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# DISEASES OF BEES

and their control

THE PENNSYLVANIA STATE UNIVERSITY  
College of Agriculture  
Agricultural Extension Service  
UNIVERSITY PARK, PENNSYLVANIA

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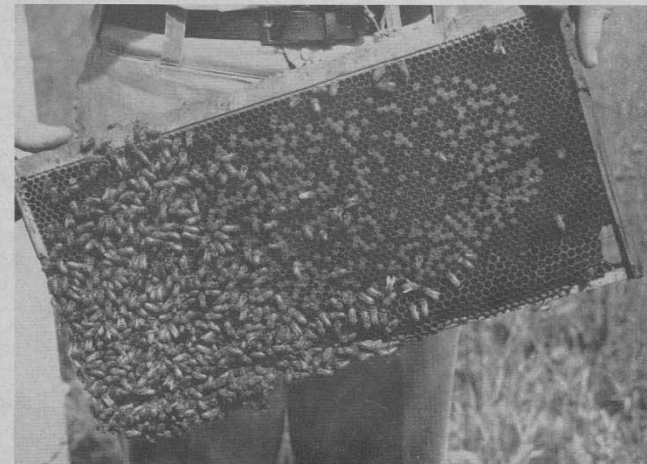
# DISEASES of BEES and their CONTROL

W. W. CLARKE, JR.

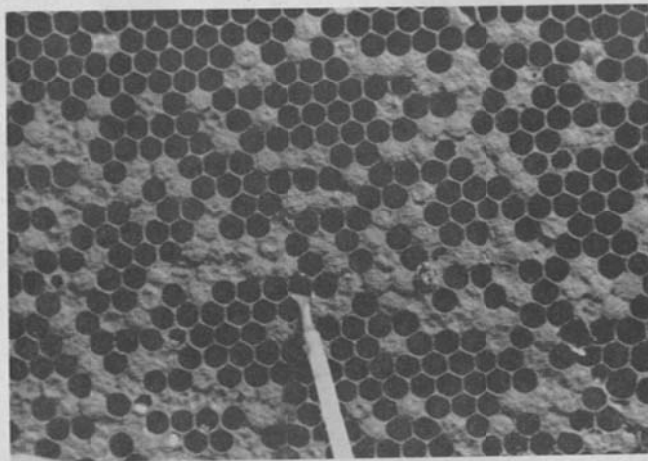
## AMERICAN FOULBROOD

**A**MERICAN FOULBROOD is an infectious disease of the brood caused by bacteria known as *Bacillus larvae*. It is the most destructive of the brood diseases. *Bacillus larvae* occur in two forms, the vegetative and the spore. The disease is transmitted primarily by the spore form. The spores may come in contact with larvae of any age but they germinate and start growing only in larvae not more than two days old. The bacteria of the disease kill the young bees in the larval and pupal stages by growth within the stomach and after the cells are sealed, causing a typical decay of young brood.

The brood in an infected colony is usually irregularly arranged with the infected cells being discolored, sunken, or with punctured cappings. One of the first visible symptoms of American foulbrood is the dead larvae which have turned brown and decayed in the cell. The dead larvae gradually change the white of a normal larva to a light brown, then a dark coffee-brown color, and eventually dry down into almost black scales. These scales



Comb of brood, typical of bees infected with American foulbrood. Cappings sunken and punctured with much dead brood.



Dead larvae showing stringing condition of infected brood.

lie flat along the lower walls of the cells with the rear portion curved part way up on the bottom of the cell and they are very difficult to remove. The dead larvae develop a consistency similar to that of glue and give off an offensive pungent odor. If a match is pushed into the mass, it will often string out for an inch or more. Occasionally pupae, which have been killed by the disease, will rot down with the thin, dried tongue of the pupae attached to the upper wall of the cell. This is one of the most reliable symptoms of American foulbrood. It takes about one month for the brood to decay and dry into a scale.

**Spread of American Foulbrood** The disease usually spreads fairly rapidly through the hive and the colony becomes weak. Weakening of the diseased colony probably is the cause for the rapid spread to other colonies, through robbing of weak or dead colonies. Bees may go a mile or more to rob honey left unprotected in the hive of the dead colony. American foulbrood may also be spread by feeding diseased honey or transferring comb or other equipment from a diseased colony to a normal colony. It is unwise for an inexperienced beekeeper to buy bees or equipment unless it has first been inspected by an inspector or someone familiar with the disease. Even a stray swarm from a diseased colony may carry American foulbrood.

