Guide to the Care and Use of Experimental Animals, Volume 2 (1984)

IX. DOGS

Please note that the *CCAC Guide to the Care and Use of Experimental Animals*, vol. 2 (1984) is out of date and currently under revision. In the interim, sections of this chapter have been replaced by reference to more recent CCAC publications where available. The sections that have not been replaced should be viewed alongside more recent literature, such as that available on the CCAC Three Rs microsite (http://www.ccac.ca/en/alternatives/species-resources_ressources-especes/dogs_chiens.html), as well as The CVMAs *A Code of Practice for Canadian Kennel Operations* 2nd ed, 2007 (http://canadianveterinarians.net/Documents/Resources/Files/93_Kennel%20Code%20(ENTIRE)%20July%202007.pdf).

A. INTRODUCTION

1. General Characteristics

The dog exhibits a greater variance and range of physical and behavioral types (breeds) than any other domesticated animal. Several hundred true breeding varieties have been developed through centuries of domestication and fanciful selection, in various parts of the world.

Differences in size and conformation between breeds range from the Newfoundland to the Chihuahua (70 kg vs. 2 kg) and those of temperament are almost as divergent. Correlated with size differences will be variances in such physiological parameters as pulse rate (60-80 in large breeds; 90-130 in small) and respiratory rates (ranging from 16 in large to 30 in small animals). Of course, such parameters may also be markedly influenced by physiological (excitement), physical (exertion) and environmental factors.

The domestic dog (*Canis familiaris*) is capable of hybridization with wolf, coyote and jackal (Fox and Bekoff, 1975).

Territorial marking by leg cocking and urination is characteristic of all male canidae and is believed to also serve as a means of communication.

2. Behavior

Numerous behavioral studies on dogs have been undertaken over the past 25 years and there are many comprehensive general reviews of this topic (Fox and Bekoff, 1975; Solarz, 1970; Fox, 1971; Campbell, 1975; Brunner, 1968), as well as analyses of the development of genetic and social behavior in several breeds (Brunner, 1968; Scott and Fuller, 1965).

Socialization is particularly important in the early weeks of the dog's life. It is generally concluded that this period, which extends from approximately the fourth to the twelfth week, is the optimum time for the dog to develop social attachments. If pups are raised in kennels with little human contact during the period of socialization, subsequent training for specialized tasks is generally quite difficult (Fox and Bekoff, 1975; Campbell, 1975).

B. PROCUREMENT

Please refer to the CCAC guidelines on: the procurement of animals used in science (2007, http://www.ccac.ca/Documents/Standards/Guidelines/Procurement.pdf).

C. CONDITIONING

See Section 6 – Receiving Animals in the *CCAC guidelines on: the procurement of animals used in science* (2007, http://www.ccac.ca/Documents/Standards/Guidelines/Procurement.pdf).

1. Advantages

Only properly conditioned dogs should be used for survival experiments. In addition to its value in safeguarding the health of other dogs in the colony, conditioning will result in less variability in both the normal and pathological values obtained from either mongrels or purebred dogs (Secord and Russell, 1973; Pick and Eubank, 1965).

The use of a conditioned dog is also recommended for many non-survival, acute studies. The pathophysiological changes that may be associated with the chronic, low grade infections and poor nutritional status frequently encountered in the unconditioned dog, constitute a totally uncontrolled experimental variable. This may be expected, in many situations, to distort the results obtained and affect repeatability and interpretation.

Regardless of whether the dog is destined for a chronic study or an acute, non-survival experiment, it should always be subjected to a complete and thorough health examination when delivered to the facility.

2. The Initial Examination

Conditioning commences with a thorough examination by a veterinarian or a person competent to recognize the presence of canine infectious or debilitating diseases, including dermatoses and the more obvious physical and behavioral abnormalities. Dogs showing signs of any of the above should be rejected or, if conditions dictate their acceptance, adequate steps should be taken to isolate sick animals and immediately initiate appropriate treatment. A general assessment of the dog's condition and nutritional status should be made and recorded at this time.

