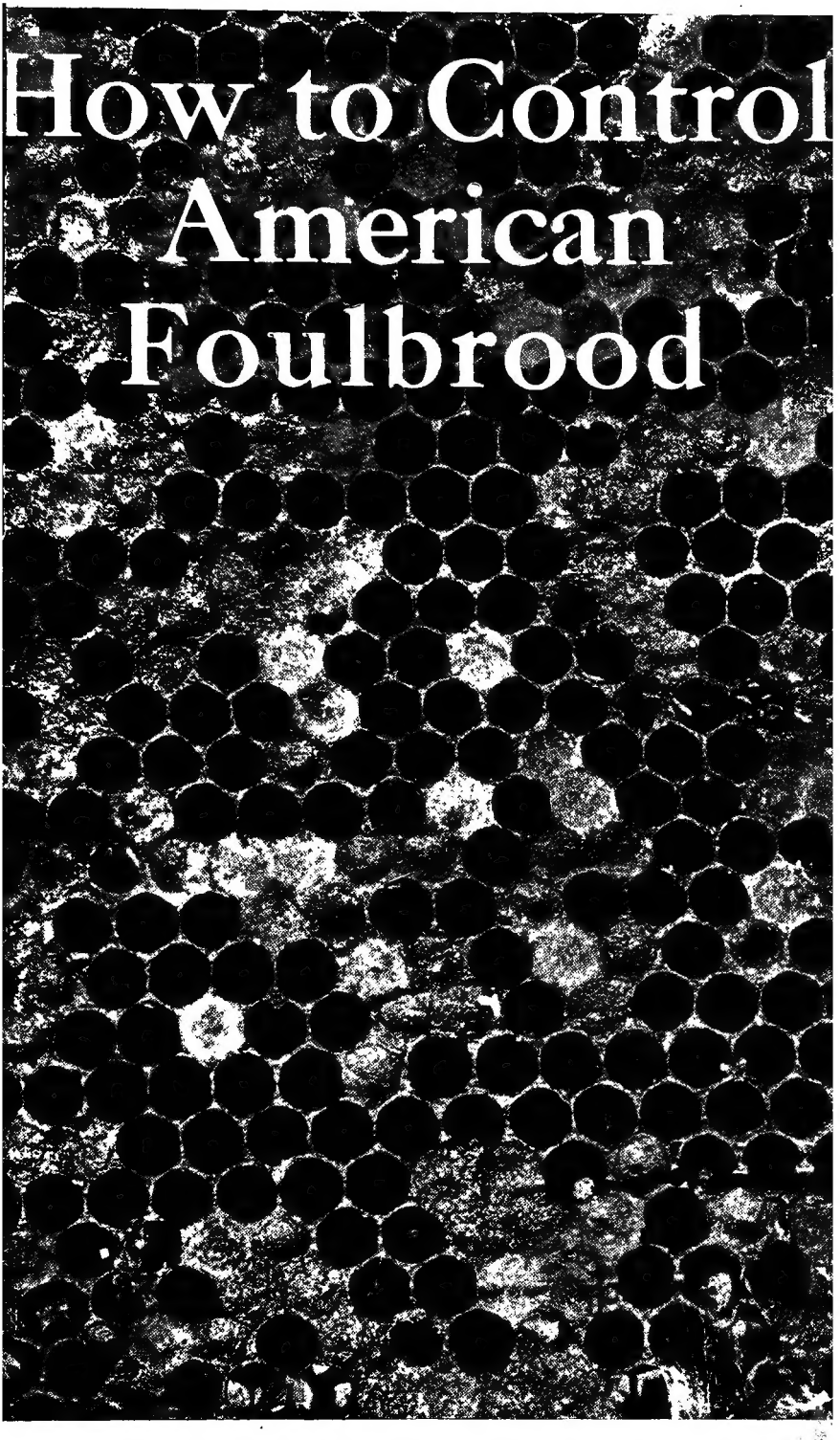
How to Control American Foulbrood



AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF WISCONSIN

DIGEST

American Foulbrood is the most serious disease of bees in Wisconsin. It is a bacterial disease carried in the honey and in old combs. Getting rid of infected honey and combs means the eradication of the disease. Pages 3-10

Extracting frames should not be saved. Although they may appear to be free of honey, there is always a possibility of a few drops of infected honey being carried over. Page 11

