Seasonal Management of Commercial Apiaries
Michigan State University Extension Service
Russell H. Kelty
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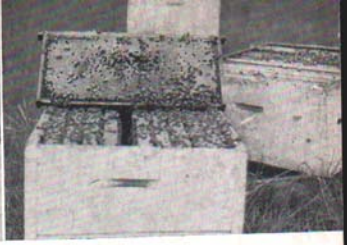

EXTENSION BULLETIN 228
JUNE 1941

Seasonal MANAGEMENT *of* COMMERCIAL APIARIES

By Russell H. Kelty

MICHIGAN STATE COLLEGE
EXTENSION DIVISION
EAST LANSING





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SEASONAL MANAGEMENT OF COMMERCIAL APIARIES

RUSSELL H. KELTY

Beekeeping is one of the oldest of the agricultural pursuits. Before the commercial production of cane-sugar from sugar-cane, honey was the principal sweet, aside from that produced from fruits, and from the sap of trees, such as sugar-maple.

Up to the time of the movable-frame hive, invented by Dr. L. L. Langstroth in 1853, the practice of beekeeping was primitive, and the equipment very simple. Since that time many inventions and improvements, in apparatus and in practice, have stimulated interest in the art and have made it possible for many beekeepers to derive sufficient income from the production of honey to warrant their devoting full time to the business.

A successful beekeeper must, of necessity, be a close observer, because bees act entirely on instinct and lack intelligence in the ordinary sense. Therefore, he is continually trying to increase his knowledge of just how the bees react to the various conditions and changes in environment which surround them. A sufficiently accurate understanding of their reactions should make it possible to apply stimuli so as to produce definite reactions and results. In practical beekeeping, the desired result is best brought about by guiding the natural instincts of the bees to suit the desire of the beekeeper.

This guiding process has been given the name "manipulation," and the term is used throughout this bulletin in its restricted and technical sense. Because certain manipulations produce better results than others under any given set of conditions, it has come about that the use of the most successful manipulations throughout the active season have become so generally adopted as to be called "systems of manipulation". In order to distinguish one system from another, each has been named for the beekeeper who originated or who advocated it and thus became identified with that particular system. There are four such systems of manipulation which are admirably suited to Michigan beekeeping conditions. It is the purpose of this bulletin to present these systems of manipulation which would, if adopted, increase the efficiency of some of our approximately 12,000 Michigan beekeepers.

Some areas of Michigan are more favorable to successful commercial honey production than others. Factors which determine the value of a location for honey production are the variety and number of nectar-bearing plants present, the type of soil, and the weather conditions prevailing. Although there are hundreds of plants which yield nectar

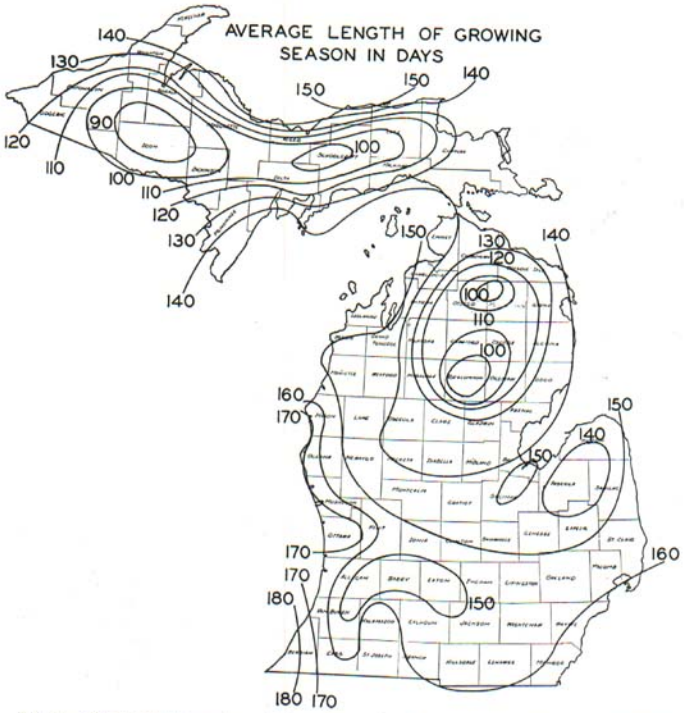


Fig. 1. The average number of days from the last killing frost in the spring to the first killing frost in the autumn. The length of growing season in Michigan is affected mostly by Lake Michigan, the westerly winds, changes in elevation and changes in latitude.

in Michigan, surplus honey is produced from a limited number, such as alsike and white clover, white and yellow sweet clover, alfalfa, basswood, wild raspberry, milkweed, fireweed and, in occasional years, from buckwheat, goldenrod, boneset, Spanish needle, asters, and heartsease. However, there are many other nectar-producing plants whose blooming dates occur at various times from early spring to fall, whose individual contribution in nectar may be little but whose combined yield stimulates the colony and aids in satisfying the daily food requirements. Among such plants are pussywillow, red maple, dandelion, fruit bloom, Canada thistle, catnip, button bush, the mustards, sumac and swamp sunflower.

