

FIELD TREATMENT OF AMERICAN FOULBROOD IN HONEY BEES

by

JOHN FORREST GARNER

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## INTRODUCTION

American foulbrood is an infectious disease of the brood of bees, caused by Bacillus larvae. The disease is characterized by a number of symptoms no one of which should be taken alone in diagnosing a case. Among the symptoms are sunken and punctured cappings, ropiness, a characteristic dark brown color, and a peculiar foul odor. All the symptoms available should be considered in making a field analysis.

American foulbrood means death to the colony in that the larvae or pupae dry down to a non-removable scale on the lower wall of the cell. The consensus of opinion is that brood is not reared in cells containing the remains of the dead bee. Fresh nectar may be stored in these cells and the spores of Bacillus larvae become mixed with the honey. The disease spreads from cell to cell, from hive to hive and from apiary to apiary by means of this infected honey. Used equipment is another important means of spreading American foulbrood, especially the use of old combs. The non-removable scale and the spread through contaminated honey suggests the only possible way to save the colony. The treatment consists in transferring the bees from the old hive into a disease free hive and the proper disposal of the

old hive and contents by thorough disinfection. This treatment is drastic on the colony. It is safe to transfer the bees onto full sheets of foundation in Kansas. By the time the foundation is drawn out far enough to store honey the bees will have used all the honey taken from the old hive.

At various times chemicals and drugs have been recommended for treating the diseased colony but all have proved useless with the exception of formalin.

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#### HISTORY OF THE TREATMENT

American foulbrood has been known almost as long as beekeeping has existed. The symptoms of the disease were known long ago and the basis of the treatment now in use was discovered several hundred years ago.

Schirach in 1771 (5) recommended the removal of all combs and honey from the bees in treating.

Dzierzon (1) recommends that the diseased colony be driven into a clean hive and that the emptied hive be singed with straw so that other bees may not be infected by it, or suck up the honey that may still be found about it, or gnaw off the propolis and carry it into their new hive. He also recommends caging the queen to prevent absconding of the colony, and also to prevent the queen laying for a few days.

Pruess in 1868 (5) recommended the removal and burning of the frames and honey and heating the hives in an oven at the boiling point for several hours.

McEvoy (3) recommends giving starters of foundation when transferring. Four days later he removed the combs built from these starters and put in full sheets of foundation. He also recommends uniting weak colonies in treating. He says it is best to treat in the evening to avoid swarming out and mixing with other bees.

Phillips (4) describes the modern shake method of treating which is a modification of the McEvoy treatment. He recommends using only strips of foundation when the bees are shaken only once.

#### DIAGNOSIS

The diseased colony may or may not be weakened, depending upon the length of time of the infection. If the

colony has been infected recently it may be strong but if it has been diseased for several months it may be very weak. It is principally the worker brood which is attacked. Rarely are the queen and drone brood attacked. The brood is irregular in appearance due to the fact that no bees emerge from the diseased cells. The disease becomes apparent in the sealed brood stage. The cappings are generally sunken, punctured, or darkened. A frame of diseased brood is often described as having a "pepperbox" effect, due to the ragged holes in the cappings.

The color of the dead larvae varies from a yellowish or light brown color to a dark brown depending upon the stage of disease. In the early stage of the development of the disease the color is yellowish to light brown. As the larva or pupa dry down to a scale the color deepens to a dark chocolate brown.

In the advanced stages of the disease the dead bee is a shapeless mass having an oily, boiled-down appearance, lying lengthwise along the lower wall of the cell. In the early stages of the disease the larva or pupa is little changed in size and shape from the normal healthy brood. When death does not take place until the pupal stage, the distal end of the proboscis is often found adhering to the upper cell wall. If a toothpick, match or a similar object

is thrust into the larva or pupa, stirred around and then removed, some of the contents will rope out. This roping varies from about one inch to several inches in length. The "rope" is not lumpy, except in the earlier stages of the disease, but is of a smooth, even consistency. The mass dries down to a hard dark brown scale which adheres firmly to the lower cell wall. This scale cannot be removed from the cell without breaking the cell wall.