Scorching hive parts does not insure complete disinfection. Drops of honey may be left behind the rabbets or smeared on the outside of the hive although the hive may be carefully scorched on the inside. Page 12

Treating for Foulbrood must be carefully done to insure success. Careless handling of diseased colonies is sure to spread infection. Pages 14-20

How to Control American Foulbrood

H. F. Wilson.

Ridding Wisconsin apiaries of foulbrood is almost entirely in the hands of beekeepers themselves. Through co-operative effort only can the amount of disease be reduced to a minimum. In counties where local beekeepers' associations exist they are organizing clean-up campaigns and with the help of the state apiary inspector are getting the better of the disease.

Wisconsin is a beekeepers' paradise, for failures are few and almost the entire state is covered with flowering plants that secrete nectar readily. But for 20 years beekeeping has suffered from a slowly-eating cancer that at one time threatened to wipe out the industry. Between 1900 and 1918, bee diseases and winter losses caused a decrease of from 30 per cent to 50 per cent of all colonies. Shortly before 1918 the interest among beekeepers had fallen to its lowest ebb and it was a common sight to see hundreds of empty hives instead of prosperous and productive apiaries. Fortunately the disease situation is improving and American foulbrood, the chief offender, is slowly being eradicated through better inspection laws and more educational work.

The three brood diseases of bees more or less common in Wisconsin are American foulbrood, European foulbrood, and sacbrood.

American foulbrood occurs wherever it has been carried either by human agencies or by the bees themselves. European foulbrood and sacbrood do not occur in a virulent form over all regions of the state; and there is a direct influence of climate and nectar secretions on both of these diseases. Sacbrood is more widespread and has caused more trouble this past season than in any of the four years previously observed. Its range does not appear to be entirely affected by the same

factors that influence European foulbrood. The latter disease is found more or less in all sections of the state, but occurs in a highly virulent form only in certain areas in the northwest, west, and northeast parts of the state. Sacbrood is more or less sporadic in all parts of the state.

BACTERIA CAUSE AMERICAN AND EUROPEAN FOULBROOD

White[1] has clearly demonstrated that the three brood diseases of bees known as American and European foulbrood and sacbrood are caused by bacteria. The bacteria may be isolated and the disease transmitted in the laboratory as well as in the field. Sacbrood, according to his investigation, is caused by a filterable virus.

Each disease develops symptoms peculiar to itself; and when these symptoms alone are present, it is not difficult to determine the specific disease. Unfortunately, however, there are several other bacteria which live on the decaying larvae and sometimes cause symptoms similar to those of American foulbrood to occur with European foulbrood and sacbrood. This often leads to confusion not only in the minds of inexperienced beekeepers but to experienced men as well.

Persons of the widest experience are often misled by some unusual symptoms. The only sure way of determining the kind of disease is through a microscopical examination. If a beekeeper finds diseased brood in a colony and does not know the cause, he should immediately cut out a sample and send it in to the state apiary inspector or to the apiarist at the state experiment station.

GENERAL SYMPTOMS OF AMERICAN FOULBROOD

Sunken cappings often punctured, together with dead larvae chocolate brown in color, are symptoms of the disease. The larvae cannot be removed from the cell but string out when the attempt is made. When the disease is first introduced into a colony (Fig. 1) the few cells which occur may be overlooked easily. Just after death the larvae are a light coffee color which gradually becomes darker. Finally, when decay is well advanced, the larva loses its shape and melts down. In this stage the mass is quite stringy or ropy. As it dries out a scale

[1]White, G. F.—Sacbrood: Bul. 431, U. S. Dept. of Agr., 1917.
American Foulbrood: Bul. 809, U. S. Dept. of Agr., 1920.
European Foulbrood: Bul. 810, U. S .Dept. of Agr., 1920.

is formed in the bottom of the cell which can hardly be removed without breaking the cell wall. In examining old combs for the presence of these scales, they should be tilted at an angle so that the bottom of the cell can be observed and the light reflected so that if any foreign substance is present it can be seen.

The disease gradually spreads through the brood nest and normally becomes widespread by fall (Fig. 2). A colony usually dies out completely by the end of the second season or is so weak in bees that it dies out in the winter or early spring. A very distinct and disagreeable odor accompanies severe cases.