Every beekeeper should become acquainted with the symptoms of American foulbrood so that he can recognize this disease in its early

stages. American foulbrood can be controlled best by treating or destroying infected colonies when the infection first starts. Once the disease is well established in an apiary, it is very difficult to bring it under control.

#### TREATMENT FOR AMERICAN FOULBROOD

**Burning** One of the safest treatments of American foulbrood is to kill the bees and destroy the contents of the infected hive along with the bees. Kill the bees by placing a teaspoon of sodium or calcium cyanide on a piece of cardboard and slide this into the entrance of the hive on the bottom board, either in early morning or late afternoon, when most of the bees are in the hive. The bees will all be dead in about five minutes. *Cyanide in any form is deadly to humans and should be used with care.* The fumes from burning sulfur may also be used.

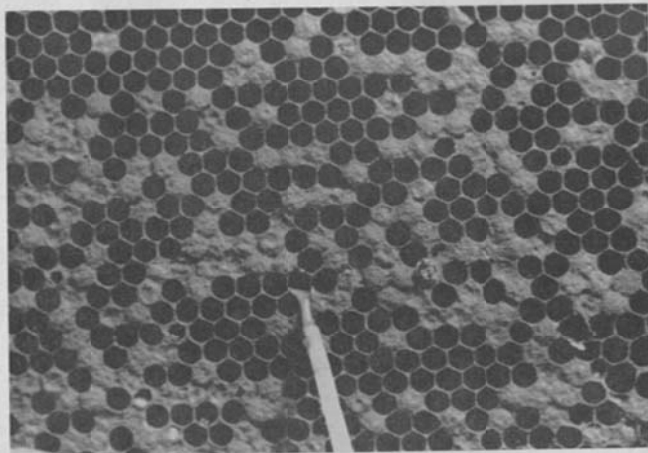
A hole should be dug in the ground about 18 inches deep and large enough in circumference to hold all the material to be burned. Build a fire in the hole and throw on the entire contents of the hive, including the bees and honey. Cover the ashes, when completely burned, to prevent any robbing of unburned honey.

The hive bodies, supers, inner covers, etc., should be disinfected immediately. Burn all parts of the hive with a blow torch or weed burner until they turn light brown.

**Disinfect Hive Parts** Be sure to hit the corners. The hive bodies may also be disinfected by scrubbing the inside of the equipment thoroughly with a solution of 1 part formaldehyde to 4 parts of water, using a stiff brush. Wear rubber gloves to protect hands and glasses to protect eyes. The work should be done outdoors to prevent the fumes from burning the eyes and throat. Allow the equipment to air out for a day or two before using. Boiling the equipment in a strong lye solution is very effective for disinfecting. The equipment should be boiled until the equipment is free of wax and propolis, and the stronger the lye the less time it takes to treat. Rubber gloves should be used to protect the skin. Dip equipment in water containing a mild acid, such as vinegar, to counteract the lye. The equipment should be dried; then it is ready for use.

It may be desirable to try to save the infected colonies, especially in communities where the disease is well established or in an apiary where a larger proportion of the colonies are infected. No treatment is entirely successful, since with all known methods, the disease may reappear over a period of years. This may be from a new source or a reoccurrence of the disease.

One of the most successful treatments in the past has been by shaking or smoking the bees into a clean hive that is filled with frames or strips of wood with 1 or 2 inches of foundation. The bees work on these strips for four days, then are shaken off and given clean



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Occasionally a colony will be affected with both diseases, making it more difficult to diagnose. If there is any doubt, it is usually wise to treat for American foulbrood.

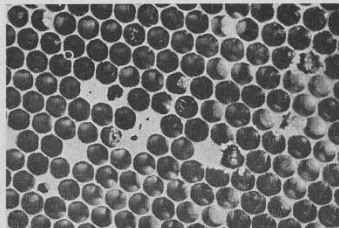
**Treatment** European foulbrood, normally, can be prevented by keeping strong colonies of Italian bees since the disease is primarily one of weak colonies and of common black and hybrid bees. The treatment for European foulbrood is simple and inexpensive, provided the disease is observed in its early stages of development. Kill the queen and feed the bees a quart of sugar syrup every three days. At the end of five days, destroy all queen cells, and leave the colony queenless for 10 days, then introduce a young vigorous Italian queen. The bees will usually clean out the dead and dying brood during the 10 days they are queenless. If the colony seems a little slow in cleaning up the disease, add a frame of sealed brood from a normal colony. Destroy the comb taken from the diseased colony.

