



# FALLOUT HAZARDS TO MAN

## Studied Through

### Life-span Tests with Beagles

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Nuclear age needs for knowledge of the potential hazard to man from fallout on food—causing skeletal accumulations of strontium 90 ( $Sr^{90}$ )—are being served by the life-span experiments with 800 beagles underway at the School of Veterinary Medicine, Davis, under the sponsorship of the U. S. Atomic Energy Commission. These tests of low level radiation effects were started in 1957 and final data will not be available for 10 or more years.

Some results to date include indications that pups can discriminate very little against  $Sr^{90}$ , assimilating almost 80% of the amount ingested in milk. Lactating dams discriminate against  $Sr^{90}$  similar to adult dogs, and other species including man (about one-half of the ingested  $Sr^{90}$  is assimilated). Observations of radiation-induced malignant tumors in beagles from ingested  $Sr^{90}$  confirm results of experiments with smaller laboratory animals. Soft tissue cancers seem to occur at an earlier age than do bone tumors. Bone cancer in the beagle during the age of maturity has only been seen in those having high  $Sr^{90}$  body burdens. The lowest cancer producing level of  $Sr^{90}$  in the dog has yet to be determined.

A wide range of incidental information on dog care is also being developed during the testing period. Modern cages have been designed and constructed that eliminate dog odor and offer solutions to many other kenneling problems. Whelping of several hundred litters of beagles indicates that the dam attains full maturity at three years of age. Records also show that about 20% of all pups die before weaning and that two-thirds of these are birth losses. Pups attain puberty between 10 to 12 months of age, which is a growth rate 10 times faster than man.

Outdoor pens for beagles. Paired dogs are placed in each pen for companionship. The pens are 300 sq. ft. in size, asphalt and gravel surfaced, and equipped with dog houses and self waterers. Barrels suspended from an overhead platform provide year around weather protection.





Dog cages for radionuclide treatment. Each 10-sq.-ft. cage has a shatterproof sliding glass front door and sliding partition between cages. Dogs stand on an expanded steel grate above the cage bottom and excreta are washed into a drainage line connecting directly to a disposal system. Air flows from the room through the cage and is exhausted to the outside.

**P**ATHOLOGICAL EFFECTS of  $Sr^{90}$  at relatively high or toxic levels have been well established by previous animal experiments. Both hard and soft tissue malignancies have been produced. However, the biological effects of feeding  $Sr^{90}$  at low levels over extended periods of time have not been thoroughly investigated. Estimation of effects in man necessitates animal experiments since life-span information is required. Information obtained from animals must be related to man with caution, however, because both physical and biological differences exist between species. For this reason, several large-scale and long-term experiments on various species are being conducted in the nation.

This progress report deals with a low-level, life-span radiobiological experiment with dogs being conducted by the School of Veterinary Medicine, University of California, Davis. The beagle was selected as the best breed for these tests because it is moderate in size, medium in length of haircoat, has an even disposition, is accustomed to packs and does not require cosmetic surgery. Such qualities were needed to allow researchers to keep several hundred dogs under experimental conditions and to accumulate data over the period of their life-span.

### Procedure

To simulate fallout as it might affect man, the radionuclide ( $Sr^{90}$ ) is mixed into the experimental diet and fed from the onset of fetal implantation (21 days after breeding) until the dog reaches early maturity (18 months of age). Six different dose levels of  $Sr^{90}$  and a large

group of control dogs are fed at a constant dietary calcium level (1%). In addition, two single intravenous injection levels of  $Sr^{90}$  are included to evaluate possible differences between the route of administration of treatments. Dietary  $Sr^{90}$  levels being used vary from  $1\frac{1}{2}$  times the present maximum radiation protection guide level to that known to be cancer-producing for the dog. A nearly equal number of beagles were placed in a radium ( $Ra^{226}$ ) experiment for comparison with another bone-seeking radionuclide. Information on radium toxicity in humans has and will become available from these tests. True "estimated effects" to be expected in man must also take species differences into consideration, however. Such factors can be obtained from experiments involving different species, where both physical and biological variables exist. Skeletal size of the dog, in relation to absorbed radiation energy, compares more favorably to man than smaller species. The mean life-span of the dog (approximately 10 years) permits time- and dose-dependent after-effects to develop which may not be produced in shorter-lived species.

### Indoor facilities

Continuous feeding of a diet containing  $Sr^{90}$  necessitates rigid safety and experimental control measures. Contaminated food, utensils, dogs and waste products are all potential radiation health problems. Only about 5% of the total amount of  $Sr^{90}$  fed is retained (fixed) in a dog's skeleton. Because almost 95% of the radionuclide fed is excreted by the animals, the duration and quantity of the contamination problem required specially designed indoor cages for pregnancy and pup rearing, as shown in photo.

Methods of determining the  $Sr^{90}$  burden in a living body are available. A whole-body counting facility is in operation, and it is sensitive to low  $Sr^{90}$  body burdens. Physical as well as biophysical problems related to the detection of  $Sr^{90}$  in living bodies at very low levels continue to be explored. Likewise, radioassay of animal hair, deciduous teeth and excreta, which may serve as methods for estimating the  $Sr^{90}$  body burden in living bodies are being investigated.

Bred dams are placed in cages two to

three weeks after mating. Daily feeding of the dam on a specified  $Sr^{90}/Ca$  level is maintained through pregnancy and nursing. After weaning, the pups are kept on the same diet until 18 months of age. Following an additional month on non-radioactive food, the dogs are placed in outdoor pens.

Each cage is cleaned morning and evening with distilled water. A dog is moved into a previously cleaned cage by opening a sliding partition into the adjacent cage. Waste is washed into a rear cage drain which connects directly into a special disposal system. The disposal system concentrates the radionuclide by ion exchange and the expended  $Sr^{90}$ -containing resins are disposed of by off-site burial.

### Outdoor pens

About 80% of the beagles' life-span will be spent in the outdoor pens shown in the photo. Paired dogs are kept in each pen for companionship. A single separating fence between pens provides a social relationship between adjacent paired dogs. The dog houses are wooden barrels suspended from an overhead platform, which also provide weather protection. On excessively hot days, an overhead sprinkler system is used for added cooling.

These outdoor pens have proven to be the most economical method of restraint as well as satisfying the requirements for the general well-being of the beagle. One animal caretaker is required for every 70 dogs on a week-long basis. Dogs kept in outdoor pens over the years have not developed disease epizootics, parasite infestations, accidental deaths or abnormal traits, such as fence jumping.

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