General Symptoms of European Foulbrood

Larvae usually die in younger stages and before cells are capped over. It is not uncommon for some cells to be capped and punctured as in American foulbrood. This confuses the beekeeper; and samples should be referred to some authority for identification. The disease appears worse in late spring and early summer when hundreds and even thousands of larvae may die in a few weeks. The disease becomes less severe as the season advances and may be entirely eliminated by the end of the season if there is a good honey flow.

The dead larvae are a greyish yellow at first and later turn to a chocolate brown. They melt down or lose shape and are found mostly at the back of the cell. The scales formed by the dead larvae are mostly loose and can be removed by the bees. They can often be jarred out and can be picked out without breaking or rupturing the cell wall. Older larvae break down and cannot be removed entirely. The tissues do not string out like the larvae in American foulbrood, but are chunky and have the consistency of cornstarch pudding.

General Symptoms of Sacbrood

Sacbrood is not unlike American foulbrood in some of its stages and might easily be mistaken for it. The larvae die after the cells are capped and the bees may remove the entire capping or puncture the cells as in the case of American foulbrood. There is a decided difference with sacbrood, however, in that larger punctures are made and usually only one.

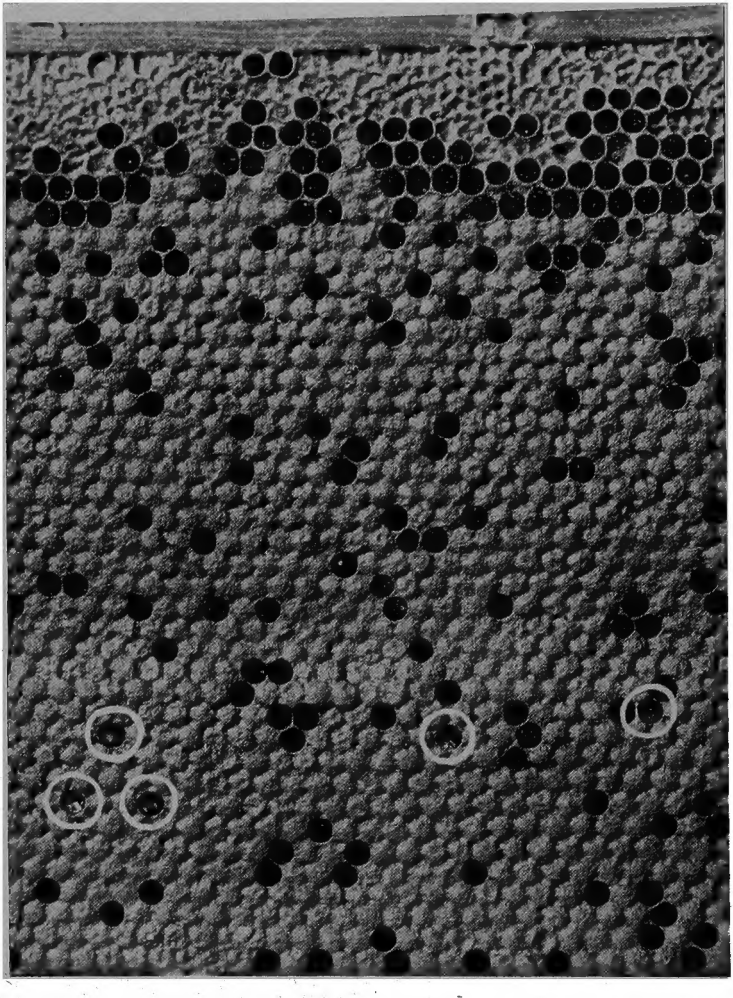


FIG. 1.—HOW AMERICAN FOULBROOD STARTS IN THE BEE COLONY

The white circles indicate five cells in which the larvae are diseased. No other cells could be found in this hive at that time, June 10, 1919.

