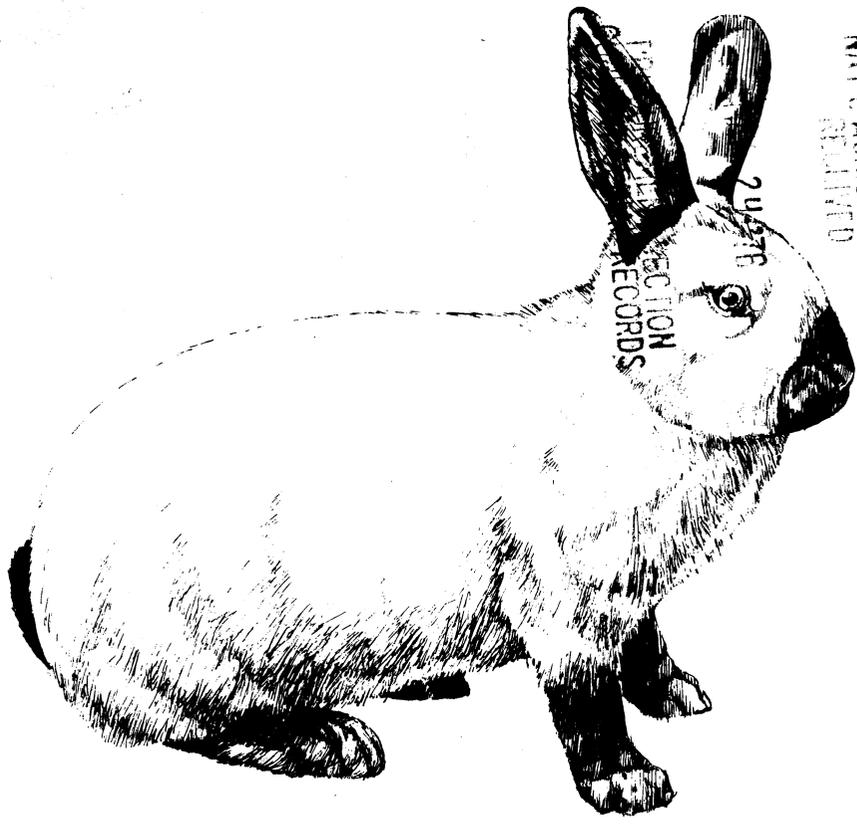


1  
Ag84Ah  
Cop 3

DC BRANCH-D

# DOMESTIC RABBITS: Diseases and Parasites



U.S. DEPT. OF AGRICULTURE  
NATL. AGRI. LIBRARY  
STAMPED

SECTION  
RECORDS



**DOMESTIC RABBITS:  
DISEASES AND PARASITES**

Agriculture Handbook No. 490

Agricultural Research Service  
**UNITED STATES DEPARTMENT OF AGRICULTURE**

Trade names and the names of commercial companies are used in this publication solely to provide specific information. Mention of a trade name or manufacturer does not constitute a guarantee or warranty of the product by the U.S. Department of Agriculture nor an endorsement by the Department over other products not mentioned.

USDA policy does not permit discrimination because of race, color, national origin, sex, or religion. Any person who believes he or she has been discriminated against in any USDA-related activity should write immediately to the Secretary of Agriculture, Washington, D.C. 20250.

Washington, D.C.

Issued February 1976

---

For sale by the Superintendent of Documents, U.S. Government Printing Office

Washington, D.C. 20402—Price 65 cents, Stock Number 001-000-03480-4

Catalog Number A 1. 76:490

## Precautions

Pesticides used improperly can be injurious to man, animals, and plants. Follow the directions and heed all precautions on the labels.

Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides when there is danger of drift, when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment if specified on the container.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly. Have them buried at a sanitary land-fill dump, or crush and bury them in a level, isolated place.

**NOTE:** Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the Federal Environmental Protection Agency, consult your county agricultural agent or State Extension specialist to be sure the intended use is still registered.

# CONTENTS

	<i>Page</i>		<i>Page</i>
Introduction .....	1	Fungal diseases .....	17
Factors in prevention and control	2	Parasitic diseases .....	19
Body soundness and livability	2	Prevention and control .....	19
Adequate nutrition .....	2	External parasites .....	19
Suitable environment .....	2	Internal parasites .....	22
Prevention, eradication, and control of transmissible diseases .....	3	Nutritional diseases .....	26
Sanitation program .....	4	Pregnancy toxemia .....	26
Disinfection .....	5	Vitamin A deficiency .....	27
Practices to maintain health and prevent disease .....	6	Vitamin E deficiency .....	28
Bacterial diseases .....	6	Hereditary diseases .....	28
Pasteurellosis .....	6	Glaucoma .....	28
Listeriosis .....	9	Malocclusion .....	28
Necrobacillosis .....	10	Splay leg and ataxia .....	29
Salmonellosis .....	10	Miscellaneous .....	30
Staphylococcosis .....	11	Mucoid enteritis .....	30
Spirochetosis .....	12	Cannibalism .....	31
Tularemia .....	13	Heat prostration .....	31
Tyzzer's disease .....	13	Broken back .....	31
Viral diseases .....	14	Sore hocks .....	32
Myxomatosis .....	14	Milkweed poisoning .....	33
Rabbit pox .....	15	Tumors .....	34
Fibroma .....	15	Fur eating and hairballs .....	34
Herpes virus .....	15	Coprophagy .....	34
Rabbit papilloma .....	16	Yellow fat .....	35
Oral papilloma .....	17	How to pack and ship specimens for laboratory diagnosis .....	35
		Shipping dead animals .....	35
		Accompanying information .....	36

# DOMESTIC RABBITS: DISEASES AND PARASITES

By K. W. HAGEN,<sup>1</sup> *bacteriologist*, and J. R. GORHAM, *veterinarian, Western Region, Agricultural Research Service, Pullman, Wash.*, and R. E. FLATT, *veterinarian, Department of Veterinary Pathology, Iowa State University, Ames, Iowa*

## INTRODUCTION

Domestication of the European rabbit probably occurred in monasteries during the Middle Ages. By the middle of the 17th century, rabbits were commonly raised in England and continental Europe. *Oryctolagus cuniculus*, one of the more successful mammals of the world, is both prolific and adaptable.

Most of the fancy breeds were developed within the last 100 years, and only since the 1900's has domestic rabbit raising been accomplished in the United States. The first commercial colonies were started in southern California. Meat rationing during World War II gave the infant industry a push. Today, approximately 200,000 people are engaged in some phase of the rabbit business, and animals are produced in almost every State. Meat processors, serving major cities, market more than 10 million

pounds annually. In medical research, more than 900,000 animals per year are used for pharmaceutical and vaccine testing. Over the years, the breeds have been improved from the long, rangy, low-meat-yield type to the compact, blocky animal of today. Production has increased from less than 65 pounds of meat per year per doe to a minimum of 120 pounds per doe, and 200 pounds per doe is not unlikely for the future. Feed required to produce 1 pound of meat has been reduced from about 6 pounds to 3.5 or 4 pounds.

This publication, based on years of research by Federal and State agencies, will provide a useful reference manual for rabbit growers. It is designed to help ranchers recognize the more common rabbit diseases and to know when professional advice is needed. It is not meant to encourage rabbit growers to diagnose and treat diseased animals without the advice of a veterinarian. There is always the pos-

---

<sup>1</sup> Deceased.

sibility that an animal may be suffering from two or more diseases at one time.

Diseases are classified according

to major cause—bacterial, viral, nutritional, hereditary, fungal, and miscellaneous, including poisoning, tumors, and vices.

## FACTORS IN PREVENTION AND CONTROL

The only rabbit that will return a profit to its owner is a healthy one. Factors conducive to good health include:

- Body soundness and livability
- Adequate nutrition
- Suitable environment
- Prevention, eradication, and control of transmissible diseases

### Body Soundness and Livability

Sound, vigorous rabbits are necessary both as quality meat products and as replacement stock. The background of animals saved for breeding should be examined carefully so that recognizable defects will not be perpetuated. A healthy, mature breeder, that has a history of several litters showing fast development, good reproduction, high livability of the young, and relative freedom from disease, is a better source of replacement stock than a rabbit that has not shown these traits. Healthy, well-framed, well-fleshed mature does producing litters containing from 8 to 12 live young, with low mortality in fryers, good feed conversion, and high weights, should be marked as potential sources of breeding stock.

Each individual selected for breeding should be carefully examined for defects and for general health. Deviations from normal should lead to elimination. Through rigid exercise of this practice, a profitable, high-producing herd can be established.

### Adequate Nutrition

The simplest diet sustaining good health, growth, and reproduction is preferred. Decline in normal health may increase susceptibility to disease agents and cause heavy monetary loss. Slow growth and development may be as costly as disease mortality. Finally, the rabbit must be more than just healthy; it must reproduce and raise young profitably.

### Suitable Environment

The term "environment" includes every factor that influences the life of the rabbit. Some of these factors are hutch size and location, nearness to other animals, dryness, temperature, amount of sunshine, shelter design, availability of water, and general management. Careful examination and control of the environment are essential for effective disease prevention.

## Prevention, Eradication, and Control of Transmissible Diseases

If disease prevention has failed and transmissible diseases are established in the rabbitry, heavy mortality may lead to business failure. Pasteurellosis, ear mange, and coccidiosis are diseases commonly experienced by some growers. These infectious diseases are usually introduced in two ways, by contact or by mechanical carriers.

