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## QUEEN REARING

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### IMPORTANCE OF GOOD QUEEN

With the possible exception of swarm control probably no factor enters so largely into successful management of bees for producing honey as does control of the quality of one's queens. Most beekeepers realize the importance of always having good queens, but few realize it strongly enough to induce them to set about securing a good queen in each colony. Moreover, of those who do try queen rearing only the lesser part succeed. Even among commercial honey producers who count their colonies by the hundred are many whose practices of queen rearing would look very crude when viewed by the expert queen breeder or by any one who has given much thought to queen rearing. It frequently happens that queens reared by such crude methods are of much poorer quality than the ones found in colonies unmolested by their owner. In other words such queen rearing is worse than none at all.

### PURPOSE OF THIS BULLETIN

It is the purpose of this bulletin to aid Minnesota beekeepers in supplying each of their colonies with a young and vigorous Italian queen before fall. Since many of the beekeepers of the state are beginners, or have at best very slight experience, the material in the following pages is meant primarily for those who must commence with the very rudiments of beekeeping. Yet at the same time it is hoped that the method outlined may also be of service to extensive beekeepers. Since Dr. C. C. Miller, America's foremost bee expert, recommends this method and says that he has used it in requeening apairies numbering at one time three hundred and eighty colonies, it is evident that it really is adequate to the needs of any Minnesota beekeeper.

### NEED FOR STUDY OF BEE BEHAVIOR

Whoever the beekeeper may be, however many colonies he may manage, before he can hope to rear better queens than the bees possess when let alone he must make a study of the fundamentals of bee behavior with special reference to the building of queen cells, the acceptance of foreign queen cells, or virgins, or laying queens, the supersedure of queens, the

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swarming instinct, and such kindred phenomena. It is through lack of knowledge of this sort that so many succeed in rearing only inferior queens, fail to rear any at all, or tho successful in getting a few respectable cells built, lose them in introducing them into their colonies. Still others who purchase valuable Italian queens from the University or from southern breeders, violate the habits and instincts of the bees in their attempts to introduce them and thus lose the major portion.

The first fundamental fact to be retained in mind is that bees are wild, untamable, uneducable creatures. Because through long ages of evolution they have developed organs and body parts specialized for functioning in certain definite ways, for giving fixed responses to given conditions of their environment, it is almost impossible for a beekeeper to modify their behavior to any appreciable degree. It is hardly safe to say that they are mere organic machines which respond to any given situation in any unalterably fixed manner. No doubt they may learn a very few habits of behavior which they do not possess when they see the light of day, but these habits are so limited in scope and so controlled by their fixed instincts as to be negligible. Their ability to make special adaptation of their behavior to special conditions of environment is almost nil. They do not plan actions; they do not adopt new ways of doing work; they do not learn by experience. Therefore, the apiarist in planning his work will do wisely to recognize that the bees possess complex systems of behavior adapted to meet every set of environmental conditions that confront them and that by no amount of work and manipulation can he break down these behavior systems and substitute new ones for them.

### HOW TO USE BEE BEHAVIOR

What, then, can the beekeeper do? He can use the instincts and habits of the bees as they are. Tho he can not change their instincts he can to a great extent control those conditions which bring their instincts to functioning in overt behavior. His problem is to observe bee behavior so that he may learn what conditions bring about desirable behavior, and what ones result in undesirable behavior. Thus he may learn what conditions in the hive and outside induce in bees the swarming impulse. Perhaps he may then by eliminating one or two of those conditions check swarming altogether. In studying the queen-rearing problem he must learn the conditions which lead bees to build queen cells most readily, to feed growing queen larvae the most and richest food, to keep them constantly at a high temperature, and to tolerate the presence of one virgin after she emerges from her cell.

### CONDITIONS UNDER WHICH BEES BUILD CELLS

There are three different sets of conditions which bring about cell building. Every bee man knows that when bees are moved by the swarming impulse they first build queen cells. Probably every bee man also knows that such cells are almost invariably large and well fed, and that the queens which emerge from them are large, vigorous, and prolific. What are the factors in the bees' environment which result in such excellent work on their part? First, the bees prepare to swarm after the season is well advanced and the average daily temperature is so high that they can easily provide their cells with the optimum amount of heat. Second, such cell building colonies are almost always strong colonies. They possess many

thousands of bees of all ages and nearly two thousand young ones emerge from their cells every twenty-four hours. There are, then, vast numbers of nurse bees to care for queen cells. As a consequence, if honey, pollen, and water are available they can easily supply the queen larvae with a great abundance of food. Third, the necessary foods just mentioned are always available at swarming time, for bees swarm **only when honey and pollen and water are each day coming in at the entrance.**