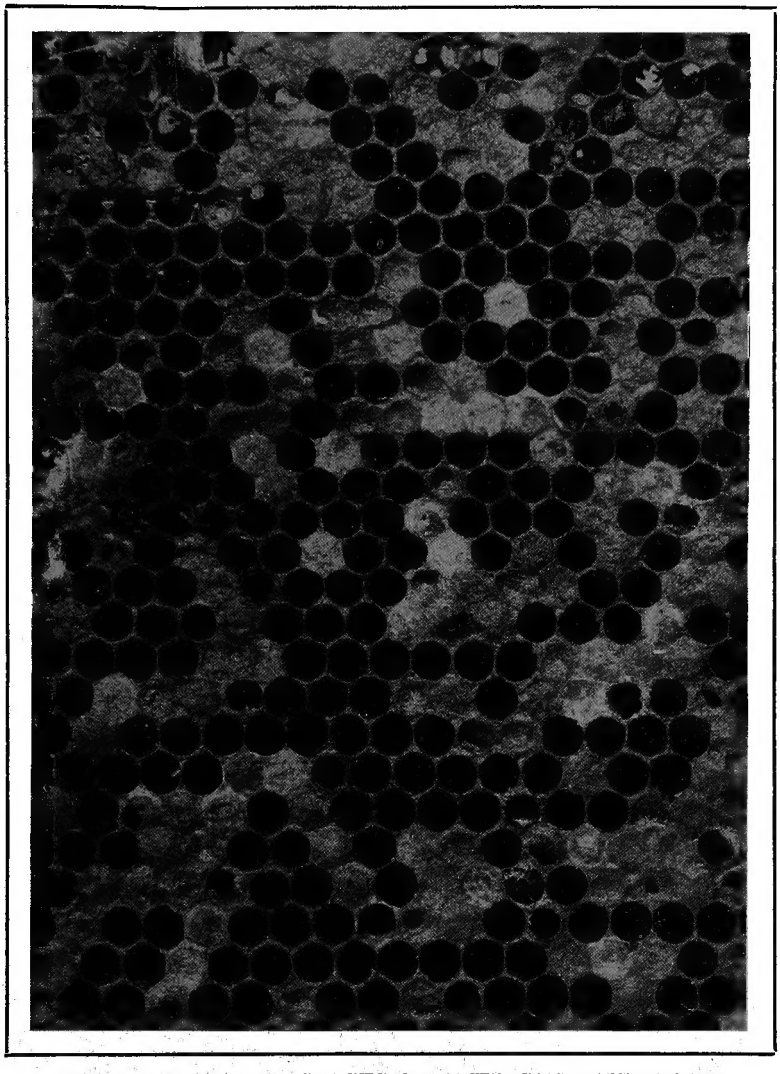


FIG. 2.—ADVANCED STAGES OF AMERICAN FOULBROOD

This frame was removed from the same hive shown in Fig. 1, July 20, 1919.

In American foulbrood there may be two or three very small punctures; and the cap may be gnawed but not entirely removed except in minute spots. In sacbrood the larvae observed soon after death have a slight yellowish tinge with the front end slightly darker. The back part of the body may remain yellowish for some time, and gradually become darker while the head portions turn almost black. Often the larvae, observed through the punctured cappings, appear brown with a reddish tinge. The body wall of the larvae does not break so easily as in the other diseases and the larvae may be removed from the cell intact. The body when ruptured appears as a granular mass with a more or less watery appearance. The larvae require a much longer time to dry down and the scales do not remain fast to the cell wall as in American foulbrood.

HOW THE DISEASES ARE SPREAD

Little is known about the method of spread for European foulbrood or sacbrood, but both of these diseases may appear suddenly in every colony in a yard. Package bees placed on empty drawn combs may develop the disease as severely as old colonies. In 1920, package bees shipped from Texas and placed on sheets of foundation developed both diseases between May 1 and June 1. The season of 1920 was favorable to these diseases and strong colonies suffered in the same proportion as weaker ones. European foulbrood disappeared as soon as the honey flow began, but the sacbrood did not disappear until the honey flow was nearly over.

The spread of American foulbrood[2] from one state to another, or over widely separated areas, is due to shipping diseased bees and infected equipment or honey.

Aside from buying diseased bees and bringing them into a disease-free territory, the buying of used hives and old combs is one of the most dangerous things a beekeeper can do. As a rule, beekeepers who have old hives or combs to sell without bees have lost their bees through disease. Old combs from such sources are almost sure to carry disease, especially if there is honey in them.

Old combs from a region in which foulbrood is known to occur should never be given to disease-free bees.

[2]Report of State Entomologist for 1917 and 1918. Bul. 20, Wis. State Dep't. of Agr.

Second hand hives and equipment should never be used without first scraping and washing them in hot lye water.