The adult rabbit is the most important contact carrier. An animal may apparently recover from a disease, but still shed infectious organisms in the feces, urine, or in droplets exhaled while breathing. Pasteurellosis and liver coccidiosis are important diseases spread by contact. The grower who introduces new stock directly to his herd or who exhibits animals at shows and fairs is most susceptible to disease outbreaks. New or exhibition animals should be held in a special isolation section of the colony until the rancher is reasonably certain that they are disease free.

Rabbits that are carriers of disease are often not recognized because they appear healthy. Tests to pinpoint which animals are carriers are not always practicable. Liver coccidiosis is found when the fryer is dressed out for market, too late for traceback to the doe that produced it. Bacterial cultures of the nasal cavity may show the presence of pasteurellosis, but the cost of these tests usually prohibits

the grower from utilizing them.

When disease prevention has failed, we must consider the means available to control and eliminate the disease. When liver coccidiosis is involved, the adult carrier may be freed from infection by chemotherapy, plus the establishment of improved management practices. In some cases, it may be necessary to depopulate to eliminate a disease. The time between depopulation and repopulation with clean, healthy animals depends on many factors. Environment plays an important part in the time interval involved.

Mechanical transmission of disease occurs when the infectious agent is accidentally carried from place to place. Man is the chief offender. The grower who treats a sick animal and then moves on to check or count newborn young can be an important carrier of respiratory infection and coccidiosis. Feed salesmen, servicemen, and pickup buyers and visitors who have made the rounds of other rabbitries may be sources of infection. The grower himself should avoid visiting other rabbitries if disease is known to be present. These examples may be considered extreme, yet they happen repeatedly and are definite factors in introduction of disease. Dogs, cats, birds, and rodents have been incriminated in carrying diseases to rabbits and should be kept out of the rabbitry. Insects also should be controlled.

### Sanitation Program

A constant sanitation program is an important part of disease prevention. A program of cleanliness is required to establish and maintain a safe environment in which animals can live and reproduce. Elimination of disease carriers is most important.

Environmental factors must be considered in any sanitation program. Particularly important is the proper type of hutch and shelter construction and its maintenance (fig. 1). The ease of cleaning, the supply of clean water, and the space for rodent-proof feed storage are important items when building a production unit. Proper

drainage is another factor. Provision should be made for water runoff from the rabbitry area. Hutches should be constructed so that individual units may be removed for disinfecting. The number of animals per unit should be adjusted to the area and the environment. Overcrowding requires more effort to keep the area clean, dry, and well ventilated. Unfavorable environmental factors lower the animal's resistance to disease and facilitate the spread of infection.

Water should be fresh, clean, and protected from contamination by urine, fecal matter, and feeds. Cleaning water containers frequently is important.



PN-4324

FIGURE 1.—Shed construction suitable for mild climates.

Feed may act as a mechanical carrier for infection when contaminated with feces. Protecting the feed from contamination by the use of properly designed and well-constructed feed hoppers is necessary in any good sanitary program. All feeders should be cleaned periodically.

Good feed utilization and waste removal are important in disease prevention. Feed scattered about the rabbitry attracts insects, mice, rats, and birds—all potential carriers of disease. Proper storage of bulk feed will aid the sanitation program. In the small rabbitry or where large quantities of bulk feed are not stored, metal garbage cans with tight lids are good feed-storage containers.

### Disinfection

Disinfection refers to the killing of infectious agents such as bacteria, viruses, and parasites. To facilitate the use of disinfectants, all equipment and other construction should be as simple and easy to clean as possible.

Fecal matter and other organic material protect disease-producing bacteria, viruses, and parasites and nullify the effectiveness of even the most efficient disinfectants. Thorough scraping and washing should precede disinfection. One compound should act as both cleanser and disinfectant.

In the routine cleaning and disinfecting of pens and sheds in a small rabbitry, ordinary lye solution is effective and economical.

One 13-ounce can of lye is enough to make 15 gallons of cleaning and disinfecting solution. For large ranches, it is advisable to buy the lye in the form of caustic soda. Each pound makes about 20 gallons of solution, which does not need to be heated although heating is advisable. In addition to acting as a disinfectant, lye cuts grease and partly dissolves and penetrates fecal material.

Use of lye has some disadvantages. Concentrated lye is a poison and is destructive to aluminum paints and clothing. The lye may be slightly irritating to the hands and face of the operator. Consequently, take precautions to avoid excessive exposure of the skin during the disinfecting process. Keep containers of lye tightly covered.

Some ranchers use steam under pressure to clean and disinfect pens and equipment. When steam is used, caked fecal material should first be soaked with water. Use of a good cleansing compound, followed by steam, cleans and disinfects very satisfactorily.

Sunlight is a potent disinfectant if the equipment is very clean and sufficient exposure time is allowed. A cement slab exposed to the direct rays of the sun is a good place to disinfect movable equipment. Dry heat in the form of a flame is effective as long as the flame is in direct contact with the infectious agent. Care must be taken as this procedure is a fire hazard.

## Practices to Maintain Health and Prevent Disease

The successful grower observes good sanitation and management, feeds an adequate diet of simple ingredients, and gives the animals plenty of fresh water.

Daily inspection of all animals in the herd is important. When sick rabbits are first noticed, the grower should immediately try to determine the cause. The following course of action is suggested:

1. Mark or note pens that contain sick animals.

2. Isolate sick animals. It is best if they can be kept in rooms or buildings separate from healthy rabbits.

3. Care for the sick animal *only after all other rabbits in the herd*

*have been cared for* to prevent carrying infection from sick to healthy rabbits. Be sure to wash hands and disinfect boots after caring for sick animals. Clean and disinfect any equipment moved from the area of sick animals to the clean animals.

4. If the cause of the trouble cannot be quickly determined, a few typically sick rabbits should be sent to a diagnostic laboratory.

5. Destroy all hopelessly sick animals, and bury or burn all dead animals. Open pits are not recommended.

6. Clean and disinfect all pens before placing new rabbits in them. Use a 2-percent lye solution (1 pound of lye to 5½ gallons of water). The solution is effective against most viruses and bacteria.

## BACTERIAL DISEASES

### Pasteurellosis

Pasteurellosis is the designation for all diseases associated with *Pasteurella multocida*. The disease manifestations are varied and include snuffles, pneumonia, pyometra, orchitis, otitis media, conjunctivitis, subcutaneous abscesses, and septicemia.

#### SNUFFLES

The mucous membranes of the nasal sinuses become infected by bacteria in the inspired air or by direct contact with infected animals or contaminated objects. The

clinical disease is characterized by a catarrhal (mucus or pus) nasal discharge (fig. 2). The extent to which the infection spreads into the lower respiratory passages depends on the virulence (invasiveness) of the bacteria and the susceptibility of the animal. If the disease is confined to the upper passages, the first signs are sneezing followed by a nasal discharge. The inner aspects of the rabbits forepaws may be caked with exudate because of attempts to wipe the exudate away from the nose. *Pasteurella* bacteria sometimes are found in the nasal sinuses of healthy-appearing rab-

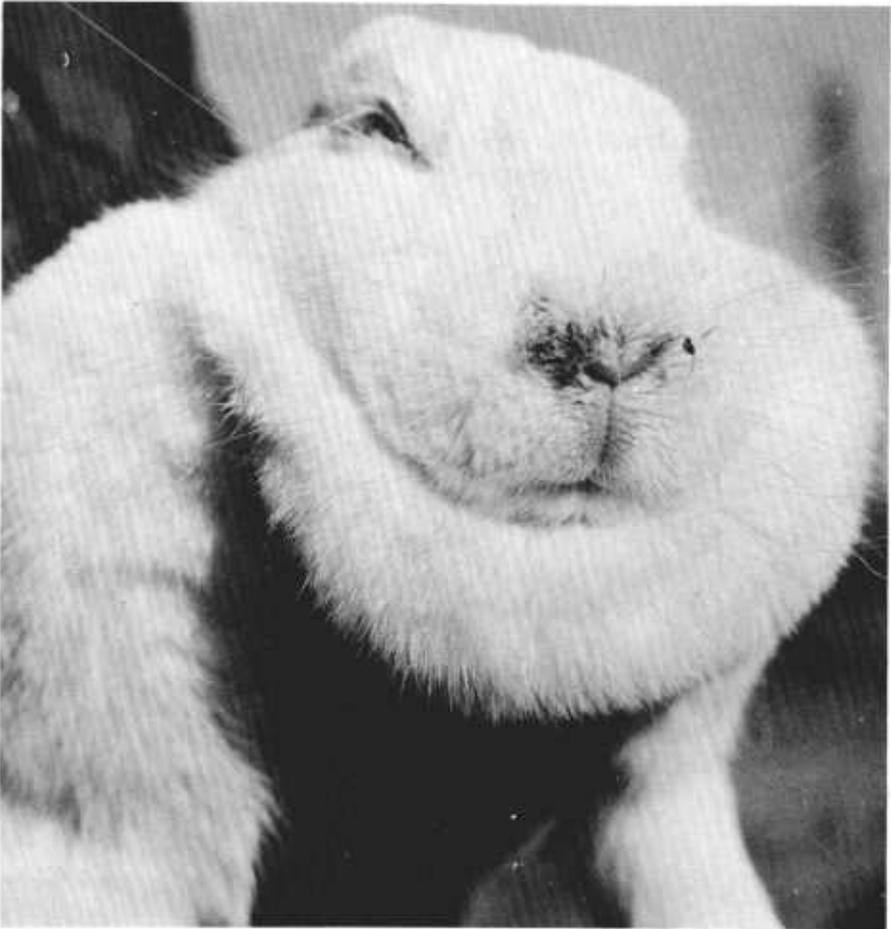
bits. Stress resulting from extremes of temperature, high humidity, pregnancy, and lactation is a primary factor in the development of snuffles.

