have lower plasma cortisol levels when they have control over the acquisition of food compared to those who pull a chain, but never know when the food is coming. One of our farm animal scientists has been giving play objects to pigs to manipulate. When they have some feeling of competence and control, their immune systems are in better condition. This is intriguing. That leads us to this more holistic view of brain functioning where we do need to take care of the psychological and behavioral needs of the animal because of the limbic system connection with brain stem function and its linkage with immune system. Hence the holistic term psychoneuroimmunosuppression is appropriate when animals are kept in deprived environments or stressful environments, whether it is lack of stimulation or over-stimulation due to crowding stress.

Now certainly in the handling of animals, whether they are dogs or whatever species, we need to consider some of the invisible spaces around their body. They have a home range and a territory. They really don't have a home range in the laboratory. Home range is defined as that area that the animal frequents and knows, but doesn't necessarily defend. The territory is the area that is defended. With an unsocialized animal, one that is not bonded with people, it tends to be fearful, and when you approach it, it will run away. You are entering its flight distance (Figure 6). If it can't run away, or is cornered, or if you approach very quickly, you then cross over the next threshold which is called the critical distance. This is where the animal that is running away will suddenly turn and defensively bite you, or horn you if it has horns. What socialization, developing an emotional bond with an animal, does is to essentially eliminate these two responses. Then one can enter the social and personal or intimate distance of the

Figure 6. Canine flight distance.
Environmental Enrichment

animal. And these are very important factors to consider in the proper handling and care of laboratory dogs. Their early socialization, which will be the detailed discussion of the next paper, is part of optimal care, the proper bonding.

A study was done a number of years ago on violent versus non-violent criminals. The violent were institutionalized because of violence towards their own kind. Some of them also had a history of violence towards animals. In these approach studies the experimenter psychiatrist said, "Okay I am going to approach you, but you tell me when you start feeling uncomfortable." Those with a violent history found it quite intolerable when the experimenter was anywhere within the 29 square foot space around them. But those with a non-violent history could tolerate much closer human proximity. And this is very intriguing because he looked into their case history backgrounds and found a rather general phenomenon. Those with a violent history who needed a lot of space in which to feel non-threatened invariably had a background of inadequate socialization with their parents, a lot of parental abuse, and so on.

So if we have a situation with laboratory dogs where they have not been adequately socialized, they are going to need even more space in order not to feel stressed by human presence. So let's get the love going when they are little puppies so they don't need a lot of space, so that they are well bonded.

The early work by Scott and Fuller at the Jackson Laboratory in Bar Harbor, Maine is really quite classic. They found that in the normal development of a puppy, a five-week old puppy is very attracted to a stranger, and will waggle his tail and follow a stranger everywhere. But increasingly, puppies show a greater and greater fear of people. If, for example, a puppy meets a human being for the first time at nine weeks of age, then it shows no attraction behavior and mainly shows fear-escape behavior. These studies were done raising puppies in large fields, large enclosures, completely screened so that they had no visual or physical contact with human beings, except at the age when they were tested. This shows very clearly that there is a critical period for developing this emotional bond with human beings. It is optimally between 5-8 weeks of age. If puppies are deprived of quality human contact until after 10 weeks of age, they will be very difficult to handle later in life. This will be more so if those puppies are of a very timid lineage. There is a real genotype-environment interaction here in the development of the social phenotype, the final product.

One of the many correlations that we made was of brain development and EEG activity with this critical period that begins around about five weeks. Clear signs of myelination in the frontal lobes of the puppies first develop at around five weeks. That is when they are really starting to get hooked up.

Subsequently, we did a study on the development of exploratory behavior in puppies. They were kept in typical group pens in the laboratory. They had frequent human contact, but were never allowed outside the group pen until five weeks of age. Then they were put into an enriched arena with all kinds of interesting objects to look at—a flashing red light, a mirror, a rat in a cage, a clicking metronome concealed inside a box and a plastic toy puppy. A puppy, when put in the arena at eight weeks of age, explored more than he did at five weeks, which you would expect. He is more coordinated. He is a little quicker and quicker-witted now. His brain is even more connected up. At 12 weeks he is even more active and at 16 weeks extremely active. The mirror and rat stimuli really do not have too much meaning early on, but we found, fairly consistently, that puppies became quite narcissistic with their mirrors after about eight weeks of age. They just couldn't leave themselves alone in the mirrors, and they discovered the rat in the cage too.

Now the flip side of this was that litter mates that we took out for the first time at five or eight weeks would explore the arena just as actively. But when taken out of the cage for the first time at 12 or 16 weeks, they did not explore at all. They stayed in the start chamber with lots of access doors and did not come out and explore, or they would crawl out and stay in one corner and just shiver throughout the 30-minute observation period.
What we demonstrated here was a critical period somewhere before 12 weeks of age where the puppy really begins to engage its environment. If it stays within a restricted environment, it adapts to that restricted environment and will show increasing fear of a more complex, novel environment.

So in order to produce an environmentally well-adjusted puppy, it is important to take it out and about into various places or at least into a large social playpen situation in order to ensure that its development is optimal. We are talking about two processes here which Jeff Linn might have additional comments about because we did apply some of these principles in the Army's "Super Dog" project. Environmental enrichment can be used to prevent this institutionalized kennel syndrome, which will be worse if you are dealing with a shy line of puppies. So the two principles to produce a well-adjusted dog that can adapt well to the laboratory situation are plenty of socialization and environmental enrichment.

You could say it is better perhaps to have dogs that are used to living in small cages and raise them under those conditions if they are going to live in small cages in the laboratory. They become kind of preconditioned, preadapted. But since we are going to see an end to small cages for dogs in the very near future, I don't think that is a valid position to take.

I will close now very briefly. There is work by a Russian scientist that I included in the book *Abnormal Behavior in Animals* that I edited many moons ago. It is about abnormal behavior in animals in terms of the connection between the psychological well-being of the animal and its resistance to disease. These diagrams show the influence of a functionally weakened cortex. These are dogs who are put into a Pavlovian conditioning situation where they can't discriminate between a signal that means food reward and a signal that means electrical shock or punishment. The signal becomes increasingly similar until they are completely confused. It kind of blows their minds. They call it a functionally weakened cortex.

When subjected to this emotional stress, which is like the dog being taken out of a group pen and put into a strange environment, there is stress there. When these dogs are subsequently given total body irradiation, 57 percent die. In the control group of the same breed that has not been subjected to prior emotional, if you like, cognitive emotional stress, because that is what the Pavlovian paradigm is, only 25 percent die with the same dose of radiation.

In another study, when the same unit dose of radiation was given to three different breeds of dogs, 70 percent of breed A (Schipperke-type) died. Fifteen percent of the pointer type dog died, and only 8 percent of the large hunting variety died. Why these differences? Well, again from the Pavlovian viewpoint, they have different temperaments, different nervous topologies. The one that was extremely susceptible to radiation is a very timid dog and has a weak, unstable nervous system. Those who had a 15 percent mortality had what they call a strong, unbalanced nervous system and are very willful outgoing dogs, but the kind of dogs who are very difficult to control, to make sit, lie down and so on. They have a very uninhibited, extroverted character. The most resistant breed had the best temperament, being an outgoing type but easily restrained, neither too fearful or impulsive.

So we need this kind of holistic thinking, since the psychic state of the animal does affect its immune system. There are also genetic variables. I am not necessarily condoning this research, but it is provides some insights into conditions for the care of laboratory dogs, and also for choosing the right kind of adaptable genotype.

I think for optimal care and probably for good experimental models, so long as we insist upon applying the present medical paradigms and justifying the necessity of research on animals, it might well behoove us to obtain animals that have a balanced, strong, resilient temperament, through selected breeding and bringing that temperament out through optimal socialization and environmental enrichment.

Where do we grow from here? Away with the cages and on with compassion and science.
Environmental Enrichment

combined. We all know how a dog will mourn the loss of its human companion. And a good family dog is the embodiment of devotion and unconditional love. In many ways they mirror some of our highest qualities. Let us reciprocate in our work with them.
Question and Answer Session

Q. In regard to stress in a canine environment, is stress a cumulative phenomenon or is there some kind of breaking point threshold?

A. I would say that it depends on the individual animal, on its phenotype and genetic background; even its nutritional status. The work of Bernie Gross at Virginia Polytechnic Institute with poultry is very intriguing. He has developed different lines, some of which adapt better to living in a group situation while others adapt better in a less stressful situation. Some genotypes require what he terms an optimal stress. Because if they don't have enough social stress within their social group, they are more susceptible to parasitic and bacterial diseases. If you have too much stress, they are more susceptible to viral diseases. We are not talking about eliminating all stresses. So it's that middle range. But we can't fit all dogs, all human beings, into that middle range because of the inherent genetic diversity. We have to have some flexibility here.

Q. If dogs are exposed to a high ammonia level for x number of hours, can I anticipate that that will have an adverse effect somewhere down the line or does that have to be a continuing phenomenon?

A. I really wish I had a straightforward answer, but I would certainly, as with any acute environmental change like that, put a label on the animals that they are not in suitable condition for experimentation. There are many experimental variables introduced by improper rearing and housing. I had an interesting experience which illustrates this problem. When I visited Leo Bustad when he was doing radiation studies at the University of California at Davis, they were raising the beagles in very, very small cages after initial dose radiation. And after many—I don't know how many months, 10-12 months perhaps—they were put outdoors into group pens. And many of them would just lie in the sunlight for days not knowing what to do. It is a good illustration that we need paced increments of experience in environmental enrichment. This is a good example of an inadvertently introduced experimental variable which raises all kinds of questions. If we are looking at subtle, deliberately induced stresses like radiation, and then we have another variable added, like a sudden environmental change, or as in your situation, increasing ammonia level, it makes sophisticated animal research almost an unattainable goal. Not easy.

Q. What then do you anticipate when the Federal regulations tell us to put a dog in a comfortable cage and get them used to the standards of the cage? What will happen to their psychological well-being?

A. Well, this describes the program Leo Bustad instigated after I visited. It included frequent human contact, play objects within pens and getting them used to it. Not just leaving them in the pen, but taking them back into the small containers so that they can make the adjustment, and they adjusted very well.

Q. We have a lot of variables to consider with our animals living under "stressful" conditions. Now we are going to introduce a new
Environmental Enrichment

set of conditions. From what you said, we are going to introduce a new stress variable into our animals. What do you see for our older group?

A. The older group will make the adjustment. I think the figures that are available from moving animals from one environment to another show that there can be an increased susceptibility to disease in the ten day to two week cycle period before the animal is re-adapted. I think looking at this in the long term, we are probably just talking about one generation of dogs at the most until the rearing conditions match the conditions in the holding facilities within the research institution. So it is a very short adaptation phase really that we are talking about in terms of the changeover.

But I think we will always have that. You know we have data from breeding kennels where dogs have been handled as puppies. They have been handled under one condition with female handlers, and then they go to another situation where there are male handlers, and that can be a stress too. I think that the better we can standardize, not simply the cage size, but the kind of handling from the breeding rearing establishment to the laboratory research establishment, the better things will go scientifically and also in terms of the animal's welfare.

Q. I agree with many of the things that you have said this morning and particularly your last comment. I think Sharon and Jack Vanderlip wrote a paper about laboratory-raised dogs who were handled by male handlers and then exhibited some bizarre behavior when they went to the laboratory and were handled by female handlers. In our experience, we have numerous examples of animals exhibiting abnormal behavior who have been purpose-bred animals, probably not conditioned when they were young. These animals don't seem to know how to act in pens and don't seem to know how to act very well when they are taken to the laboratory. They certainly don't know how to act on the end of a leash.

On the other hand, we still obtain dogs and very good quality dogs, healthy dogs, dogs that are purposely and very carefully selected, from a pound. And many people in the humane movement have opposed surplus pound dogs being sent to research labs. I would contend, based on our own experiences, that obtaining pound dogs is far more humane. These dogs seem well-adapted to people. They seem comfortable in cages and they seem to know what to do on the end of a leash. They react equally well to males and females and don't seem upset when brought to the laboratory and worked on. I would like your response to that.

A. When I was working with dogs at Galesburg Research Hospital in Illinois, we got them from the pound. Doing behavioral studies, brain studies, brain research, development studies and so on, it was very critical that when these dogs came in from the pound that they be in good health. Few of them were. Other than general health screening, because some of them were lost on the streets and terrified we had to be very careful handling them here.

The major problems that we had other than the stress condition of these animals was their adaptation to the group and single pens we put them in terms of them not wanting to evacuate there. One has to be especially alert to these problems of helping the animals adjust. We had people coming around, taking them for walks and so on so they would get adjusted—essentially housebreaking them to evacuate in their pens. I had pretty large pens for them.

Q. I agree that that can be a problem Dr. Fox, and that is obviously one way to deal with it. But I would also like to say that while I agree with many of the things you said, I have had this experience. I have no doubt that your slides show conditions that exist, but I would like to believe we do not receive our animals that way. We do not truck them to our facility that way. The animals are very carefully screened and they are screened not only for physical health, but for how they approach
and how they interact with people as well. I was distressed earlier in your presentation to see the slide of an animal that had a very large lesion. That appeared to be possibly a dog that was put on a heating pad under anesthesia. What was that?

A. The dog had been deliberately burned by a vivisector in a medical school. The point that I think you need to realize is that by my presenting evidence of problems, I am not implying that these are general. That is a projection on your part.

