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Gift B.A. Slocum
7/11/1928

FOUL BROOD:
ITS
ORIGIN, DEVELOPMENT
AND CURE.

BY ALBERT R. KOHNKE,
YOUNGSTOWN, O.

YOUNGSTOWN, OHIO:
YOUNGSTOWN PUBLISHING COMPANY.
1882.

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PREFACE.

HAVING been engaged in apiculture quite extensively in Germany, and on a smaller scale in this country, I have been in the position to notice the sad havoc foul brood has worked, in Europe as well as in this country ; being also in the possession of extensive material, in the shape of essays, reports and manual extracts of day-books kept by bee-keepers engaged in curing this disease, furnished me by friends and acquaintances ; and being also aware that foul brood prevails more or less in almost every State in the Union, I have ventured to offer the bee-keeping public a concise method, delineated in these pages, by which they will be enabled successfully to combat this dreadful malady. I have drawn on the experience and experiments of the most noted scientists and apiarists of Germany, such as Professors Kolbe, Cech, Fischer, Preuss and Lamprecht, but especially Hilbert and Schoenfeld, to whom the bee-keeping fraternity of the whole world is indebted for their efforts and final success of curing foul brood, and to whom I offer my sincerest thanks.

THE AUTHOR.

GENERAL HISTORY OF FOUL BROOD.

It is generally conceded that apiculture is an important factor in the economy of nature, assisting greatly in the fertilization of plants, without which they would bear no fruit; that is, seed. But besides this, the proceeds from a well-managed apiary very frequently are equal to, sometimes exceeding that of the same number of acres, as colonies are kept. Many good farmers and horticulturists are also extensive bee-keepers, and quite often make more money out of their apiaries than out of the ground they till. This has induced many to make apiculture their sole occupation, and, if well managed, has generally proven to be a success. But the apiarist has to contend with many disasters which threaten to ruin his colonies, chiefest among which is probably brood pest, generally called foul brood.

This disease seems to have been known since bees were domesticated, having been mentioned by ancient writers on apiculture. It will quite often ruin and annihilate the apiaries of extensive countries in a very short time, if not stayed in its progress. To combat this pestilence different ineffective nostrums, spices, tea and coffee were used, without success of course.

Not before the investigations of men like Fischer, Hilbert, Lamprecht, Preuss, Schoenfeld and others threw some light on the subject as to the nature, cause and development of this malady, was it possible to discover a remedy and successfully combat this disease.

Immediately after its discovery as being of a putrifactive nature caused by Bacteria, different antiseptics were tried, especially Phenol and Thymol. But these would either kill the bees if used in solution strong enough to destroy bacteria; or, if diluted so as to be harmless to bees, would not kill bacteria of foul brood.

Not until salicylic acid had been discovered by Professor Kolbe as an antiseptic, and recommended by others to try it in foul brood, was there a shadow of hope.

Mr. Hilbert, whose apiary was affected with foul brood in its worst type, finally went to work and gave salicylic acid a severe

and thorough test; and, after many failures, he discovered at last a method leading to success, ridding his apiary of disease entirely. But as yet he was the only one claiming success, and when he went to proclaim the same before the National Bee-keepers Association of Germany and Austria, he found few believers; the more so, as others had—or said they had—tried the remedy and failed, at the same time advising the use of other antiseptics better adapted to the purpose. But most or all of them used or recommended were so poisonous and of such a strong odor that the bees were either killed or left the hive, and nothing short of an inodorous and non-poisonous disinfectant would do, if such could be discovered. This was accomplished by Professor Kolbe, of Germany, who found in salicylic acid a substance possessed of these properties. Mr. Hilbert, on being informed of these properties of salicylic acid, not only disinfected his hives, bees and comb, but mixed it in with honey, which he fed his diseased colonies, thus disinfecting his bees internally as well as externally. Though final success has been proven to be readily attainable, it has also been proven that it requires the utmost care, perseverance and intelligence to reach the desired goal. These quite a number of bee-keepers do not exercise, and, after a few superficial, careless trials with salicylic acid, give it up in disgust. They take into consideration only the *cost of curing*, objecting to buy good honey or sugar and medicine, to effect a cure internally as well as externally, thinking to rid themselves of all further trouble by cremation. How futile this latter process proves to be they discover very soon, for one colony after another will be infected and succumb, until nothing is left but empty stands to tell the sorry tale of misfortune of their former occupants, and their owner's want of care, precaution and perseverance—such desolate apiaries, as well as the surrounding country, being entirely unfitted to begin anew for a long time after. Besides that, cremation of useful objects—especially such as bees are—is barbarous, and betrays but a limited degree of intellect; the more so, when proper remedies are *known*, to apply which the bee-keeper is too lazy and careless. It reminds one of the dark ages, and does not correspond exactly to our present ideas as to the study of the healing arts; nor would such a disciple of cremation like to be treated the same way by some humane M. D., under similar circumstances, to prevent the spreading of disease, like yellow fever, small-pox, etc. If some should be narrow-minded enough to rejoin that we, as man, may dominate over animal creation and

protect our own interest, they forget entirely that their own body is as much an animal as the body of a horse or bee, and subject to the same general laws of contagion and decomposition.