#### **PNEUMONIA**

Upper respiratory disease (snuffles) may spread to the lungs and cause pneumonia. Rabbit mortality surveys reveal pneumonia to be present in 25 percent of the animals

examined; it is the greatest single cause of death in mature animals. Signs of pneumonia are depression, labored breathing, bluish eye color in albinos, and a nasal discharge. The body temperature is usually above normal.

Gross lesions of the lungs appear as red consolidated areas, sunken purple areas, and abscesses. The consolidated lesions are most often in the anterior lobes of the lungs



PN-4325

**FIGURE 2.**—Adult showing signs of snuffles. Note discharge from nose.

(fig. 3). A catarrhal exudate is found in the air passages. Abscesses appear with thin fibrous capsules close to the surface of the lungs. Sometimes there are adhesions between the wall of the chest cavity and the lungs. Good ventilation without drafts, low humidity, and treatment with antibiotics are recommended. *Pasteurella* organisms are sensitive to oxytetracyclines, streptomycin, sulfaquinoxaline, and furazolidone.

### PYOMETRA

Pyometra means pus in the uterus. The walls of the uterus usually are dilated, and the organ is filled with pus. Affected females will not reproduce and, therefore,



PN-4326

FIGURE 3.—Gross appearance of rabbit lungs, showing consolidation due to *Pasteurella* bacteria.

are culled and often slaughtered. Pyometra results from the introduction of *Pasteurella* bacteria into the uterus during mating and may be traced to a single buck with a chronic infection of the testicles. Treatment of pyometra is seldom attempted because the disease is usually not noticed until the female is slaughtered. Successful treatment is unlikely.

### ORCHITIS

Orchitis is an infection of the testicles of a buck. The testicle becomes enlarged and contains an abscess. Pus can be seen when the testicle is cut open. Sometimes infection is limited to the membranes covering the penis, and this is called balanoposthitis. Balanoposthitis appears as a reddening and swelling of the membrane covering the penis, and a white exudate (pus) is present on these membranes. As described above, the infection is transmitted to does by infected bucks during breeding. Treatment is seldom attempted; however, balanoposthitis may be treated by applying antibiotic ointment containing penicillin to the penis.

### OTITIS MEDIA

Middle ear infection of one or both ears causes filling of the tympanic cavity with a purulent exudate. If the process spreads to the inner ear, the equilibrium of the animal is disturbed, and head tilt or wryneck results (fig. 4). Although the *Pasteurella* organism is



PN-4327

FIGURE 4.—Wryneck resulting from a middle ear infection.

sensitive to certain antibiotics, treatment is generally not effective because of the isolated location of the infection.

#### CONJUNCTIVITIS

Conjunctivitis, or weepy eye, is infection of the membranes that cover the surface of the eye and the inner part of the eyelids. The eyelids are swollen, and white exudate may cover the eye and surrounding fur (fig. 5). Infection of the eye usually occurs as a result of extension of the infection from the nasal cavity (snuffles). Antibiotic ophthalmic ointment containing penicillin is used to treat this form of the disease.

#### SUBCUTANEOUS ABSCESESSES

*Pasteurella* may cause abscesses in many organs, but abscesses are especially evident when they occur in the subcutaneous tissue. These appear as soft swellings under the skin. Treatment consists of opening

and draining of the abscess and applying antibiotic ointment.

#### SEPTICEMIA

This disease is usually an overwhelming blood stream infection of short duration without clinical signs. Tissue changes are limited to a few hemorrhagic areas on the heart and pericardium, swelling of the spleen, and slight congestion of the upper digestive tract. The lack of clinical signs and short duration do not allow time for suitable treatment.

#### Listeriosis

*Listeria monocytogenes* causes a septicemic infection in young animals, a meningo-encephalitis in adults, and metritis and fetal mortality in pregnant does.



PN-4328

FIGURE 5.—Conjunctivitis (weepy eye) caused by *Pasteurella* infection.

In septicemia, death can be sudden and without previous illness. Generally the rabbit is depressed, weak, has a nasal discharge, and may have convulsions. Nervous signs include incoordination, loss of equilibrium, and rolling movements. These signs may persist for several days or weeks, and complete recovery is rare. Sick pregnant animals have a purulent metritis, lose weight, and may abort. Survivors generally are useless for breeding because of uterine damage and pyometra (pus within the uterus).

The most consistent lesion at necropsy is liver necrosis. The lesions consist of a few pinpoint foci to almost complete studding of the liver. The mesenteric lymph nodes may be enlarged and reddened. In cases of metritis, the uterine wall is thickened, the mucous membrane may be covered with a grayish exudate, and the fetuses are decomposed or mummified. When infected fetuses are retained in the uterus, a severe metritis develops.

Due to their tolerance by the rabbit and specific action, antibiotics of the tetracycline group are the best drugs for treating listeriosis. Therapy should be started early with adequate dosages. Penicillin and erythromycin are also used. In treating pregnant rabbits, antibiotics probably will not prevent fetal death, and females saved by antibiotics may be sterile as a result of the infection. The most effective prevention of losses is immediate isolation of diseased

pregnant animals. Pregnant females and those does that have recently delivered young are most susceptible. Males and nonpregnant females rarely contract listeriosis by the oral route.

## Necrobacillosis

*Fusobacterium necrophorum* in farm animals is considered a secondary invader rather than a primary cause of disease.

Lesions first appear on the lower lip, which becomes swollen, purplish, and painful to the touch. Later, small abscesses are seen that contain a thick, purulent material. These abscesses are enclosed in a tough, fibrous capsule, with little tendency to rupture and drain. When the liver and lungs become involved, the animal becomes emaciated and dies after several weeks.

When the disease is recognized and treated in its early stages, recovery is usual; when there is extensive ulceration and abscessation, death ensues. The organism is sensitive to penicillin.

## Salmonellosis

Naturally occurring *Salmonella typhimurium* infections are uncommon in domestic rabbits. Salmonella organisms are easily spread by fecal contamination, and a single infected animal can quickly infect a whole colony. Rabbits can also become infected by human caretakers as the salmonella bacteria occur in humans as well.

Infection usually takes place by the oral route, and signs appear after 3 to 6 days. The first signs are listlessness, ruffled haircoat, loss of appetite, and diarrhea. Later, the respiration rate increases, and body temperature may rise. In the acute form, the disease progresses rapidly to death, whereas in the chronic form there may be no signs of illness other than a transient diarrhea.

The most prominent lesions found at necropsy are in the liver, spleen, mesenteric lymph nodes, lungs, and intestine. Hemorrhagic and ulcerative changes are present in the intestine. The liver and spleen are usually enlarged and contain pinpoint, pale areas of necrosis. The lymph nodes may be soft, hemorrhagic, and enlarged. Surviving rabbits become carriers and may shed bacteria in their feces intermittently for a long time.

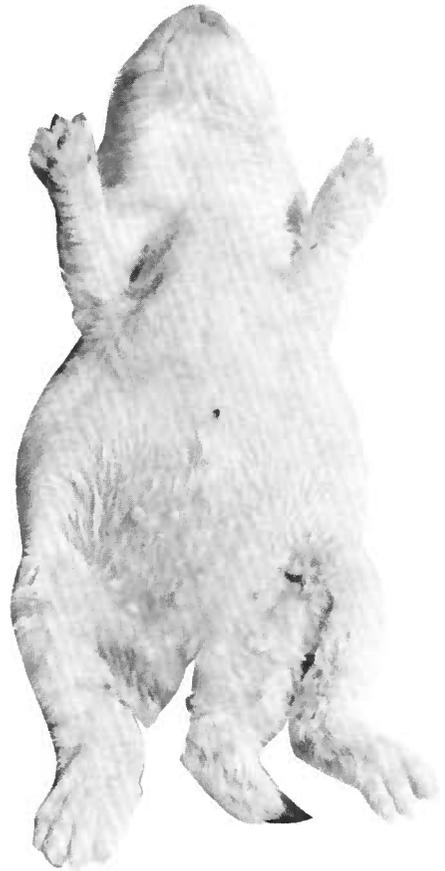
Streptomycin and nitrofurazone have been used effectively against salmonella. Animals treated with chlortetracycline respond to the medication, but may continue to excrete organisms in their feces long after treatment. Pigeons, sparrows, and wild rodents have been shown to be reservoirs of salmonella. Feed and bedding should be stored so as to protect them from these possible carriers.

### Staphylococcosis

*Staphylococcus aureus* causes septicemic infections as well as abscesses in numerous organs in-

cluding the subcutaneous tissue, lungs, kidneys, and heart. This organism is especially known for causing infection in the breasts of nursing does. The breasts become swollen, hot, and may become bluish accounting for the name blue-breast that is sometimes used.

Cutaneous lesions in young animals appear as small abscesses and later develop into firm caseous nodules (fig. 6). These abscesses are



PN-4329

FIGURE 6.—Cutaneous abscesses on young rabbit caused by *Staphylococcus*.

usually found on the lower abdomen, on the inner aspects of the forelegs, and on the lower jaw. Small white nodules may also be found in the lungs and heart. The staphylococcus organism may also cause bronchopneumonia. The lungs appear consolidated with numerous necrotic lesions. The bronchi and trachea may contain a mucopurulent exudate.

Bacteria enter the skin through broken or abraded areas following birth; transmission occurs from mother to young. Staphylococci live in the nasal passages of rabbits, and the close contact associated with kindling (birth) and nursing offers opportunities for both direct contact and aerosol transmission.