Spread of disease locally is caused by exposing infected honey to robber bees or through interchanging infected combs from diseased to healthy colonies. When the disease once appears in a yard, immediate measures should be taken to stamp it out. No risk however small should be taken by exposing a diseased colony to robbing; and diseased colonies should not be opened at all during brood rearing when bees are not able to gather nectar in the field. A single drop of honey taken from a diseased colony may be sufficient to carry the disease to a healthy colony.

After the honey flow, manipulation of diseased colonies should be left until late October when brood rearing has ceased. The danger is not so great then because the infected honey will nearly always be put in the center of the brood nest and will be consumed before the next brood rearing period begins.

Removal of Infected Honey and Combs Necessary

There is but a single principle involved in the eradication of American foulbrood. That is to destroy every living germ in a hive and eliminate all sources of reinfection.

A study of the conditions within a diseased colony shows that the adult bees are not affected, and that they do not carry the disease except in the distribution of honey which contains the bacteria or spores. When all germ-bearing honey and combs are removed from a colony of bees, the disease disappears.

A certain amount of diseased honey is carried by the bees in transferring them from the old combs to sheets of foundation, but apparently all of this honey is consumed during the first 24 to 48-hour period in the new hive.

A strong colony of bees when transferred to full sheets of foundation will, in less than 48 hours, draw out cells far enough so that the queen will lay eggs in them. They may also store small amounts of honey in cells surrounding the brood, but this honey is used up by the bees before the eggs hatch. This provides a period of at least four days for the entire consumption of the honey. Then for a period of three days, theoretically, the young larvae are not fed honey, but

FIG. 3.—ABANDONED APIARIES RESULTING FROM AMERICAN FOULBROOD

Neglect on the part of the poor beekeeper leaves such deserted apiaries as a menace to better beekeepers.

royal jelly so that their food is not subject to infection during that period except as the bacteria taken in with the food may remain in the mouth cavity of the nurse bee and become mixed with the larvae food. However, from the fact that the larvae do not show disease symptoms until after they have reached the end of the feeding stage, it is possible that infection does not take place until after the larvae are three days old. In this case there is an actual period of seven or eight days in which all of the diseased honey carried from the old brood chamber may be consumed. During this period, however, the bees will be bringing in food from the field and storing it in other parts of the hive as well as keeping a supply near the brood nest. If infected honey can be reached either in the store room or through exposed combs during the treatment of other colonies, reinfection may occur. The beekeeper then must carefully carry out every detail of the treatment and keep infected honey or combs in a tight storeroom.

No beekeeper who is careless or neglects to remove all infected honey or combs and keep them away from the bees can expect to eradicate disease from his apiary.

Why Extracting Frames Should Not Be Saved

Many beekeepers have attempted to save dry brood-free extracting combs thinking that unless brood had been reared in them they were free from disease. Brood-free extracting frames that are absolutely dry and free of small drops of dried honey do not carry the disease. Careful observations show that so-called dry combs are seldom entirely free from honey unless the colony from which they are taken has been brought near to the point of starvation.[3] If there is a fair amount of stores present in the brood chamber, bees clean up the extracting combs and usually—but not always—put the honey in a few cells. In many cases a very small amount may be left in a cell and over a long period of time, perhaps five or six months or from one season to another, these tiny drops dry out and form a very small scale which does not show in glancing over the combs. These small scales of dried honey may contain spores of the disease and when honey is again stored in these cells, the scales are softened and the spores liberated.

[3]Just how the honey in the extracting supers becomes infected is not clearly understood. During a heavy honey flow the bees deposit nectar in the brood chamber and later carry it to the supers—perhaps this is the explanation.

Where the honey from these cells is fed to the bees, a new infection is started which soon spreads to other parts of the brood nest.

In an experiment made in 1919, eight sets of "brood free" dry extracting combs taken from colonies diseased with American foulbrood were given to eight two-pound packages of bees. Sugar syrup was fed to these so that they had abundance of stores up to the time of the honey flow.

In six of these, disease did not appear at all during the season. In two others the disease appeared with the first set of brood and continued to increase until the colonies were treated in July. While only two of the colonies became diseased, the amount of disease carried was 25 per cent. Such a high percentage makes the use of dry extracting combs very dangerous.