In the heavier soils areas of Michigan the legumes are the main source of nectar. In general, the best yields of honey are obtained in

the better farming areas where the soil is "sweet" and rich in plant nutrients and humus, with deep top soil and high water table. Areas in which dairy farming is practiced, where alsike and white clover are native to the soil, where sweet clover is pastured and raised for seed, where alfalfa is grown for both hay and seed, are most likely to be favorable for honey production. In northern Michigan cut-over lands, large tracts of wild raspberry, milkweed, and fireweed are found on lighter soils, and in favorable seasons much honey is produced from these honey plants.

The amount and distribution of rainfall is important. Ample moisture during the growing season, with occasional showers and high temperatures during the blooming season, and a fairly wide range in

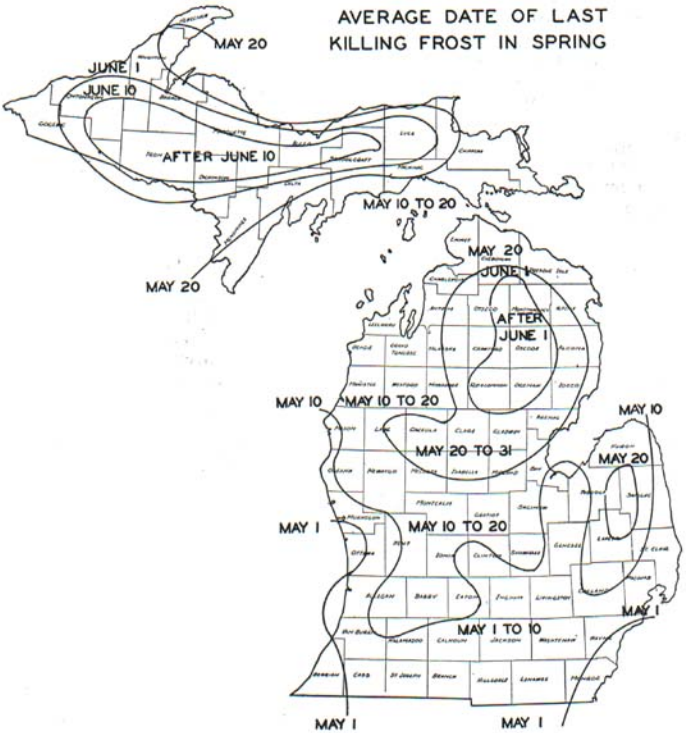


Fig. 2. The average date of the last killing frost in the spring is the earliest (May 1) in southwestern Michigan and the latest, after June 10, in the north-central portion of the Upper Peninsula.

temperature between day and night aid nectar secretion. Larger honey crops accompany a slightly dry blooming period. Very little honey is produced during a cool, wet blooming period. Sweet soils, well-supplied with humus, enable legumes to produce more nectar than do sour soils. Honey plants seldom yield nectar heavily two years in succession. Two bumper crops seldom occur in succession.

Statistics show that colonies must return a minimum of $5 per year gross income over a period of years to be profitable. Therefore, unless it is possible to produce an average crop of from 80 to 100 pounds of extracted or 50 to 60 pounds of comb honey per year in a given locality over a period of years, the beekeeper may not be financially successful unless a special effort is made to market the honey advantageously. In the more favorable areas of Michigan it is possible to produce an average crop of from 100 to 150 pounds per colony of extracted honey or 75 to 100 pounds of comb honey per year.

The condition of the colony in the spring will depend almost entirely upon the management of the colony from August 1 to October 15 of the previous year. Proper manipulation during this period will lessen the amount of attention necessary during the following spring. In fact, without proper attention during the previous fall the colony is likely to be in such poor condition in the spring that it will be difficult or impossible to increase its population to the maximum by the time the clover honey-flow begins.

Best results from commercial beekeeping will be obtained when the beekeeper has a certain definite program of the season's work to use as a guide throughout the active season. This program should include approximate dates for seasonal manipulations in the beekeeper's own locality, and furthermore, should embody any particular aim or special activity for the season. For instance, if it is desired to rear queens, special preparation will be necessary before the time to rear the queens is at hand. Also, if the beekeeper intends to increase his colonies, he should make special preparation in advance of the time when increase can best be made.

The Beekeeper's Guide (accompanying this bulletin) should serve as an outline to the beekeeper in performing the various seasonal manipulations. By indicating the proper time for performing special manipulations, the guide will aid the beekeeper in making the necessary preparations in advance.

DESIRED COLONY CONDITIONS AT VARIOUS CRITICAL DATES OF THE SEASON

(SEE CHART IN CENTER OF BULLETIN)

August 1

About August 1, every colony which is to be in the proper condition to put into winter quarters in October and November should contain a good queen, preferably less than a year old, six to eight pounds of bees, and the equivalent of a full hive body of food, 60 to 70 pounds of honey and pollen. A good queen is one having the following qualities: the ability to produce offspring of uniform color and size, whether they be three-banded or golden Italians, Caucasians or

Carniolans, *which gather large crops of honey;* whose bees are fairly gentle but not too gentle, relatively non-propolizing, non-swarming, non-robbing in disposition, yet having the desire to protect their home; whose bees are good housecleaners, resisting European foulbrood and sacbrood, and if possible, American foulbrood; whose bees "winter" well and "spring" well, and have the ability to expand the broodnest rapidly in April and May to insure the working force necessary to gather a commercially profitable crop of honey during June, July and August.

Six to eight pounds of bees are desirable to insure proper care of a broodnest large enough to provide ample winter population for the colony, and to gather nectar from fall flowers, if available. The hive body of honey is to insure an ample food supply to care for this large broodnest during August and September, because approximately six pounds of honey may be required for one pound of bees produced.