Mastitis results from invasion of the milk glands by the disease-producing bacteria. The glands and teats become red and swollen and may advance to blue-black tissues, which are feverish to the touch. The doe may refuse to nurse her young and generally loses her appetite. Young from does with mastitis should not be fostered out to other nursing does because the disease will be transmitted to the doe. Mastitis may also result from abrasions to the teats or insufficient removal of milk when too few young are left with the doe or when the young are weaned too soon.

Staphylococci may be sensitive to several antibiotics including penicillin, tetracyclines, streptomycin, and furadantin; however, some strains of the organism are resistant to one or more of these

drugs, and laboratory tests may be necessary to determine which drugs should be used.

### Spirochetosis

Spirochetosis, sometimes called "vent disease" or rabbit syphilis, is caused by *Treponema cuniculi*. The term "rabbit syphilis" is erroneous and creates confusion with experimental human syphilis in rabbits.

Lesions of spirochetosis may resemble those of injury, fungal infection, and ectoparasites. A correct diagnosis is important since the disease is transmitted by breeding, and an isolated case may lead to an outbreak among the breeding stock. Exchange of infected bucks may spread the infection among colonies. The first signs are usually small blisters around the external sex organs. Lesions involving the nose, mouth, and ears also occur in both sexes. They are irregular in shape, tan-brown, and either edematous or dry and scaly. Sometimes weeping, coalescing vesicles are found. Facial and other lesions are usually secondary and the result of reinfection by contact with genital-anal lesions when the animal cleans itself. All lesions show many spirochetes by special microscopic (dark-field) examination. Old lesions heal completely without scarring, but recovered rabbits are susceptible to later infection.

Small raw areas around the external genitals and vent caused by irritation from urine or wet hutch floors are frequently confused with *T. cuniculi* infections. These areas

enlarge, coalesce, and may become purulent, but when covered with a crust these cases may be mistaken for true vent disease. A positive diagnosis can be made by a microscopic examination of the lesions.

The spread of spirochetosis can be prevented by examining the genitals of both sexes before mating and by eliminating rabbits with lesions. The organism is sensitive to arsenicals and penicillin. A single intramuscular injection of 100,000 units of penicillin is the recommended treatment.

### Tularemia

Tularemia, sometimes called rabbit fever or deer fly fever, is an infectious disease of wild animals and man that is caused by *Francisella tularensis*. Tularemia can be carried by many wild and domestic animals, certain birds, deer flies, and ticks. It is an important malady of wild rabbits, not the domestic ranch-raised rabbit.

Infected wild rabbits appear sluggish in movement and are visibly sick. Yellow or white spots on the liver or spleen are common lesions. Diagnosis is made by bacterial cultures of suspect lesions. Domestic rabbits are susceptible to infection with this organism under laboratory conditions, but the disease has not been reported naturally occurring in commercial rabbitries.

### Tyzzler's Disease

Tyzzler's disease was first described in Japanese waltzing mice,

but since has been found in a variety of animals, including rabbits. *Bacillus piliformis* is the causative organism.

Signs of the acute form seen in weanling animals are diarrhea, listlessness, lack of appetite, and dehydration, followed by death in 72 hours. Lesions include necrosis in the wall of the cecum and focal necrosis in the liver and heart (fig. 7). The organisms are found in cells near necrotic areas, and the demonstration of typical bacteria within the cell is essential to diagnosis. Animals surviving the acute stage may progress to adulthood, but fail to grow at the normal rate.

Transmission of Tyzzler's disease is by direct contact with fecal-contaminated feed and bedding. Some form of stress, such as overcrowding or extremes in temperature, is



PN-4330

FIGURE 7.—Tyzzler's disease. This rabbit died acutely with diarrhea. At autopsy, focal areas of cell death (arrows) were seen in the liver. Photograph courtesy of Academic Press and Co., New York.

necessary for initiating the condition in nature.

Antibiotics reduce the effect of

the disease in experimental mice. The bacteria are most susceptible to tetracycline and penicillin.

## VIRAL DISEASES

### Myxomatosis

Myxoma virus was first isolated in South America from diseased laboratory rabbits; the virus was later found to be a widespread natural infection in cottontails. In wild cottontails, it causes only mild tumors, which regress after several weeks; the disease is fatal only in the very young. In contrast, the disease can completely wipe out some susceptible populations of domestic rabbits. Confirmed cases of myxomatosis follow the geographical distribution of the California brush rabbit, which is limited by the Pacific Ocean, the Columbia River in Oregon, the Cascade-Sierra Nevada Mountains, and the tip of the peninsula of lower California. Transmission of the disease by mosquitoes led to the name "mosquito disease." Myxomatosis is also referred to as "big head disease" because of edema around the eyes, ears, lips, and nose in the early stages of the infection.

Clinical signs include lusterless eyes with a purulent discharge and elevated body temperature. Edema of the ears causes them to become heavy and pendulous (fig. 8). As the disease progresses, edema of the anogenital region and a nasal discharge occur; death follows in 10 to 12 days. In the few cases that



PN-4331

FIGURE 8.—This animal, affected with myxomatosis, shows heavy, pendulous ears and matted eyes.

survive, widespread subcutaneous gelatinous tumors develop all over the body.

Rabbits dying from myxomatosis exhibit no characteristic internal changes by which the infection can be definitely diagnosed. Usually, there is congestion and consolidation of the lungs, and the spleen is enlarged, dark red, and pulpy. The cut surface of each edematous subcutaneous tissue is white, gelatinous, and glistening; when pressed, clear fluid exudes. Clinical signs and tissue examination are required for diagnosis, which is confirmed by inoculation of test rabbits and virus isolation.

The virus is spread by direct contact and by biting insects, such as

mosquitoes and fleas, which act as mechanical vectors. Control consists of prompt identification of the disease and destruction of infected animals. Practices that reduce mosquito populations, such as draining or spraying breeding areas, should be followed. Screening the entire rabbitry is an effective but costly solution. Antibiotics are not effective in treating sick animals, but an attenuated vaccine has been developed, which confers protection.

### Rabbit Pox

The disease can occur with or without clinical disease being manifested. In either case, the lesions include lymphadenitis, papular nodules on the mucous membranes, and orchitis. Mortality is highest among the unweaned young, and may approach 75 percent. Rabbit pox virus is rarely a cause of epizootics, but it is usually very serious when it does occur. Vaccination with vaccinia virus confers immunity.

### Fibroma

Rabbit fibroma virus was isolated from nodules beneath the skin of wild cottontail rabbits. These fibromas (growths) were transmitted to both wild and domestic rabbits. It was once believed that fibroma virus only infected wild rabbits; however, an outbreak was recently reported in a commercial rabbitry.

In the cottontail rabbit, fibroma virus causes a benign tumor which

regresses within a few weeks. Young domestic rabbits, on the other hand, develop small subcutaneous nodules to diffuse indurations involving muscle and tendon. The external genitalia become red and swollen. Death is frequent in unweaned young.

The cut surfaces of the nodules are pale and glistening and may have radiating white streaks. In young animals, the tumors are more widely spread over the body and often coalesce. There may be involvement of the kidneys, liver, intestinal tract, bone marrow, and mesentery.

The role of mosquitoes and other insects as vectors of rabbit fibroma virus has been established. Given the proper environment (such as an epizootic in wild cottontail rabbits) and an adequate mosquito population, this viral disease could result in significant economic loss of young domestic rabbits.

### Herpes Virus

Virus III or *Herpesvirus cuniculi* of rabbits exists as a latent infection in some stock lines of domestic rabbits. The virus does not produce a natural disease, nor are other species of animals susceptible. A virus with characteristics of the herpes group has been recovered from rabbits with respiratory signs. Its role as a pathogen has not been elucidated, but its association with respiratory disease may be important.

Another herpes virus that may be responsible for producing lymphoid tumors in cottontail rabbits has recently been isolated from these rabbits.

### Rabbit Papilloma

Rabbit papilloma virus was identified as the causative agent of wartlike growth on the skin of cottontail rabbits (fig. 9). The domes-

tic rabbit and the jackrabbit are susceptible to experimental infection. The virus can be recovered from lesions on cottontail rabbits, but not from papillomas on domestic rabbits. Naturally occurring papillomatosis has been found in domestic rabbits in southern California, but the virus produces no evidence of a generalized illness.

The most common sites for papil-



PN-4332

FIGURE 9.—Rabbit papilloma. Scaly growths on the ear were caused by papilloma virus.

lomas are the ears and eyelids, and the growths vary in size and conformity. The growths are well keratinized, and the upper surfaces are irregular and often split. The lower portions of the growth are pinkish and fleshy to the touch. As the warts become older, they increase in size, become more cornified, and are hard to the touch. At this stage, they are easily scratched off by the rabbit or knocked off when handled. Papillomas removed in this way leave a free-bleeding surface, which heals without complications.

Rabbit papilloma virus is probably spread by free-flying insects

such as the mosquito; there is no virus multiplication in insect tissue. Transmission of the virus from lesions of cottontail rabbits to domestic rabbits is most likely.

### Oral Papilloma

Wartlike growths in the mouth, especially on the lower surface of the tongue, are caused by a virus different from the rabbit (Shope) papilloma virus. Several spontaneous outbreaks of this disease have occurred, but all have been in the State of New York. The growths on the tongue usually regress without specific treatment.

## FUNGAL DISEASES

Two main groups of fungi, Trichophyton and Microsporum, are found on the rabbit and produce disease of the skin and fur under certain conditions. Not only may rabbits serve as reservoirs for human infection, but man may transmit his fungus infection to rabbits. Because they produce a similar disease known as ringworm, the two organisms will be discussed together in this section.