In order to see the scale of Bacillus larvae it is better for the observer to stand with his back to the light and hold the diseased frame in front of him at an angle so that the light will strike the lower cell wall from above.

American foulbrood in the advanced stages has an odor similar to a poor grade of glue which is heated. White (8) simply calls this the foulbrood odor.

If American foulbrood is suspected in a colony it can be definitely determined by means of smears made from the diseased brood or from the scale. According to White (8) a very large number of spores free from rods with no other bacterial species present is the characteristic microscopic picture. The vegetative form is a slender rod with a tendency to grow in chains. Bacillus larvae is a spore forming bacteria which is resistant to heat. No one symptom can be depended upon for the determination of the disease. All should be considered. If in doubt upon an examination of

the combs, microscopic mounts should be made from suspected material.

### GENERAL PROCEDURE IN TREATMENT

About the same general preparations for treatment are to be made for each method of treatment used. When preparing to use any one of the methods be sure that all details necessary are taken care of for the success of the treatment.

#### Time to Treat

Treatment should always be made during a honey flow. Chances for robbing are very slight at this time. Honey may be exposed a long time during a honey flow without being noticed by a bee. Treatment should also be made between the time the bees begin work in the morning and the time they stop in the evening. Treatment may be done at dusk or after but the bees have a tendency to crawl. Warm sunshiny days rather than cool cloudy days are better for treating. Bees do not react to smoke on cold days but have a tendency to cling to the combs.

#### Hives

For each colony to be treated there should be prepared a disease free hive. This hive should be equipped with new frames and full sheets of foundation. A strip of queen ex-



cluder should be put in the entrance of the new hive after treatment is completed to prevent absconding of the colony. The old method was to use strips of foundation for starter instead of full sheets but it has been proven that there is no danger of reinfection by the use of full sheets of foundation. All the honey carried by the bees from the diseased hive to the new hive is used in drawing out the full sheets of foundation and none is left for storage in the cells.

#### Disposal of Old Hives and Contents

After a transfer is completed the few remaining bees should be killed. This is easily done by shaking a small amount of calcium cyanide into the old hive. The hives should be made bee-tight at once or placed in a bee-tight building until disposal can be made.

If only a few colonies are treated it is generally the best plan to burn the frames and combs. Honey should never be burned on the surface of the ground, before it has become sterilized, for it will run on the ground and be picked up by the bees. A better plan is to burn the combs in a pit. A pit three feet in diameter by one and one-half feet deep is large enough in which to burn two to six colonies. If the pit is too small the honey will run over the sides.

When ready to treat the colonies a good fire should be made in the pit. Then as each of the hives is treated the frames are thrown upon the fire one by one as consumed. As the combs melt down the honey will collect at the bottom of the pit where it will boil. When the frames and combs are completely burned the pit should be well covered with earth to a depth that will not likely be uncovered.

If the hives are in poor condition it is best to throw them on the fire with the combs and honey. When the hive bodies are worth saving they may be stacked up on a bottom board six or more high, painted with kerosene or gasoline on the inside and burned until it is dark brown in color. A small amount of straw or paper thrown into the hives aids in starting the fire. After the fire is going well a cover may be put on, but leaving an air space. This permits the hives to burn well. When the hives have been sufficiently burned the cover can be put on tightly to smother the fire. The two lower bodies many times are not heated sufficiently to sterilize them, therefore, they may be put on top of a second stack. It is a good idea to remove all metal rabbets from the hive bodies before burning. All hive bottoms, metal covers, and supers should be disinfected by heat.

Many beekeepers do not like to sacrifice drawn combs by burning since they are valuable. If a large number of

colonies are to be treated it may be worth while to try to save the combs. A practical way to do this is to extract the honey, wash the combs in water, and then treat them with one of the recommended formalin treatments, Vansell (7) and Hutzleman (2). All equipment used in connection with the contaminated honey should be thoroughly sterilized. Jay Smith (6) has indicated a method whereby the combs may be treated, without uncapping the honey and brood cells, at a very small cost per comb. Some bee-keepers wish to save wax by rendering the diseased combs. It is necessary to boil the wax under slight pressure for thirty minutes to kill the spores of Bacillus larvae. Before honey from diseased combs is safe for feeding or other disposal it should be diluted one-half with water and boiled for one-half hour in a closed container. This container should not be more than three-fourths full.