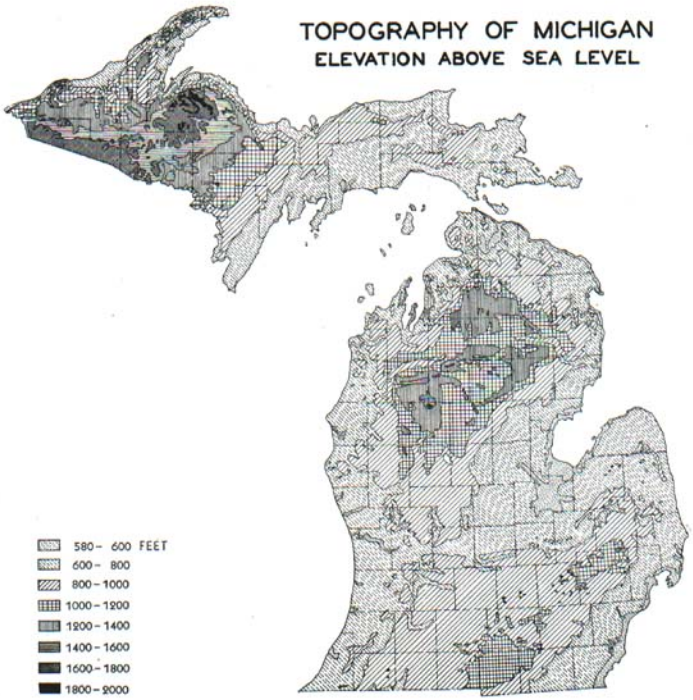


Fig. 3. Areas with the higher elevations tend to have the shorter growing seasons.

Unless the colony set-up August 1 includes those requirements, the colony may not be in the desired condition October 1. Therefore, the beekeeper should endeavor to provide each of the requirements and pay particular attention to the performance of the queen, replacing her if she shows signs of failure.

Particular emphasis is placed on the food requirements during this period because many beekeepers make the mistake of removing all honey except that which may be in the broodnest when they are removing supers for extracting. A prolific queen may fill much of the comb space in the broodnest with brood, and unless a full hive body of honey is left on the colony, adverse weather conditions during August and September may reduce the colony to near starvation, damage the morale of the colony and check brood-rearing to such an extent that the colony will not be likely to winter well.

During this period the activity of the queen may be confined to a single hive body by a queen-excluder, the full hive body of honey being placed directly above the queen-excluder and the supers above the hive body of honey. Then the broodnest will be in the lower part of the hive when winter comes, with the honey arranged above the broodnest. On the other hand, the queen may be allowed to use a two-story broodnest.

October 1 to 15

To winter well, the colony requires a good queen, six to eight pounds of bees and a full hive body of well-ripened honey and pollen. The queen may be the same queen which has been in the hive since August 1, or for the whole year. However, if she has shown signs of failing, she should be replaced even at this late date, else the colony may go queenless during the winter.

The bees in the hive October 1 to 15 are not the same bees that were in the hive August 1. They are mostly new bees reared since August 1. Many of the bees which were in the hive August 1 have worn themselves out gathering honey and rearing the new bees to carry on over the winter.

The full hive body of honey may be that which was left on the hive August 1, provided there was a honey flow during August and September sufficient to care for daily brood-rearing requirements. If there was no honey flow during August and September, the honey left on the hive August 1 may have been partially or completely consumed by the bees; this condition makes it necessary that the beekeeper give the colony additional honey or sugar syrup to make up a total of from 60 to 70 pounds of food for winter stores. October 1–15 the beekeeper should remove the queen-excluder and make certain that the clustering space is in the lower hive body, beneath the full hive body of honey. If feeding is necessary, it is important that this be done while the weather is still warm enough for bees to move freely to permit them to manipulate and rearrange the syrup and comfortably arrange themselves in their winter cluster beneath their food supply before the steady cold weather begins.

Colonies in which the winter cluster forms within a ball of honey consume less stores than colonies in which the winter cluster is unprotected by solid combs of honey on sides and top.

November 1 to 10

The work of packing should be delayed until fairly steady cool weather of a temperature of approximately 50° F. occurs. Bees which may be spilled on the ground can then crawl back into the hive, yet the weather is cool enough to discourage ready flight from the colonies.

A description of the methods suggested for insulating bees for the winter period is given in the closing pages of this bulletin. Some form of efficient insulation aids the colony in conserving its energy and food supply and is one of the important factors in successful wintering. The colony also needs some form of windbreak, such as a hedge, snow fence, brush or dense trees, to break the force of the wind from the north, east and west. A south exposure which provides ample air and