3. Records

At the time of acceptance and initial examination of the random source dog, it is essential to establish a proper record for each animal. This should include all details that may be available on its previous history, date of delivery, general condition, findings of the initial examination, immunization and other procedures as implemented, etc.

This record must stay with the dog and be fully maintained up to date, throughout the animal's stay at the research institution, terminating with entries on its disposition (euthanasia).

4. Quarantine

A quarantine period of at least two to three weeks is recommended, except for animals to be used immediately for acute, non-survival, experiments. Quarantine may be considered as the initial phase of the dog's period of conditioning, permitting a more accurate assessment of the dog's health status and the implementation of an appropriate vaccination program. Quarantine will also allow time for the proper identification and treatment of all parasites, including the necessary follow-up treatments to cope with all stages of their life cycles (see parasites, under Health Care).

Certain infectious diseases, such as canine distemper, can be insidious in their onset due to very variable incubation periods and differences in the resistance of individuals. The quarantine period should provide time for such latent infections to become manifest. The quarantine area should be completely separated from the colony area and, insofar as possible, should be self-sustained.

Cages for the quarantine area should be designed to minimize cross-contamination and nose-to-nose contact.

Observations on each animal should be carried out on a daily basis during quarantine, with a complete examination being carried out again at the end of this period.

5. Immunization Program

Regardless of whether a formal quarantine procedure is followed or not, all dogs that are to be conditioned for chronic studies should receive preventive inoculations against canine distemper and infectious canine hepatitis. Vaccination against canine leptospirosis should be undertaken if this disease is endemic and, in some situations it may also be advantageous to vaccinate against canine parainfluenza virus.

Parvovirus vaccines for canine use have been developed (Pollock, 1983; Povey, 1982) and if the disease is prevalent in the area, may, following consultation with a veterinary clinician, be incorporated into the immunization routine (CVMA, 1981). This is particularly advisable where a breeding colony is being maintained.

Anti-rabies vaccination is of benefit in institutionalized and confined dogs, when colony replacements are from randomly acquired animals.

Vaccines specific for each of the above mentioned diseases are available singly or in combination. The vaccination program should be developed in consultation with a veterinary clinician.

6. Miscellaneous Procedures

Further benefits from a conditioning program are that it permits the animal to adjust to laboratory routines, feeding, watering (particularly to automatic watering systems) and handling. The conditioning period will also provide an opportunity to bring the animal's nutritional state to a satisfactory level. This may require vitamin and mineral supplements in addition to good quality food. The need for this is a clinical decision, which should be made by the examining veterinarian.

D. HOUSING

Please refer to Chapter VI Social and Behavioural Requirements of Experimental Animals in the *CCAC Guide to the Care and Use of Experimental Animals*, vol. 1, 2nd ed. (1993, http://www.ccac.ca/Documents/Standards/Guidelines/Experimental_Animals_vol1.pdf).

2. Group Housing

A simple way of adapting existing facilities so that they cater to the nature of the canine, is by releasing compatible groups of dogs into rooms with non-porous floors. Corridors can sometimes be used as indoor runs and, if an outdoor runway can also be provided, these will provide further opportunities for socializing and activity beneficial to the dogs.

Generally, group housing of compatible animals is the least stressful type of confinement for all dogs and, therefore, should be provided wherever possible.

3. Restricted Floor Pens

Floor pens will provide an adequate opportunity for exercise, particularly where they are divided into a holding zone and run. The latter may be either indoor or outdoor. Dogs individually confined for long periods should be housed in these pens, preferably with access, through a hatch, to individual outdoor exercise runs. Runs will, in addition to providing for exercise, permit the dog to defecate outside and, in the case of males, to mark out territory.