But even if the bee keeper exercises all care and patience, he may not succeed if he pursues methods of treatment which are obtained by general remarks or short essays only in bee papers or conventions. Some of the first trials with salicylic acid in 1875 failed, because the acid had been used in the form of a powder and concentrated solutions to dust and wash the hive—the bees leaving the hive immediately after it had been introduced. So, in this country, quite a number of bee-keepers claim to have tried the remedy without avail. Now, if they had given a short outline of the method they pursued, their mistakes might have been readily pointed out. Hence the assertions of bee-keepers to have found salicylic acid of no use, prove, if anything, that they have used the remedy without care and method; for, as long as there are reliable and experienced bee keepers who are successful in this direction, assertions to the contrary prove nothing. Aside from the quantity of the acid employed, the quality is of as much importance. It must be absolutely *pure*. Another point to be observed is the proper solvent. It is well known that salicylic acid does not readily dissolve in water, but very much so in alcohol; but alcohol of 95 per cent. —0.8157 spec. gr.—(for such should be used), costs 40 cts. a pint; in addition to this, the cost of salicylic acid, which is 50 cts. an ounce, seems to some bee-keepers expensive medicine; and to make the acid soluble in water (*cheap* is the watchword), some saving bee-keepers add another chemical to it, which they have heard has that desirable property, to-wit: to make the acid soluble. To attain this object, borax has been advised by some as the proper solvent in addition to water; the more so, as it is possessed of the same property as salicylic acid in destroying bacteria. A little knowledge of chemistry and medicine would have prevented such mistakes. It is here the place, I think, to show the fallacy of that combination.

I. It is well known that there are quite a number of remedies to arrest or prevent fermentation and putrefaction, as also the formation of animal or vegetable fungoid growth. To satisfy the curious, I will name a few of them: All mineral acids, wood vinegar, salt, common vinegar, strong solution of sugar, arsenic, corrosive sublimate, creosote, phenol, thymol, borax, as, also, salicylic acid. Each of these has its own sphere of application. Not *one*

of them may be used, under *all* circumstances, insuring success. Some are too poisonous to be used in septic diseases of the living animal organism; others are ineffective in certain diseases. Some of the less poisonous have been tried to cure foul brood without the least success; especially has that been the case as to phenol and thymol, as, also, borax.

II. It is also well known, especially to the medical profession, that acids and alkalies are incompatible; that is, if one is given as a medicine, to produce a certain effect, as a general rule the other must be avoided. There are exceptions, of course, which may be stated thus: If the acid to be used as a medicine is very strong, a weak alkali may be permissible without interfering with the action of the medicine, and *vice versa*.

III. It is also well known that chemicals used as remedies or medicine, which would, on mixing, exchange component parts, can not be given together, and should not be mixed.

Now, what is borax? Answer: Biborate of soda; that is, a chemical combination of two parts of boracic acid and one of soda. Those conversant with chemistry know that, in aqueous solutions, boracic acid is one of the weakest acids known, and, also, that soda is one of the strongest alkilies. Now, let us see what takes place on mixing these two chemicals, salicylic acid and borax. Salicylic acid decomposes the borax, to illustrate which I will subjoin the following diagram:

Borax — { biborate of _____ boracic acid free in solution.
 { Soda _____
 { Salicylic acid _____ salicylate of soda.

It will be seen by the above diagram, that, instead of having salicylic acid and borax in solution, we have boracic acid and salicylate of soda (or sodium). But it is well known that salicylate of sodium is entirely worthless as a disinfectant, which is true, not only of this chemical, but of all other salts of salicylic acid. The acid itself must be employed if a reliable disinfectant is desired, to corroborate which, I refer the reader to the article on SALICYLIC ACID in the Dispensatory of the United States, 1877, 14th Edition.

It is quite a matter of course that attempts to cure foul brood by such a compound could not but be accompanied by entire failure. Those claiming to have been successful with it, probably never had a case of genuine foul brood.