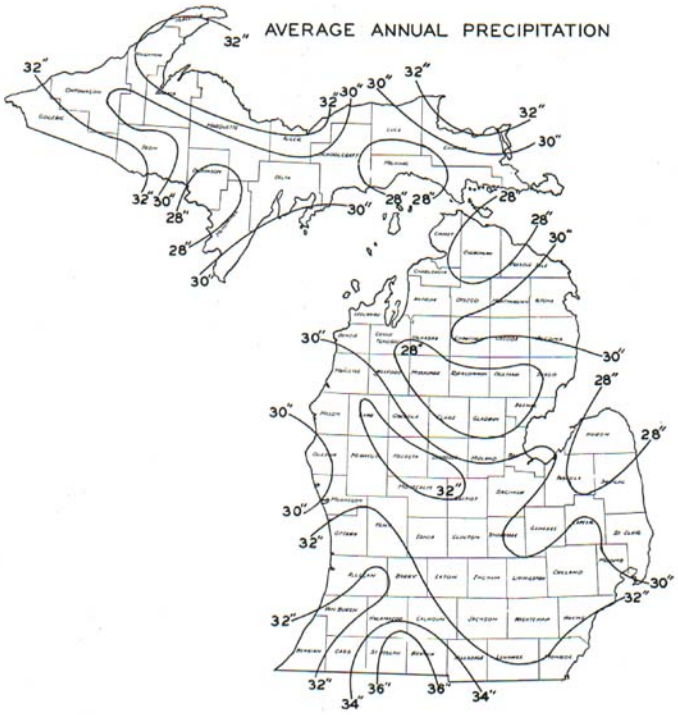


Fig. 4. The average annual precipitation in Michigan varies from about 28 to 36 inches. The average for the state is about 31 inches. Precipitation includes rain, melted snow, sleet, and hail. The amount and distribution of the precipitation during the year influence crop yields considerably.

water drainage is desirable. After packing, no further attention is ordinarily needed until April 1.

April 1 to 15

Although brood-rearing may start in early March in normal seasons, it is unsafe to disturb the colony until settled weather with temperatures of 65° to 80° F. occurs, and then the less disturbance the better.

The April 1 requirements for a colony of bees which is to produce a commercially profitable crop of honey are: A good queen, four to five pounds of bees to heat a sufficiently large broodnest area to enable a prolific queen to expand egg-laying activities rapidly, brood in two to four combs, and a minimum quantity of 30 to 40 pounds of honey and 10 to 15 pounds of pollen. If the food supply is less than 20 pounds, brood-rearing activity may be checked.

The colony needs insulation in spring more than in fall and winter because in spring it must maintain a broodnest temperature of 94° to 96° F. while the cluster temperature in winter is but 57° F. Because Michigan winds are cooled by surrounding lakes until a late date, an efficient windbreak is a paying investment in spring.

The period April 1 to May 15 is the most critical of the entire year for colony development. Colonies which have wintered poorly for any reason, dwindle in population during this period so rapidly that it may be impossible for them to get into condition to store surplus honey by June 15.

May 1 to 15

Well-wintered colonies, May 1 to 15, should contain a good queen, six to eight pounds of bees, not less than 25 pounds of honey or syrup, 10 to 15 pounds of pollen, and ample comb space for egg-laying. A two-story broodnest is necessary to provide sufficient "parking space" for the rapidly emerging young bees, the storage of incoming nectar from fruit bloom and dandelion, and sufficient comb space to enable a prolific queen to increase rapidly her daily rate of egg-laying without becoming overcrowded in a honey-bound broodnest.

If unfavorable weather during May prevents the storage of nectar from dandelions, fruit bloom and other seasonal nectar-bearing plants, it is important that the beekeeper feed the colony sugar syrup (made of equal parts sugar and water) to maintain a minimum food supply of 20 to 25 pounds, or three combs of food. Some successful honey producers stimulate the bees during late May and early June by feeding all colonies, continually, with division-board feeders, pail-feeders, sprinkling cans or dippers. If the latter are used, the front of the hive should be raised an inch and the syrup sprinkled or poured into empty combs, or over the combs or on the bottom board, at the rate of a pint per hive per day. The beekeeper must provide ample comb space to accommodate the rapid increase in population which follows this type of manipulation.

Approximately six weeks after the egg is laid a worker bee may become a nectar-gathering bee. Inasmuch as the nectar flow from clovers begins June 10 to 25, the bees which are to be ready to go to the field at the beginning of the nectar flow must be laid as eggs by the queen

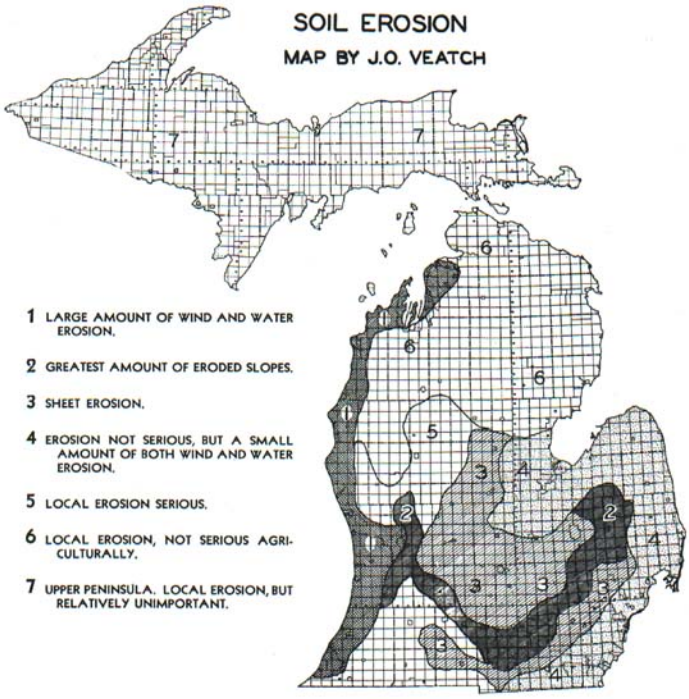


Fig. 5. Erosion varies with the type of soil, the slopes, the amount and distribution of rainfall, and the vegetative cover on the land.

prior to May 1 to 15. The successful commercial honey producer should make certain that these requirements are met so that colonies can be ready to take full advantage of the early part of the nectar flow from clovers.