Q. It was a projection on my part, and I appreciate your clarifying it.
Socialization and Management of Purpose-Bred Dogs

Thomas Carroll, DVM
David A. Valerio, DVM
George Pucak, DVM

The Hazleton housing facility at Cumberland is an indoor/outdoor facility. Brood stock are housed outside in 20 square foot pens that are up off the ground. Whelping takes place in inside pens in an environmentally-controlled whelping room. This past Winter we moved into what we call a grow-out building where the puppies go at four weeks of age. At eight weeks of age and older, the puppies are moved outside.

Hazleton owns approximately 300 acres at the Cumberland campus. We still have quite a few plywood houses in use, but we are gradually converting to the plastic dog houses, and our USDA inspector likes them very much.

Whelping cages are double-decked. The feces drop through the wire right into a pan which is washed down. We actually have our own sewage treatment plant at our facility where we re-circulate water. We also have chlorination facilities.

The grow-out building has 92 double-decked cages. With respect to puppies that are housed outside, we put no more than three pups per cage and that is broken down by sex--all the males are together and all the females are together.

The housing facility at Hazleton-Laboratory Research Enterprises (Hazleton-LRE) is totally enclosed. All the animals are housed inside. The brood stock are housed in buildings with respect to the breed.

Parturition takes place in the whelping rooms where the puppies remain until they are six weeks of age. At six weeks the pups are taken to another building, their kennel area, and that's where they remain.

The present and future construction taking place in Kalamazoo at the Hazleton-LRE facility is geared toward more autonomous housing. We will have housing for the brood stock, and whelping will take place in another specified building.

We examine our bitches on Mondays, Wednesdays and Fridays for proestrus. With respect to socialization, we encourage good verbal contact with the bitches by technicians. We don't offer treats on a routine basis, but quite frequently we will offer a treat to our brood bitch, for example when she comes to the front of the cage to the technician. You would be surprised at the rapport that the technicians build with these brood bitches. For instance, they can walk into the whelping area where they don't ordinarily work, and the dogs will begin to bark when they hear their voices.

When we detect proestrus we consider that day one. We always have; it's just a tradition. On day nine, the bitch is taken to the male's cage where copulation takes place. The bitch then goes back to her home cage and on day 11 the process is repeated.

Pregnancy examination takes place somewhere between 14 and 21 days prior to expected whelping. The bitch is taken to the whelping area and the physical examination is done there. The delivery and parturition obviously take place there. When the litter is weaned at about eight weeks postpartum the bitch is removed from her litter and taken back to her home cage in the brood stock area. We use paper for bedding in our whelping cages. It's disposable so we can get it out and burn it. These cages are scrubbed and washed every day.

A tremendous emphasis is placed on
Environmental Enrichment

neonatal care. We do no total hand rearing, but we do a lot of fostering and supplemental bottle feeding. Hand rearing has been unsuccessful for us, so we don't attempt it. Daily observation and the administration of any indicated therapeutic agents are done by the technicians. We like the human infant bottle. The Evenflo is the one that seems to have the most pliable nipple. We like it better than the pet nurser, especially for beagle pups and our mongrels. We use the Esbilac liquid for supplementary feedings.

Our pups are routinely vaccinated using the Bordetella influenza intranasal vaccine at three weeks of age. At five weeks we use the modified-live canine parvovirus vaccine. At seven and 10 weeks distemper, adenovirus, influenza and parvovirus vaccines are given, and at 14 weeks we combine the leptospirosis with an inactivated rabies.

This also is a critical period for socialization. There has to be some pain that the animal experiences with an injection. I think one of the things you can do, maybe not a major factor but something you can do, is to use good equipment such as good sharp needles. There are vaccines available that don't sting. Have the technicians make it a pleasant experience, if possible.

Continuing to describe the colony health program, our brood bitches are vaccinated at weaning. Every time a bitch is weaned, she is vaccinated with the combination product. That way we know we are not vaccinating any gestating bitches. If a bitch has a misconception or loses her pups, then she is vaccinated at that time. Studs are vaccinated annually.

The internal parasite control program includes routine de-worming, which is performed at three and five weeks of age. Mongrels get de-wormed at three, five and seven weeks.

Composite fecal examinations are done at six weeks of age. We pick up the fecal material as it drops through the cage. We also at that time can monitor the bitch because she is still with the pups. Since we started this mongrel colony only about five years ago, as opposed to the beagles which have been there for 25 years, we still experience some roundworm problems. I think that is probably from somatic cysts that are still present. So we do composite exams on mongrels on an eight-week cycle.

With respect to worming, this is another excellent time for some good positive human physical contact. We have gone to the liquid wormers and you can now get some that are very effective and very palatable. Use them as a treat, if you will, for puppies. I am not belittling the capsules or tablets. They are very effective, but I feel that a liquid that is palatable can be utilized as a treat and still get the mission accomplished.

All brood bitches are treated with ivermectin at weaning. That is a popular anthelminthic and very effective. The studs are examined and treated for parasites every six months. The parasite-infected fecal material that we are finding now is less than 1 percent with beagles and 2-1/2 to 3 percent with mongrels. Here again, I think that is because of the somatic cysts.

With regard to our brucellosis and heartworm surveillance program, all of our bitches are tested at weaning or if conception does not take place. All the studs are checked every six months. The canine brucellosis test that we utilize is the Pittman-Moore rapid slide agglutination test (RSAT). We don't routinely check pups but we can do it if the client requests it.

The first formal socialization behavior program started in 1977 after a visit by a consultant and recommendations from him. We set up that program and he re-visited the facility in 1983. In March of 1988, we had two other behaviorists come in and work with us for two days to revise the program. They encouraged the use of leashes, and initiated the use of treats as rewards. We also put more emphasis on the socialization and environmental enrichment of our new mongrel dogs.

Our socialization staff now consists of 13 full-time positions. We are in the process of constructing a new building which is totally devoted to socialization. It will probably mean the addition of about three more people. That accounts for about 20 percent of our work force at the Cumberland facility.

Pups from one to two weeks of age are removed from their whelping pens, and are
gently stroked and fondled for one to two minutes, three times a week. This is time and money well spent.

At three to five weeks of age, three times a week, the pups are placed in a socialization cart, and offered a mush which is gruel or soft food. The pups are placed individually on top of the cart and a nylon leash is placed around their neck. We don't attempt to leash break these dogs or train them to a leash, but it is a means of environmental enrichment that we think has been invaluable. A treat is offered at this time if the pup doesn't jump and fight against the leash. We reward him for tolerating the leash around his neck.

Also at this time the tail is picked up, the mouth is opened, the ears are examined. This serves two purposes. These technicians, these socialization people, are certainly able to tell the normal from the abnormal. It is also a means of training the pup for future physical examinations.

One type of socialization cart is a metal cart which has holes drilled into it so we can wash it out and disinfect it. Another type of socialization cart has a stainless steel bottom which resembles an exam table or some solid surface. The pups have been on wire all of their lives. They are encouraged when the socializer goes to the cage to come to him in front of the cage, and are offered a treat, a reward for doing so.

With pups from 11 weeks of age until they depart, procedures are carried out as above twice a week. We do not offer any soft food at this time, only treats.

With the special emphasis I mentioned on the mongrels at 10 and 15 weeks of age, they spend five days in the socialization building. The socialization cart is a wheelbarrow that we have designed to suit our needs, as far as being able to move it along from cage to cage and socialize the puppies.

When their run is cleaned the pups are brought out leashed and walked up and down the aisle. They are then placed in a cage with plastisol mats that we have found to be excellent in keeping puppies clean.

One problem that we noticed was that we weren't getting them into the socialization program early enough. That's critical. We were waiting a little too late. The pups had always been exposed to people pretty much at eye level. The cage hits you at about the waist. When the pup was in that run, with the socializer towering over him, the pup couldn't handle it very well. So getting them in at a younger age has certainly been an asset. They adapt to a person standing over them a lot sooner.

While the run is being washed out and after the socializer takes the pup for a walk on the leash, the pup goes into a stainless cage for about 15-20 minutes. This is an environmental enrichment for possible future housing in stainless steel. We use some plastic gallon jugs as a toy. We also use nylon straps, something they can tug on, something they can play with and roll around. Enrichment devices don't have to be expensive items to be effective.

Dr. Fox touched on brood stock selection with respect to genetic selection. For brood stock selection, we do our behavioral evaluation of each potential breeder and that is scored and certainly is part of our selection. We have a geneticist as a consultant who has helped to set up this program. Certainly, behavior is not the only criterion, but it is a very important one in brood stock selection. We have complete breeding and behavior records. We are just installing an IBM AS400 system which will increase our capability as far as record keeping.

Some comments on the physical characteristics of the beagle and the mongrel. Obviously, with the beagle we want the tricolor dog; with the mongrels no tricolors. They are very undesirable. We are also in the process of developing a smaller mongrel colony--smaller in size. Look at a 7-10 kg. dog, and obviously you don't want tricolor coat colors there. Weight: The beagle is 9-11 kg., our mongrel is 12-16 kg. As I said, the mini-mongrel or the smaller dog is 7-10 kg. Hair coat: The beagle has shorter hair, the mongrel, medium to short, and the smaller mongrel, medium to short. Height: The beagles are about 13 inches at the withers and the mongrels are about 16-20 inches.

Looking at genotypes or the comparison between the two, the mongrel is very diver-
Environmental Enrichment

sified. It is truly a mixed-breed dog and as far as the biomedical research community is concerned, it is being used primarily in pharmacology.

With regard to behavior, I think you have to say that the mongrel is more vocal. In our experience, they bark more. They are louder and they are more active. I wouldn't call them hyperactive, but compared to the more docile beagle, they are certainly more physically active. I would say that the mongrel is more adaptable and will take on a new environment more readily than a beagle would. At least that has been my experience, my observation.

As far as production, we are averaging about 1-1/2 more pups weaned out of the mongrel bitches than we are out of the beagles. Difficult delivery in the mongrel is almost unheard of for us. It is just very rare. Whereas with the beagle, we probably do a C-section about once a month.
Q. How many puppies does each socialization staff person handle?

A. I'll tell you what our population of puppies is; maybe that will help you. We are probably in the neighborhood of a monthly population of 7,000 or so. With respect to socialization, we have both black and white staff, we have males and females, and we encourage the use of the white lab coats, especially in the whelping and socialization area.

Comment. I would like to make an observation. There is a difference between chosen and controlled handling.

Comment. So what you are advocating, or what you are suggesting is that we need more indulgence handling.

Comment. A good combination of both, indulgence handling and some controlled handling.

Q. You talked about socialization and environmental enrichment. That was very interesting. I would like to ask a practical question that has to do with the Federal regulations with regard to space. How is your organization going to meet that?

A. We have looked at two approaches. We might either hire more people, and it will take a lot more people, and develop some socialization or some exercise areas. We might have to have people (8 hours a day) moving dogs from their home cage to either the exercise area or an area with 80 square feet. Or a combination of that would be, for example, in the grow-out building where we could have removable partitions to achieve the 80 square feet.

Q. Beagles may not be housed with the new regulations in an environment that goes below 55 degrees or above 85 degrees. How are you going to handle that?

A. The dogs are inside environmentally-controlled facilities. The humidity concerns us a great deal. I am not sure how we will maintain 70% humidity when we are washing down and so forth.
MANAGEMENT
Policy, Program and People: The Three P’s to Well-being

Thomas L. Wolfle, DVM, PhD

The well-being of laboratory dogs depends upon appropriate institutional policies, effective programs that implement these policies, and dedicated people that can put the programs and policies into practice. Policies, programs, and people: the three P’s to well-being. The well-being of dogs is enabled from programs that among other things promote adequate veterinary care, personnel selection and training, good nutrition, disease prevention, and appropriate husbandry including comfortable, sanitary kennels, social housing, and human interaction. The well-being of dogs, therefore, cannot be assured from a single practice or group of practices dedicated to that end alone. Well-being is manifest as the ever-changing result of all practices that impinge upon the animal, and practices that address well-being must always be considered in context of the management program and personnel who implement them.

Numerous workshops and conferences have concentrated on that aspect of canine husbandry that has become known as "exercise requirements," in deference to the wording of the 1985 Amendment to the Animal Welfare Act. The application of the unfortunate anthropomorphic label "exercise," as a major contributing factor to well-being, over and above that provided by well-run colonies in compliance with the Guide for the Care and Use of Laboratory Animals, fails to demonstrate a reasonable understanding of dog behavior. With the exception of treadmills or other forced movement, exercise is difficult to measure. Most frequently, provision of "exercise space" has been suggested as the necessary and sufficient factor. However, of different sizes, authors have been unable to demonstrate even minor improvements in physical, physiological, or psychological condition.

If Not Exercise, What?

Dogs have thrived for millennia as companions to people and in cooperative hunting packs. In each case development of a unique social attachment enables the relationship. To ensure propagation of this relationship, nature has endowed dogs with a remarkable ability to socially attach to classes of organisms (e.g., dogs, people, and sheep) with which they are raised during critical periods of development. This "critical period for socialization" ranges from approximately 6 to 12 weeks of age and most frequently serves to ensure attachment of the pup to its dam and litter mates. Introduction of people, or other animals, during this period likewise solidifies a life-long relationship. Socialization to humans has been demonstrated repeatedly to be essential for dogs to co-exist with people--in research colonies or homes--without undue stress and fear. Pups unsocialized to people grow into fearful, fear-biting adults.