Where restricted pens are used for housing or conditioning, the provision of resting platforms (jump boards) is recommended. A heated area of a floor pen, with appropriate drainage away from it, serves the same purpose. It is preferable that jump boards be hinged or removable to facilitate proper kennel cleaning. Proper jump board construction, maintenance and sanitation are important factors in minimizing their possible role in parasite and disease transmission.

It is often possible to hold more than one dog in a restricted floor pen; where size and compatibility permit, this practice is recommended. Dogs are claimed to be happier, less noisy and less destructive if housed in pairs or groups (Hime, 1976).

4. Cages

Dog cages of a variety of designs, sizes, combinations and construction are readily available commercially. Stainless steel is the material of choice for cage construction; however, fibreglass and Formica or Arborite are satisfactory.

Floors of cages should be sloped forward to facilitate cleaning and drainage. The use of a removable floor grid of plastic coated expanded metal facilitates cleaning and appears to lessen the risk of foot problems, particularly for animals that are caged for long periods of time. If a grid floor is not used and no resting board is available, then newspaper bedding (preferably shredded) should be provided. Extra bedding should be given to the chronic subject to prevent or at least retard the development of "capped" hocks and elbows.

The sides or walls of pens and runs should be so designed and constructed as to assure that animals cannot climb or jump from pen to pen, or get over dividers. The pen sides or walls should be "nose and paw proof", to prevent the potential of having the animal bitten by an adjacent dog.

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.

E. NUTRITION

1. Nutrient Requirements

The recommended nutritional standards for research dogs generally accepted in Canada are those given in the (U.S.) National Research Council's "Nutrient Requirements of Dogs and Cats" (U.S. NRC, 2006). Numerous dried and semi-dried dog foods in the form of meal, kibble and patties, are available commercially, as are a variety of canned dog foods. Any of these types of feed, if they are of good quality, may serve as a complete ration.

Combinations may be used to give variety. Most large commercial producers of dog foods prepare products that constitute complete and balanced rations in themselves which, if fed in an appropriate way, are not likely to give rise to nutritional disorders (Kronfeld, 1975). Adding supplements in the way of scraps, etc., will not usually improve the nutritional value of the feed; however, it may increase palatability.

Dietary problems are more often attributable to improper feeding practices than to nutritional inadequacies per se in commercial dog feeds (Kronfeld, 1975; Morris, 1977). Nutrient requirements of dogs have been reviewed in terms of the varying requirements of different phases of the life cycle, and the variability associated with activity levels, environmental changes and physiological state (Sokolowski, 1982).

2. Feeding

Mature dogs normally require feeding only once per day. Puppies from weaning to four months of age should be fed three times daily, then twice daily until mature. Recommendations on daily amount of feed per kilogram of body weight have been published in the NRC Nutrient Requirements (U.S. NRC, 2006) and should be followed for laboratory housed dogs to reduce the likelihood of overfeeding. The time of feeding should be regular and water should always be available *ad lib*.

During pregnancy and lactation, bitches should be fed twice daily and consideration should be given to supplementation, particularly if the quality of the ration is in doubt. It is important to provide a ration with a high net protein availability during gestation.

3. Special Diets

Special diets for use in the management of gastrointestinal, renal and cardiovascular diseases are available commercially. Useful information has been published on the formulation of such diets (Kronfeld, 1975; Morris, 1977).

When research institutions need to raise puppies, it is essential that a good quality diet be fed both to the lactating bitch and to the weanling puppy. Occasionally, puppies may have to be raised separately from their mother. Procedures to follow in such an eventuality have been reviewed (Morris, 1977; Sokolowski, 1982; Degraff, 1980).

Not all commercial dog and puppy foods are of equal quality and there is little doubt, but that some health problems, particularly vitamin and mineral deficiencies such as rickets, may be associated with the feeding of inferior quality foods (Lowe, 1976).

4. Food Related Problems

Dogs may sustain food deprivation for about a week without serious effects. They will, however, become significantly less resistant to stress if their body weight falls to more than 15% below normal.