June 1 to 15

During this period, colonies capable of producing maximum crops of honey should contain: A good queen capable of maintaining a high rate of egg-laying activity, 12 to 20 pounds of bees of which a large proportion are of the proper age to go to the field to gather nectar, 12 to 16 combs of brood, 20 to 25 pounds of honey or syrup, 10 to 15 pounds of pollen, ample comb space for brood-rearing, storage of nectar and bee "parking space".

When the colony shows a daily gain in weight of from two to five pounds it is time to restrict the broodnest and put on the supers. The

queen may be allowed the freedom of the entire hive until the nectar flow has definitely begun. Should weather conditions delay the normal opening date of the nectar flow, the problem of preventing swarming preparations is greatly increased. It may be avoided by expanding the comb space to prevent the bees from feeling over-crowded. Further suggestions for colony manipulation at this time are presented in later pages under "Systems of Management".

Inasmuch as it requires approximately 10 weeks for a colony of bees to become strong enough to gather a maximum crop of surplus honey, the period April 1 to June 15 must necessarily be one of steady progress for the colony. While the beekeeper may not need to give all colonies frequent inspection and should not disturb the bees more often than is absolutely necessary, he should know the required conditions within the colony for each successive week of the period and he should make sufficiently frequent inspections to be able to tell how closely each colony is meeting those requirements.

Those colonies which are behind schedule because of failing queens, lack of food, lack of comb space, lack of insulation, or lack of bees to expand the broodnest area, should be so handled that the deficiency will be met in time to allow the colony to reach maximum population **by mid-June.**

SPRING MANAGEMENT

The curve shown in The Beekeeper's Guide for Seasonal Management is set up as an example of performance of a colony which would reach maximum strength in time to gather a maximum crop of alsike and white clover honey and follow through the sweet clover and alfalfa nectar flow.

The population decreases in March and early April because old bees are dying off more rapidly than young bees are emerging. It is important at this period that the colony have an energetic, prolific queen, capable of rapidly expanding the broodnest, else the population curve will not recover its upward trend in time to reach its peak at the beginning of the clover nectar flow.

The population increase of a poorly wintered colony may be so delayed that the colony will be unable to take advantage of the first portion of the nectar flow and consequently will not gather more than one-third to one-half of a normal crop of honey. Furthermore, weak colonies usually need more manipulation than stronger colonies and may be a liability rather than an asset in the apiary. If the queen in these colonies is young and worth saving, a two-pound package of bees without a queen, added during late April or early May may enable such colonies to produce a profitable crop. If the queen is not performing satisfactorily, she may be killed and a two-pound package of bees with a queen added. Colonies which have not attained the necessary population at the beginning of the honey flow can be profitably strengthened with two or three pounds of bees.

The period between the bottom of the population curve (mid-April) and the peak (mid-June) is the greatest population increase of the year. To obtain a maximum population of 12 to 20 pounds of bees it

may be necessary to use three or more hive bodies for brood-rearing. During the month of May a gain in population of one-third to one-half pound of bees daily is possible, and the beekeeper must be alert and ready to provide the necessary comb space for expansion **before** it is required by the bees. Yet he should not provide more comb space than the bees will need to occupy very shortly.

While there is danger of frost (until May 15) additional comb space should be provided below the broodnest. However, if the colony commences the construction of queen cells, indicating definite preparations to swarm, the comb space may be added above or between sections of the broodnest. After destroying the queen cells, one or two combs of emerging brood may be "raised" to encourage the queen to occupy this new comb space immediately. May 15, strong colonies should occupy two hive bodies.

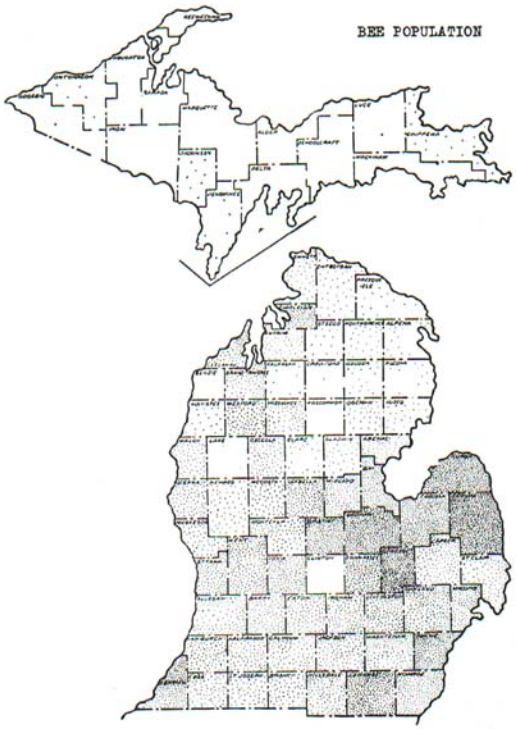


Fig. 6. Bee population of Michigan. One dot equals 20 colonies.