Co-equal to human socialization in importance to the well-being of dogs, but not a replacement for it, is conspecific housing. Since they, by nature, live in social groups, or packs, and since dogs in research settings spend a great amount of time without human contact, social housing for most breeds is a practical and ethologically sound practice. When providing for the well-being of dogs, and taking into account these social needs, it becomes obvious that cage size, or the oppor-
Management

tunity to "exercise" per se, should not become the driving operant because, under proper conditions of social housing and human interaction, these issues become exceedingly unimportant. A focus on exercise and cage size, regardless of the frequency of use or size of the exercise area would, in fact, not lead to species relevant practices. The term "exercise" is thus best dismissed in favor of the term "well-being," to include human interaction and conspecific socialization in addition to those elements included in programs of husbandry and veterinary care.

Puppy Petting Institutionalized

It is ironic that expensive housing and support equipment is relatively less difficult to justify in some institutions than socialization of dogs. Stated another way, a major contributing factor to the well-being of dogs is getting the institutional CEO to defend to the senior faculty that puppy petting is serious stuff! Carried to extreme, a highly unlikely prospect, this might even require saying to uncooperative faculty that unless their dogs are adapted to people and housed in compatible social groups they can grovel for grants somewhere else! The solution? An institutional policy and support of the CEO in which resources needed for the well-being of animals competes effectively with other institutional priorities. Beyond the scope of this paper, but certainly to be considered in such a policy, is the impact on the animals of management-induced distress, and the consequences of this distress on the quality and validity of research data. Operationally, such a policy evolves through delegation to the Institutional Animal Care and Use Committee (IACUC) the authority to commit resources needed to address the problems, including reallocation of personnel to positions in which planning and implementation of the program can proceed. While issues of well-being, enrichment, social housing and exercise are but a part of the bigger picture of colony management, their implementation depends upon sound institutional support and an institutional program that will embrace the inevitable changes. The value of this program far exceeds any single combination of acts to enrich cages, and without it any number of enrichment or "exercise" programs will not likely compete successfully for the resources required to sustain them.

Laboratory animal science has a long history of concern for animals. It did not begin in 1985--nor with the Silver Spring Monkeys! Since its first publication in 1963, the Institute of Laboratory Animal Resources/National Research Council's *Guide for the Care and Use of Laboratory Animals* (NIH, 1985) has stressed that humane care and species-relevant environmental enrichment is a major responsibility of investigators and institutions using animals in research, testing and education. Although the *Guide* places this responsibility on each institution using animals in research, each revision committee for 25 years has been unwilling to attempt to write definitive standards on how this is to be achieved because of the great variability of the research on how this is to be achieved because of the great variability of the research requirements and the differing physical and psychosocial needs of the many dogs and other species of animals used in research. Recognizing that well-being is not a defined science for which standards can be established for all animals and institutions, professional judgment is required in the implementation and interpretation of the *Guide*. The 1986 Public Health Service Policy on Humane Care and Use of Laboratory Animals (USPHS, 1986), the 1985 U.S. Government Principles for the Utilization and Care of Vertebrate Animals Used in Testing, Research and Training (Federal Register, 1985), and the American Association for the Accreditation of Laboratory Animal Science (AALAC) are all based upon the tenants of the *Guide* and depend upon sound professional judgment for its interpretation and implementation. Resulting from a clear mandate, but with freedom for expression, numerous institutional programs have been designed with different approaches. Clearly, when uniform practices would tend to cause mistakes to be repeated, this multifaceted approach is best for the health and well-being of the nation's research animals.
Setting Goals and Priorities

Providing for the well-being of laboratory dogs stems from a humane ethic. It also stems from a desire for sound experimental designs in which all extraneous variables are controlled to the extent possible. It matters little which philosophical approach one may ascribe to, for both demand that animals be well-adapted to (unstressed by) housing and husbandry practices. However, strong one's feelings may be about the matter, these goals are not achieved from desire alone. Indeed, institutions may boast state-of-the-art housing and equipment, but fail to inform the animals that the expenditures benefit them. Others, with modest facilities, may speak clearly to the animals through personnel and practices. It is often observed that bricks and mortar are not the necessary ingredients for good animal care, yet it has been a propagated misconception by many that good animal programs begin with buildings and cages. Well-being begins with people and programs. Although each species differs its requirements, the umbrella program that embraces the requirements for each colony is the same for dogs, rodents, or nonhuman primates.

Social (Conspecific) Housing

Reared with their ancestral history and behavioral preferences in mind, most breeds of dogs used in research are highly social and have developed elaborate sociological and political strategies for group living. As do many people, they seemingly draw much of their ability to cope with everyday events from others with whom they interact. Solitary confinement for most social species (and most but not every individual) is one of the greatest stressors that can be bestowed upon them. Ample evidence has accrued to support the currently prevailing wisdom that single caging of dogs is not in their best interest. When one looks at U.S. dog colonies as they exist today, however, it is likely that many of these animals are comfortably adapted to solitary living, especially in those situations where human companionship is provided and they are in visual and auditory contact with other dogs. It can also be argued that individual dogs have been single housed, or tethered, for so long that to force a change on them would be highly stressful. Whereas this might be true for the individual in the short term, it is unlikely to be so for future generations. Institutions in which this applies should seek the support of institutional officials and the IACUC to review the practice of single housing and develop a plan for a phase-in of group housing. This is not likely to be easy or inexpensive for many institutions or for investigators who feel that ongoing research is based upon data derived from single housing. Nevertheless, it is imperative that these practices be reviewed by IACUC's in order for institutions that require single housing to be able to defend the policy to the public, to federal inspectors, and to site visitors.

With increasing emphasis on "performance" rather than "engineering" standards, inspectors and site visitors are likely to begin paying more attention to animal issues and less to the structural ones. This is not to say that today every dog must be housed with a cage mate, because rearing history, aggression, health, and protocol requirements may preclude it. But it does suggest that every institution should be able to state convincingly in a colony plan that dogs, at some point in the future, are to be socially housed.

Socialization to People

However strongly the case for social housing can be stated, it pales in comparison to the need for human socialization. Socialization to people is a process that creates in dogs (and some other animals) a sense of attachment to people, which replaces the fear and aggression of unsocialized dogs. Unsocialized, fearful, aggressive dogs should not be kept in a research facility for more than the few days it takes to determine the fact. In these cases, euthanasia is the appropriate humane response. To avoid future occurrences, purchase contracts and rearing policies should clearly indicate that dogs are to be socialized.

If only one approach could be provided for dogs' well-being from among social housing, spacious caging, "exercise," or human contact,
Management

it should, without doubt, be the latter. However enriched the quarters, when it comes time for unsocialized dogs to be restrained for venipuncture or removed from the cage or handled for any reason, they are highly distressed. This is unacceptable for scientific and humane reasons. Dogs can be reared in spacious kennels or paddocks with other dogs and seemingly be healthy and happy, but this will not provide them with the resources to enable them to cope when a person enters the scene or this environment changes. Coping is a key concept because it connotes the ability of dogs to adapt to stresses with minimal behavioral or physiological alteration, and in current parlance this is the performance specification for socialization.

Performance vs. Engineering Standards

Many approaches can be utilized to effectively socialize puppies, each with similar outcomes. Evaluation of the effectiveness of the procedure can be readily accomplished without even seeing the socialization process or knowing how it is performed. Observation of the dogs, in interaction with kennel mates and with personnel, constitutes objective performance measures by which to evaluate the outcome of the program and the well-being of the dogs. On the other hand, assessment by engineering standards would require specification of frequencies, durations, and sizes of enclosures, none of which would likely be predictive of well-being, or of the value of exercise.

How socialization is achieved is seemingly unimportant because dogs are extremely adaptable during a critical age of opportunity. If handled during 6–10 weeks of age, socialization is achieved. The socialization program can be quite elaborate with introduction of puppies to leashes, platform scales, changes in floor texture and lighting, and even different handlers. It can also be quite simple. What is important is that, at least some of the time during this period, a one-on-one relationship must be established between each puppy and a person. In a colony of 160 foxhound bitches producing 1,000 puppies per year from 125 litters averaging about eight puppies each and experiencing 20% mortality to one year, this was achieved in something less than five minutes per-pup per-week with twice-weekly interactions with each litter. Socialization of this colony required about eight person hours a day. This program did not assess the minimum time required to achieve socialization but it did determine that socialization could be firmly achieved and for life for an investment of bi-weekly sessions of less than five minutes per-pup per-week! This program evolved through four steps, the actual starting times and durations varied between the times indicated, but variation had little effect on success of outcome.

Step 1: Beginning between 4–6 weeks of age and continuing until 6–8 weeks. Technician enters kennel with litter without bitch. Sits quietly for 15–20 minutes, offers canned dog food on fingers for those who wish to take it. Repeat twice per week. Sitting leaves human scent, which is explored by pups when person leaves—considered to be an important first step. Pups are not picked up or restrained.

Step 2: Beginning 6–8 weeks and continuing for one week. First visit: Person enters kennel, sits, feeds pups as before and places leather collar on each pup. Second visit: Sitting, feeding, and checking for collar fit. Leash is attached to each pup inside kennel for a few minutes and released.

Step 3: Beginning at 8–9 weeks and continuing for variable duration depending on extent of interaction at other times. Person enters kennel, leashes pup and fastens leash to door of its own kennel. Sits with litter, petting, holding, and feeding. In subsequent sessions multiple litters can be handled at the same time with person dividing time among each.

Step 4: From 9 weeks on. Pups are led with leash, first in the vicinity of the kennel and on subsequent sessions to
other areas of the facility to include: Teaching to stand on examination table without jumping off, mock physical examinations, feel of vibrating clippers, sitting on wobbly platform scales, going from bright kennel with textured floor to central corridor with waxed floor, up/down stairs, on gravel and grass, etc. The goal of this step is to expose each pup to a variety of experiences for the purpose of teaching self-confidence and developing the ability to adapt to new situations.

Each pup is rated on a three-variable Socialization Scale of 1 to 5, with 5 being the best performance.

Variable 1: Kennel greeting. The manner in which the pup greets the person upon opening kennel door. This is thought to be the most reliable and easily used indicator.

5 -- Eagerly greets person at door--with enthusiasm!
4 -- Greets person at door, but lacks enthusiasm.
3 -- Comes forward, but not all the way to the door.
2 -- Stays in back of cage cowering, but does not bite.
1 -- Cowers in back of kennel--would bit if approached!

Variable 2: On leash. The manner in which the pup responds to leash.

5 -- Eager to go on leash, tugs on leash in front of person, exploring surroundings.
4 -- Eager to go on leash but with less exploration, occasionally balks at new situations.
3 -- Requires some coaxing to go on leash, frequently balks at each new situation.
2 -- Reluctant to lead but will walk some, does not explore surroundings.

1 -- Will not lead, resists all attempts to lead.

Variable 3: Table behavior. The ease with which the pup stays on examination table and accepts mock procedures.

5 -- Eager to stand on table, holds alert posture with no indication of fear or trembling.
4 -- Stands on table without trembling, tends to smell and explore.
3 -- Stands on table with some assistance.
2 -- Will not stand on table without being held.
1 -- Resists being placed on table.

The Socialization Scale is useful in monitoring behavior of dogs at subsequent ages: after being placed in outdoor paddocks from 4 to 9 months of age, after being issued to an investigator, or after being placed into breeding. With notably few exceptions, animals that ranked high in Variable 1 (kennel greeting) remained highly social and easy to handle through life. Variable 3 (table behavior) was generally less predictive of future behavior than was Variable 1 or 2. Of special note is the observation that poorly socialized dogs became more fearful of people in the outside paddocks, remained at the periphery of the group of dogs that surrounded technicians or the veterinarian, and were difficult to catch. Well-socialized dogs jumped upon, and were eager to play, with people entering the paddock, and were easy to catch. Release of a socialized dog into a paddock (or exercise pen) had little bearing on its subsequent behavior to people or to other dogs. Release of unsocialized dogs (those that might be thought to be in most need of remedial exercise) into paddocks increased the permitted "flight-distance" between themselves and people and reinforced their fear of people.

The Risks of Being a "5"

Animals that rated all "5's" proved to be too socialized to people to perform well as breeders or to become good parents. They
Management

generally preferred human attention to that of kennel mates, even at time of breeding and nursing. Although these animals were good for most protocols, they lacked proper balance between socialization to people and to other dogs. When pair or group housed, the most highly socialized dog was generally dominant, especially when the kennel was approached by a person. Fighting was sometimes observed over competition for human attention.

The Risk of Being Only a "1"

"One's" were not suitable for breeding or research. They generally get along well with other dogs, breed well, and nurse their litters--when people are not around. Their fear of people overrides their nursing instincts and they break-off nursing to bark at people passing the kennel (barking at this time is intensified due to maternal protective behavior, but well-socialized dogs tend to be much quieter in general--a good alternative to debarking!) After pups experience repeated disruptions of nursing because of mother's agitation at passing people, they become poor prospects for socialization. Unsocialized bitches should not be used for breeding for this reason.