Coprophagy is a frequent occurrence in kennelled dogs, the actual causes for which are not well-established. A simple means of overcoming the problem is to daily sprinkle a small amount of an unseasoned commercial meat tenderizer over the food (Morris, 1977).

F. BREEDING

1. Colony Management

Breeding stock should be penned separately, as the multiple housing of breeding females is frequently accompanied by pseudopregnancies. Males should be held separately from the females, as housing in the same area usually decreases their libido. The female should be brought to the male's pen (territory) for mating (Fox, 1965).

Bitches should always be allowed to whelp in isolated pens and their whelping cage should be kept at temperatures of 27^{o} to 30^{o}C ($80\text{-}85^{o}$ F) (Harrop, 1960). Disposable whelping cages are available commercially and may prove convenient.

Artificial insemination (AI) may be carried out successfully in dogs, and its use should be considered in special situations, as for example in dogs with bleeding disorders, where its use will avoid hematoma of the penis. AI also facilitates the using of selected males from remote sources (Sweeny, 1977; Kirk, 1970).

The excretion of urine and feces in puppies up until two or three weeks of age usually requires stimulation through maternal licking of the anal and external genital regions. Hand reared puppies will need to be stimulated by periodic stroking over these areas with moist, warm gauze, to facilitate elimination (Degraff, 1980).

2. Estrous Cycle

The bitch has a modified monestrous cycle, with heat occurring twice yearly, most often in early spring and late summer. The estrous cycle consists of four active phases (proestrus, estrus, metestrus, diestrus) and a period of inactivity or rest. The reproductive tract changes that characterize these phases are synchronized with the cyclic secretions of gonadotropic and ovarian hormones.

Proestrus has a duration of eight to ten days, during which the vulva swells and a hemorrhagic discharge occurs. During this stage, males are attracted, but the bitch will not permit coitus.

Estrus, which averages about six days (range four to eight days), is the phase during which the bitch will accept the male and permit coitus. Ovulation normally occurs at about 48 hours into the estrous phase. The hemorrhagic discharge of proestrus will cease and be replaced by a clear, straw coloured exudate as the bitch enters the estrous phase. That a bitch is in estrus and, therefore, ready to accept the male can usually be determined by the fact that she will flip her tail to one side when touched by hand on the back of the pelvis or over the sacrum.

A short metestrous phase occurs at the termination of estrus, lasting for two or three days. During this phase, the vulva returns to normal and after a few days the bitch ceases to attract the male. Diestrus is of approximately two months' duration and, if conception has occurred, will be the period of pregnancy. Anestrus begins at the termination of either diestrus or pregnancy, and lasts for approximately three months, during which time the bitch's reproductive system is comparatively quiescent.

Microscopical examination of vaginal smears may be used to accurately differentiate between the various phases of the estrous cycle, for experimental purposes and in the occasional bitch in which the macroscopical and behavioral signs of heat are unclear. The cytological features that characterize the state of estrus and the stages of the cycle are easily visualized microscopically (Fowler, Felman and Loeb, 1974; Banks, 1981).

3. Parturition

It is important that the signs of pending parturition be recognized, in order to provide the bitch with the privacy she requires, and for assistance in whelping should it become necessary.

One of the earliest signs of parturition in the bitch is the onset of lactation, as milk can usually be expressed from the teats several days prior to whelping.

As parturition approaches, a bitch will usually start to prepare a bed by tearing up paper, or scratching at the floor in a specific area. She will appear restless and may show signs of anxiety such as panting and looking rather apprehensively at her hind quarters.

Immediately prior to the onset of birth, relaxation of the sacrosciatic and sacroiliac ligaments and musculature occurs, giving the hind quarters a sunken appearance. This should be followed shortly by involuntary uterine contractions at decreasing intervals, which will later be assisted by voluntary contractions of the abdominal muscles and diaphragm (Harrop, 1960; Sweeny, 1977; Kirk, 1970).