Those who winter their bees in a two-story broodnest may reverse the position of the upper and lower broodnests as soon as the upper broodnest becomes full of brood and bees. Those who use Jumbo or Modified Dadant hives may find that during late May and early June additional comb space is needed to avoid swarming preparations.

After danger of frost is past, strong colonies which completely occupy two standard 10-frame broodnests and then commence swarming preparations (as indicated by the presence of queen cells containing eggs or larvae) may be given additional comb space in the form of a hive body of dark combs inserted between the upper and lower halves of the broodnest, placing one or two combs of emerging brood in the center of the newly added comb space to encourage immediate occupation by the queen and bees. This tends to produce a tall, narrow broodnest which may give less swarming trouble than a large, round broodnest, and provides ample "parking space" for the rapidly emerging bees.

Strong colonies may obtain sufficient nectar from dandelion and fruit bloom to need additional space just previous to the clover nectar flow. If queen cells containing eggs are found in early June, additional comb space may be placed under the top hive body.

Whenever the beekeeper finds queen cells containing eggs or larvae, they are to be destroyed and the broodnest "stretched" vertically by the addition of more comb space and the rearrangement of the broodnest in a vertical column with empty combs at the sides. By this simple means it is possible to reduce swarming preparations in strong colonies to a minimum. No effort is made to restrict the free range of the queen until the clover nectar flow has definitely commenced as indicated by a steady daily gain in weight.

The outstanding characteristic of this period from mid-April to mid-June is the tremendous increase in colony population.

SPECIAL PROBLEMS

Smoker Manipulation—To obtain full efficiency, the smoker should give off cool smoke. The material used in the smoker should be such that the smoke given off will be cool and palatable to the beekeeper. Burlap makes a hot smoke unless wax or propolis is added. Wood and shavings burn out quickly and the creosote in the smoke may cause discomfort to the beekeeper. Burlap containing propolis makes very satisfactory material. Probably the most satisfactory smoker material is sumac "bobs". The odor is pleasant to the beekeeper and the smoke effectively controls the bees in the hive.

Proper use of the smoker calls for considerable skill on the part of the beekeeper. Smoke should be applied sparingly, but effectively, never in excess. The bees should be brought under the influence of the smoke before a considerable number have taken to the air to avoid unnecessary stinging.

If the bees are busily working in the field very little smoke need be applied by the beekeeper when opening the hive. If the weather is cool or rainy, a little smoke may be applied at the entrance before opening the hive. Avoid jarring the hive or quickly removing the cover

and inner cover. The smoke should be directed over the bees and sparingly forced down between the combs frequently enough to keep the guard bees from taking wing. Too much smoke may so completely demoralize the colony that they will gather little nectar during the remainder of the day. Unless absolutely necessary, bees should not be manipulated when they are not working because they are then easily aroused.

"Drifting"—This is the term applied to a condition resulting from the failure of the bees from various colonies to orient themselves to their proper hives, with the result that they enter the hive adjoining their own by mistake. "Drifting" is more prevalent during stiff winds in early spring and the bees always "drift" in the direction from which the wind is blowing, probably because they approach their hive headed

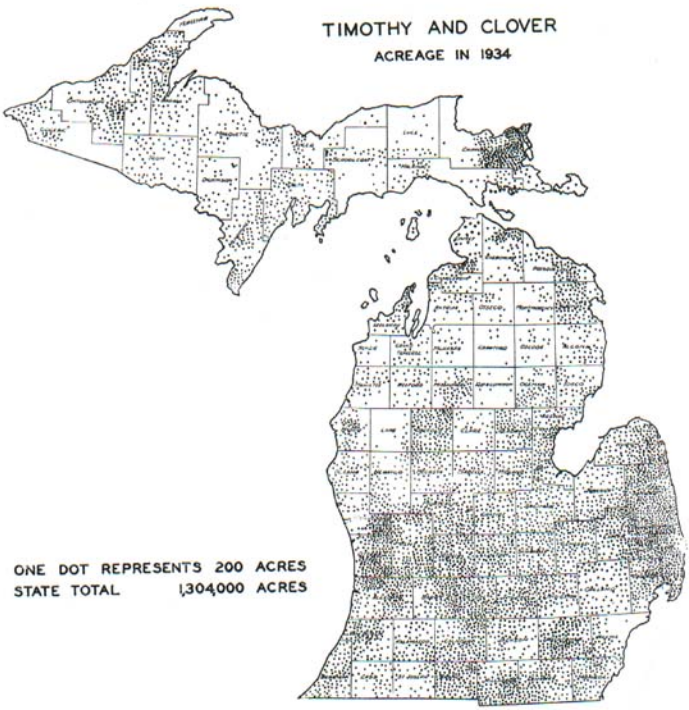


Fig. 7. The clovers are a main source of nectar wherever they are found in quantity in Michigan.

into the wind. Bees wintered in the cellar are more likely to "drift" than colonies wintered out-of-doors and for that reason the bees should be removed from the cellar in the evening. It is also of assistance to contract the entrances to one inch by five-eighths inch. During the night the bees will become settled and quiet and will be more likely to orient themselves properly in the morning.