Being a well-rounded dog requires that socialization begin neither too early nor too late, with the optimum starting period being approximately six weeks of age. Initiated too early and the pup is oversocialized to people; initiated too late results in oversocialization to other dogs. Rarely, in most colony situations, can a dog become adequately socialized to people if socialization is not begun before 12-16 weeks of age. Many weeks of intensive work will be required at this age. Unsocialized juveniles or adults are generally highly stressed around people and should be euthanized.

Exercise!

At 16 weeks of age the pups of this colony are placed into quarter-acre paddocks in groups of 20 age-matched juveniles. The paddocks are equipped with shelters bedded with straw, concrete culverts for play and privacy, and feeders. This was occasionally enriched by a passing rabbit or truck, and by daily visits by technicians, with each experience eliciting much running, barking, and play. In this latter case, exercise was stimulated from objects outside the group. Running or "exercise" was never observed when only a single individual was in the paddock (unless stimulated by aforementioned enrichments). Running was observed only in response to social play or interaction with other creatures or things. Space per se never elicited running or play, but social stimulation did consistently. This of course raises the question of what is to be the essential criteria if "exercise" to be required in future animal welfare regulations. It should be clear that exercise is an irrelevant concept for dogs, and that efforts should be placed on socialization to people and rearing dogs in social groups.

There are, of course, a number of unanswered questions. Some practical issues are: If unsocialized dogs have their fear of people reinforced by being released into larger cages where the "flight distance" can increase, are these dogs (the ones most likely to be perceived as "exercising" when released into large space) good candidates for release for exercise? If well-being is, in part, due to an animal's capacity to adapt to and cope with changes in environment, does a fearful dog that is routinely placed in large exercise pens, at the expense of controlled exposure to people, ever learn to adapt to people? If not, what is the status of well-being of this dog when in a smaller cage where the "flight distance" is forcibly decreased? What is the status of this dog, as reflected by the neuroendocrine and immune systems, when placed on study? What is the status of the data derived from this dog? As it would seem, do dogs socialized to people benefit little from release into a large pen or paddock away from people? For highly socialized dogs, does forced separation from people increase the level of distress? We know some of these answers and need to know more. Perhaps this should be seen as a time of opportunity to learn more about the behavior and physiology of stress of laboratory dogs, both for their welfare and for the validity of studies on which
they are used. With adequate consideration of the 3-P's, and training and dedication by enforcement agencies, "exercise" might yet be formulated into a most attractive and beneficial package—even for dogs . . . .

BIBLIOGRAPHY

American Association for the Accreditation of Laboratory Animal Science (AAALAS) is a voluntary, non-profit accreditation body that uses the Guide as the principal basis for accreditation.


Caging Systems for Dogs Under the New Standards of the Animal Welfare Act

William E. Britz, Jr., DVM

My purpose in being here today is to review the caging and housing systems used for dogs and to discuss what can be done to meet the proposed regulations. I am very concerned because there has been a lot of money invested in equipment, and unless some things in the proposed regulations are changed, they could make present equipment obsolete.

With regard to stacked individual dog cages, I think that all of you have experienced much difficulty since the last revision of the Guide. When the inside height of the cages was increased from 34 inches to 36 inches, we realized there would be problems when you tried to get those new cages through doorways into the animal rooms. When dog cages are stacked to conserve floor space and you must have 36 inches height you also have to take into account the one-inch tubes and structures that hold the cage above the excreta pan. Before you know it you have a stacked cage unit with a total height of 96 inches. The standard doors in most animal rooms are 82 to 84 inches clear opening height. Therefore, the stacked cages cannot pass through the doorways. I have seen some interesting things done to get around the problem, such as using smaller casters—which may increase the difficulty of moving the stacked cages over rough floors. I have also seen small mechanical lifts used to allow the cages to be unstacked and transported on platform trucks.

We have another problem in the caging business. Cages cannot be built to sliding scales. The USDA requirement to measure the dog from the tip of his nose to the base of the tail and then calculate the size of the cage is fine, but we cannot build many sizes of cages for dogs. So the cage manufacturers take a nominal size and build on the basis of that. With stacked dog cages, the nominal sizes selected were those recommended in the NIH Guide, eight square feet and 12.1 square feet (I don't know where the ".1" came from).

I'd now like to talk about dog runs. Even four or five years ago runs were becoming more popular. There will always be a requirement for individual caging for metabolism studies, for some toxicology studies and that sort of thing, but in those cases where institutions had the space and could manage it financially, they were installing runs.

I want to point out that the materials we are using in caging systems are changing. We sell very few metal floors anymore for dog cages. They are almost all vinyl-coated expanded metal grates, hopefully making it more comfortable for the animals.

We are also using different materials for resting boards. We have found that high-density polyethylene, the same material used for "cutting boards," is warmer to the touch and hopefully more comfortable for the animal. I walked in a cat facility one day on a site visit in which there were two racks of identical cages sitting side by side. Some had polyethylene resting boards and others had stainless steel resting boards. In those with stainless steel resting boards, every cat was in the litter box. In all the cages with polyethylene boards the cats were up on the resting benches. I think they were telling us something!

We are also trying to make this equipment easier for people to use and maintain. We
have reduced the weight of floor sections in runs by using vinyl-coated expanded aluminum mesh so that the smaller animal technicians can handle them. When they can be lifted easily it makes cleaning the runs easier.

At the Baylor Dental School in Dallas large runs were installed with ramps that accessed two banks of cages on the back wall. They individually housed the dogs in the cages for their studies that needed to have them separated, but they could open a guillotine door at the back wall and allow the dogs to use the run area individually, or together. Those runs were installed five years ago.

Other kinds of run units have been produced over the years. We and several other manufacturers have designed portable dog runs on casters. Some of these units are designed so that they can be completely and easily dismantled. The sides, the front, the back, and the base come apart. The sides are built with a removable panel so that even though these are built on a 12 square foot frame they can be opened up into 12, 24, 36, or 48 square foot areas. This is one approach to try and solve the space problem, and still get the things moved in and out of the facility. I think equipment of this type has some application in metabolism and toxicology studies.

Some run units have been designed with quick disconnect tabs so that they can be taken apart simply by lifting the front off, lifting the back off and pulling the sides apart. They are connected with interlocking tabs, like those on the side of a stake bed truck. These units have application in areas where runs must be disassembled and moved completely out of a room. This also allows them to be washed in a cage washer easily. This feature is particularly beneficial in toxicology studies where there is a need to occasionally completely clean the caging units.

With regard to a typical floor plan for the installation of runs, we like to see some sort of hand washing facility in every animal room. Ideally, the floor should slope from the center of the room with trench drains at the side walls at the back of the runs. With this arrangement we have seen that the easier it is to wash the facility down, the more often it gets washed down. If the runs have resting boards, they should be designed so that they can be easily raised or removed for access to the drain underneath.

Many runs being installed today are provided with a removable divider panel separating two runs. Tabs on the corner allow the divider to be easily removed making one larger run. Part of the movement from cages to runs is based on the fact that runs have much more versatility from the standpoint that you can house animals other than dogs in them. With the addition of top panels they may be used to house primates, cats, and large birds. If the runs are designed properly they may be used to house swine, sheep and goats.

Many facilities have had runs installed with 24 square feet of floor area in compliance with the current NIH Guide. If the proposed standards could be amended, with regard to the 80 square foot exercise area, to allow some multiple of 24, i.e., 48 or even 72 square feet, two or more adjoining runs could be utilized to provide the required exercise space. This is where removable dividers or shift doors in the side panels would be invaluable. Some institutions are also proposing to use aisle space along the run area to provide the required exercise area. Even with the space available and properly designed equipment, the proposed rules will require extensive labor and a well-coordinated plan to meet the exercise requirements.

Another institution has solved the problem by installing a deck half-way up the sides of the run with a ramp from the floor to the deck. The animal essentially had access to two floor areas with the same run. The floor area available to the animal was essentially 48 square feet (as long as they don't deduct the area occupied by the ramp!) This installation was at a major pharmaceutical company where they had dogs, and the dogs do exercise! They run up and down the ramp and around the top and back down. Of course, they do that primarily when someone walks into the room! It does give them some activity and variation of motion.

I have looked at our sales history which shows sales of dog cages vs. runs over the last four years. It clearly demonstrated that in
Management

1985 there were significant cage sales and then those decreased gradually over the past four years. At the same time, there was a dramatic increase in the sale of runs for dogs during 1985 and 1986. In 1987, when the proposed rules were published, institutions held back on purchasing new caging and sales decreased. Later, in 1988 and 1989 when institutions were forced to make decisions, run sales increased. I think that is representative of what we have seen in the industry. Our company alone has produced over $2.5 million of dog runs during this period, and the majority have been designed with 24 square feet of floor area in accordance with the Guide. I would hate to see those made obsolete by the proposed regulations—without definitive proof that it is needed.
Comment. [Michael Corio] I just returned from the UK and the interesting phenomenon that I learned throughout Europe is that, particularly in the UK which is controlled by the Home Office as they call it, they are not allowed to have their dogs on any raised floors within the kennels. They are all on concrete. This either puts them on bedding or a washed down floor situation versus the raised floors that you talked about, vinyl or whatever. I don't know if anyone wants to comment on that, but it is an interesting phenomenon.

There are two other things that I could comment on. Around 1977 a pharmaceutical company in California installed dog cages, double tiered with a removable panel. None of us here did the job, and again the interesting phenomenon is that when they pulled the removable panel built into cages and human personnel were in the rooms, the dogs had access to the other cages. When they had the panels pulled when there weren't any humans in the room, although they had access to the other cages, the dogs remained in their home cages, and stayed there.

Two other comments and I will conclude. The reverse panel that Bill mentioned, the upside down panel, turned out to be really significant for use particularly with pigs for socialization. I can reference several pharmaceutical companies that I know, on the East Coast obviously, that have used the car door concept with cages for as many years as I have been in business. They have used it back with the old tile cages that were built probably in the 40's or 50's. They ordered cages because they have had this concept for years. They allow the dogs to come out of the cages--the cages fit within the room from end of wall to end of wall. They have a method for controlling the puppies from going underneath the front of the cage where the casters are, so they allow the dogs in groups to come out of the cages, versus runs, on a daily basis, as well as while they are cleaning the cages. For that reason some people are still staying with the cage idea because it covers the primary enclosure and then covers the 80 square feet for the exercise area.

Q. The in-house joke nowadays is that you fellows are all going to make a fortune, which isn't necessarily true. The problem, as I see it, is that most of us that need to make a profit and those of us who need to depend on grants are not going to be able to afford sudden, tremendous increases in cost with the potential of five years from now going through it again. I think, in addition to talking about two modes of housing, we need to talk about new modes of financing. One thought is the lease concept. I am serious I am not making jokes. I think that we have to think in terms of how we are going to pay this off through cash flow. We obviously can't pay for it in large lump sums, so we are going to have to think of other ways of financing.

A. You are right, and we have had a number of people come to us and ask about leasing. We, of course, can't financially handle that, but there are companies in the States that strictly do leasing. Lease America is one, I think, and there are any number of them you can find that will take it on, but you are going to pay more in the long run.

I also want to say that I am proud of the fact that 51 of those 5,000 "pro-research" let-
Management

ters came from my company. We recently converted to an ESOP company where everyone is part owner and every employee sent in an individual letter.

Comment. A lot of things done in the UK are based on practice rather than on any scientific reason. Cage size is also different in the UK. They encourage group housing, but for a beagle they would require a minimum space of about 4-1/2 square meters. Basically that is 45 square feet, more or less. That would be for one dog, but in that same area they could house three dogs. So their space requirements are also much less. There are problems that are associated with bedding and using a bedding environment with dogs, because dogs sleep laying in the bedding. They inhale the dust, and our pathologist tell us that the plant dust sometimes interferes with the interpretation of lung pathology or may compound problems with lung pathology. So there is a give and take for every type of caging system, whether it is on wire or bare floors.
Environmental Variables and Animal Care

Emerson L. Besch, PhD

I was asked to comment on environmental variables as they relate to animals, particularly dog-housing facilities. My comments will address several of these variables presented in the USDA Proposed Rules, 9 CFR Part 3, Animal Welfare-- Standards. I also will attempt to provide suggestions for changes based on data from the literature.

Webster's Dictionary defines environment as the aggregate of surrounding things, conditions or influences. According to my reading of the proposed regulations some environmental variables are considered, but the environment in toto is not covered.

In terms of animal facilities, one might argue that an animal's bioenvironment contains more than what is covered in the proposed regulations (see Table 1 for my full list of environmental factors). While there may be "unevenness" in the amount of detail provided for each element of the animal's environment, in my view the USDA has done a reasonably good job in addressing many of these issues. For example, temperature, humidity, ventilation, and lighting are emphasized; husbandry, sanitation, and gaseous and particulate contamination also are addressed.

Unfortunately, while some parts of the proposed rules contain detailed information, other parts, e.g., those dealing with air diffusion and gaseous contaminants, are rather "fuzzy" and some terms are used rather loosely (e.g., "full spectrum light"). Environmental factors generally involve a lot more than temperature, humidity and so-called ventilation (which I think is used rather flippantly in the proposed rules). Environmental factors involve other things like air diffusion, air particulates, gas discontaminants, confinement, population density, etc. The proposed rules attempt to clarify the intent and applicability of the regulations regarding animal housing facilities by including three categories: general, indoor, and outdoor.