Fungus infections cause patchy areas of hair loss with thickened skin covered with yellow, dry crusts (fig. 10). The hairs may be broken close to the skin surface and become matted. The name "ringworm" is suggested by the circular lesion that often develops from the outward growth of the fungi. Le-

sions are usually found on the nose, ears, eyelids, and feet. Their size varies, and in severe cases whole areas of the body may be involved. The infection is usually most severe in the nursing young; single small lesions are more likely found in the adult. Diagnosis of fungus infection depends on finding fungi in skin and hair scrapings and by culture. Examination under Wood's (ultraviolet) light may indicate Microsporum, but not Trichophyton.

Infection of the young probably occurs in the nestbox. The nestbox material becomes contaminated with fungus from the adult, and minor skin abrasions allow the fungus to become established on the young. During nursing, the young



PN-4333

FIGURE 10.—Ringworm infection showing loss of fur and scaling of the skin on the ears (arrow).

are in direct contact with skin and fur around the teats, and the fungus is easily transferred to the mouth and nose regions of the infants. These same fungal organisms are found on dogs, cats, domestic livestock, and wild rodents around farm buildings.

When small numbers of animals

are involved, a topical medication may be useful. A synthetic compound, hexetidine, has been valuable in treating isolated cases of ringworm. It is applied directly to the affected areas. In larger outbreaks, an oral or systemic medication is preferred. Griseofulvin, an antifungal drug, is the medication

of choice. Each animal should receive 12 milligrams per pound body weight per day for at least 15 days. Griseofulvin can be added to the pelleted ration, 0.37 grams per

pound of feed, and fed to all animals for 14 days. During treatment, a fungicidal dust (sulfur) should be added to the nestbox material.

## PARASITIC DISEASES

Rabbits are susceptible to a number of parasites, but only a few are of economic importance. The problems caused by all these parasites are greatly influenced by methods of feeding, handling, or housing. If these are satisfactory and recently acquired animals are quarantined for a few days and checked for disease, most economic parasitisms can be avoided.

### Prevention and Control

The best preventive measures are sanitation, good housing, adequate food ration, and an understanding of potential parasite problems. Where good husbandry is the rule, rabbits are rarely infested with parasites in significant numbers. Modern pens are so constructed that they can be kept clean and free from the infective forms of parasites. The proper cleaning of cages and use of good disinfectants together with a good diet are the keys to parasite control. Prevention of parasite infection is far cheaper and preferable to treatment.

### External Parasites

#### EAR AND SKIN MANGE

*Psoroptes cuniculi*, the common ear mite of rabbits, causes ear mange or canker. This condition is probably the second most common parasitic disease in commercial rabbitries. It is surpassed in importance only by coccidiosis. Both occur in well-managed colonies that are housed on wire floors.

The mites live in the ear canal and cause damage to the skin lining this area. An exudate of brown, waxy material soon covers the inner ear (fig. 11). This dark encrustation consists of cellular debris, keratin, dried blood, and mites in varying stages of development. In severe cases, the entire inner surface of the external ear may be involved.

An effective medicine for ear mange is made of 1 part iodoform, 10 parts ether (to dissolve the iodoform), and 25 parts mineral oil. Lindane (benzene-hexachloride) is also effective when used as a 0.25-percent suspension in oil. Mineral oil by itself may be used. The following procedure is recommended



FIGURE 11.—Treating ear mites with cotton swab soaked in medicated oil, PN-4334

for treatment. First, treat all animals. Start with those rabbits showing few signs of disease, and finish with those having severe lesions. This will minimize spreading of the parasite. Second, swab the entire inner ear with medicine on a cotton applicator stick. Allow a small amount to run down into the ear passage. Third, if scales or crusts are sparse, be sure to work the oil well into the ear. If heavy crusts are present, saturate them with oil until they become soft, and then remove them with tweezers. Then medicate the ear again. Burn all cotton swabs and material removed from the ear.

Ear mange can be treated and eliminated from colonies by rigidly following the above treatment program. However, all animals *must* be treated, and all new introductions to the colony must be free of mites to keep the condition from recurring.

*Psoroptes cuniculi*, *Notoedres cati*, and *Cheyletiella parasitovorax* may also cause mange on the skin of the head and body in rabbits. These parasites may cause the skin to become dry, scaly, irritated, and itching with hair loss in affected areas. Treatment is by dusting with talc containing 0.25 percent lindane.

#### CUTEREBRID FLIES

Larvae of *Cuterebra* flies are common subcutaneous parasites of wild rabbits but infrequent parasites of domestic rabbits. The adult fly appears wherever populations

of wild rabbits exist. Rabbits are infected when the fly deposits eggs on the fur. Grub worms hatch from these eggs and burrow into the skin to form warbles. The larvae grow under the skin and may get as long as three-quarters of an inch (fig. 12). When full grown, the grubs leave the skin, drop to the ground, and develop into adult flies. The warbles cause little trouble when they are found in small numbers. The larvae can be removed by enlarging the opening in the skin and drawing them out with tweezers. The wound then should be painted with an antiseptic.

#### FLEAS AND TICKS

Rabbits are not commonly infested with fleas, but the rabbit flea, *Spilopsyllus cuniculi*, and the dog and cat fleas, *Ctenocephalides canis* and *C. felis*, occasionally have been reported on rabbits. There are four stages in the life cycle of these fleas—egg, larva, pupa, and adult.

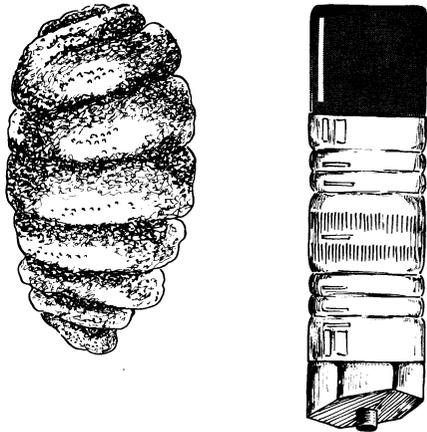


FIGURE 12.—*Cuterebra* larva. An eraser on a pencil is shown for size comparison.

The eggs are deposited on bedding and in cracks of the nestboxes and develop into larvae in a short time. These larvae then form pupae from which the adult fleas emerge. Control is aimed at killing the adults on the host and the immature forms in the nestbox. To destroy adult fleas, dust the animals with a commercial preparation of pyrethrum or rotenone. Dusting should be repeated several times during a 2-week period. Immature forms can be controlled by burning old nestbox litter and scrubbing nestboxes with hot water and household bleach.

The rabbit tick, *Haemaphysalis leporispalustris*, is a common parasite of wild rabbits, but is rarely found on domestic rabbits because their housing is not compatible with the life cycle of the tick; however, this tick is one of the reservoirs of tularemia. This is a serious human disease, and care should be taken to insure that wild rabbits are not allowed access to areas in which domestic rabbits are being raised.

## Internal Parasites

### COCCIDIA

Coccidiosis is the most prevalent parasitic disease of domestic rabbits. It is caused by a microscopic parasite that invades the lining of the intestine or liver. In these locations, the parasite multiplies extensively, and then leaves the body in the feces. At least four species or types of coccidia live in the in-

testine, and one species grows in the liver.

Not all species of coccidia are equally harmful, and rabbits tolerate moderate numbers of some without displaying illness. The most dangerous of the intestinal forms are *Eimeria magna* and *E. irresidua*. These produce diarrhea, poor appetite, weight loss, and sometimes death. *E. irresidua* evokes the most severe tissue damage. In some cases, patches of epithelium die and slough away from the intestinal wall. The diagnosis of coccidiosis depends on the finding of the oocysts (parasite) in the feces or intestinal contents. However, experience is needed to judge if sufficient numbers of parasites are present to account for the disease signs, since other disorders may produce similar signs.

Control of intestinal coccidiosis depends largely on management practices that minimize the danger of fecal contamination of feed, water, and hutch floors. Wire bottom floors greatly reduce the hazard presented by solid floors or slots. Feeders should be designed so that fecal contamination is held to a minimum. An automatic water system is recommended. Oocysts passed out in the feces require moisture and warmth to sporulate and become infective (fig. 13). Dry, wire floors and automatic water systems hinder sporulation of the parasite.

Treatment has only a temporary effect on intestinal coccidiosis, but may be useful in controlling out-

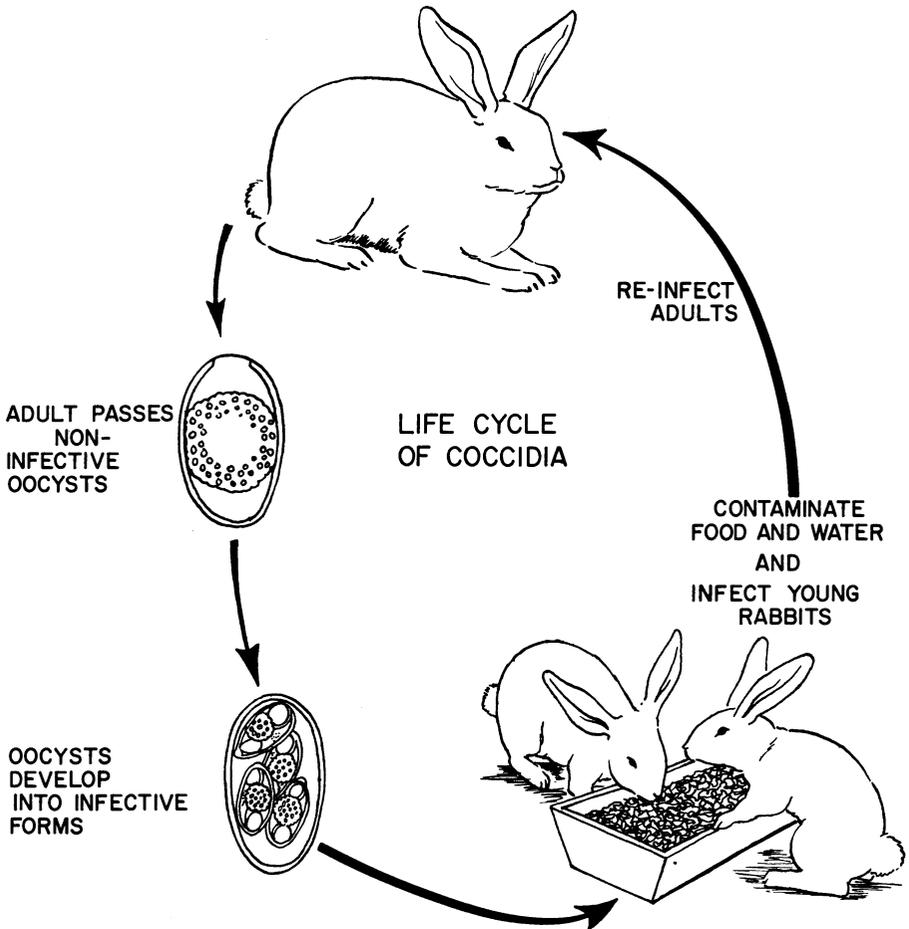


FIGURE 13.—Life cycle of coccidia.