Precaution should always be taken in manipulation of equipment to have the diseased colony exposed as little as possible.

#### METHODS OF TREATMENT

The methods used are not altogether original with the author. General ideas concerning the treatments were obtained from bee-keepers and the value and details were worked out by experiment.

### Shake Method

After shaking, in addition to a clean hive, a bee-tight hive or box will be necessary in which to put the frames of honey and brood. Several newspapers should be in readiness on which the bees are to be shaken in front of the clean hive.

The diseased colony (Plate I, Figure 1, A) is now set to one side out of direct flight of field bees and the disease free hive (B), set exactly in its place. Several thicknesses of newspaper are put in front of the disease free hive (B), in such a manner that they extend under the bottom board a few inches. A weight or stone on each corner of the newspaper prevents the wind from blowing it around. Any thin nectar which falls during shaking will fall upon the newspaper and can be easily burned. The diseased colony (A) is now opened, the frames taken out one by one and shaken. The ends of the top bars are held by the tips of the fingers, and with a quick movement upward, followed by a downward shake, the bees are dislodged. The first frame is shaken at the entrance to permit the bees to locate the new hive. They then fan their wings and attract the other bees to the location. As soon as the frames are shaken they are put into the bee-tight hive (C) and covered quickly to pre-

vent robbing. Then the empty hive and bottom board are given a jar over the paper and the bees dislodged. If very little thin nectar is in the diseased hive, only a few thicknesses of newspaper are needed, while if much nectar is present several thicknesses are required to keep the nectar from soaking through the paper.

If the queen is located during the operation it is a good plan to place her gently at the entrance of the disease free hive, for a queen heavy with eggs is easily injured in shaking. After most of the bees are inside the hive the queen excluder or strip of perforated zinc is put across the entrance. This will prevent abscondence since the queen cannot leave, while at the same time the workers can leave and enter the hive.

There are two main sources of spread in using the shake method, the drifting of bees from the diseased colony to other colonies, and the scattering of honey in shaking. Re-infection may be caused by the scattering of honey which is later picked up by honeybees. A revision of Farmers Bulletin, 1084, "Control of American Foulbrood," by U. S. D. A., is to appear in the future. They recommend shaking be made inside the hive rather than in front of it. They also recommend putting an old worthless drawn comb in the hive for storing the honey. This comb is to be left in the hive for twenty-four hours and then taken out and destroyed.

This is all very good in case of careful beekeepers but it will not work for beekeepers in general. They will be careless and leave the comb in too long or will try to save the drawn comb regardless of the dangers of reinfection.

Seventeen colonies were treated by this method. No reinfection or spread resulted, but four colonies were queenless and one absconded. The case of abscondence can be accounted for in that no queen excluder was put in the entrance of the clean hive after treatment. The queenlessness probably resulted from shaking the queen from the frames onto the ground in front of the hives. The person treating does not have time to look for queens since it is necessary that this treatment be completed as quickly as possible.

This method cannot be used in case of box hives.

#### Smoke Up Method

The diseased colony is left on the old stand and the cover and inner cover removed. The disease free hive (Plate I, Figure 2, B) without bottom board is placed upon the old hive (A). To keep the old hive and the disease free hive from coming in direct contact with each other a rectangular piece is cut out of the center of several thicknesses of newspaper, the piece being a little smaller than the inside dimensions of the hive. The piece of paper left is similar to a gasket used between a cylinder head and the

block of a motor. The gasket of paper is placed between the disease free hive and the hive containing the diseased colony. It is well to have an empty super or empty hive body (C) on top of the disease free hive to give the bees more room. A screen cover is then placed on top of the empty super. This screen cover is made by tacking common window screen upon a wooden frame of the same length and width as the hive body. The screen cover will allow the surplus smoke to escape, otherwise so much smoke will remain there that the bees will be disorganized and partially suffocated. Smoke is blown in at the entrance of the old hive. Only a moderate amount of smoke should be used. Too much smoke is likely to disorganize the colony and the bees will not move upward. Drumming helps to get the bees to go upward. This can be done by beating upon the hive body with a stick or similar object. If drumming is used then less smoke is required to transfer the bees.