One of my criticisms of the current regulations relates to the definitions of indoor and outdoor animal facilities. For example, the definition of "indoor housing facility" emphasizes "environmental controls" in an enclosed structure or facility. Whereas, the definition of "outdoor housing facility," emphasizes "temperature controls." Controlling temperature is not synonymous with controlling the environment. For example, no matter how well temperature is controlled, it would not improve the environment of an outdoor facility that is downwind from an incinerator or near a large, continuous noise generator.

For the indoor facility, control of other

Table 1.

| ENVIRONMENTAL FACTORS | \hline
| TEMPERATURE | AIR DIFFUSION |
| HUMIDITY | AEROSOL PARTICULATES |
| VENTILATION RATE | GASEOUS CONTAMINATION |
| ILLUMINATION | CONFINEMENT |
| NOISE | POPULATION DENSITY |
| SANITATION AND HUSBANDRY | |

53
environmental variables (e.g., humidity and ventilation) is inferred from the term "environmental controls," but this is not the case with the term "temperature controls" used in connection with outdoor housing facilities. Similar variables which may be coincident to the outside facility—and mobile or traveling facilities—also should be addressed. This appears to have been accomplished under the subsection of the proposed rules, entitled "Housing Facilities and Operating Facilities" (page 10899) and "Temperature in Housing Facilities" (pages 10900-01). In these subsections the emphasis regarding environment now is on "...heating, cooling, and ventilation for the health, comfort, and well-being of dogs and cats housed..." (1) indoor, (2) in the sheltered portion of sheltered housing facilities, and (3) mobile or traveling facilities.

Although minimum temperatures are proposed on pages 10900-01 for indoor, sheltered, and mobile or traveling animal facilities, it is unclear how these values were determined. For example, Table 2 shows the minimum temperatures required.

- It is unclear how the minimum temperature can be both 35°F (1.7°C) and 45°F (7.2°C) for all dogs and cats, except the unacclimated breeds that cannot tolerate lower temperatures, and sick, aged, young, or infirm animals.
- For acclimated dogs, the minimum temperature allowed continues to be 50°F (10°C), although no scientific basis appears to exist for this assumption.
- Including the beagle as an example of a short-haired breed (page 10901) that cannot be acclimated to temperatures less than 50°F (10°C) will certainly surprise many beagle owners, particularly in Northern States.
- Because homeotherms are known to physiologically adapt to changes—within limits—in thermal environments, they should be able to "qualify" for a different minimum temperature. But no allowance apparently is made for this in the proposed rules.

For minimum and maximum temperatures, no mention is made of relative humidity, although relative humidity is covered under the section entitled "Ventilation in Housing Facilities." The humidity issue will be covered later. However, for now:

- The proposed maximum indoor temperature of 95°F (35°C) presumably is for indoor, mobile or traveling facilities (i.e., no mention is made of primary enclosures).
Although "microenvironments" are not part of my presentation, the issue of temperature differentials does not appear to be addressed in the proposed regulations. (Figure 1)

In other research using dogs (Figure 2), the existence of and potential consequences of dew-point temperature differentials between primary enclosures and animal rooms have been discussed. Dry-bulb temperature differentials for dog cages also have been reported.

Similar results for rodent cages (and animal shipping containers) also have been reported. Obviously, unless it is made clear that the proposed maximum temperature applies to primary enclosures, animals could be exposed to temperatures higher than $95^\circ F$ ($35^\circ C$), although the animal facility/licensed vendor may be in compliance with the USDA regulations.

Because USDA inspections have revealed that some licensees do not meet minimum standards for the treatment for dogs and cats, it is proposed that the specific provisions for outdoor housing facilities be made more stringent than they currently are. For example, outdoor facilities should contain:

- Accessible structure—allows animals to sit, stand, lie in a normal manner, and turn about freely.
- Provision for adequate shelter and protection from the cold and heat.
- Protection from the direct rays of the sun and direct effect of wind, rain, or snow.
- A wind and rain break at the entrance.
- A shelter with clean, dry bedding material.
- Provision for additional outside area of shade for all animals at one time; protection from direct rays of the sun.
- Other provisions regarding surfaces, shelter structure materials, and floor materials.

The proposed verbiage regarding "Unknown Acclimation Status of Dogs" in an outdoor facility appears to be overly restrictive (page 10901) by stating that animals "...must not be kept in an outdoor facility in any month in which, during the past five years, the temperature at the facility has been less than $35^\circ F$ ($1.7^\circ C$)."

However, southern states periodically experience "freaky" weather when temperatures below $35^\circ F$ may be experienced in some months (e.g., November, March) in which moderate temperatures ($>45^\circ F$) usually are the "norm." In that event and according to the proposed rule, no dog could be kept in an outdoor facility during November or March for the following five-year period. Presumably, the wording "at the facility" (page 10901, column 1) means "outside" of the facility?

Because ventilation is defined as the movement of air to or from a space by natural or mechanical means, the section entitled "Ventilation of Housing Facilities" appears to contain some vague language. The proposed regulations also are unclear in the use of terms such as "minimize" ammonia levels and "minimize" exhaust fumes.

In terms of environmental quality, the purpose of ventilation is to control mass and energy factors. The airflow rate for mass dilu-
Management

Table 3. Effective temperatures for 23 experimental conditions.

<table>
<thead>
<tr>
<th>Dry-bulb temperature (°C)</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
</tr>
</thead>
<tbody>
<tr>
<td>24.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.4</td>
<td>24.6</td>
<td>25.3</td>
<td>25.8</td>
<td>25.9</td>
</tr>
<tr>
<td>32.5</td>
<td>28.7</td>
<td>27.4</td>
<td>28.4</td>
<td>29.3</td>
</tr>
<tr>
<td>35.0</td>
<td>28.4</td>
<td>29.3</td>
<td>30.2</td>
<td>31.4</td>
</tr>
<tr>
<td>37.8</td>
<td>30.2</td>
<td>31.4</td>
<td>32.6</td>
<td>33.8</td>
</tr>
<tr>
<td>39.5</td>
<td></td>
<td></td>
<td>33.8</td>
<td></td>
</tr>
<tr>
<td>40.5</td>
<td></td>
<td></td>
<td></td>
<td>34.7</td>
</tr>
</tbody>
</table>

Although in animal experimentation, a 12L:12D photoperiod may be ideal, the proportion of light in a L:D cycle apparently can be varied without serious consequences to the animal. The proposed minimum of eight hour/day of light does not preclude increasing the number of light hours in a 24-hour solar day. However, the cited example (page 10901, column 3) of excessive light is argumentative and inadequate. Whether light is excessive depends upon a number of things, including the intensity of the light source, distance of the animal from the source and the physiological or anatomical variable being affected by the light.

One last word about humidity involves the use of a psychrometric chart to illustrate why specifying only dry-bulb temperature and not relative humidity can alter the animal's environment (Table 3). Utilizing a psychrometric chart, it is relatively easy to express thermal conditions in terms of effective temperature (ET). From this, it is clear that an ET can be derived from different combinations of dry-bulb temperature and relative humidity.

Because the proposed rules establish 95°F (35°C) as the maximum temperature for indoor, mobile or traveling facilities, the 30–70% rh range may be inappropriate. For example, Table 4 showed that a dog (beagle) may be physiologically stressed when exposed to 95°F (35°C) and high relative humidity (e.g., 60–70%). At 95°F (35°C) and low relative humidity (e.g., 40%), no "stress" was detected. Nonetheless, the temperature at which the dog is physiologically adapted also is important. Perhaps what is needed is a "comfort index" similar to what has been developed for humans.

Table 4. Frequency (fc) of dogs reaching criterion of 1.1°F increase in rectal temperature in 2 hours or less at various effective temperatures.

<table>
<thead>
<tr>
<th>Dry-bulb temperature (°C)</th>
<th>Effective temperature (°C)</th>
<th>Frequency</th>
<th>Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.5/60</td>
<td>34.7</td>
<td>8</td>
<td>Stress</td>
</tr>
<tr>
<td>39.5/60</td>
<td>33.8</td>
<td>8</td>
<td>Stress</td>
</tr>
<tr>
<td>39.5/50</td>
<td>32.6</td>
<td>8</td>
<td>Stress</td>
</tr>
<tr>
<td>37.8/60</td>
<td>32.8</td>
<td>8</td>
<td>Stress</td>
</tr>
<tr>
<td>37.8/50</td>
<td>31.4</td>
<td>7</td>
<td>Stress</td>
</tr>
<tr>
<td>35.0/70</td>
<td>31.4</td>
<td>6</td>
<td>Stress</td>
</tr>
<tr>
<td>37.8/40</td>
<td>30.2</td>
<td>2</td>
<td>Stress</td>
</tr>
<tr>
<td>35.0/80</td>
<td>30.2</td>
<td>4</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/70</td>
<td>29.3</td>
<td>1</td>
<td>Stress</td>
</tr>
<tr>
<td>35.0/90</td>
<td>28.4</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/60</td>
<td>28.4</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/50</td>
<td>27.4</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/40</td>
<td>26.9</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/30</td>
<td>26.7</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/20</td>
<td>26.1</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>32.2/10</td>
<td>25.3</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>29.4/70</td>
<td>24.6</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>26.7/70</td>
<td>23.9</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>26.7/60</td>
<td>23.2</td>
<td>0</td>
<td>Stress</td>
</tr>
<tr>
<td>26.7/50</td>
<td>21.1</td>
<td>0</td>
<td>Stress</td>
</tr>
</tbody>
</table>

56
Environmental quality described in terms of physical factors. Mass factors include gaseous and particulate contaminants and water vapor. Heat may result from internal occupants (animals and humans), lights, motors, and cage-washing equipment.

The important factor in animal facility ventilation is the cage (or primary enclosure) air exchange rate (Woods, et al., Lab. Anim. Sci. 25(4): 425-433, 1975) which is the product of Room Air Supply Rate expressed in vol/unit time (e.g., liters/sec) and a calculated room coupling coefficient.

The effectiveness of mass dilution of a space is determined by whether the ventilation is "space-coupled" or "supply-coupled." That is, when the primary enclosure is a room, "space-coupled" or "room-coupled" ventilation is effective; when the primary enclosure is a cage (i.e., a space within a space), the effectiveness of cage ventilation is dependent upon the relationship between the room air supply rate and the room coupling coefficient.

With respect to lighting in animal facilities, the proposed rules appear to deal reasonably well with the first two of the three factors associated with light. These are (1) photoperiod, (2) spectrum, and (3) intensity.

It has been recommended elsewhere (Holley et al., Lighting Requirements in Microgravity-Rodents and Nonhuman Primates, NASA Tech Memo 101077, Dec. 1, 1988) that animals should be exposed to light with spectral characteristics similar to sunlight. The question is whether this can be achieved--and effectively evaluated by USDA Inspectors--in animal housing facilities.
EFFECTS OF EXERCISE PROGRAMS
Research Studies in Exercise and Behavior of Dogs

J. Derrell Clark, DVM

I appreciate the opportunity to be here, and I want to commend the Scientists Center for conducting these two very timely conferences.

The topic that I am going to address is assessment of the type of enclosure on exercise of dogs. I have an ongoing NIH funded project on this topic. This is an 18-month study. We have only completed nine months of it, so I can only provide preliminary data with limited results and no conclusions at this point. I was reluctant to present a paper at this conference because the study is only partially complete and it is too early to draw any conclusions. But since it is such a timely topic, and since there is so little research in this area, I consented to present our data.

With this caveat, let me explain my approach to this presentation. I am going to divide it into three parts. Initially, I will provide background, rationale and philosophy on the issue of exercise in dogs. Secondly, I will describe our protocol. Finally, I will report briefly on the early results.

The long-term objective of the types of studies that Dr. Hughes and I are doing is to determine the appropriate balance between optimal well-being of laboratory dogs and confinement systems that are available for housing them. Our general goal is to optimize the care of research dogs within reasonable and practical laboratory conditions. One critical concern in the care of laboratory dogs is allowance for physical exercise. Under normal conditions dogs are highly aerobic; they tend to be mobile and move around. They forage when they are in a feral condition. We know confinement curtails these foraging activities and mobility. At the present time, it is not clear how much exercise is really needed for laboratory dogs.

Initially let me talk about the background, rationale and philosophy of the exercise issue.

Historically, since implementation of the Animal Welfare Act in 1965, the issues of cage space and the necessity for supplemental exercise for dogs confined for use in research and teaching has been controversial and widely discussed. There is a maxim that states that history repeats itself, and I think we are seeing that happening right now. In 1972, the USDA issued a notice of proposed rules requesting information, data, views and arguments from the public as to what standards, if any, should be established with respect to exercise requirements for dogs. So we have already experienced this situation once before in 1972. I can vividly recall us objecting in 1972 because we might have to walk dogs 30 minutes or an hour a day. For a period of time this topic was hotly debated, just as it is now. There were a number of work conferences to gain further information from the public and provide responses to USDA and Congress, just as we are doing now.

Basically there were two categories of responses in 1972. First, there were those who opposed the exercise requirement on the basis that there was no scientific justification for it, and secondly, there were those who favored it on the basis that empirical evidence supports the need for exercise in most breeds of dogs.