About the only remedy for "drifting" is to exchange the places of the hives affected, putting the colonies which are overflowing with confused bees in the place of the colonies which have lost bees from "drifting". In a large apiary the day following the removal of bees from the cellar is often a very busy one for the beekeeper, especially if there is a strong wind. A little straw or brush placed over the entrance on such days encourages the bees to memorize their locations and relieves the situation somewhat. Bees are less likely to "drift" when trees or shrubs are interspersed between hives in the apiary. Clumps of evergreens are ideal for this purpose. Bees "drift" badly in long, unbroken, wind-swept rows unless the hives are six feet apart and the rows at least two rods apart.

The tendency for confused bees to "drift" toward the sun is noticeable.

Entrances—On the first warm days in spring the entrances to all colonies should be inspected. Those from which no bees are flying should arouse suspicion. If an examination shows the colony is dead, the entrance should be closed immediately to prevent "robbing". At the first opportunity the dead colony should be removed from the apiary, especially if there is any likelihood that the colony was affected with foul-brood.

All entrances from which bees are flying should be cleaned carefully with a bent wire or scraper. If possible the bottom boards should be entirely cleaned off, removing the dead bees, bits of wax and dirt that have accumulated during the winter months. This insures against clogging of the entrance as hive activity increases. The hive entrances of all weak colonies should be contracted to one "bee-way" until more room is needed.

First Inspection—The strength of the colony can be estimated approximately in early spring by the number of bees that are leaving the entrance per minute. On warm days in April when pussy-willow and red-maple are in bloom, strong colonies will have from 30 to 90 or more bees per minute leaving the hive; those colonies having less than 15 to 20 bees per minute leaving the hive usually need attention. This is not an infallible test because the position of the broodnest in the hive will influence the rate of flight somewhat during the first warm days.

Although brood-rearing in Michigan usually commences in March, it is seldom that there are days in which the temperature rises sufficiently to warrant the inspection of colonies until about the middle of April. On exceptionally warm days, previous to this time, a hurried examination of the broodnest might be made, but always with the danger that the bees might "ball" their queen.

The first examination of the colony is for the purpose of determin-

Fig. 8. Alfalfa has become an important source of nectar in Michigan, particularly where grown for seed.

ing (1) whether the colony is "queen-right"; (2) whether it has sufficient stores; (3) whether there are sufficient bees to care for the broodnest. Of course it is not necessary to find the queen herself to know that she is there. The presence of eggs, larvae, or of sealed brood—unless queen cells are also present, insure the presence of the queen. The amount of stores required depends somewhat on the strength of the colony but there should be present the equivalent of about 35 pounds of honey, or from five to six Langstroth frames full, on April 15. A strong colony of bees at this time will cover five to eight combs and there should be brood on at least three combs.

The strong colonies that have plenty of stores, bees and brood on April 20 will need no attention until the broodnest commences to show signs of crowding.

A	B	C	D
Queenless 3 frames honey 3 frames bees No brood	Queen-right 2 frames honey 6 frames bees 3 frames brood	Queen-right 3 frames honey 3 frames bees 1 frame brood	Queen-right 5 frames honey 3 frames bees ½ frame brood
E	**F**	**G**	**H**
Queen-right 5 frames honey 8 frames bees 4 frames brood	Failing Queen 5 frames honey 5 frames bees ½ frame brood	Queen-right 2 frames honey 3 frames bees 1 frame brood	Queen-right 4 frames honey 6 frames bees 1 frame brood

In all probability, however, the first inspection will show some colonies in the classification shown in the foregoing diagrams. Hence an explanation of manipulations that might properly be applied to colonies described above will be of assistance.

First Manipulations—A, being queenless, even though it has considerable honey and bees, should be united with another queen-right colony instead of being given a queen, because it is difficult to secure queens early in the spring when wanted on short notice. Furthermore, colonies which lose their queens during the winter may be lacking in vigor and therefore need the support of additional bees. It is not practical to unite queenless colonies with weak colonies, but rather with a colony such as C which is moderately strong, but needs additional bees and stores.

B, having plenty of bees and brood but lacking stores, should be fed 15 or 20 pounds of sugar syrup made of equal parts of sugar and water, from a pepper-box feeder placed over the hole in the inner cover, or, the syrup may be sprinkled directly into empty combs with a sprinkling can.

D, being queen-right and having plenty of honey, needs bees. A queenless two or three pound package may be united with D or a queenless colony.

E is an average normal colony and will need no manipulation at this time.

F, having a failing queen as indicated by the fact that although there is plenty of honey and bees in the hive, there is but one-half frame of patchy brood present, should be united with another colony which is queen-right but lacking in bees and stores, such as G.

H, since it is queen-right and has plenty of stores and bees, should have more brood. If the queen does not soon expand the broodnest she should be replaced with a young, laying queen.

Other conditions than those mentioned will doubtless be found in some colonies during the first inspection, but if the beekeeper remembers that the sole object at this season is to manipulate each colony so that it will have an opportunity to reach maximum strength by the end of a six to eight weeks' period, the proper method of procedure should suggest itself.

Unpacking—Bees wintered out-of-doors have the advantage over bees wintered in the cellar in rapidity of spring development, provided the winter packing material is allowed to remain on the hives until danger of frost is past. Of course it will be necessary to remove the packing material from the top of the packing-case in order to make the first inspection and subsequent manipulations such as uniting of weak colonies and feeding. It is well to replace this packing after each visit because those colonies which need attention are the ones which need protection the most. Even the strongest colonies should not be unpacked until danger of frost is over unless the broodnest becomes over-crowded.