This method requires a much longer time to perform than the other methods described. The bees are slow to react to the smoke. This is probably due to the fact that both hive bodies are soon filled with smoke and the bees are moving from a place where the smoke is more concentrated to where it is less concentrated.

When most of the bees have moved upward the old hive is moved from under the disease free hive. A clean bottom

board is put upon the old stand and the disease free hive containing the bees is placed upon it. The screen cover can now be removed and a disease free hive cover put on. The empty super may be removed after the bees have become quiet. Bees are likely to collect in large numbers on the top bars of the frames of the diseased hive and also toward the back of the frames and when the old hive is removed many bees remain in it. They collect on the top bars of the frames partly due to the fact that it is hard for them to go on up and partly because the smoke is almost as concentrated in the disease free hive body as it is below. The bees collect on the frames toward the rear of the hive because in smoking the smoke goes in at the entrance and then drifts upward. Smoke does not penetrate to the rear of the hive as readily as to the front unless blown in with force.

Full sheets of foundation should always be used when this method is in operation. If only starters of foundation are used there will be nothing for the bees to get hold of in going upward and therefore the only way they can move upward is on the end bars and the sides and the ends of the hive body.

In treating by the smoke up method reinfection may occur due to the fact that it takes quite a long time to run the bees up into the clean hive. The bees fill up on honey



and may have some left for storage after the foundation is partly drawn out. Spread of the disease may occur for when the old hive is taken away many bees are amassed on the tops of the frames. They are disorganized and when they fly are likely to drift to other colonies. Having loads of honey they will be readily admitted by strange colonies.

Twelve colonies were transferred by this method. Upon reinspection, one colony was found to be reinfected with American foulbrood. Two colonies absconded and no spread resulted. The case of reinfection was probably due to the slowness of the method, since there were no colonies of bees within one mile of the reinfected colony. The bees have ample time to fill up on contaminated honey before they enter the disease free hive. Abscondence in this method is most likely due to two factors. Queen excluders were not used and the bees were in weakened and disorganized condition after treatment.

#### Smoke Down Method

By this method the bees are smoked downward from the diseased hive into a disease free hive. A gasket of newspaper is prepared as described in the smoke up method.

The hive containing the diseased colony is moved from its stand and set to one side. The disease free hive without cover and inner cover is put upon the old stand. A puff

of smoke is now blown in at the entrance of the diseased colony and then the bottom board removed. The gasket of newspaper is now put on the disease free hive and the old hive (Plate II, Figure 1, A) set upon the disease free hive (B). The gasket of newspaper prevents any contact whatever between the disease free hive and the hive containing the diseased colony. The cover is removed from the old hive and the inner cover moved forward about two inches. Smoke is gently puffed in at this opening and the bees driven downward. After the bees are started down at one end, the inner cover may be moved back and smoke puffed in at the other end. Then the inner cover may be removed and smoke blown where needed over the frames. One precaution to take is not to smoke too vigorously. If smoke is blown in too fast the bees will move fast and pour out the entrance of the disease free hive. This method seems to work somewhat better if two empty disease free hive bodies with full sheets of foundation are used. This is especially true of strong colonies. This precaution gives the bees more space to move into and will eliminate the rushing of the bees out the entrance.

The chances for reinfection or spread by this method are very slight. Very few bees leave the hive and no drifting occurs. The bees move quickly from the old hive to the

disease free hive and therefore take up only a small amount of honey.

Twenty colonies were treated by this method. No reinfection or spread resulted. Two were not reinspected. Two colonies absconded and one was robbed out late in the season. The colonies which absconded were without queen excluders in the entrances. Not all colonies abscond without queen excluders.