FIG. 4.—AMERICAN FOULBROOD CAUSED A HEAVY LOSS IN THIS APIARY

In 1918 an average of 187 pounds of honey per colony was produced here. In 1919 nearly every colony was diseased and almost cleaned out due to the introduction of the disease in the fall of 1918.

Five sets of frames with foundation which had been worked on but slightly or not at all were also taken from diseased colonies of the year before and given to package bees. Sugar syrup was fed to these colonies until the honey flow began. No disease appeared in any of these colonies.

DOES SCORCHING INSURE COMPLETE DISINFECTION?

Bees do not leave honey scattered about on the walls of the hive or on frames and will immediately gather up the smallest

drop that may fall from a cell. Therefore, there is no more danger of the disease being carried on clean hive parts than on the body of the bee. If the disease is spread at all outside infected honey or combs, it would seem that the bacteria would adhere to the body of the bee and continue as a source of infection indefinitely, for we know that the spores of the bacteria may live over for several years. On the other hand, in every case where the diseased brood and infected honey is removed the disease is eliminated; and we must conclude that the bacteria are not carried over on the body of the bee. The same is true of hive bodies and frames—if they are absolutely free of honey the bacteria are not carried over on them.

In a large number of tests the hive body, bottom board and cover were taken from a diseased colony instead of from a clean hive. Clean frames with full sheets of foundation were used and the bees brushed on to them. The percentage of successful treatment was as large in every case as with scorched hive parts. The danger of using old hive bodies lies in carrying them over until the next season and not thoroughly cleaning them of drops of infected honey which may have gotten on to them after removal from the bees.

If all hive parts and frames are thoroughly scraped and washed with hot lye water so that all particles of liquid or crystalized honey are removed there is no danger of reinfection from this source.

Where a number of colonies are to be treated, hive bodies free of burr combs may be taken from treated colonies and used to shake other diseased colonies into if done at once.

Never use a hive body from a diseased colony on another colony having drawn combs without scraping and cleaning. Clean not only the inside of the hive but the outside and edges as well. Take special care to clean up all honey from behind the rabbets.

Scorching out the hive body is no safer than scraping and washing unless every inch of surface both inside and out is treated. Many beekeepers carefully scorch out the inside of the hive but overlook honey behind the rabbets or smeared on the outside of the hive.

Frames Should Be Saved

It is not economy to destroy the frames from diseased colonies except where one or two colonies out of a large num-

ber are affected and the beekeeper undertakes to stamp out the disease by destroying hive, bees and all. It is also unnecessary to scorch the frames but they must be scraped and cleaned of wax and honey. To insure the removal of particles of crystalized honey place the frames in boiling water for five minutes and dip in a second tank of boiling water. If the frames are loose a few extra nails will make them rigid.

WHY BEEKEEPERS FAIL TO ERADICATE FOULBROOD

1. Careless manipulation during the treatment.
2. Exposing diseased combs or honey to robbers.
3. Failure to remove all infected honey from the hive body or frames.
4. Failure to clean up the extractor or floor of the extracting house and storage room.
5. Leaving infected honey on the floor and then setting hive bodies in it after they are cleaned. The honey crystallizes and may remain on the hive body until put on a colony the following year.
6. Improper attention to hospital colonies such as leaving them exposed and treating after the honey flow is over. All hospital colonies should be treated before the end of the honey flow.

BRUSH BUT DO NOT SHAKE

Shaking bees from combs infected with foulbrood is a bad practice and is always likely to scatter diseased honey where bees from healthy colonies may gather it. It is possible to brush bees from combs without spilling a drop of honey. This requires but little more time than shaking. When bees are shaken out of a hive there is always some danger that stray bees carrying a load of honey may go into a neighboring hive.

Bees are attracted to loose honey wherever they find it even during a honey flow, and a few robber bees are always to be found in the yard during a heavy flow.

When the treatment is finished, burn the brush. A brush which has been used in the treatment of diseased colonies should not be used with healthy colonies. A whisk broom or a bunch of stiff grass—tied so that pieces of grass will not break off—is better to use than a brush having bristles that dip into the cells. If a whisk broom is used, get a soft one and cut out about one-half the brush part.

When and How to Treat

Do not treat bees by brushing unless there is sufficient honey coming in to keep bees from robbing. Diseased bees may be treated in the late fall after brood rearing has ceased by transferring to combs filled with uninfected honey.