G. HEALTH CARE

1. General

Subsequent to the initial examination referred to above (Conditioning), regular health examinations should be undertaken on all dogs on long-term experiments. Such animals should be revaccinated annually for canine distemper, canine parainfluenza, rabies and leptospirosis, if the duration of their use is sufficiently long for this to become necessary.

Early recognition of the onset and development of disease in a colony is vital. Animal care and research technicians should be able to recognize the common signs of illness. The following review of some commonly encountered canine health problems and diseases is intended to assist research laboratory workers in recognizing a developing problem and taking the proper initial steps, prior to obtaining professional veterinary assistance.

2. Early Signs of Sickness

A sick animal is less alert and active and responds poorly to sounds or calls. Eyes may appear dull, the coat less glossy.

Most infectious diseases are accompanied by an increase in body temperature. This is often sufficient, at least in the initial period, to cause loss of appetite, as well as a degree of lethargy.

The consistency and colour of the feces may change.

It is important to take cognizance of any animal which "goes off its food", and seems less active than usual. When these signs are noticed, rectal temperatures should be monitored and, if elevated, the animal should be removed from the others for closer observation. When the temperature is being taken, the ocular conjunctiva may also be checked for congestion (reddening) and the respiratory rate noted, as these are further indications of the onset of a febril, often infectious disease.

Professional veterinary advice should be sought if any of the above signs develop and persist for more than a few hours.

The veterinary literature deals extensively with the recognition, prevention and treatment of canine diseases. A few general and specialty references to aspects of canine medicine and surgery that may be of particular interest to investigators using dogs and to animal care personnel have been cited here as sources of more detailed information (Catcott and

Smithcors, 1966; Archibald, 1965; Ormrod, 1966; Evans and deLahunta, 1971; Lin, Liu and Moffitt, 1960; Felson, 1968; Schwartzman and Kral, 1967; Magrane, 1965).

3. Infectious Diseases

The early recognition of canine distemper requires astute observation. Four to seven days following exposure there will be a substantial temperature rise lasting 24-48 hours. The temperature then falls back to near normal for from several days to as long as three weeks. To the casual observer the animal may appear to have recovered. Careful observation and temperature monitoring will, however, reveal signs that the dog is not really well and its temperature will usually be found to persist at about 0.5 degrees above normal throughout. At the end of this latent period, the usual clinical signs associated with canine distemper become manifest (ocular and nasal discharges, gastroenteritis and respiratory impediment). Vaccination, if carried out during the latent period, may precipitate the onset of the second phase of the disease.

A relatively new virus disease entity, which has spread rapidly amongst dogs throughout the world over the past few years, has been characterized as a viral enteritis having a sudden onset of vomiting, followed either by recovery or by collapse and death in from 12 hours to five days. There appears to be no breed or age resistance and deaths occur in dogs ranging from a few weeks to old age. It is generally accepted that a canine parvovirus is the organism primarily responsible for this condition (Povey, 1982) and that a canine coronavirus may also cause a similar viral enteritis (Pollock, 1983). Vaccination programs and, where an outbreak occurs, treatment of this condition, should not be undertaken without proper veterinary advice.

4. Parasites

Random source dogs often harbour a variety of internal parasites, treatment for which should have been an integral part of the quarantine and conditioning procedures.

A fecal examination at any time will ascertain the type and extent of an internal parasite infestation, which, in turn, will dictate the appropriate medication. The more common intestinal parasites are Cestodes (tapeworms), Nematodes (roundworm, hookworm, whipworms), Protozoa (coccidia, giardia, and toxoplasma). No single anthelmintic available at present is totally effective against all types of intestinal parasites that may be found, although such a product may eventually become available.

The incidence of Heartworm disease has been surveyed annually in Canada since 1977 and its prevalence in S.W. Ontario is of concern, as is the apparent increase in cases among animals that have never left Canada (Slocombe and McMillan, 1983). Screening of research dogs for the presence of microfilaria should be considered.