#### Bottom Board Method

The bottom board method is correctly named in that the bees are smoked across a bottom board, from the diseased hive, into the disease free hive. The diseased colony is moved from the stand and a disease free hive (Plate II, Figure 2, B) is placed upon the old stand. Then a bottom board is placed in front of the disease free hive so that it forms a level platform with the bottom board of the disease free hive. The diseased colony (A) is placed upon the bottom board with its entrance facing the entrance of the disease free hive. The cover is then removed from the old hive and smoke blown in underneath the inner cover. After the bees start down and out the entrance, the inner cover can be removed and smoke blown in where needed over the frames. The bees are easy to drive from the old hive by this method but hard to make enter the disease free hive.

They usually pour out the entrance of the old hive and move out in several directions. They collect on the sides and underneath both hives, and under the bottom board. This method proved unsatisfactory so the "chute" method was developed.

Three colonies were treated by this method resulting in two cases of abscondence and no reinfection or spread. This method proved very unsatisfactory, therefore, only a few colonies were treated.

#### Chute Method

The old hive containing the diseased colony is moved from its stand and the disease free hive is put in its place. An inner cover with the hole closed is raised to the level of the bottom board and to the entrance of the disease free hive by putting small pieces of boards or other objects beneath it, (Plate III, Figure 1). Two small boards (Figure 2 B) about ten inches wide are now nailed to the sides of the disease free hive (Figure 1, A) and to the sides of the inner cover but not to the diseased hive. This forms a pen or chute and prevents the bees from going beneath the hive, or from clustering on the sides. If the inner cover and the bottom board of the disease free hive do not come flush together the open space may be filled with pieces of burlap or cloth. The cover and bottom board are taken from the old

hive. The old hive is now placed on end upon the inner cover so that the top bars of the frames are facing outward and then the side boards are nailed to it, (Plate III, Figure 2, C). It is essential that the top bars of the frames face outward for often there is a great deal of bur and brace combs present, and if the hive is turned the other way it will be more difficult for the bees to get out when smoked. The bees are now smoked, the smoke being blown in first from the upper end of the top bars. This will have a tendency to drive the bees downward and toward the chute. As the bees begin coming out they are likely to collect on the bottom of the frames. They are brushed from the frames and toward the entrance of the disease free hive. The person treating is able to operate the smoke with one hand and use the brush with the other. If the entrance to the hive is small the bees are likely to crawl up the front of the hive and up the sides of the chute. A large entrance will eliminate this difficulty. It is easy to see when all the bees are out of the old hive. This method is quick, few bees fly into the air, and only a very few remain in the old hive when the treatment is finished. It is absolutely essential that the chute is bee-tight. Otherwise the bees will get under the hives, cluster on the sides of the hives, or on the outside of the chute.

By this method there is practically no chance for rein-

fection. Very few bees get into the air so there is little chance for spread by drifting bees.

If the colony is in two hive bodies it will be difficult to carry out the treatment as described above. Instead the hive containing the diseased colony is set in the chute so that its entrance faces the entrance of the disease free hive. The chute is then made bee-tight and the bees smoked downward and out the entrance of the old hive into the chute. This modification of the method was used with very good success.

Ten colonies were treated by this method resulting in no reinfection or spread and four cases of abscondence. Three cases of abscondence resulted from transferring bees from box hives into box hives. Bees should never be transferred into boxes for box hives are a violation of good bee-keeping practices. The other case of abscondence was probably due to the fact that no queen excluder was placed in the entrance of the hive.

#### Smoke Over Method

The smoke over method consists of smoking the bees from the hive containing the diseased colony, up and over the top rear end of the hive and in at the entrance of the disease free hive.

The diseased colony (Plate IV, Figure 1, B) is moved directly forward from its stand until the rear of the hive clears the position where the entrance was formerly located. The box (C) is placed on the old stand and the disease free hive (A) put on it in such a position that the entrance is level with the top rear end of the old hive. If the box is not of sufficient size, blocks or pieces of board may be used to elevate the entrance until it is level with the top rear end of the old hive.