FIG. 5.—THE BRUSHING TREATMENT FOR AMERICAN FOULBROOD.

Hive A is the foulbrood colony. B is the empty hive into which the brushed combs are to be placed.

Bees may be successfully treated during any period of a honey flow, but the most desirable time is shortly after the beginning of the main honey flow. This period for Wisconsin is June 15 to June 20. Diseased colonies found after the honey flow is over should be treated in late October after all brood rearing has ceased by transferring to combs of "disease-free" honey. If the operator is careful in transferring the bees at that time, robbers will get very little honey, and this will quite likely be put where the bees will use it during the winter.

Plan your work and have your hive bodies ready so that every diseased colony in the yard can be treated on the same or the following day. Melt up the combs and clean the hives at once.

The immediate removal of diseased combs and honey is the greatest insurance against reinfection. Do not store the hives over until next spring and do not bring a diseased hive or comb into the extracting house or storeroom reserved for disease free hives and supers.

If a colony is found diseased do not open it when no honey is coming in from the field. One of the most fruitful sources of infection is the exposure of combs containing infected honey or exposing diseased colonies to robbers. Colonies of bees vary greatly in the amount of robbing they do. Some colonies

are continually on the hunt for stores while others remain peacefully at home. Possibly the amount of stores has some effect but no difference has been observed here between colonies having abundant stores and those with small amounts. Diseased colonies that are weak at the end of the honey flow should be destroyed at once. As soon as the disease is found, close the hive, carry it into the cellar and destroy bees and combs immediately. Also see that none of the bees escape after they are in the cellar, for bees loaded with honey fly back to the old stand. When they do not find the old home, they will go to the nearest hive and be allowed to enter.

METHOD OF TREATMENT

Regardless of the plan to be used, the principle is the same in every case—removal of infected honey and disease bearing combs. After trying several methods of accomplishing this and observing the results, the following method seems to be the simplest and safest if carefully done.

1. Colonies that are known to be diseased should not be given extracting combs prior to the treatment. If colonies have been supered and the bees have built comb between the frames, lift off the extracting supers. Then starting with the one next to the brood chamber, draw a knife between each frame and separate it from the next. Do not do this until the super is placed back on the hive. The operator should carry a can of steaming hot water with him and drop the knife into the water while moving the supers. Be careful not to allow any honey to drop outside the hive. This operation should be done the day before treating so that the bees will clean up the edges of the comb. The job of treating will then be less messy and the chances of dropping honey outside the hive will be greatly reduced.

2. Select an empty hive body that is bee tight and nail a tight bottom to it. Then place a cover on it that can be moved freely back and forth when diseased combs are being put into it.

3. If the colony is only of medium strength, use one brood chamber with full sheets of foundation. With unusually strong colonies use two. Place an empty super on these to brush the bees into.

FIG. 6.—A SOURCE OF INFECTION FOR NEARBY COLONIES

After the bees died out from American foulbrood the wax moths entered and destroyed the combs in this hive. The honey which leaked out was a source of ready infection for healthy colonies.

4. Place the hive body which is to receive the diseased combs to the left and rear of the colony to be treated, and put the supers of foundation and empty super at the left of the diseased colony.

5. Now lift the diseased hive from the bottom board and place on a tight fitting board at the right of the old stand. Then place a queen excluding board on the bottom board still on the old stand and set the clean hives and super on top of the queen excluder. The excluder will help a great deal to keep the bees from absconding.

6. Slide the cover of the diseased colony slightly to one side. Then lift out a frame and stand it on top of one of the frames below the empty super into which the bees are to be brushed. The bees may then be brushed off, no honey will be thrown onto the frames and less honey will be carried into the new hive than when the bees are shaken from the frames. As soon as the bees are brushed from the comb, place it in the hive body at the left and cover.

If more than one hive body was on the diseased colony stack them one above the other with a bee tight board below and

the cover above. When the frames from one body have been removed, shift the empty body to the top of the hive body now holding the diseased combs and use it to hold the next set of frames.

7. As soon as a colony has been treated, remove all infected

FIG. 7.—DISEASE MEANS WASTE

In two years American foulbrood killed 120 colonies which had been producing annually 12,500 pounds of extracted honey.

combs to the storeroom before treating the next colony.