What was and still is the basis of these two positions? There is little valid scientific evidence to support the need for supplemental exercise for the health and physiological well-being of dogs. There is even less information
available regarding the effects of cage size and exercise on the behavioral well-being of dogs. Most of the information that we have is either anthropomorphic or anecdotal. We are faced with two positions. What are those two positions? Animal activists and some other members of society contend that dogs should not be kept in cages without some additional opportunity for exercise. They believe that freedom of movement in larger areas is instinctive for dogs and is therefore the humane and proper thing to do. A publication put out by the Animal Welfare Institute in 1979 states that dogs should not be housed in cages. They recommend housing compatible dogs in a room and providing an outdoor area or corridor for a runway. The Animal Welfare Institute also considers large kennel runways or room indoor pens acceptable. In those institutions where dogs must be caged, the animals should be released for exercise twice a day in the largest available space. This position is almost identical to the proposed Animal Welfare Act. This is position one.

Position two, the general position supported by members of the biomedical scientific community, has been that dogs do not need additional exercise beyond the activities that they get in a cage to maintain a normal state of physiological well-being. We believe that additional opportunity for exercise is desirable where possible, but should not be a mandatory requirement under the law unless the need is scientifically proven. Some also argue that forced exercise in large pens, daily walking, or daily removal from cages to pens is too costly.

In the 1970's the USDA did not include an exercise requirement for dogs in the regulations. However, the controversy did not end at that point. Animal activists and others continued to pursue this matter.

In December of 1985 both houses of the Congress passed, and President Reagan signed into law, a Farm Bill which included the amendments to the Animal Welfare Act. Now we are dealing with the proposed regulations.

Some factors that affect exercise have been mentioned today, but since I am giving an overview here let me reiterate them. It is possible that several factors such as source of the animal, cage, behavior, sex, breed and socialization may affect the physiological and behavioral well-being of confined dogs.

Regarding source, in the past a suggested compromise has been that handling should be contingent upon the origin and the background of the dogs. That is, if they were purpose-bred dogs, dogs that had not been accustomed to having their freedom and foraging, then these dogs may not need supplemental exercise, and so maybe it was okay to keep them in a cage. But random source dogs, dogs that had been accustomed to freedom and foraging, should be handled differently because they are not accustomed to a confined environment. Some people associate freedom to roam with exercise. That is the philosophy of this position.

The second factor is age. By conventional wisdom, we all know that young dogs and puppies are far more active than older dogs.

Behavior, breed, and socialization: Some argue that space or size of the primary enclosure is not the determining factor in dog exercise, but that individual behavior is a critical factor. I think conventional wisdom agrees with this. An active dog may get plenty of exercise in a small enclosure. A breed such as terrier or other feisty dog gets plenty of physical exercise even in a small enclosure. Whereas a breed like a hound, a more passive, laid-back breed of dog, will lay around. As Tom Wolfle pointed out this morning, even if you give them five acres, they spend most of their time lying down.

We have heard already, and will hear later from Dr. Hughes' group, that well-socialized dogs are more likely to be active than socially deprived dogs. There are several factors involved with exercise and the impact it has on an animal's well-being.

I am not going to take the time to review the literature on exercise in dogs, but there are less than a dozen references in the literature and some of those are not related to well-being or even related to dogs per se; dogs were just used as a model for exercise in people. There is very little scientific information regarding exercise, but there are a few studies. The consensus of the results that I
have seen so far is that for the most part, caging does not really impact exercise per se in the dogs.

Let me move on now to what we are doing at the University of Georgia. If anyone has any questions regarding some of the previous work that has been done in the scientific literature, we can discuss that later.

The specific goal of the study that we are currently conducting is to evaluate the influence of different confinement conditions on physical fitness in dogs. To reduce as many variables as possible, we used 18 purpose-bred female beagles, as uniform as possible in size, behavior and age. When we started this study they were 9–10 months of age and weighed about 17–20 pounds.

We have six groups of three dogs and conceptually have incorporated the best case scenario down to the worst case. The best case, conceptually, is a 20' x 30' pen on a farm; the second group is housed in outdoor runs, 6' x 20'; there is a group in indoor runs, 4' x 12'. Two groups are in standard cages, 36" x 48"; one of these is simply caged, the second has forced exercise. The worst case, conceptually, is a small cage, 28" x 34". It is less than what is required by the Guide and the Animal Welfare Act.

The rationale for these different confinement conditions is that:

Condition 1) the best case scenario conceptually simulates the housing practices for millions of dogs that are kept as pets. Many backyards or dog pens are no bigger than 20' x 30'. These dogs are kept out on a farm in a very relaxing environment in a 20' x 30' pen, and few people, I believe, would argue that that is not a relatively good environment for the dogs.

Condition 2) the 6' x 20' outdoor run provides 120 square feet with a dog house.

Condition 3) the indoor run provides 48 square feet. There is one difference here. These dogs are totally isolated. This happened to be the type of run that we had available for this study. There is no social contact here.

Condition 4) conventional dog cages are used to cage many dogs in the United States today. One group is caged continually and the other group is caged similarly, but they are exercised five days a week for 30 minutes.

Condition 5) some old cages are used. Some cages we had in storage are about 40 years old. These cages do not meet the USDA or the Guide standards. They provide 6.6 square feet of space.

The dogs remain in these conditions for three months at a time, and then they are rotated to another system so that during the 18 months of the study all the dogs will be housed in all of the conditions. What are the parameters we are measuring? At the end of every three-month period, during the final week, we bring each dog in and condition or train it on the treadmill for 10 minutes a day for four days. Then on the fifth day we do an EKG and measure heart rate for 10 minutes while the dog is on the treadmill. Dogs are anesthetized and we take biopsies of the muscles from the foreleg and one from the rear leg. We then do muscle enzyme studies on those muscle samples.

The primary focus of this study is measurement of heart rate and muscle enzymes. These are measures of physical fitness. We are not measuring overall well-being.

A secondary measurement in this study is plasma cortisol. One of the classic measures of stress/distress is cortisol, so we are determining cortisol levels. We are also doing some behavioral work, since behavior is part of the overall aspect of well-being in animals. We video tape each dog two hours per month, and at the end of the study we will determine if there are any differences in the behavior of the dogs under the different conditions.

Regarding physical fitness, the two parameters we are using are very good measures of physical fitness, whether in people, dogs, or other animals. These are traditional measures that exercise physiologists use. The reduction in submaximal exercise heart rate has commonly been used in dogs as well as the muscle oxidating enzyme capacities. We are measuring succinate dehydrogenase levels. Previous studies show that when you change the environment of a dog, it takes one to two
Effects of Exercise Programs

months for them to develop a steady-state. That is the reason we are using three-month intervals. We are giving dogs ample time to reach a steady-state in the condition in which they are being housed.

Again our results are preliminary. Of the two parameters that we are measuring, heart rate and muscle enzymes, the better measure is the muscle enzyme, succinate dehydrogenase, because it is less labile. As you know, heart rates of animals can change dramatically based on a number of factors. Even though heart rate is a good measure of physical fitness, it is still more labile.

In early results, based on testing of six dogs in each condition, there are no significant differences in succinate dehydrogenase between dogs housed in any of the six conditions.

Regarding heart rate after five to 10 minutes of exercise, there is little significant difference between dogs in any housing condition. There is little benefit to forced exercise or housing in pens. On the other hand, housing in cages appears to have little or no detrimental effect.
Question and Answer Session

Q. Why is succinate dehydrogenase a good measure of physical fitness?

A. Succinate dehydrogenase is one of the enzymes that occurs on the muscle mitochondrial membrane and is used in oxidation or utilization of oxygen. As a person or animal becomes more physically fit they get more mitochondrial surface and thus they have more succinate dehydrogenase. The more succinate dehydrogenase that a person or an animal has, the more physically fit they are and the more oxygen they can utilize. They can produce more energy, and they can exercise longer. It is a very good measure of physical fitness in animals and people.

Q. Do you have any subjective sense of whether there were behavioral differences between the groups?

A. Just a bit. The technicians observed that one or two dogs in the isolated runs behave somewhat differently. If confirmed this would support the idea that dogs are social animals and need to have contact with other animals.

Another interesting observation is that some of these dogs probably have never been outside or been on the ground. When they are taken from cages to the farm environment, one or two of them behaved differently. Within a couple of days the dogs appeared to adapt well and behaved like all the other dogs, which addresses the question that someone asked this morning about changing from one environment to another. I think dogs and most animals do adapt readily. Part of the stress/distress phenomena is that humans and animals can adapt to changing conditions, unless it is so stressful that they then go into distress.

Q. I am interested in the sequence of the change. In other words do the dogs move from one to the other in the same sequence or are they skipped around in some random manner?

A. We were interested in that also in planning our protocol. If one tries to do it randomly with six groups and six conditions, there are many options. To randomly look at all options would require years of study. We decided to simply rotate from group to group in an arbitrary circle or cycle.

Q. Is your study done under extreme winter and summer condition, during all kinds of weather?

A. Yes. Weather is a variable that we do not control in this study. As you can see, there are numerous variables in this study. On the other hand, we believe the study is sufficiently important that it should be done. Conditions are different for laboratory dogs housed throughout the country.

Q. Do you see changes in weight as the dogs go from one condition to another?

A. We are weighing the dogs regularly, but I do not have the data with me. We do not observe much difference in the weight of dogs.
The physiological and behavioral well-being of laboratory animals is of great importance to research scientists, government and animal welfare groups. The new amendments to the Animal Welfare Act (PL 99-189) require that an exercise program be established for dogs. The statutory responsibilities of the program are to be delegated to the attending veterinarian in accordance with general standards promulgated by the Secretary of Agriculture.

Recently, however, APHIS has proposed rules which involve increasing the cage size for individually-housed animals, run-housing for individuals or groups of animals and an exercise release program. Rather than being proposed as fairly general guidelines, these rules establish rigid standards which we may have to adhere to. Part of the difficulty in establishing and interpreting these proposed exercise standards is in defining the type of exercise program that would benefit a dog. Since APHIS has not, as yet, defined exercise or what constitutes an exercise program, we must use a recognized reference, the dictionary. According to Dorland's Medical Dictionary (1981), exercise is "the performance of physical exertion for improvement of health or the correction of physical deformity." Using this definition leaves us with some difficulty. In general, we do not use physically deformed dogs for the great majority of our research programs, so an exercise program need not be designed to correct a deformity that is not present. This then leaves us with improvement of health. The implication is that without some type of exercise program the health of a man or an animal will be adversely affected. What this program should be or how it should be developed to provide an improvement in health is unclear.

Another definition of exercise states that exercise "is the act of bringing into play or realizing an action." In previous studies, it appeared that providing dogs with human contact on a regular basis resulted in movement which appeared more like exercise (Campbell, Hughes, Griffin, et al., 1988). It should be noted that human contact also enhances positive behavioral characteristics and improves handling (Wolfle, 1987). The major problem with this study, as well as other cage space utilization and exercise studies is that the behavioral observations were empirical and subject to investigator bias (Newton, 1972; Namand, Sweeney, Creame, et al., 1975; Hite, Hanson, Bohidar, et al., 1977).

We undertook the present series of studies in an attempt to minimize investigator bias by using a computerized video digitizer system and computer-controlled data acquisition processing unit to accurately quantify the distance a dog moves and how much time it spends moving. A video camera was mounted over the animal's cage or run. A CCTV monitor and time lapse video recorder were used to record the animal's movements. A Videomex III multiple zone motion monitor was used as an image analyzer that allowed rapid real time acquisition and analysis from a video picture processing up to 30 frames per second. The analyzer was operated with an Apple IIe computer. The distance traveled routine compares the present position of an object to its previous position. The minimum distance necessary for the animal to move to be recorded was calibrated to be 10 cm. The distances traveled were recorded hourly, then
Table 1. Average Distance Traveled and Time Moving for Single (sg) and Pair (pr) Housed Beagle Dogs.

<table>
<thead>
<tr>
<th>Cage Size</th>
<th>Distance Total</th>
<th>Time Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 x 1 m - sg.</td>
<td>65± 5.81</td>
<td>4.8± 0.4</td>
</tr>
<tr>
<td>1 x 2 m - sg.</td>
<td>13± 1.8</td>
<td>6.4± 0.4</td>
</tr>
<tr>
<td>1 x 1.5 m - pr.</td>
<td>109± 15</td>
<td>8.8± 0.5</td>
</tr>
<tr>
<td>1 x 2 m - pr.</td>
<td>8.6± 1.0</td>
<td>3.5± 0.2</td>
</tr>
</tbody>
</table>

1 = mean ± SEM

In the first series of studies (Hughes, Campbell, Kenney, 1989), we examined how cage size and pair-housing affect exercise. Four housing plans were examined. For single-housed beagles, we used a standard size cage, 1 x 1 meter, which slightly exceeds APHIS regulations, as well as a cage over twice APHIS standards (this 1 x 2 meter cage would meet proposed APHIS standards). To evaluate how cohabitation affects exercise, a pair of dogs were housed in the same 1 x 2 meter cage (within current APHIS regulations) and in a cage 25 percent smaller than current APHIS/NIH standards, 1 x 1 1/2 meters (NIH, 1985). The idea behind this latter type of cage was that each dog of a pair would have more space than if housed alone, but would have the added benefit of a companion animal. The order of the study and pairing assignments were done randomly.

In the second study, we housed the dogs in an 80 sq. ft. run. They were housed either one, two or three per run. All dogs had been acclimated to the runs for several weeks prior to initiating the study.