**To Make Feed** Dissolve 2 parts of sugar to 1 part of hot water by volume. Feed the bees in the evening and after the syrup has cooled to room temperature. Add a half-ounce of terramycin to 5 pounds of sugar to help in the control of European foulbrood.

#### SACBROOD

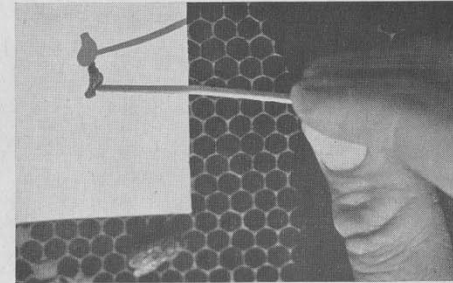
Sacbrood is apparently caused by a filterable virus, which cannot be seen under a microscope. Infection takes place by way of the alimentary canal. The brood is usually killed after the cell is capped and the larva has spun its cocoon. The larva is fully extended on the floor of the cell. In a case of heavy infection, a few coiled larvae may be killed. Sacbrood does not usually cause severe losses. It is important to be able to recognize the disease so as not to confuse it with the foulbrood diseases. Sacbrood is usually most common in the spring.

**Symptoms** The brood is slightly irregular. Dead brood is scattered among the healthy brood. The cappings over dead brood are first punctured and later removed by the bees. The



An area of brood showing a few larvae dead of sacbrood and a few cells with perforated cappings under which larvae have died of the same cause.

A single larva dead of sacbrood removed from the cell on a toothpick. It is characteristic of this disease.



larva changes from white to slightly yellowish after death. This gradually turns gray and becomes darker, beginning with the head of the larva. This soon changes to brown or gray-brown and later dark brown. The dried scale lies the full length of the cell with the head end raised and the tail flat on the bottom of the cell. The raised head is a distinctive symptom of sacbrood. The skin of the larvae remains tough and is easily removed from the cells intact. The disease gets its name from the tough nature of the skin which reminds one of a sack.

**Treatment** Sacbrood will usually clear itself in the late spring when the honeyflow has started. Strong colonies and good beekeeping seem most effective in overcoming this disease. Requeening with young vigorous Italian queens often is effective.

#### CHARACTERISTICS OF BROOD DISEASES

SYMPTOM	AMERICAN FOULBROOD	EUROPEAN FOULBROOD	SACBROOD
General appearance of brood comb	Brood irregular; intermingling of capped, open, sunken and punctured cells	Brood irregular; dead brood mostly in open cells	Brood slightly irregular; dead brood mostly in cells with punctured cappings or uncapped cells
Age at time of death	Late larval and early pupal stages; rarely coiled stage	Coiled stage; occasionally late larval stage	Usually older sealed larvae. Occasionally young unsealed larvae or young pupae

SYMPTOM	AMERICAN FOULBROOD	EUROPEAN FOULBROOD	SACBROOD
Color of dead brood	Dull white, then light brown; later coffee-brown or almost black	Dull white, grayish-white, yellowish-white to brown, becoming dark brown or nearly black	Grayish to straw-colored, becoming brown, grayish-black or black; head end usually darker
Consistency of dead brood	At first watery; becoming ropy	At first watery; afterwards pasty; rarely ropy	Watery and granular. Tough skin forms a sac ropy
Odor	Distinctive odor in later stages. Glue or glue pot odor	Slight to penetrating sour odor	None to slightly sour
Scale	Brittle rough texture. Lies flat on lower side of cell, head lying flat. Fine thread-like tongue of dead pupae extended upward. Difficult to remove	Tough and rubbery. Usually twisted in cell. Tracheae often clearly visible, easily removed from cells	Brittle, lies flat on lower side of cell; head prominently raised. Does not adhere tightly to cell wall

Adapted from U.S.D.A. Circular No. 392, "Diagnosing Bee Diseases in the Apiary."

#### CHILLED BROOD

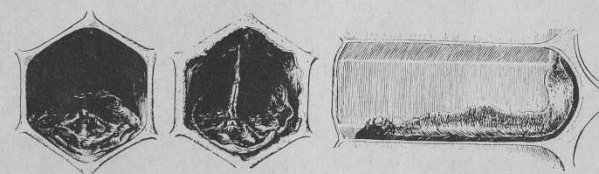
If larvae are underfed or, if the brood chamber covers a larger area than the bees can keep warm, some of the brood will die. The dead brood, which is the result of chilling, turns gray and resembles sacbrood in appearance. The chilled brood will be removed from the cells as soon as the colony develops strength and becomes normal.