By employing the solutions I shall recommend, and by strictly observing all precautionary measures mentioned, the affected colo-

nies will be cured, without disturbing the bees too much, or driving them out of their hives by the use of obnoxious chemicals, nor will the bee-keeper be compelled to resort to burning his bees, hives, wax, honey and implements, and thus incur a double loss. But the capability of reproduction is so enormous with this contagion, that its existence is made impossible only, if the process of disinfection is gone through with every six days, until cured (three days would be preferable), to effect which it will require from three to six weeks, according to the stage of the disease and size of colony.

That bee-keeper who has neither the time nor the ambition to spend money and work to persistently observe the method delineated in this pamphlet, will certainly make a failure of his weak attempts at curing his diseased stocks, and he must not blame the method, but himself. It is his fault, if his apiary and the surrounding objects have the odor of decaying animals. He will ever after be unfit to engage in bee-keeping, for the contagion will adhere to his house, yard, clothes and implements, and no re-stocking will be of any use, but will prove to be an additional loss to the one already sustained, caused by a lack of persistency to attain a certain object. And any bee-keeper who would sell, out of an affected apiary, bees, queens and honey, should be regarded as a criminal, amenable to the law as such, for he endangers the health and property of his fellow-man. The pretext of ignorance should not excuse any one, as it does not elsewhere.

INDICATIONS OF FOUL BROOD.

Before foul brood makes its actual appearance certain signs forestall the disease, which, though a sign of some other irregularities in a colony, will admonish the bee-keeper to be cautious. First—The colony is not as industrious as others of the same size and stamp. Second—On examination, the brood will be found not to be compact but scattered, empty cells here and there, where sealed brood should be. If the bee-keeper interferes now by feeding medicated honey, the composition of which I will describe in subsequent pages, he will prevent an outbreak of the disease. If not, he will notice, on examining the colony after a few days again, third—Some cells with small holes in the sealing, which will also present a sunken appearance. Opening the cells a brown, ropy, bad-smelling mass will be seen, which, if not removed, dries and adheres to the base of cell so tenaciously that the bees are unable to remove it in any other way than by gnawing the cell-walls down

to the base. On rubbing the dried mass between the fingers, the odor from it resembles very much decomposed glue.

ORIGIN OF THE DISEASE.

Noted observations regarding the start, spread and cure of the disease, have led to suppose:

1st. Foul brood originates by bees and brood being exposed to sudden cold and dampness.

2d. It may also be caused by want of proper and sufficient nourishment.

3d. Also by over-stimulative feeding, in consequence of which the bees rear more brood than they are able to feed properly. For there is enough evidence to prove that foul brood originated in apiaries, excluding the idea of contagion. Now, if even one colony of an apiary has been subject to one of these causes, and become diseased in consequence thereof, the disease will spread by contagion, infecting the whole apiary.

4th. Prevention being better than cure, it behooves a careful apiarist to see that his bees are not exposed to any of the primary causes, if he can help it. Combs with brood should not be removed from the hive on cold and windy days. He should see that his bees are not in want of proper and sufficient food, honey as well as pollen. Especially will the want of pollen cause the bees and brood to die; the more so, if they are actively engaged in brood rearing, because pollen contains the nitrogenous compounds absolutely necessary so build up the animal tissue. If pollen is wanting, he should furnish a substitute by feeding the bees flour. If flour is fed outside the hive, the bees will not take any more than they are in actual need of; hence, overdoing stimulative feeding is out of the question as regards that substitute. But there are other substances which contain albumen in excess, and if these are fed to a weak colony in the hive, will induce breeding to such an extent that the bees are unable to feed all the brood properly, which, in spite of abundant food, causes the brood to die of starvation, and thereby causing the colony to be a first-class subject to the disease.

Besides the above enumerated causes of foul brood in an apiary, there may be one more, viz.: a poor queen—that is to say, a queen's progeny may be so weak as not to have life enough to grow to maturity, but die when they are five, six and seven days old. In such a case a disinfectant will of course be of no avail, but the queen must be removed and killed; the colony must be provided with

means to raise a new queen, which is preferable to giving them a fertile queen, as the colony should be prevented from raising brood until hive and bees have been thoroughly disinfected. Queens have even been known whose eggs would not hatch at all. Such cases are, of course, of very rare occurrence; but it is best to mention them here, that bee-keepers who have a case of apparently incurable foul brood may be prepared to meet the same.

TREATMENT OF FOUL BROOD.

A bee-keeper who does not discover foul brood before his nostrils remind him that something must be wrong with his bees, is not the proper person to treat the case; for, most likely, the colony would be so far gone as not to pay for the trouble, and the best he could do would be to brimstone the bees late in the evening, when all are in; burn everything except the hive, taking care that no bees can get to it before it is thoroughly disinfected.

TO TREAT A COLONY WHICH IS BADLY DISEASED.