In the third study, we attempted to examine how human interaction would affect a dog's exercise when it was housed in a standard 1 x 1 meter cage. In this program, a technician went into the animal room and interacted with each of the dogs, petting, stroking and otherwise playing with the animal in its individual cage for five minutes. The total time the technician was actively in contact with the dog was 30 minutes. This was in addition to normal time spent with the animal and was done in the afternoon during a time that would be associated with the afternoon food and water check. The activity patterns during this time were compared with the same group of animals housed in an identical manner but without the benefit of the additional half-hour of human contact.

In the fourth study an exercise release program was instituted. Each dog was released into an 80 sq. ft. enclosure for 30 minutes per day. The distance traveled and time spent moving were recorded daily for five days. These studies were done in the afternoon.

For all studies, six adult male beagle dogs were used. These had been colony bred and were well acclimated to cage housing and animal facility routines. There was a 12-hour photoperiod, and husbandry practices began at 7:00 am with feeding usually occurring between 7:00-8:00 am. Water was provided ad libitum. All dogs were randomly assigned to the test and were acclimated to a new cage or new housing situation prior to testing.

When comparing standard single-cage with double-cage housing, dogs in the standard single cage spent slightly less time moving—eight percent (4.75 minutes/hour) versus 11 percent (6.75 minutes/hour), but single-housed dogs in a standard cage went significantly further, 55 meters/hour compared to 13 meters/hour for dogs in a double-sized cage (Table 1). In other words, dogs travel a significantly greater distance at a faster speed in a 12-hour day when housed in a single current APHIS/NIH size cage. Total distance traveled is 654 meters in the standard cage. If one were to follow the proposed new APHIS standards for a double-sized cage, the dog would travel only about 20 percent as far (156 meters) during the same 12-hour time period. Doubling the size of the cage thus does not increase or promote exercise.

When two dogs were placed in a 1 x 2 meter cage, exercise did not increase. In fact, a dog housed with a cage mate spent less time moving (42 minutes) and traveled less distance (104 meters) in a day than when housed
Effects of Exercise Programs

Figure 1. A comparison of the activity patterns traveled and percent of time moving of single (SG) and pair (PR) housed dogs in different sized cages. Single dogs housed in a regulation size cage moved a greater distance than either a single dog in a double size cage or a pair of dogs in a regulation size cage. Paired dogs were significantly more active when the cage size was smaller than recommended.

Figure 2. The time a single housed dog spent moving increased when humans were in the area (0700 - 1000 hours) was similar regardless of cage size. Time expressed in military time.

Figure 3. Dogs in pairs show similar patterns in time spent moving. Most activity occurred when humans were in the area. When the light went on in the morning, the pair housed dogs in the 1 x 1.5 m cage spend a significantly greater (p < 0.05) part of the first hour (0400 to 0500 hr) moving than any of the other groups.

Figure 4. The total distance travelled over a 12 hour period.
in the same double-size cage alone. When we reduced the cage size by 25 percent, the distance traveled and the amount of time spent moving increased significantly (p < 0.05). The distance traveled went up more than ten-fold from 104 meters to 1,305 meters per day. In addition, the time spent moving more than doubled to 105 minutes/day.

From this data, it would appear that in order to increase activity (the distance and time spent moving) pair-housing provided little or no benefit (Figure 1). Pair-housing in a cage 25 percent smaller than currently accepted as standard or maintaining dogs singly in the current standard size cage resulted in the greatest amount of movement.

Regardless of the type or size of cage, a similar activity pattern emerged in all groups (Figures 2 & 3). A burst of activity occurred when the lights went on. This was followed by a lower level of activity until the human workforce entered the area. Activity increased markedly when the animal care staff were in the room cleaning, feeding, and checking the animals. The activity then decreased, reaching the daily lows when corresponding human activity in the areas was the lowest, during the lunch hours. After lunch, the activity continued at a low level then increased during afternoon room and animal checks. When the staff vacated the area for the evening, the dogs reduced their level of activity.

Housing dogs in a 80 sq. ft. run produced the highest total level of activity (Figure 4). Dogs traveled over 4,000 meters during a 12-hour day when housed in a run. This is a significantly greater distance than any other type of cage. The percent of time spent moving during that 12-hour period, however, was not greater than in a cage (Figure 5). The dogs still spent very few minutes, less than 45 minutes of the day, moving. The distance
Effects of Exercise Programs

Figure 6.

Distance Travelled by Dogs in a Kennel

![Graph showing distance travelled by dogs in a kennel over time.]

Figure 8.

Mean Distance Travelled in a Pen

![Graph showing mean distance travelled in a pen.]

Figure 7.

Distance Travelled and Percent Time Moving During a 30 Minute Period

![Graph showing distance travelled and percent time moving.]

Size of enclosure = 8ft x 10ft

traveled did not change when dogs were housed singly, in pairs or three per run (Figure 6). Similarly, the time spent moving and the daily variations in activity were the same regardless of how many dogs were in the run or if they were in a cage.

When dogs were released from their cage for exercise, they went 206 meters during the 30-minute release period (Figure 7). The actual time spent moving during that 30 minutes was only about 21 percent or 6.5 minutes. It is interesting to note that the distance traveled and the time spent moving decreased as the dog became acclimated to the release program (Figure 8). During the first day of release the dog traveled 206 meters during 6.7 minutes while by day five it traveled only 151 meters during 4.7 minutes. During the first day of release, travel decreased during each five-minute interval until it reached a baseline at 30 minutes. After five days of daily release, the dog started out at a lower level of activity, went down to a baseline activity level by 10 minutes, and continued at that same low level of activity for the duration of the period.

When we compared the activity during a 30-minute exercise release programs with the
activity in the various types of cages, it is apparent that 30 minutes of exercise still remains a fraction of the distance traveled for a single animal housed in a standard size cage (Figure 9). Even if you were to add the 30 minutes of exercise to the total distance traveled for single-housed or pair-housed animals in a large cage, the total distance traveled still does not approach that of the single-housed animal in a standard cage. The addition of the distance traveled during 30 minutes of exercise release to the distance traveled in standard cages does not equal the distance traveled by a pair of dogs in a reduced size cage. It would appear, therefore, that although releasing the dogs for 30 minutes of activity does provide for some level of exercise, this same activity level is not as great as one might have expected and can be achieved by other means.

Human contact for 30 minutes does not enhance the average distance traveled per hour over a 12-hour day (Figure 10). Dogs with enhanced human contact traveled 8.5 m/hour, while dogs with normal routine care traveled almost 14 m/hour. The greater distance traveled for the dog without the enhanced human contact was primarily during the beginning part of the day. Dogs without extra attention traveled further during the first three house than did the dogs when they had enhanced human contact. Distance traveled during the contact period was essentially identical when the dogs with enhanced human contact (28 meters) were compared to those without enhanced contact (24 meters). The variation in time spent moving did not change, and maximal activity still occurred during the morning hours. There was only a slight increase in the activity time during contact in the dogs with the enhanced contact. They were active for almost seven percent of the 30 minutes, or slightly more than two minutes when contact was increased. With the dogs that had no increase in contact the activity was 4.3 percent of the 30 minutes.

As in the other studies, it is apparent that regardless of the type of housing or care procedures dogs exhibit a daily variation in their activity pattern (Hughes, Campbell, Kenney, 1989). The majority of the dog's activity occurs during the morning hours when there is the greatest amount of human activity in the area. Providing increased human contact will
Effects of Exercise Programs

improve the handling and behavioral characteristics of the dog, but it will not increase the amount of exercise-type activity. Increasing human contact, in fact, reduces the level of activity of the dogs. Dogs that don’t have enhanced human contact may move around the cage more in order to try to attract attention, whereas when they are provided with only a few minutes of individual attention a day their activity pattern decreases. Direct human contact by petting or stroking in a cage does not increase activity.

Conclusion

On the average, only 1/2 to 1-1/2 hours of any 12-hour day is spent in any type of activity regardless of the housing system. Increasing human contact will improve the handling qualities of the dog, but it has little or no effect on the promotion of exercise per se. Cage size has a marked effect on the distance a dog travels. These effects are, however, not what one might have predicted. A pair of dogs in a cage 25 percent smaller than APHIS and NIH standards travel a significantly greater distance than in any other type of cage. A single beagle housed in a standard sized cage travels a greater distance than either that same dog in a cage twice as large or a pair of dogs in the same double-sized cage.

A release for 30 minutes will result in a level of activity over that which may normally be seen during that same period of time without release. However, this effect is dependent upon how the animal was housed prior to that release. That is, if the dog is housed as proposed in the new APHIS standards in a cage twice the current size, the actual total distance the dog would travel in a day would still be significantly less than a dog which was housed in our present standard-size cage.

There is no doubt that a run-type of housing will result in the greatest amount of exercise for an individual or a group of animals. We do, however, have to examine the cost-benefit ratio for the 80 sq. ft. pen. At the present time, approximately 16 dogs can be housed in one over one 1 x 1 meter cages in the same space as a single 80 sq. ft. pen. According to the proposed guidelines, we would be permitted to house five beagle-size dogs in that 80 sq. ft. pen. The requirement for the use of run-type housing would therefore necessitate that we triple our existing dog space in order to maintain research at current levels. We have also shown that dogs are basically lazy. They don’t like to exercise and have no particular inclination to run about an area. There is absolutely no evidence to show that animals suffer in the present size cages (Campbell, Hughes, Griffin, et al., 1988; Hite, Hanson, Bohidar, et al., 1977; Hughes, Campbell, Kenney, 1989). Simply advocating larger cages because it makes a human feel better is not adequate and does not promote exercise. In ethological studies, it has been shown that "...animals in nature that have feed, are warm and are not afraid of predators or are not sexually frustrated, do not exercise. Exercise is an unbiological activity at variance with the law of conservation of energy. Wild animals either play (with each other or by themselves or with appropriate inanimate objects) or they just sleep" (Fox, 1986). Simply increasing cage size does not increase exercise nor does providing enhanced human contact increase exercise; in fact, the reverse is true. Increasing cage and human contact decreases the time and distance a dog moves. However, dogs are interested in people and by providing an additional period of human interaction the handling characteristics will be enhanced. It is only when cage size is reduced below that size that it is standard for two dogs did exercise increase.

Since the standards that APHIS has proposed for exercise will either be very expensive or provide no increase in exercise, I would like to suggest that APHIS re-examine what Congress intended exercise to encompass by re-examining the record of the conferences involved in formulating this statute. In 131, Congressional Record S14178 (Daily Edition, October 25, 1985), Senator Dole stated that all standards including exercise would defer to scientific protocol, thus indicating that exercise programs should be written by the attending veterinarian with only broad, general input from APHIS. Furthermore, concerning exercise standards, Senator Dole
Howard C. Hughes, DVM and Sarah Campbell, BS

felt that exercise "...is intended to include a variety of practical means to allow dogs movement which could include housing in pens or kennels but when dogs are housed in cages, simple removal from the cage during cleaning would be appropriate." (131 Congressional Record S17943, Daily Edition, December 18, 1985).

It is apparent that the proposed regulations will be excessive and expensive to implement. Since all cage sizes used in this study provided ample opportunity for the purpose-bred beagle to exercise, I would suggest that APHIS reconsider these proposed regulations and assign the attending veterinarian the authority to develop a program for their facilities. If it can be demonstrated that the housing system used provides the opportunity to exercise, then additional measures need not be taken. Only where the housing and management program cannot be sure to provide for exercise appropriate with the breed or previous housing should a formal program be considered.

REFERENCES


Question and Answer Session

Q. Was there any attempt to evaluate the nature of the movement of the animals?

A. Yes, we would look at them on the video. For the most part in the morning they would stand at the front of the cage (this was in a run or the cage) and look at the door. They would hear human activity out in the corridor, and then they would run around the cage in a circle. When the humans weren't in the area they would just stand at the door, or they would lie down.

Q. I guess the nature of my question is, is there any indication or any correlation that the smaller the cage size, even though there is more movement, that that movement tends to be stereotypic movement?

A. No. There is no evidence of stereotypic movement in any of those dogs. They have the same general patterns.

Q. Even in the circling?

A. Well it's not really circling. They just use the area to move around in the cage, using the maximum amount of space.

Q. Do you monitor them 24-hours a day?

A. As far as nighttime movement, we do not look at any evening activity. It was computer limited. We had 12 hours of time that we could look at. We felt that dogs basically are animals that move about during the day. We do understand that dogs do move to some degree in the evening.

Q. [inaudible]

A. I don't disagree with that. My feeling is that we were told that we were supposed to exercise dogs. We are not supposed to make them happy, and, unfortunately, that's what we are left with. If they (the USDA) are going to give us performance standards to work with, and exercise is a level of activity, then you have to be able to try and quantify it in some way or another. We found no evidence by observing the videos that dogs were unhappy. Sarah is going to talk about some things like indicators of stress, and that might give you a little better handle on that. We find that, regardless of the type of housing, we have no evidence that the dogs are unhappy.

Q. I have the impression from our colony that socialized dogs were, in fact, much quieter than unsocialized dogs. In some of the wings in the facility there were older dogs that had not been socialized, and they were extremely noisy. You would watch them from a distance and there was a lot of circling, barking and jumping on the wire. In the socialized wings there was some of that, but they were generally much calmer, not so frantic. They would basically sit back while waiting for the feed cart to come. That would certainly belie the fact that a happy dog is, in fact, one that is content with people. If that is happiness, they are less happy.