Laboratory procedures for the identification and treatment of the internal parasites of the dog are well-documented (Howard and Matsumoto, 1977; Soifer, 1977).

Toxocara canis infestation is becoming increasingly common, particularly in puppies, due to transplacental migration of the larvae. Toxocara larvae migrate to the lung and are often present in the lungs of newborn puppies. A heavy infestation can cause considerable hemorrhage into the alveoli. Control is difficult and must be based on

regular monitoring by fecal examination in breeding bitches, combined with a treatment regimen which takes into account the life cycle of these parasites. The common anthelmintics are not effective against the larval or egg stages of this parasite, and elimination of toxocara from a colony may be next to impossible once it has become established. There is a zoonotic risk of visceral larva migrans from roundworm infected dogs, of which personnel handling them should be aware (Kornblatt and Schanty, 1980).

External parasites such as fleas, lice and ticks, are particularly common in random source animals and will spread rapidly through a laboratory dog colony. Insecticidal shampoos or dips are probably the best method of control. A variety of agents are available for use on dogs for this purpose which have varying levels of effectiveness and toxicity (Fadox, 1981). Several treatments may be necessary to control an infestation.
Mites (*Demodex*, *Sarcoptes*) are not uncommonly encountered as external parasites in randomly acquired dogs. It is questionable if effective treatment is feasible. Even in relatively light or very early infestations, where treatment of a pet would be warranted, it is advisable that research animals be euthanized, because of the great danger of spread and the uncertainty of a permanent cure. On the other hand, otodectes, ear mites, which are very common, will usually respond well to local therapy (Fadox, 1981).

5. Injuries

From time to time, injuries occur which will range from scraped noses, lacerations and torn nails, to bite wounds. Even fractured limbs may occasionally be encountered.

Injuries, when detected, will require immediate first aid. It should always be remembered that an injured animal will usually be frightened, and that manipulation of the injury may cause pain. Precautions in the form of careful restraint and the application of a muzzle should be taken as an initial step prior to first aid treatment, even though the patient may be known to be docile and friendly.

Profuse hemorrhages should be controlled by direct pressure over the bleeding site and, where necessary, the application of a tourniquet.

Bite wounds should be washed, the hair around the edge of the wound trimmed and any hair in the wound itself picked out. A mild antiseptic solution can then be applied.

Puncture wounds, especially those caused by the bite of another animal, should never be sutured. Lacerations, on the other hand, may be sewn up as long as proper drainage from the wound is provided.

Fractures of the long bones are best handled initially by keeping the animal as quiet as possible. If the dog must be moved, it will be necessary to first immobilize the fracture. Application of a modified Robert-Jones dressing (several thicknesses of absorbent cotton wrapped around the whole limb and held in place by an elastic bandage) is probably the easiest way to accomplish this, until such time as the animal can receive proper, professional attention.

Heat stroke may occasionally occur, particularly in the brachycephalic breeds such as the bulldogs. Attendants should be aware of the signs of impending heat prostration which include excessive panting, a rapid pulse, weakness, vomiting, a very high body temperature (41^{o}C or higher) and injected (purplish) mucous membranes. Immediate

attempts should be made to reduce body temperature through such means as immersion in a cold water bath or hosing down with cold water and the administration of cold water enemas. Once recovered, the animal should be placed in a cool, well-ventilated area.

6. Proper Veterinary Care

Adequate, professional, veterinary care should always be available on an ongoing basis for facilities where dogs are being maintained for research purposes. If a veterinarian is not employed by the institution in an animal care capacity on a full-time basis, it is imperative that a functional part-time or consulting arrangement be established with a local veterinary practitioner.

To make proper use of the veterinary consultant, he or she should be involved in more than just the treatment of diseases as they may occur. He or she should be actively concerned with such matters as the development of conditioning, vaccination and health monitoring programs, as well as in the design of research projects and the screening of protocols to assure the most appropriate veterinary drugs, biologics, anesthesia and surgical procedures, are being used. Adherence to the above principle may serve to save the institution and the researcher from embarrassment and the animals from unnecessary pain and distress.