If the colony is yet quite strong, but the brood nearly one-half or more diseased, disinfect the bees by spraying them with an atomizer, with Solution No. 3, heated to 90 degrees Fahrenheit; put them into a new or well disinfected hive, on no more combs than they can cover well, removing also all parts of such comb as contain dead brood, and feed 85 CC of Solution No. 5 every day. Every three or four days the bees must be sprayed with Solution No. 3. If the colony is put on foundation (don't put them on already built out combs), in a few days brood will appear, when the feed must be changed from No. 5 to No. 6 Solution. If during the honey bloom, bees will need no further assistance; but if honey is scarce, they must be fed with good honey or sugar syrup, and a substitute for pollen provided. To prevent spread of the contagion, moisten the entrance of *all* the hives in the apiary every evening with Solution No. 2.

TO TREAT A COLONY ONLY A LITTLE DISEASED.

Cut out the comb containing decayed larvæ. Disinfect the bees by spraying them with Solution No. 3, heated to 90 or 95 degrees Fahrenheit; do this on empty comb, not on their brood frames. Disinfect brood, honey and pollen by spraying them every three or four days with Solution No. 4. Put bees and frames in a new or well disinfected hive, and feed them every day 80 CC of Solution No. 6.

TO DISINFECT HIVES AND OTHER IMPLEMENTS.

Wash and rinse well in a warm solution (about 90 degrees Fahrenheit) of No. 2, everything you handle or touch, or having come in contact with foul brood, yourself and the outer garments you wear not excepted.

HOW TO PREPARE THE SOLUTIONS.

SOLUTION No. 1—Pure salicylic acid..... 10 grammes.
Alcohol of 95° or of 0.8157 sp. gr. 100 grammes.

Keep in well corked bottles.

SOLUTION No. 2—Take of Sol. No. 1 30 CC
Soft water.. 500 CC

SOLUTION No. 3 —Take of Sol. No. 1 22 CC
Soft water..... 500 CC

SOLUTION No. 4—Take of Sol. No. 1..... 14 CC
Soft water... .. 500 CC

SOLUTION No. 5—Take of Sol. No. 1..... 10 CC
Soft water. 1000 CC
Good honey..... 700 CC

Boil the water and add the honey while boiling, and then add Solution No. 1, amounts as given above.

SOLUTION No. 6—Take of Sol. No. 1..... 5 CC
Soft water..... 1000 CC
Good honey..... 700 CC

Prepare as Solution No. 5.

FURTHER EXPLANATIONS AND DIRECTIONS.

It is absolutely necessary to adhere strictly to the above given proportions of the different solutions to be sure of success. For this reason I have not deemed it advisable to reduce the French weights and measures, which are employed in Germany, especially in all scientific works, to our system of weights and measures; the more so, as those employed by grocers and bee keepers are different from those of the druggists, and as a bee-keeper, or any person engaged in curing foul brood, has to have "graduates," to avoid going to a druggist to get correct measures, sometimes several miles, and as these graduates do not cost more in one denomination than in the other; I have retained those being in use by scientific men all over the world. Besides that, a reduction would involve

large fractions, to which the druggists' weights and measures are not adapted. But to guide the intelligent apiarist, I will explain the weights and measures as above used, as far as possible. Solution 1 is prepared by weight, of which it takes one part of the acid to ten of alcohol of the proper strength. Solutions No. 2, 3, 4, 5 and 6 are to be prepared by measure. CC means cubic centimeter. One thousand of these is called a "liter," and the weight of a liter of water, at its greatest density, is called a kilogramme, and the weight of one CC, or cubic centimeter, of water at its greatest density, is called one gramme, being the unit of weight.

10 grammes	154.3402 Troy grains.
100 grammes.....	1543.4023 Troy grains.
10 CC or cubic centimeters.....	2.7053 fluid drachms.
100 CC or cubic centimeters	1.5675 pints, apothecary's measure.

It thus appears that if exactness is required, a reduction is not advisable, and only Solution No. 1 may be prepared by using any weight in the proportion of one to ten. Hence, to be sure, two French graduates should be obtained—one to measure up to 100 CC and the other up to 500 CC. A thermometer is also necessary, to observe strictly the temperature as given above, as also an atomizer for spraying. Care must be taken not to mistake the different solutions, but each one kept in a labeled bottle, well corked. The solutions should be well heated before using, and cooled down to the proper degree of temperature before applied. For the convenience of bee-keepers, I have put up such sets of apparatus, which I shall, with a bottle of Solution No. 1, send by express on receipt of \$5.00. Orders filled in rotation. Persons ordering such must allow from two to three weeks in filling them.