A. I don't disagree with that. I think in our human contact study we saw that the dogs were less active in the morning when the nor-
mal routine care procedures were taking place. Again, we are looking at activity as a measure of exercise. It is a very difficult thing. And I agree with you. The dogs that exhibit probably the most exercise and run around the very most are the ones that are, as far as purpose-bred animals are concerned, not well socialized. Also, I think that if you look at the pet population, some of the smaller breeds of dogs that are not quite as well socialized, at least not to the veterinarian, tend to be more frenetic. They are the ones that don’t seem to be as well socialized with humans.

Q. It seems to me that human contact is very beneficial.

A. There is no question in my mind that good, positive, human contact, whether it is giving treats or contact, just for a small amount of time on a routine basis, probably does more than a formal exercise program that we or APHIS or anyone else could possibly design. The inclination by the folks who really work with them is that the dogs were easier to handle. They were nicer, except for one dog who used to lift his leg on Marion Abramowitz every time she went into socialize him. He might have been territorial marking at that time.
Effects of Exercise Programs on Serum Biochemical Stress Indicators in Purpose-Bred Beagle Dogs

Sarah A. Campbell, BS

As we all know, the physiological well-being of laboratory animals is an important issue. The new amendments to the Animal Welfare Act require that an exercise program be established for dogs by the attending veterinarian. Such a program must be in accordance with the standards which were discussed earlier today. Part of the difficulty in establishing standards of exercise is defining what type of exercise program is beneficial or detrimental. There are few documented effects of a moderate exercise program on hematology, clinical chemistry, or immunological function in purpose-bred animals. In addition, there is so much interspecies and interbreed variation in exercise that when left alone some dogs, like some people, may or may not exercise.

Another area which is unclear is how to assess the well-being of an animal (well-being is defined as the state of being happy and healthy in The American Heritage Dictionary.) How should the quality of life be measured? It is possible to determine the health of an animal by physical or biochemical examination. But how do you determine if the animal is happy? It is not difficult to argue that if an animal is stressed it’s well-being is also threatened. Yet if the animal is living in a non-stressful, controlled environment it could also be argued that it’s well-being is not threatened. Does the lack of an exercise program in laboratory housed animals have a stressful effect? It was with these questions in mind that a study was designed to evaluate the effects of cage housing both with and without an exercise program on dogs. I would like to point out that this study was designed and completed prior to the new regulations becoming public.

Sixteen purpose-bred male beagles, approximately one year of age, were used. Prior to the start of the study all dogs, which weighed between 11 and 14 kg, received a physical examination, and blood was collected for baseline determinations.

The dogs were randomly sorted into four groups as follows: Group 1 was housed in standard 1m x 1m cages, Group 2 was housed in standard cages with individual exercise, Group 3 was housed in a 1m x 2m run, and Group 4 was maintained in a standard cage with exercise as a group. The run cage was basically two standard cages bolted together with the center divider removed. The dogs were maintained in temperature and humidity controlled rooms. There was a 12-hour light and 12-hour dark cycle. Animal care was completed in the room prior to 8:00 am. The dogs were fed a commercially available diet at 4:00 pm each day. The food was removed from the cages the following morning at 7:00 am. Water was available ad libitum. The dogs in the cage and run-type housing were maintained in a one-way observation room so that observations could be done without disturbing them. The dogs which were exercised either alone or in a group were maintained in a conventional animal room and exercised in another one-way observation room. The observer sat quietly behind the opposite side of the wall. When observing cage-housed animals the cages were positioned towards this wall, so that there would be an unobstructed view of all the dogs. When observing free-roaming dogs the area was divided into four quadrants. The type of activity,
Effects of Exercise Programs

quadrant, and duration of time was noted continuously. All groups were observed for 35 minutes three times per week for type and duration of activity. The amount of exercise was chosen using the assumption that a reasonable exercise program would be similar to a moderate human program of about three times per week. The first five minutes was considered acclimation time and no notes were recorded. Activities included sitting, standing, walking, lying down, running, playing, fighting and mounting. Body weight was recorded on a weekly basis.

Observational data was evaluated by a computerized statistical analysis system (SAS). Statistical analysis included ANOVA to compare each type of activity among the four groups and a paired t-test of each activity between all groups at each time point. In addition, the activities were regrouped into exercise and non-exercise categories. Exercise was defined as running, walking, playing, fighting or mounting and non-exercise was defined as sitting, standing, or lying down.

Blood was collected at approximately the same time each week and analyzed for complete blood count (CBC), serum chemistry (CHEM), serum cortisol, and lymphocyte transformation. Samples collected for serum cortisol were spun down, separated and stored at -70°C for later evaluation. The hematologic data (CBC & CHEM) were sorted and placed in tables by group and test value for each week. Each set of group values was calculated by computer for mean, standard deviation, and standard error of the mean. A comparison was made between groups using the student t-test.

The purpose of the lymphocyte transformation assay was to measure the proliferative response of cells to specific mitogens or culture medium. Lymphocyte proliferation is a sensitive and quantitatively accurate evaluation of T-cell and B-cell function. Five ul of heparinized whole blood was added to microtiter wells containing 100 ul of either CM (control), phytohemagglutinin P (PHA), a mitogen of T-cells, or pokeweed (PWM), a mitogen of B-cells. The microtiter plates were incubated at 37°C and 5 percent CO₂ for 96 hours. Prior to harvesting the cells 10 ul of tritiated thymidine was added to each well. Once harvested the cells were trapped on fiberglass paper disks which were released into scintillation vials. Ten ul of scintillation cocktail was added to each vial and then counted for two minutes in a scintillation counter. Results of the lymphocyte transformation assay were subjected to several statistical computer programs which included between group comparisons using a non-parametric one-way analysis test (Kruskall-Wallis) and within-group analysis using paired t-tests.

Upon completion of the four weeks of exercise the dogs were returned to standard 1m x 1m cages and allowed to reacclimate for a final one week prior to having blood samples collected.

With regard to the results of the study, there were no obvious changes in the behavior or physical appearance of the dogs during the six weeks. Body weights did not vary between any of the groups at any time. The type of cage, whether a standard 1m x 1m cage or a 1m x 2m run, had no significant effect on the length of time the dog spent sitting, standing, or lying down. The dogs which were exercised alone did not perform activities which one would classify traditionally as exercise. That is to say they did not run, play, or move about the area vigorously. When an individual animal was released from his cage he would walk about the exercise area slowly and investigate it for about 90 percent of the time. The dogs which were released as a group were the only animals that performed activities compatible with exercise for the entire time period. Fighting within this group did not occur until the middle of the third week of exercise, when several of the dogs began to show aggressive behavior. This aggressive behavior occurred in the middle of the 30-minute period and lasted for approximately three to five minutes, after which the dogs returned to a more playful state. At no time during group exercise did any of the dogs sustain any injury due to fighting. All dogs, regardless of their group, were observed to move vigorously about their primary enclosure when a handler or an animal care person entered the area for maintenance. At this time, the dogs would
circle about their cages, vocalize, run and jump. When the dogs which were released as a group were being placed in the exercise area, it was noted by that handler that they paid more attention to him than they did to each other.

The type of housing and presence or absence of an exercise program produced no effects in the hematologic and clinical chemistry determinations. There were no significant differences between the groups at any one time point. No changes occurred during the exercise period or when the dogs were returned to a non-exercise state. Similarly, there were no significant effects on the serum cortisol levels (Figure 1). At each week, except week three, the differences between groups is less than 2 ul/dl. Group four appears to have a much higher level of serum cortisol than the other three groups. As I stated earlier, these are the group-exercised animals which had short periods of fighting. Yet when the mean of group four is compared to the mean of each of the other groups, there is no statistical significance.

Another notable point on this figure is that the cortisol levels are lower in all four groups at the last time point. This trend could be attributed to the dogs becoming more familiar with the weekly handling for blood collection.

The mean counts per minute of each group in the lymphocyte transformation assay using PHA was also not statistically significant when comparisons were made between groups (Figure 2). To determine mean counts per minute, you take the counts per minute of a stimulated sample which includes the mitogen, subtract from that the counts per minute of the sample that had the culture medium in it, and divide by the absolute number of lymphocytes for that individual dog.

PHA is a plant substance which stimulates T-cells. Although we see a large increase in the counts per minute for group three, this is due to one animal within that group giving a much higher result. Group three contains the dogs which were housed in 1m x 2m cages. Because of the large standard deviation in this group, there was no statistical significance.

The mean CPM of the PWM assay for B-cell function shows a variable difference be-
Effects of Exercise Programs

tween groups and within groups from week to week (Figure 3). The cause of this is unknown. Again, because of the large standard deviations within the groups when compared statistically, no significant differences were found. You will note that all four groups had an increasing trend in the CPM at the last point on the graph. However, when compared back to baseline and the points during the exercise period this was not significantly different.

![Figure 3](image)

Figure 3. Mean pokeweed mitogen results for each group. Notice an increasing trend in all groups at week 5, which was one week after the exercise period. When compared statistically with the other points, there was no difference at the $P < 0.05$ level. CPM = counts per minute. See Figure 1 for description of groups.

The overall results of this study indicated that there were no significant effects on hematology, clinical chemistry, or indicators of stress produced by a moderate exercise program. Similarly, this study indicated that the type of housing and the complete absence of a formal exercise program had no measurable adverse effects on these same biochemical parameters. These findings correspond to other studies which have evaluated cage activity in purpose-bred beagles. Furthermore, it should be noted that when the exercise program was discontinued the dogs were returned to a cage-type housing environment without developing any clinical signs or biochemical changes indicative of stress. This finding may have important implications for animals used in drug development work which must be housed individually for experimental reasons after having been maintained with an exercise program.

At the conclusion of this study we found that in establishing an exercise program it was not necessary to have the animal released into a specific area to obtain exercise. But simply providing them with an adequate period of human contact will encourage exercise, play and improve handling characteristics of the animals.
Question and Answer Session

Q. How does human contact affect the results of this study?

A. In this study, we didn’t look at human contact as part of the exercise program. The person would observe the animals through a one-way observation wall. So the activity he recorded was with no human being present in the area, either with the group that was exercised alone or the group that was released (the four dogs together). The person would put them in that area and then leave the area and allow them to acclimate for five minutes before he started recording his observations.

Q. [inaudible]

A. Yes, I guess you could in that sense. In this study, when we did the statistical analysis, we only looked at four points that were common for either a cage housed animal or the ones that were released as a group, because an animal in a cage by itself wouldn’t be running and playing or mounting. So that is why we only looked at those four other parameters such as sitting, lying down or walking about the area. And we found no statistical significance.

Q. How did you account for the effects of human handling on cortisol levels?

A. I didn’t really. There were variations between the groups, but all the dogs were handled the same way to have the blood samples collected.

Q. Did you ask the technicians to record any change in behavior during blood collection?

A. Yes, I did ask the technician to note for me if the dog was very difficult to handle for the blood collection, because that would also have affected the B- and T-cell assays. Except for that one dog in group three, most of the other dogs were very good about the blood collection.

Q. I wonder if they were all well socialized?

A. Yes, all of the dogs were received from LRE so they had been through a socialization program. We asked specifically for all dogs to be the exact same age to help cut down on those variables too.

Q. Those are important factors as far as cortisol levels because in order to get a true measure you need it quickly. If you calmly, quietly and quickly go and collect the samples from a dog and take the blood out within 3–5 minutes, you can get a sample that is fairly accurate, as long as there was no previous excitement and the dogs were well socialized. It is important to do the blood collection quickly, because otherwise, although cortisol is used as the classic measure of stress and distress, it is not a very good measure. As a scientific community, we have got to come up with a lot better measures than that as the measure of well-being.
Effects of Exercise Programs

Comment. (another person) I know, it is just that when measuring stress hormones, there is always an impact due to handling. And I think there is a lot of data available now to show that there are impacts. For the most part, we don't know what those impacts are.

Comment. (another person) What we were looking at was a change from normal routine handling to an additional sort of program of socialization, or exercise or what have you, to compare normal routine and we were looking for good, normal research animals.

Comment. (another person) What Andrew is suggesting is that there is a possibility that the cortisol levels that we see are elevated through the collection process.

A. We don't have any reference values for tethered cannulated animals. These values that we reported are less than the normal reference range for dogs, for dogs as a general population.

Q. Samples can be taken very quietly from the adapted animals.

A. Yes, I agree with that. These dogs were used to having blood collected, used to being worked with. Not like a rhesus monkey grabbed out of a cage that naturally gets excited.

Q. [inaudible]

A. Not in this particular study. It was suggested we assess T- and B-cell function instead. I did a literature search for some rat work, and my understanding of the one paper that I read on that is that beta-endorphin and catecholamine are at much steadier levels than the glucocorticoids would be so it would be something to look at in the future.

Q. [inaudible]

A. There wasn't any indication of stress of exercise or caging, no.

Q. [inaudible]

A. The law says that other than petting, stroking, and otherwise fondling isolated dogs, we have to exercise them.

Q. Don't you find that during a 30-minute or longer exercise period that dogs are active for only a short part of that time?

A. I think the results that Dr. Hughes showed in our study where we did put them in an 80 square foot pen for 30 minutes, and tracked the distance they traveled over a five minute period, indicates just what you are saying. They are very active for the first five minutes and then they start to settle down.