When the hives are in position as explained the cover is removed from the diseased colony (B) and the inner cover is moved forward about two inches. The hole which is sometimes used for a bee escape is covered. Smoke is then blown in at the entrance of the diseased colony, only a moderate amount of smoke is necessary. Furious smoking will only tend to disorganize the colony. Soon after smoking has been started the bees will begin to appear at the top and rear end of the hive and to cross over into the disease free hive (A). Once started the bees readily enter the disease free hive. Few bees enter the air and the person treating can see the reaction of the bees at all times. One decided advantage is that the queen may nearly always be seen when she enters the disease free hive. When the bees seem to have all or nearly all entered the disease free hive the inner cover should be removed and shaken at the entrance of

the disease free hive, for sometimes bees collect on the under side of it. If at any time the bees seem to be collecting on the under side of the inner cover they may be caused to move out by drumming or rapping on the inner cover.

After the treatment has been completed the box (C) is removed and the disease free hive (A) is lowered to the stand formerly occupied by the diseased colony.

Conditions are similar in the smoke over method and the smoke up method in that the bees are being smoked upward, but they do not react the same in each case. In the smoke up method the bees are going directly upward into the disease free hive, from a place where the smoke is concentrated to where it is less concentrated. The conditions are not the same in the smoke over method for the bees go up and out over the top rear end of the old hive into the new hive. They are moving from a place where smoke is present to one where there is no smoke.

Seven colonies were treated by this method. There was no reinfection or spread. There was one case of queenlessness. This method proved to be very satisfactory. The bees move quickly from the old hive and readily enter the disease free hive.

#### Burning

If upon examination of the diseased colony it is found



to be too weak to be worth while treating it is often advisable to burn. For this a pit is dug, as described in the general procedure for treatment, on suitable ground where no plants or trees will be injured and in such location that a serious fire cannot be started.

Before burning, the bees are killed. This is easily done by shaking some calcium cyanide over the frames and then replacing the cover. Sulphur burned in the smoker has been recommended for killing the bees in the hive. This is very unsatisfactory for it is slow, inefficient, and very disagreeable. As soon as the bees are dead the frames are taken from the hive and thrown upon the fire. The fire should be started sometime before the frames are thrown on so that they will burn quickly. Care should be taken to spill no honey when the frames are put on the fire. If the bees are not killed before the colony is burned a large number will drift to nearby colonies. They will be well filled with honey and therefore will be readily admitted by strange colonies. Care should be taken that all dead bees are burned along with the honey.

Colonies found diseased late in the season will not live through the winter after treatment unless fed, and therefore should be burned. Also if only one colony is found to be infected in an apiary, it may be advisable to burn and thus insure a clean up.

Many empty diseased hives and combs were burned. This is essential for a thorough clean up. Seventeen colonies were burned resulting in no spread or reinfection.

#### REINSPECTION

All colonies were reinspected between three and six weeks after treatment. The colonies which were treated were thoroughly examined for reinfection and all surrounding colonies were inspected for any possible spread.

#### EXPLANATION OF TABLE I

Table I, included in this thesis as pages 25 and 26, gives the results of the treatments in condensed form. The table gives the methods used, dates of treatments, types of hives used, number of colonies treated, the time of day when treated and the results obtained.

#### CONCLUSIONS

1. With the equipment on hand the smoke down method, the smoke over method, and the chute method prove the most satisfactory.
2. The smoke down method and the chute method work very well for box hives.
3. The smoke up method and the bottom board method are rather impractical.

Date of Treating	Shake Method				Chute Method				Smoke Over Method			
	Type of Hive	Num-ber	Time of Treatment	Results	Type of Hive	Num-ber	Time of Treatment	Results	Type of Hive	Num-ber	Time of Treatment	Results
May 27												
May 31												
June 1												
June 7												
June 9	S	5	P.M.	1 absconded 2 queenless 2 no reinfection No spread								
June 11												
June 13												
June 15												
June 20					S	2	2 P.M.	No reinfection No spread				
June 20					S	1	5 P.M.	No reinfection No spread				
June 21					Box	1	10 A.M.	No reinfection No spread				
June 21					S	1	2 P.M.	No reinfection No spread				
June 22												
June 23	S	3	P.M.	2 queenless No reinfection No spread	S	1	P.M.	Absconded No spread				
June 28	S	2	2 P.M.	No reinfection No spread								
June 28					Box	1	7 P.M.	No reinfection No spread				
June 29												
July 5					Box	3	P.M.	3 absconded No spread				
July 6	S	1		No reinfection No spread								
July 7												
July 19									S	1	10 A.M.	No reinfection No spread
July 21									S	5	P.M.	1 queenless 4 no reinfection No spread
July 26												
July 29	M.D.	5	8 A.M. to 12 A.M.	No reinfection No spread								
August 17												
September 6									M.D.	1	4 P.M.	No reinfection No spread
September 17												
September 20												
September 21	S	1	5 P.M.	No reinfection No spread								
Totals		17				10				7		