REFERENCES

ANIMAL WELFARE INSTITUTE. Basic care of experimental animals (5th ed.). Animal Welfare Inst. New York NY, National Research Council (U.S.) 1972. Nutrient Requirements of Dogs. National Academy of Sciences, Washington DC 1970.

ANIMAL WELFARE INSTITUTE. Comfortable quarters for laboratory animals. Animal Welfare Inst., New York NY 1979.

ARCHIBALD, J.A. Canine surgery (5th ed.). American Veterinary Publications, Santa Barbara CA 1965.

BANKS, W.J. Applied veterinary histology. William & Wilkins, Baltimore MD 1981: 549-550.

BEAVER, B.C. Behavioral considerations for laboratory dogs and cats. Compend. Contin. Educ. Pract. Vet. 1981; 3: 212.

BRUNNER, F. Application of behavioral studies in small animal practice. In: Abnormal Behavior in Animals (M.W. Fox, ed.). W.B. Saunders Co., Philadelphia PA, 1968.

CAMPBELL, W.E. Behavior problems in dogs. American Veterinary Publications Inc., Santa Barbara CA, 1975.

CANADIAN GENERAL STANDARDS BOARD. Minimal nutritional, testing, labelling and manufacturing procedure for pet foods. Standards Council of Canada, Ottawa ON 1983: 16.

CANADIAN VETERINARY MEDICAL ASSOCIATION (CVMA). Small animal practice committee Vaccination guidelines for dogs and cats. Can. Vet. J. 1981; 22: 324.

CATCOTT, E.J. and SMITHCORS, J.F. Progress in canine practice. American Veterinary Publications, Santa Barbara CA 1966.

DEGRAFF, S. Care of the orphan puppy (Part II). Compend. Contin. Educ. Anim. Hlth. Tech. 1980; 1: 104.

EVANS, H.E. and deLAHUNTA, A. Miller's guide to the dissection of the dog. W.B. Saunders Co, Philadelphia PA 1971.

FADOX, V.A. Ectoparasites of dog and cat. Comp. Contin. Educ. Pract. Vet. 1981; 3: 292.

FELSON, B., ed. Roentgen techniques in laboratory animals (radiology of the dog and other experimental animals). Committee for the Preparation of a Technical Guide for Roentgen Techniques in Laboratory Animals. W.B. Saunders Co., Philadelphia PA 1968.

FOWLER, E.H., FELDMAN, M.K. and LOEB, W.F. Comparison of histological features of ovarian and uterine tissues with vaginal smears of the bitch. Amer. J. Vet. Res. 1974; 32, 327.

FOX, M.W. Canine behavior. Charles C. Thomas, Springfield IL 1965.

FOX, M.W. Behavior of wolves, dogs and related canids. Jonathan Cape, London UK, 1971.

FOX, M. W. and BEKOFF, M. The behavior of dogs. In: The Behavior of Domestic Animals (3rd ed.) (E.S.E. Hafez, ed.). Baillière Tindall, London UK, 1975: 370-409.

GAINES DOG RESEARCH CENTRE. Basic guide to canine nutrition (4th ed.). General Foods Corp, White Plains NY 1977.

HARROP, A.E. Reproduction in the dog. Ballière, Tindall and Cox. London UK 1960.

HIME, J.M. The dog. In: The UFAW Handbook on the Care and Management of Laboratory Animals (5th ed.). Churchill Livingstone, Edinburgh UK 1976: 311-329.

HITE, M., HANSON, H.M., BOHIDAR, N.R., CONTI, P.A. and MATTIS, P.A. Effect of cage size on patterns of activity and health of beagle dogs. Lab. Anim. Sci. 1977; 27: 60.

HOWARD, E.B. and MATSUMOTO, G. Laboratory procedures. In: Animal Health Technology (2nd ed.) (E.J. Catcott, ed.). American Veterinary Publications, Santa Barbara CA 1977: 227-295.