breaks. When indicated, a ration containing 0.025 percent sulfaquinoxaline may be fed for 2 or 3 weeks to reduce the numbers of the parasites to a level where control can be accomplished by proper management. Intestinal coccidia develop a tolerance to the drug if used continuously, so treatment is not suggested unless clinical disease appears.

*Eimeria stiedae*, the one species

of coccidia that multiplies in the liver, is considered to be the most pathogenic coccidia of rabbits. Like the other forms, it enters the intestinal wall, but migrates to the bile ducts where it reproduces. Infections lasting more than 16 days can be recognized by the white, circular nodules on the liver (fig. 14). The parasite multiplies in the epithelial cells of the bile ducts, which become thickened and tortuous and



PN-4335

FIGURE 14.—Livers of rabbits affected with hepatic coccidiosis.

contain a vast number of oocysts. In the early stages of infection, there are no unusual symptoms, then the appetite decreases, a pot-belly develops, and sometimes death follows. In moderate infections, there is no mortality, but disfigurement of the liver makes it unmarketable; hence, this type of coccidiosis is always of economic significance.

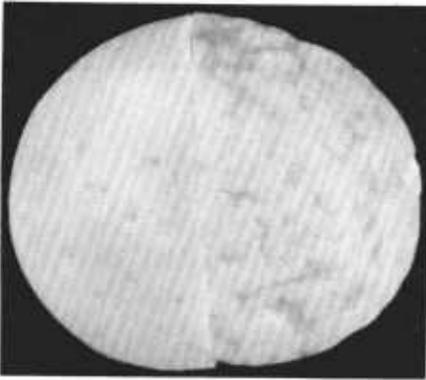
Liver coccidiosis is acquired in the same manner as intestinal coccidiosis. The control measures are also similar; however, liver coccidiosis can be controlled more easily by proper management. When the disease does occur, feed containing 0.025 percent sulfaquinoxaline is an effective treatment. It can be fed at this level for a long time; it should be used only until management control measures can be introduced.

#### NOSEMA

*Nosema cuniculi* is the cause of a mild but longstanding disease in

rabbits. The condition was first described as a chronic encephalitis and later as a spontaneous paralytic disease. A chronic nephritis caused by the parasite was overlooked for many years, but current studies indicate that many apparently healthy animals have kidney lesions related to this infection. These lesions vary from cortical scarring with small, multiple, indented gray areas on the surface to a granulomatous nephritis (fig. 15). The scars extend from the cortical surface to the medulla.

Nosematosis is a contagious, colony infection. The organisms are passed in the urine and transmitted when there is urinary contamination of feed or water. Transmission may also occur to unborn rabbits in the uterus when the doe has the disease. The disease can be controlled by providing good sanitation and preventing contamination of food and water by urine. No treatment is available.



PN-4336

FIGURE 15.—Halves of kidneys from two rabbits showing pitting of their surface caused by *Nosco cuniculi*.

### ROUNDWORMS

*Obeliscooides cuniculi* and *Trichostrongylus calcaratus* are slender, cylindrical roundworms found in the digestive tract. Fortunately, infections are rarely encountered in commercial operations.

*Obeliscooides*, the stomach worm, is a very slender, reddish worm about one-half inch long. *Trichostrongylus* is about the same size but is found in the small intestine. Both have similar life cycles. Eggs are passed in the feces, and after a short period small infective larvae develop. Moisture and warmth favor larval development; larvae are ingested and pass to the stomach or small intestine where they grow into adults.

Signs of infection depend on the degree of the infestation. Light infestations produce little effect; heavy infestation may cause diarrhea and emaciation. The stomach worm produces ulceration of the stomach wall. Rabbits kept on the ground are more apt to be parasitized than those on wire. Control can be accomplished by proper sanitation.

The pinworm, *Passalurus ambiguus*, is a common parasite of rabbits. These worms are glistening, white worms, one-half inch long. They are often seen on the surface of freshly passed feces or through the wall of the cecum when animals are slaughtered. Ordinarily, pinworms do little harm. As the mature worms become inactive, they are passed out of the cecum as fecal pellets are formed. These parasites are spread from animal to animal by ingesting feed and water contaminated by the droppings of infected animals. Management methods used to control coccidiosis are effective against pinworms. When treatment is necessary, piperazine citrate is effective when administered at 100 mg/100 ml drinking water for 1 day.

When treatment is necessary, piperazine citrate is effective when administered at 100 mg/100 ml drinking water for 1 day.

### TAPEWORMS

Tapeworms occur in rabbits as adults in the intestine and as larval forms in the liver and abdominal cavity. The adult forms are very rare in hutch-raised rabbits, but larval forms are occasionally observed.

The rabbit tapeworm, *Cittotania ctenoides*, is flat, ribbon shaped, and made up of numerous segments. It has a head with four suckers with which the worm attaches to the lining of the intestine. Rabbits harboring a few tapeworms show no signs of disease. When many tapeworms are present, diarrhea and emaciation occur.

Control is readily accomplished by good sanitation.

The larval forms of tapeworm most often found are those of *Taenia pisiformis*. They are found in the abdominal cavity and in the liver. Rabbits acquire these tapeworm infections by ingesting contaminated feed and water containing tapeworm segments and eggs from the feces of dogs. The young larvae are then released from the eggs, penetrate the digestive tract, and migrate to the liver. They migrate within the liver, leaving white streaks behind, then leave the liver and enter the abdominal cavity. They form small fluid-filled cysts (cysticerci), which may be attached to the membranes holding the intestinal tract or may exist free in the abdominal cavity (fig. 16). Each cyst contains an embryonic tapeworm, which, when consumed by a dog, will develop into a mature tapeworm.

By excluding dogs from the rabbitry, transmission of tapeworm eggs can be prevented (fig. 17). Dogs kept on premises where rabbits are raised should not be allowed to eat any part of a raw rabbit carcass. Treatment for larval stages in the rabbit is not practical so control must be accomplished by management.



PN-4337

FIGURE 16.—Rabbit liver with several cysticerci attached (arrow).

## NUTRITIONAL DISEASES

### Pregnancy Toxemia

Also known as ketosis, this disease is a toxemia of pregnancy that is most commonly noted in first-litter females. Signs of ketosis are dullness of the eyes, sluggishness, respiratory distress, prostration and death after 1 to 4 days. The disease occurs in the last week of pregnancy and is more prevalent in obese animals. The probable cause is starvation. For

some reason, there is a loss of appetite and failure to eat. This may be the result of minor digestive upset, an abrupt reduction in exercise, or a ration containing too little digestible carbohydrate. When carbohydrate energy declines, body fat is mobilized for energy, and ketone bodies are produced which enter the bloodstream. The liver becomes fatty and appears yellow and soft.

Birth of the litter or abortion is

## ADULT TAPE WORM IN DOG'S INTESTINE

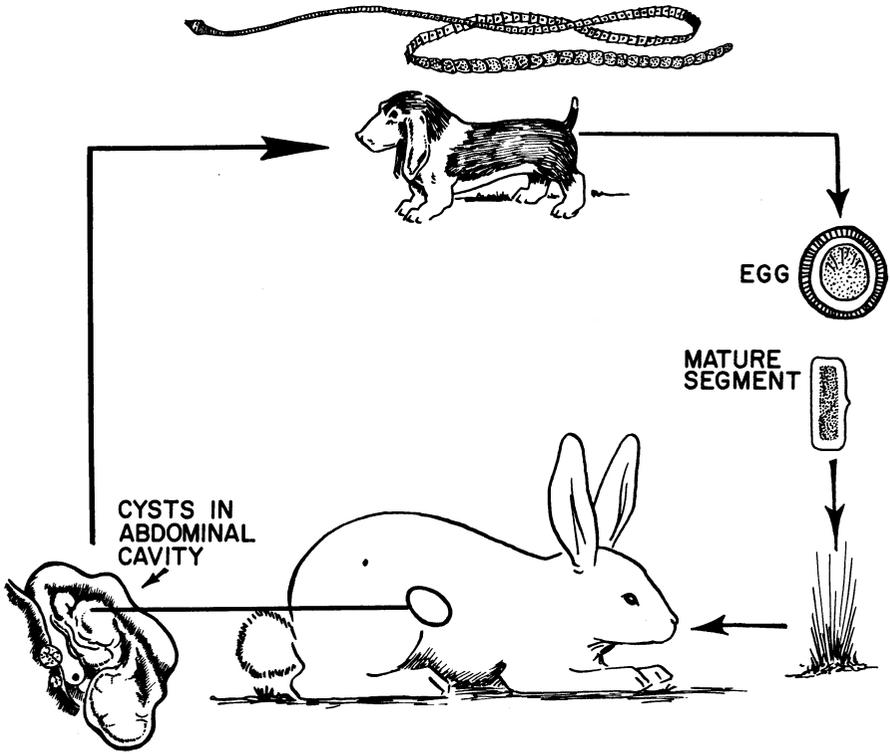


FIGURE 17.—Life cycle of the dog tapeworm.

apt to be curative if either occurs shortly after the onset of signs. Injections of fluids containing glucose may reverse the breakdown of body fats and halt production of ketones. Junior does should not be too fat when bred for the first litter.