Date of Treating	Smoke Up Method				Smoke Down Method				Bottom Board Method			Burn Method	
	Type of Hive	Num-ber	Time of Treatment	Results	Type of Hive	Num-ber	Time of Treatment	Results	Type of Hive	Num-ber	Time of Treatment	Results	Number Treated
May 27					S	3	10 A.M. to 12 A.M.	No reinfection No spread					
May 31	S	6	9 A.M. to 1 P.M.	2 absconded 4 no reinfection No spread									1
June 1													1
June 7					S	2	A.M.	No reinfection No spread					1
June 9					S	1	A.M.	No reinfection No spread	S	1	A.M.	Absconded No spread	3
June 11	S	2	A.M.	2 absconded No spread	S	4	P.M.	No reinfection No spread					
June 13					Box	1	6 P.M.	Absconded No spread					
June 15					S	2	3 P.M.	Not reinspected					1
June 20													
June 20													
June 21													1
June 21	S	1	5 P.M.	Reinfected									1
June 22					S	2	10:30 A.M.	1 absconded 1 no reinfection No spread					
June 23													
June 28	S	1	3 P.M.	No reinfection No spread	S	1	4 P.M.	No reinfection No spread					1
June 28	Box	1	8 P.M.	No reinfection No spread									
June 29					H.M.	2	5 P.M.	No reinfection No spread					
July 5	Box	1	P.M.	Absconded No spread									1
July 6													
July 7													1
July 19													2
July 21									Box	1	P.M.	Absconded No spread	2
July 26									M.D.	1	8 P.M.	No reinfection No spread	
July 29													
August 17													1
September 6													
September 17					M.D.	1	7:30 P.M.	Robbed out					
September 20					S	1	5 P.M.	No reinfection No spread					
September 21													
Totals		12				20				3			17

4. The shaking method is not to be recommended unless the colonies are isolated because honey is likely to be scattered, bees drift, and a high percentage of queenlessness results.

5. After treatment is made queen excluders should always be put in the entrances of hives.

6. Treatment should be made only on warm days during a honeyflow. Unfavorable results are obtained when treatment is made during cold rainy weather.

7. The spread of American foulbrood cannot always be definitely determined the same season in which treatment is made, by inspecting the colonies in the immediate vicinity of the treated colony. If the infected honey is picked up by honeybees it may be stored in a super or in a part of the hive where it will not be used for brood rearing until the next season.

8. If all bees, honey, and brood are burned a thorough clean-up is insured.

## PLATE I

Figure 1. Photograph showing the position of the hives for the shake method:

- A. Diseased colony
- B. Disease free hive
- C. Bee-tight hive

Figure 2. Photograph showing the position of the hives for the smoke up method:

- A. Diseased colony
- B. Disease free hive
- C. Empty hive body

PLATE I



Figure 1



Figure 2

## PLATE II

Figure 1. Photograph showing the position of the hives for the smoke down method:

A. Diseased colony

B. Disease free hive

Figure 2. Photograph showing the position of the hives for the bottom board method:

A. Diseased colony

B. Disease free hive



PLATE II



Figure 1



Figure 2

## PLATE III

Figure 1. Photograph showing the first steps in the arrangement of the equipment for the chute method:

- A. Disease free hive
- B. Side board nailed to the hive  
and the inner cover

Figure 2. Photograph showing the position of the hives for the chute method:

- A. Disease free hive
- B. Side board in place
- C. Diseased colony

PLATE III



Figure 1



Figure 2

## PLATE IV

Figure 1. Photograph showing the position of the hives for the smoke over method:

- A. Disease free hive
- B. Diseased colony
- C. Empty hive body

PLATE IV



Figure 1

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