The loss of brood from chilling or lack of feed may be prevented, if the following precautions are taken:

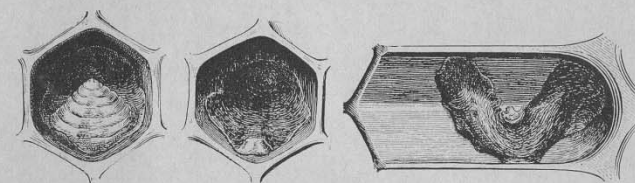
1. Work with the bees as little as possible, if weather is cold.
2. Replace combs in same order they were removed, especially if the colony is weak and in the early spring.
3. Do not leave frames of brood standing outside the hive any longer than necessary.

#### SCALE CHARACTERISTICS OF BROOD DISEASES

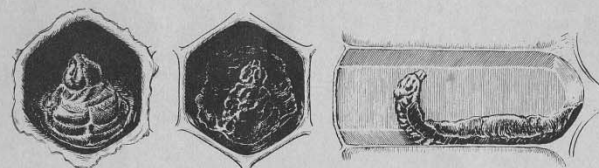
(Courtesy of the U. S. Department of Agriculture)



Scales from American Foulbrood, left to right: scale formed by drying of dead pupae; tongue of dead pupae adhering to the root of the cell; longitudinal view of a scale formed by drying of dead larva.



Scales from European Foulbrood, left to right: infected larva decomposing; scale formed by dried larva; longitudinal view of a scale from dried larva.



Scales from Sacbrood, left to right: infected larva decomposing; scale formed by dried larva; longitudinal view of a scale from dried larva.

#### PARALYSIS

Paralysis of the adult honeybee recently has been proved to be caused by a filtrable virus too small to be seen under the usual microscope. The disease is widespread but usually causes greater losses in warm than in cold climates. Paralysis may be serious, since a colony heavily infected will probably not gather honey because the bees of field age are lost.

**Symptoms** Bees suffering from paralysis are usually weak and there is a trembling or shaking movement of the body and wings. As a rule, they lose the hair from their bodies, becoming shiny, and the legs and wings are sprawled. Sick bees, that are motionless, will sometimes show the trembling movement when disturbed. The paralyzed bees, occasionally, will try to fly but are unable to leave the ground. The healthy bees of the colony can be seen fighting the diseased bees in an effort to drive them away from the hive.

A colony may recover from paralysis after a short time but sometimes the condition continues for a year or more without killing the colony. Usually only 1 or 2 colonies in an apiary will show signs of the disease.

**Treatment** The treatment of paralysis has not been consistent. Best results have been obtained when the old queen is killed and the colony requeened with a young queen of vigorous stock. It is usually a help to add a frame of sealed brood from a healthy colony to build up this colony strength of young bees.

#### NOSEMA DISEASE

Nosema disease is an intestinal disease of the adult bee caused by the protozoan *Nosema apis*. Little attention has been paid to this serious disease, owing to difficulty in recognizing it, especially by the beekeeper in the field. It is very noticeable in the spring, and may be responsible for the so-called spring dwindling that is so common. It may also be responsible, to a degree, for the supersedure of queens, especially those established from package bees.

**Symptoms** A colony infected with *Nosema apis* is usually restless and the colony becomes weak. The death rate among the adults may be high when heavily infected and the colony dwindles rapidly. In the individual bee, it is usually noticed that the bee cannot fly more than a few yards without alighting. Many bees will be seen crawling on the ground, the bottom board, or at the hive entrance. Sometimes infected bees crawl up blades of grass in an effort to fly. The legs of affected bees may be dragged along in crawling, as if paralyzed, and the wing held at abnormal angles. Such bees are capable of only feeble fanning with their wings. The abdomen is often distended with feces.

The intestinal tract of the infected bee is usually swollen and discolored. In a healthy bee, the intestine is brownish-red, yellowish, or grayish-white. Circular constrictions show for nearly the entire length of the intestine and the tissues are fairly tough. In the infected bee the intestines are a dull grayish-white, and some, or all of the circular constrictions disappear. The tissues become soft and watery. A microscope is almost necessary for a satisfactory diagnosis of Nosema disease.

**Treatment** There seems to be no cure for Nosema. It may be prevented to a considerable extent by keeping the bees in a dry, sunny location. Stagnant pools of water should be eliminated or replaced with running water, since stagnant pools may become contaminated with Nosema spores and the disease transmitted to the hive when the water is carried back to the hive. Colonies should have well-ripened honey of good quality or heavy sugar syrup for wintering. An upper entrance should be provided to allow moisture to escape from the hives.