### Vitamin A Deficiency

Low-grade vitamin A deficiency adversely affects the reproductive performance of the female, often before other signs are noted. Premature degeneration of the ovum and reduced numbers of fertilized

ova result. Resorption of the fetus or abortion during late gestation is also noted.

Rabbits born to females fed a diet deficient in vitamin A may be hydrocephalic at birth. Hydrocephalus, also called water on the brain, is characterized by distention of the portion of the skull that covers the brain. Cases may not be apparent because the young die soon after birth or are born dead.

Animals that live show signs of nervous system involvement. Wry-neck, loss of equilibrium, and incoordination persist for several

days or weeks. Impaired coordination may prevent animals from eating, and eventually they die of starvation. Enlargement of the head is caused by increased pressure on the brain. On cut section, the ventricles (cavities) of the brain are greatly enlarged and filled with a clear, colorless fluid.

Hydrocephalus is caused by low maternal blood levels of vitamin A throughout the gestation period. When maternal blood levels fall below 20  $\mu\text{g}/100$  ml serum, hydrocephalus appears in a large percentage of the young. Commercial diets, in general, supply adequate levels of vitamin A; however, the vitamin does deteriorate after prolonged storage of alfalfa hay.

## Vitamin E Deficiency

Infant mortality, characterized by death of entire litters at 3 to 10 days of age without clinical signs prior to death, has been associated with vitamin E deficiency. Affected infants do not reveal any gross lesions of diagnostic significance. Producing females become less fertile as the deficiency progresses. The problem can be treated since adequate supplementation of vitamin E will stop infant mortality and correct infertility. Alfalfa hay is a suitable source of vitamin E in commercial rations, and 8 to 9 mg/100 g feed is adequate.

## HEREDITARY DISEASES

### Glaucoma

Glaucoma occurs in both laboratory and commercial rabbit colonies. This condition is of interest to ophthalmologists because of its similarity to congenital glaucoma in humans, and the rabbit may serve as a useful animal model.

Glaucoma appears first as a light-bluish cloudiness on the cornea. One or both eyes may be affected. Progressive opacity follows, and protrusion of the eyeball becomes noticeable. Corneal opacity may lead to blindness. Complications associated with glaucoma are difficulty in breeding affected ani-

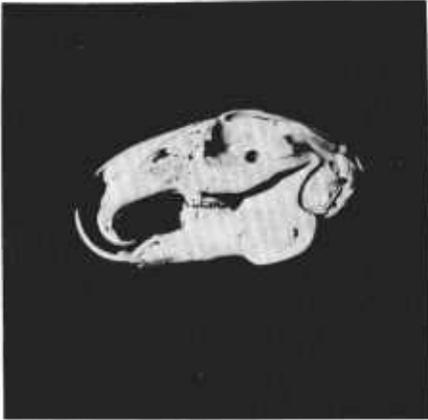
mals, poor appetite, and a general loss of good health.

Glaucoma is probably the result of an abnormal drainage mechanism and the inability to maintain normal fluid relationships in the eye. It is a semilethal defect that is transmitted as a recessive trait.

### Malocclusion

Malocclusion or wolf teeth has long been recognized as a common minor problem in rabbit colonies. The dental formula of the rabbit is: Incisors 2/1, canines 0/0, premolars 3/2, and molars 3/3. Constant chewing and gnawing

keep the teeth ground down to proper length and size. When the lower jaw is shorter or longer than the upper jaw, malocclusion of the incisors results in overgrowth (fig. 18). The cheek teeth (premolars



PN-4338

FIGURE 18.—Malocclusion.

and molars) meet and grind evenly in normal animals. These teeth continue to grow and depend on constant grinding against opposing teeth to maintain their shape. If there is a malposition of the jaw, broken teeth, or malformation, overgrowth will occur in the cheek teeth similar to that which occurs in the incisors.

Signs of malocclusion are gradual loss of appetite and weight. Both sides of the mouth may become stained with saliva. Animals become progressively listless, dehydrated, and unable to chew properly. Complications are abscessed teeth, growth of teeth into the upper jaw, and death from starvation.

Malocclusion of the incisors can be corrected temporarily by cutting back the teeth so the animals can eat and attain good condition prior to slaughter. Since malocclusion is inherited, it can be eliminated by selective breeding.

### Splay Leg and Ataxia

Splay leg in rabbits is due to a simple recessive genetic factor. The condition is similar to the hip dysplasia found in certain breeds of dogs.

The disease is characterized by an inability to put weight on one or both hindlegs, and may even involve all four limbs. The limbs are twisted so that the animal exhibits a double-jointed posture. The animals are not paralyzed. They eat normally, appear to be well, and move by wriggling along on their belly and chest. The pathologic effects are limited to the hip and shoulder.

Ataxia (muscle incoordination) resembles splay leg in some respects. It is, however, a lethal recessive genetic factor. The disease usually appears when the animal is 2 to 3 months of age and runs its course in 30 days. In ataxia, the nervous system is involved, and at first the animal may not be able to use its hindlegs effectively. Later the animal cannot move, and its body temperature drops below normal until death ensues.

## MISCELLANEOUS

## Muroid Enteritis

Mortality statistics show that enteritis accounts for almost 50 percent of the deaths from nestbox to weaning in commercial rabbitries. Enteritis incidence is very low until the fourth week, peaks at 7 weeks, declines sharply after 8 weeks, and is unimportant after 16 weeks.

Generally, sick rabbits lose their appetite, have a hunched appearance with dull, squinted eyes, and have diarrhea of varying intensity (fig. 19). The fur loses its sheen, and the coat becomes rough. Rectal temperature may be normal (102.5° F) or subnormal. As diarrhea and dehydration progress, the animal may lose 20 to 25 percent of its body weight in 24 to 48 hours. The course of the disease may terminate in death after 24 to 72

hours following acute signs; whereas in the chronic phase, the animals may live for 4 to 10 days. In general, 95 percent of the mortality has occurred by the sixth day. Not all cases terminate in death; however, less than 50 percent recover, and these generally prove unprofitable because of weight loss and poor feed conversion.

Pathologic changes are confined to the gastrointestinal tract. The small intestine may show only increased mucus production. In chronic or subacute cases, the cecum and large intestine may be packed with a clear, thick gelatinous substance. Acute cases show excess fluid in the intestine. Varying degrees of gastritis are noted when the stomach is distended with fluid. Other viscera are not affected except through secondary infection. Pneumonia is a frequent complication.

The cause of muroid enteritis is obscure and probably complex. Diet has been implicated; however, extensive research using different combinations of cereal grains, plant protein supplements, vitamins, minerals, legumes, and carbonaceous hays have led to the conclusion that the kinds of foods used were not primary factors in preventing, causing, or curing the disease. Diet may be implicated in the multiple causation theory of the disease.

Several bacterial species have been isolated from affected rabbits, but their importance is difficult to



PN-4339

FIGURE 19.—This rabbit has muroid enteritis. Note feces on hindfeet, rough fur coat, hunched posture, and squinty eyes.

assess. Coliform bacilli and anaerobic bacteria have been isolated, but these are normally present in the intestine, and their pathogenicity has not been proved.

Limited attempts to isolate a virus or to transmit one have failed. Coccidiosis is often found in animals with enteritis, but their presence is probably not related to the disease.

Unfortunately, there is no specific treatment for mucoid enteritis. Chlortetracyclines and oxytetracyclines added to food or water have been reported effective in reducing loss. These antibiotics may be fed to does during the entire suckling period.

### **Cannibalism**

Most cases of cannibalism are the result of the diet being inadequate in either quality or quantity or because the doe was disturbed following kindling. Proper feeding and seclusion at kindling will usually prevent the tendency. A valuable doe that destroys her first litter should be given another chance. If she continues, she should be culled from the breeding population.

### **Heat Prostration**

Heat prostration results from prolonged exposure to excessive heat. Losses may be high in females due to kindle or in infant rabbits if the nestboxes are poorly ventilated. Just before dying, the animals breathe rapidly and become comatose.

Adult animals suffering from the heat may be relieved by spraying them with water or placing a wet burlap feed sack on the cage floor for the animals to rest on. Bedding and fur should be removed from the nestbox to allow free circulation of air in the boxes for the infants.

In locations subject to high temperatures, overhead water sprinklers help to reduce the air's temperature by evaporation. Aluminum-roofed sheds help to reflect the heat, and burlap sacks soaked in water can be hung from the edges of the roofs to shade and cool the air.