It may be objected, that swarms sometimes do come forth outside the honey flow, even in early spring, and that therefore the three conditions just named are not always present when swarms issue. Quite true. But such swarms are not natural swarms. They do not represent attempts of the bees to multiply and reproduce colonies in the normal way. Frequently bees build queen cells for the purpose of superseding their queen, she dies, and the bees grow excited when the first virgin takes a trial flight and rush out with her. All the swarms that issue during a honey dearth, many of those issuing during a honey flow, are of this nature. Furthermore, many queens thus reared outside the regular swarming season are poor ones. Therefore the statement that the best cells can be reared only when the temperature is high, when the hives are crowded with bees, and when honey and pollen are coming in, still holds good.

### WHEN NOT TO REAR CELLS

The first work of the apiarist when attempting to rear queen cells by artificial methods is to provide these three essential conditions. Of course he can not provide a high temperature. He must wait for that. Therefore, he can not rear good cells in spring. If he would have his colonies headed only by the best queens he must forego his desire to requeen before the weather becomes warm (about May 20). Too many try to rear good queens in April or early May. It can not be done. Those who rear such queens are the ones who so frequently wonder how the great beekeepers of the country get queens which lay ten, twelve, or even fourteen combs full of eggs in twenty-one days.

### CONTROLLED CONDITIONS

But the apiarist can control the second condition. He can make a few colonies strong enough for cell building at any time when the weather is warm enough. It is an easy matter to get brood and young bees from other colonies and add to the few cell builders till they become rousing colonies. One must be careful, however, to get plenty of young bees, for only young bees build queen cells and feed the larvae. A colony may be very, very strong in old bees and still construct poor queen cells. Of course old bees are needed too. They must carry in the supplies. But young bees build the queen cells, so a strong cell-building colony means a colony strong in young nurse bees.

The third condition is also controllable. One can create an artificial honey flow at any time when bees can fly. He can also provide pollen, if necessary, stored by the bees the previous year. However, during the months when the temperature is sufficiently high to warrant the rearing of queens, pollen is ordinarily available in the field, so only honey or sirup need be provided. Such food must consist of honey thinned with water or sugar

sirup made of one part sugar and one part water fed in quantities of about a pint each day. By feeding just this way most of the commercial queen breeders are able to carry on their operations, regardless of honey flows, during every warm month of the year.

Yet good queen breeders do not like heavy honey flows and seek locations where only light honey flows are found. For altho some honey must come in each day to keep a colony's morale at the right pitch for cell building, heavy honey flows demoralize their cell building behavior very badly. They may become so interested in gathering honey as to neglect cells, underfeed the larvae, seal them too soon, or otherwise spoil them. At such times the queen breeder frequently finds it necessary to destroy scores of cells. So far as possible, then, the ordinary beekeeper should avoid having cells built during heavy honey flows.

### SUMMARY OF NECESSARY CONDITIONS

To recapitulate, three conditions constitute the A B C of successful queen rearing, namely: warm weather, very strong colonies of young bees, the gathering of honey and pollen each day. Unless all of them are present each day it is useless to attempt to rear good queens. With all of them present any workable method of getting cells built is likely to produce good results. Since, however, some methods, tho successful, are yet wasteful of time and ill adapted to the ordinary beekeeper's needs, it seems advisable to present in detail one or two methods of getting cells.

### SWARM CELLS

Probably the most common method is to avail one's self of swarm cells. Unless very drastic preventive treatment be used on them a goodly portion of one's colonies build natural swarm cells and cast swarms. It is easy for even a beginner in beekeeping to cut out these when the virgins are ready to emerge and use them to displace undesirable queens in his apiary. If he possesses a few good Italian colonies and can get swarm cells from them this practice is excellent. No cells are ever built better than natural swarm cells. When such cells are built all the essential conditions for cell building are present in the superlative degree. Furthermore, the eggs from which the queen larvae hatch have been fed in the swarm cells from the beginning, and so the larvae have been fed and treated as prospective queens from their earliest appearance. There is no danger that any of them have been developed too far toward workers before being selected for queens. Unfortunately this can not be said of all queens reared by artificial methods.

### Objection to Swarm Cells

But swarm cells are available only during the main honey flow and not many beekeepers find it profitable or convenient to requeen their bees at that time. Indeed it is frequently impossible to do so. At best, requeening a colony during the usual clover flow reduces the surplus honey. For bees do not work well when queenless, yet with the best of luck colonies to be requeened must be without a laying queen ten days, and many of them losing their first virgin must remain so more than twice

that time. Whenever one attempts to requeen a hundred colonies he must expect twenty to lose their first virgins. So requeening as a general thing must be left over till the honey flow ends.