KIRK, R.W. Dogs in reproduction and breeding techniques for laboratory animals. (E.S.E. Hafez, ed.). Lea and Febiger, Philadelphia PA 1970: 224-236.

KORNBLATT, A.N. and SCHANTY, P.M. Veterinary and public health considerations in canine roundworm control. A survey of practising veterinarians. J. Am. Vet. Med. Assoc. 1980; 177: 1212.

KRONFELD, D.S. Nature and use of commercial dog foods. In: Diet and Disease in Dogs. Univ. of California, Irvine CA, 1975: 20-31.

LIN, R.K.S., LIU, C. and MOFFITT, R.L. A stereotaxic atlas of the dog's brain. Charles C. Thomas, Springfield IL 1960.

LOEW, F.W. Vitamin and mineral supplements: Uses and abuses. In: Diet and Disease in Dogs (D.S. Kronfeld, D.G. Low, eds.). Univ. of California Press, Irvine CA 1976: 75-84.

MAGRANE, W.G. Canine ophthalmology. Lea and Febiger, Philadelphia PA 1965.

MORRIS, M.L., Jr. Index of dietetic management in current veterinary therapy (VI). Small Animal Practice (R.W. Kirk, ed.). W.B. Saunders Co., Philadelphia PA 1977: 59-73.

NATIONAL RESEARCH COUNCIL (U.S.). Animals for Research (1Oth ed.). National Academy of Sciences, Washington DC, 1977.

NEWTON, W.M. An evaluation of the effects of various degrees of long-term confinement on adult beagle dogs. Lab. Anim. Sci. 1972; 22: 860.

ORMROD, A.N. Surgery of the dog and cat. Baillière, Tindall and Carrell, London UK 1966.

PICK, J.R. and EUBANK, J.W. A clinico-pathologic study of heterogeneous dog populations in North Carolina. Lab Anim Care 1965; 15: 11.

POLLOCK, R.V.H. Canine viral enteritis. In: Current Veterinary Therapy (VIII). Small Animal Practice (R.W. Kirk, ed.). W.B. Saunders Co, Philadelphia PA, 1983: 1164-1168.br>

POVEY, C. Development of a vaccine incorporating killed virus of canine origin for the prevention of canine parvovirus infection. Can. Vet. J. 1982; 23: 15.

SCOTT, J.P. and FULLER, J.L. Genetics and social behavior of the dog. University of Chicago Press, Chicago IL, 1965.

SECORD, D.C. and RUSSELL, J.C. A clinical laboratory study of conditioned mongrel dogs and Labrador retrievers. Lab Anim Sci. 1973; 23: 567.

SHWARTZMAN, R.M. and KRAL, F. Atlas of canine feline dermatoses. Lea and Febiger, Philadelphia PA 1967.

SLOCOMBE, J.O.D. and McMILLAN, I. Heartworm in dogs in Canada in 1982. Can. Vet. J. 1983; 24: 227.

SOIFER, F.K. Intestinal parasitism. In: Current Veterinary Therapy (VI). Small Animal Practice (R.W. Kirk, ed.). W.B. Saunders Co., Philadelphia PA 1977: 958-966.

SOKOLOWSKI, J.H. Dietary management of the dog: Nutrition for life. Compend. Contin. Educ. Pract. Vet. 1982; 4: 920.

SOLARZ, A.K. Behavior in the beagle as an experimental dog (A.C Anderson, ed.). Iowa State University Press, Ames IA, 1970: 453-468.

SWEENY, W.T. Veterinary management techniques in canine breeding colonies. In: Current Veterinary Therapy (VI). Small Animal Practice (R.W. Kirk, ed.). W.B. Saunders Co., Philadelphia PA 1977: 54-58.

U.S. Dept. of Health, Education, and Welfare. Proposed veterinary care, space and exercise, and audio visual requirements. U.S. Federal Register 39 (187), 1974: 34420.