8. Do not wait until fall or winter to melt up the wax and clean the combs. Do it at once. Otherwise you are almost sure to have your yard accidentally reinfected before fall.

Even with the most careful treatment reinfection may appear in a few colonies either the same or following year. These should be treated or destroyed as soon as a few cells appear.

THE DOUBLE-SHAKE TREATMENT

Some beekeepers recommend the "double-shake method." The bees are first shaken onto frames with starters. After about four days these are removed and the bees shaken a sec-

ond time onto full sheets of foundation. This practically insures getting rid of the disease if no outside source of infection exists.

FIG. 8.—DISEASE WAS FORCED OUT

This apiarist cured 185 colonies of the disease and later had for sale 7,382 pounds of comb honey and 4,750 pounds of extracted honey.

Drawn Combs Used With Foundation

Among Wisconsin beekeepers there is a practice which is more or less doubtful as to success. When the bees are run onto full sheets of foundation, one frame at the side of the hive is left out and an old drawn comb is put in its place. The idea is that the bees store the honey they have brought with them in this comb and that by removing it the next or following day the infected honey will all be removed. The very fact that the bees store honey in this comb makes the practice dangerous. No matter how careful a beekeeper may be, he cannot open the hive and remove the comb without inciting a number of bees to gorge themselves with honey from this comb. Thus the period for using up the infected honey carried by the bees at the time of shaking has been reduced 24 to 48 hours. By that time cells will be sufficiently built out on the foundation for immediate storage of the honey carried from the old comb.

DISPOSAL OF HONEY AND BROOD FROM DISEASED COLONIES

If only one, two, or three colonies in a yard are found diseased it is better to destroy the brood at once by burning in a closed space of some kind. If a whole yard is to be treated, so-called "hospital colonies" may be made by stacking the combs from four or five colonies on top of a slightly diseased colony above a queen excluder until the brood is hatched out. Then the "hospital colonies" are treated and the brood combs from them are melted down or destroyed.

Hospital colonies kept around a yard are extremely dangerous and are likely to be a continual source of reinfection no matter how carefully they may be looked after.

Honey from such colonies should be extracted and bottled as soon as taken from the hive. All combs, including those with brood from the lower hive body of each colony, should be melted down and the wax extracted at once.

Hospital colonies should not be allowed to run longer than 21 days before treatment. The bees should be removed from the upper stories by means of a bee escape and the hive bodies removed and carried into the storeroom before treating the bottom part.

Hospital colonies should be set at some distance from the main yard and all hive bodies must be bee tight except for the entrance.

Hive bodies and hive parts from hospital colonies should be thoroughly scraped and cleaned before using on other colonies because during the period of treatment they are likely to be somewhat smeared with honey and it is almost sure to carry spores of the disease from these colonies.

THE BEEKEEPER HIS OWN INSPECTOR

Every person who keeps bees should frequently look through the brood nest of each colony to see that conditions are normal. If the appearance of healthy brood is well known, any abnormal condition will be easy to detect. If diseased or dead larvae are found, report the condition either to the local or state inspector.

A single diseased larva in the spring may result in a badly diseased colony in the fall. Such a colony may become weakened to the extent that it is robbed out and the disease scattered to many colonies in the yard.

In exceptional cases, very strong colonies are able to overcome a slight infection; and it is not unusual to find colonies in which the disease continues but does not seem to make much progress during any one season.

Cases of this kind are very rare but the danger of spread is so great that these colonies should be treated the same as other diseased colonies. Treat your own bees as you would wish your neighbor to treat his if his apiary were diseased and yours were clean.

How to Ship Samples of Infected Comb

When selecting a sample to send in for examination, be sure to get a piece of comb three or four inches square. Do not pack in a tin or paper box but use wood. A small cigar box is good.

Co-operate with your neighbor beekeeper and his neighbor beyond to locate the disease in every infected apiary. Help wipe out foulbrood by cleaning up your own yard if it is diseased. Organize a local clean-up campaign to drive the disease entirely out of your county.

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W. A. SUMNER, Agr. Journalism
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FREDA M. BACHMANN, Agr. Bacteriology
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GRACE LANGDON, Agr. Journalism
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W. B. TISDALE, Plant Pathology

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RUTH BITTERMAN, Plant Pathology
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META SCHROEDER, Agr. Bacteriology
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P. W. SENN, Genetics
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