For obtaining the best cells outside the swarming season two excellent methods may be used. Only one of these, the simpler, will be discussed here.

### Preparation of Cell Building Colonies

The first thing necessary is the preparation of cell building colonies. Such colonies may be prepared by adding to them combs of hatching brood till they each contain ten full combs. This should be done ten days before they are expected to build any cells, so that in the interim many thousands of young bees may emerge from the brood. If such strong colonies already exist in the apiary, of course it is not necessary to add anything to them. Besides being strong the colony selected should be composed of dark, cross bees, the darker and crosser the better. Such bees build more and better cells than light Italians. If one could get Carniolan or Caucasian bees for cell building he would do better still.

### Selection of Breeder

Having provided for the cell building colony to be ready at a given date one must prepare for the larvae to be used on that date. The first step is to select a breeding queen and put her into a weak colony, a colony not to exceed three combs of brood. If one possesses a particularly desirable queen in a strong colony he may take away from her all except three combs of brood and then move her hive to a new hive stand so that she will be left with few bees as well as few combs of brood. Such a weak colony will now build worker comb and the queen will probably lay only worker eggs, whereas strong colonies build mostly drone comb and their queens lay drone eggs in every available drone cell. An additional reason for keeping a choice breeding queen in a weak colony is that by so doing her egg laying is restricted and her life prolonged.

### The Comb of Larvae

The frame to hold the prospective cells may be prepared by inserting in an ordinary new frame three short strips of foundation leaving two inches between strips, and hanging it in the center of the weak colony containing the breeding queen. These strips should not be over an inch deep. When provided with honey or sugar sirup each day the bees will commence to construct comb on these foundation strips. As explained above, being weak, they will construct only worker comb and the queen will follow them and deposit eggs in the cells as fast as they are built. Care must be taken, however, that these bees carry in food each day. The presence of an abundance of honey in the hive does not induce comb building; only incoming food does that.

In from six to ten days the bees will have a comb constructed in the form of three lobes reaching half way to the bottom bar, each lobe representing one of the original strips of foundation. Because of the lobes the distance along the margin from one end of the comb to the other is increased and it is to secure this effect that the three short strips of foundation are used instead of one long one. The cells along the margin will contain eggs, those along the top bar advanced larvae (perhaps sealed), and those between, larvae in all intermediate stages.

On the afternoon of the day when he has his cell building colonies ready, the apiarist should remove from the breeder this frame of larvae, cut away the marginal area of eggs and thus expose along the new margin larvae not more than a day old. Next he should kill every two larvae out of three so that when queen cells are constructed they may not adjoin each other. The comb is now ready to insert into the cell building colony. All these operations should be done so rapidly as to avoid undue exposure of the larvae.

#### Render Cell Builders Queenless

On the morning of this same day the final steps in the preparation of the cell builder should be taken. When we left the cell builder it was full of brood and bees and had a good queen. Much of the brood has now emerged so that the colony is doubly strong. But queenright bees do not build queen cells, therefore the queen and all the unsealed brood should be removed and stored over an excluder above some other colony. Very few bees should be taken along for they will be needed in the cell builder. In this cell builder should be left a great deal of honey and pollen and to it should be given in some kind of feeder at least a pint of thick sirup. One comb should be left out to make room for the prepared comb of larvae.

A word should be said in explanation of this treatment. It is no doubt clear that by rendering the colony broodless as well as queenless the natural instinct of the bees to build cells under queenless conditions is much intensified. Thousands of nurse bees have been secreting larval food at full capacity and when left suddenly without larvae to feed the food naturally accumulates in still greater abundance. The feeding of thick sugar sirup further accentuates the secretion. Thus all conditions for cell construction are made ideal. So by afternoon or evening these bees are ready to pounce upon any larvae given them and construct a great number of queen cells.

#### Building the Cells

Into the center of this colony, then, the prepared frame of larvae may be placed. On the next day one may expect to find from twenty to fifty or more cells started. Most probably there will be more cells started than the colony can carry to maturity. In fact, it is usually inadvisable to leave more than ten or twenty cells for one colony to complete. One may keep watch, however, and if he finds the bees can keep thirty cells supplied with more jelly than the larvae eat he may leave that many. But no pains should be spared to secure the very best cells obtainable. Good cells mean good queens; good queens, strong colonies; strong colonies, big honey crops.