### **Broken Back**

This condition is characterized by sudden paralysis with no apparent cause. Paralysis extends from the middle of the back with complete paralysis from this point back. The animal moves with its front legs and drags the hind-quarters. The urinary bladder may become greatly distended. Paralyzed animals have a misplaced or slipped vertebra. Malposition of the vertebra compresses and damages the spinal cord with resulting paralysis. Injury to the vertebra may be caused by improper handling, using a tatoo box too short for the size of the animal, or by injuries occurring in the cage. Many injuries occur at night when predator animals invade the rabbitry. In an effort to evade the predator and protect the young, the adult

“stamps” firmly with its hindfeet. As a result the vertebra becomes misplaced and the spinal cord becomes damaged. There is no treatment, and the affected rabbit should be killed.

### Sore Hocks

Sore hocks are inflamed bare spots, devoid of fur, found on the bottom surface of the hindlegs (fig. 20). In more severely affected cases, secondary infections with staphy-

lococcus and abscesses occur. Both front and hind feet may become involved. As the hocks of the hind feet become painful, the animal throws more weight to the front feet, adding stress to the front feet and causing them to become affected. Wet, dirty hutch floors and the irritating action of urine ammonia are predisposing factors. The breed of the rabbit is also a factor in the development of sore hocks as the disease is seen more

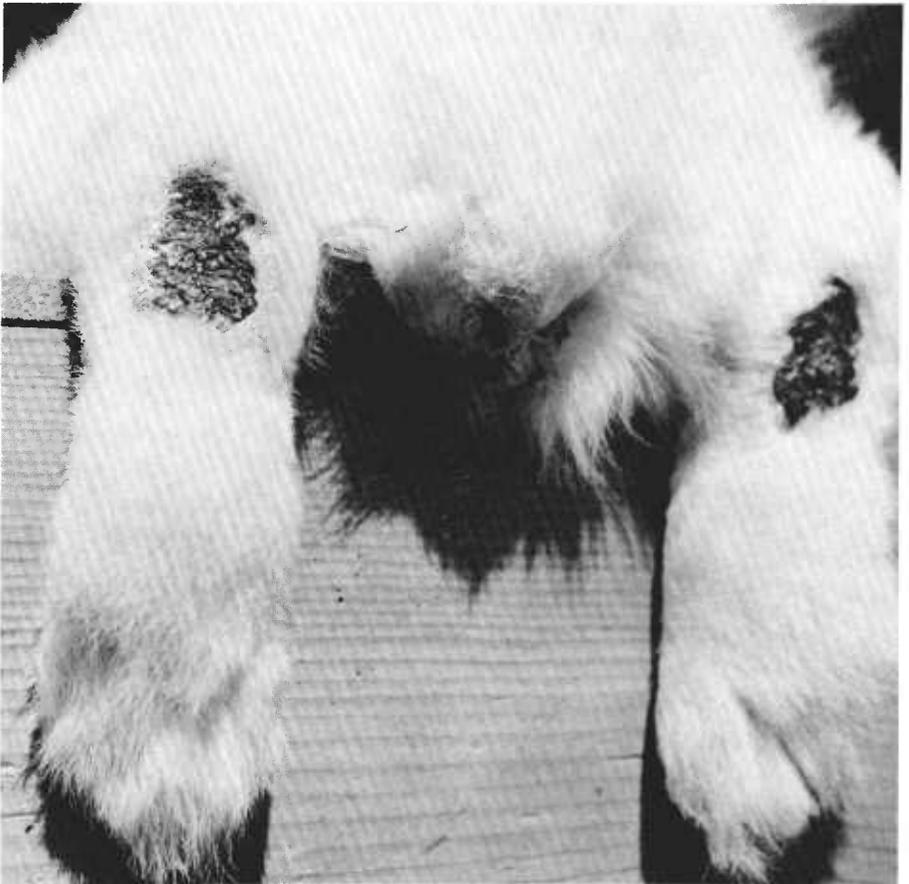


FIGURE 20.—Sore hocks.

often in large breeds as compared with smaller breeds.

### Milkweed Poisoning

The leaves and stems of the woollypod milkweed, *Asclepias*

*eriocarpa*, are toxic to the rabbit. The leaves are greenish yellow and broad, and the underside is covered with a woolly growth (fig. 21). Leaves may be found in wheat or oat straw, but never in rice straw.



FIGURE 21.—Woollypod milkweed.

PN-4341

The milkweed plant grows only in the Pacific Southwest.

When rabbits eat the leaves or stems of the plant, they develop a paralysis of the neck and shoulders. The head is tucked down between the front legs, and the nose rests on the floor. The back is arched higher than normal. As neck muscles become paralyzed, the animal is unable to lift its head or to control its legs. The front legs extend to the sides while the hindlegs extend outward and forward. In more advanced stages, the head lies flat on the floor, the ears droop to the sides, and any movement is jerky and unsteady. Eventually, the animal becomes completely paralyzed and succumbs to starvation. In the early stages, the animal can be saved if it can be force fed and given water.

### Tumors

Spontaneous tumors in the rabbit are rarely reported because the animals are slaughtered before they reach the age at which tumors are most apt to occur. With the increasing use of the rabbit as a laboratory animal, interest in these growths can be expected. Tumors have been observed in the uterus, kidneys, blood, lymph nodes, bones, testicles, skin, and other organs. Adenocarcinomas of the uteri are not uncommon in does over 2 years old. Usually they are multiple and occur in both uteri. Most cases of lymphosarcoma (tumors of cells from lymph nodes) have been in

mature females. Neoplastic cells are found in numerous body organs, but the most outstanding lesions are in the kidneys. Tumors originating from embryonic cells from the kidneys (embryonal nephroma) are observed with some frequency in domestic rabbits.

### Fur Eating and Hairballs

Several rabbits in a hutch may eat body fur, eyelashes, and whiskers. Single rabbits eat fur on their sides, back and rump. The cause is most likely improper diet; however, sometimes it appears to be a vice. Fiber deficiency or inadequate protein may be factors. A 15-percent fiber level is probably the minimum that should be fed to either growing or producing rabbits.

Rabbits may also eat small amounts of hair by licking or grooming themselves. The hair may accumulate in the stomach and form hairballs. These usually cause no disease, but they may obstruct the stomach. When obstruction occurs, the rabbit quits eating, loses weight, and may die. Mineral oil given by stomach tube is recommended for treatment.

### Coprophagy

The process of taking soft fecal pellets from the vent and swallowing them intact is a natural physiological procedure for the rabbit that should not be misinterpreted as a nutritional condition or de-

praved appetite. Coprophagy is practiced at night by tame rabbits and during the day by wild rabbits in their burrows. Fermentation of the feces in the large intestine supplies an abundance of certain B vitamins to the fecal pellets, probably improves the quality of the protein in the soft pellets, and improves fiber breakdown by bacterial action. By permitting a second passage of food through the digestive tract, the rabbit gains additional nutritive value from the food.

### **Yellow Fat**

Yellow fat is not an abnormal condition nor the result of an in-

fectious process. It is included here only to prevent misunderstanding or association with a disease condition. Yellow fat is a genetic trait determined by a recessive gene. Alfalfa and other green feeds contain xanthophyll, a fat soluble compound that is yellow in color. Animals with the yellow fat gene lack an enzyme that reduces (changes) the xanthophyll pigment to a colorless product. Therefore, the xanthophyll is deposited in the body fat making it yellow. White fat in meat rabbits is preferred to yellow fat.

## **HOW TO PACK AND SHIP SPECIMENS FOR LABORATORY DIAGNOSIS**

The best way for a rancher to obtain an accurate diagnosis is to take the dead animals, or two or three sick animals showing typical signs, to the nearest laboratory. Then he can supply any additional information the pathologist may need. If this is not convenient, the dead animals may be shipped.

### **Shipping Dead Animals**

As it is against postal regulations to send frozen carcasses of diseased animals through the mail, shipment must be made by bus or air express. Label the outside of the box, "Biological Specimen," "Rush," and "Keep in a Cool Place."

If the carcass is to be shipped a

short distance, chill it thoroughly and place it in the center of a box containing sawdust or shavings. For long-distance shipments, place dry ice around the carcass, then pack it as indicated above. Never put dry ice in an airtight jar or can. When the ice melts, gas is formed if the gas cannot escape, it may cause an explosion. Properly used, dry ice will prevent spoilage for 2 or 3 days.

If dry ice is not available, place the animal in a can with a tight lid, freeze solid, and pack in crushed ice surrounded by sawdust to take up the water. A wooden box can be used for shipment, but if a bucket can be substituted for a wooden box, no sawdust is necessary.

Many specimens decompose after arriving at the laboratory because no one is available to take care of them promptly. With this in mind, do not send fresh specimens that will arrive on a weekend; most laboratories do not operate on Saturday and Sunday. Address the package to the laboratory itself, not to an individual employee. This will insure more immediate attention. Do not send carcasses that have started to decompose. It is better to kill an animal or two that show typical signs, or to ship them alive if there is a chance that they may reach their destination before death.

### Accompanying Information

Letters that do not contain sufficient information are a problem to the pathologist. In some diseases, a complete history is more useful than the carcass. The accompanying letter should contain the following information:

- (1) Number of rabbits on the ranch.
- (2) Number of sick or dead animals.

- (3) Age and sex of affected animals.
- (4) Description of the disease as you observed it. For example, rabbits develop watery diarrhea, quit eating and drinking, and die in 1 or 2 days.
- (5) Dates of first losses and subsequent losses.
- (6) Incidence of infection (whether it is in just one house or pen, or scattered throughout the rabbitry).
- (7) What treatment, if any, has been given.
- (8) Type and brand of feed used for past 6 months.
- (9) Type of housing (whether the rabbits are kept on wire or solid floors).
- (10) Any other information that might help explain the outbreak.

It is best to telephone the laboratory so they can be alerted to the arrival of the specimen. Should further information be necessary, it can also be obtained at that time.