#### Care of Cells

If the comb of eggs and larvae is cut so as to leave one-day old larvae along the margin, the cells built thereon will be sealed five days later and the queens will emerge from them on the eleventh or twelfth day. After the cells are sealed one should kill all those built above the margin on older larvae, and then put the frame in the top story of a strong colony with a queen excluder between that story and the brood nest containing the queen. The cells will be kept in such a colony fully as well as in the cell builder. The brood taken from the cell builder and stored on



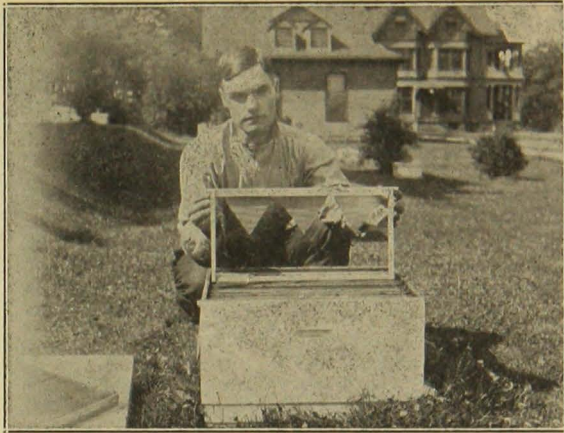


Fig. 1. Frame Prepared with Three Triangular Pieces of Foundation

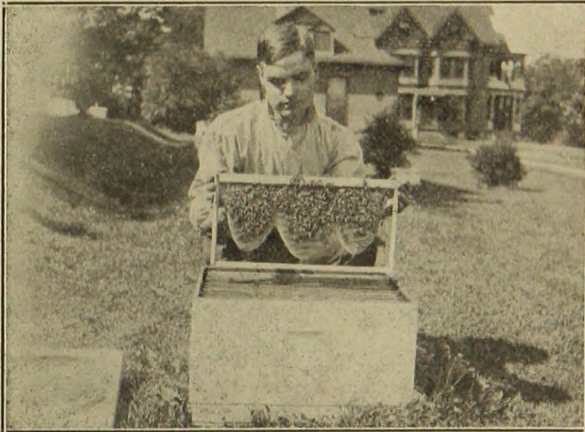


Fig. 2. Seven Days Later. Foundation Drawn Out and Filled with Eggs and Larvae



Fig. 3. Comb with Eggs Cut Away from Edges

another colony may be returned to it, and the queen also, if still alive. If she is dead one cell may be given to the colony when they are all mature.

### When to Use Cells

On the tenth or eleventh day the cells are ready to use. Sometimes one cell may be constructed on an older larva than the apiarist knows about and the queen from such a cell may emerge on the tenth night and play havoc with her defenseless younger sisters. So it is usually advisable to use the cells on the tenth day unless examination shows them to be still immature. The examination may be made by holding the cells between the eye and a strong light (in sunlight). If the virgins are all dark in color; or can move, they are ripe; if light, or even white, in color they are too immature to stand handling and exposure. The best age for introduction is when the virgins can kick their legs in the cells.

### Introducing Cells to Colonies

Preparation for using these cells must be made six days before they are ready, that is, four days after the frame of prepared larvae is hung into the cell-building colony. This preparation consists first in finding and killing the queens in the colonies to which the cells are to be given. Then on the tenth day when the cells are ready, these colonies, having been queenless six days, will contain queen cells constructed on their own brood. These must all be destroyed. The bees will then be in a hopelessly queenless condition, having no young larvae, and will therefore be glad to accept foreign cells. If, however, one were to kill the queens in his colonies and give ripe cells immediately he would find most of his virgins absent on the next examination. Bees usually rear cells, or try to rear them, from their own brood before they will accept foreign cells or foreign laying queens. To ignorance of this fundamental habit of bees on the part of the beekeepers most disasters to newly introduced cells or queens are due.

Ten days after putting the cells into colonies most of the queens will be laying. But some will have disappeared. One can not expect one hundred per cent to mate and return to their hives. In fact not more than eighty per cent of all virgins succeed in doing so. To those colonies whose queens have been lost, a second lot of cells maturing ten days later than the first may be given. Or laying queens may be provided for them. If any still remain queenless after the second trial, laying queens should be provided or they should be given sealed brood before being given the third lot of cells. Otherwise they are likely to decline in strength very decidedly before they get laying queens.

Sometimes, when requeening old colonies an apiarist makes a few nuclei of two combs of brood and bees each, mates queens in these, and then unites one of these with each old colony which has lost its virgin. This is an excellent plan for every one to follow because such nuclei, possessing only young bees, accept cells more readily than full colonies, and because by mating extra queens one insures that each old colony may be provided for at the proper time.