When the weather has finally become settled, sometimes during the period from May 1 to 15, the beekeeper can commence unpacking, giv-

Fig. 9. Sweet clover hay acreage of Michigan. One dot equals 200 acres. Probably a much larger acreage of sweet clover is used for pasture, which also provides much nectar.

ing the strongest colonies first attention. Those colonies which have already needed stimulation and colonies which have been united, may be left packed even after May 15 if the broodnest does not become overcrowded. In fact these weaker colonies, if unpacked, may receive sufficient set-back from one cool night to spoil their chances of reaching maximum strength in time for the main honey-flow.

Moving—In the spring, many beekeepers will be interested in moving bees to orchards. With properly prepared colonies, moving short distances is rather simple. The beekeeper should remember that when he takes bees onto a highway he becomes liable for any damages following injury suffered by the public. Therefore, the hives must be well stapled together and absolutely bee-tight. Old, rotten hives should not be moved on a highway. To move bees successfully, the beekeeper should consider:

1. The method of preparation of the colony.
2. The temperature and humidity of the atmosphere.
3. The distance of the proposed trip.

The amount of preparation necessary to move bees depends upon the strength of the colonies, the amount of brood in the hives and the temperature and humidity of the atmosphere. At fruit bloom time, before the colony has built up to swarming strength, it is possible to move bees a few miles safely by screening the entrance only. A month later the colony might be so much stronger in population and have so much more brood in the broodnest that to try to move the bees without screening the entire top of the hive might mean that the colony would become overheated, suffocate and melt down its combs—a total loss.

If strong colonies are to be moved a long distance, requiring several hours on the truck, these precautions should be taken: First, remove from the hive newly constructed combs of honey and especially combs of unsealed honey because these combs are the most likely to melt and drown the bees if the colony becomes overheated. Provide each colony with clustering space above the broodnest either in the form of a moving screen two inches deep or an empty shallow super covered with screen.

It is well to prepare colonies for moving during the daytime, checking carefully to make sure that cracks and knot-holes or any space large enough for a bee to pass is closed before the hive is ready to screen. Securely fasten the hive bodies and bottom board together, either with hive staples or, better, with new lath cut to length and nailed vertically with plain shingle nails at the two sides of the front and rear of the hive. Lath are more rigid than hive staples and more rapidly put on and taken off. It is well to put the top screens on the hives several hours before the bees are to be moved so to cool the bees and encourage them to cluster before being moved. In case the day is cool or in case of rain, the outer cover may be placed diagonally over the screen, but otherwise it is left off. When evening comes and the bees are all in the hive, the front entrance is also screened. Because it is cooler in the evening and there is less danger of bees escaping from the hive, it is well to move bees during the night, especially on

long trips but after the bees have been confined to the hive by screens, they may be moved in daylight if preferable.

In loading hives on the truck, provision must be made for ample ventilation from the front and sides of the truck rack. The entrances of hives should face either forward or towards the sides of the truck rack. 2 x 2's are placed on top of the lower tier of hives before the next tier is loaded to insure a two-inch air space over the top of the lower tiers. Loads of bee hives three or four tiers high may be successfully transported in this manner provided ample ventilation is arranged for. The whole load should be securely bound together along the sides and across the ends by means of strips of board two or three inches wide, as long as the load, cleated into each outside hive in each tier along the sides and across the ends.

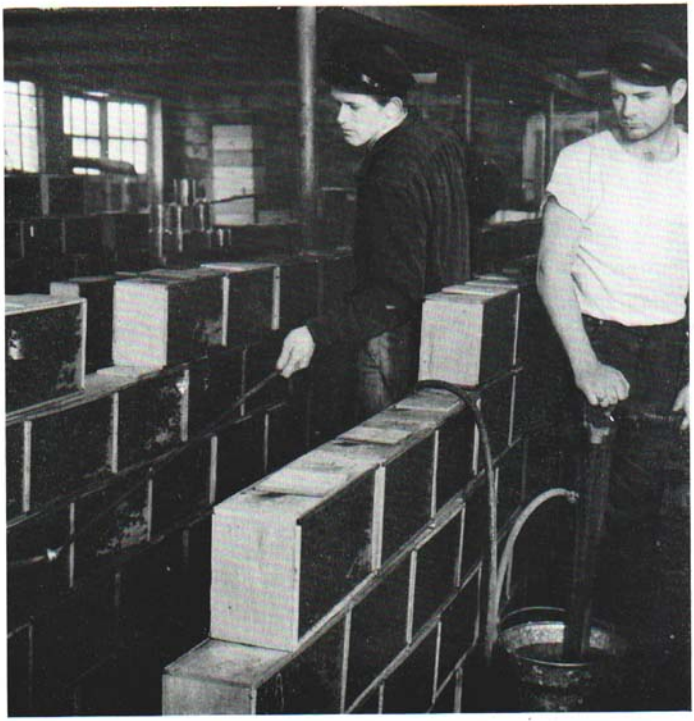


Fig. 10. Feeding package bees with sugar syrup before putting the bees in hives. A bucket pump may be used to spray the syrup onto the bees.

Once loading is commenced, the motor should be left running since the vibration of the motor tends to pacify the bees and reduces their tendency to fly if bees are escaping from any hive. Likewise, if it is necessary to stop enroute, the motor should be left running and the driver should avoid stopping near a bright light such as street lights; else, any loose bees may fly to the light and remain behind as a nuisance. In hot weather, a load of bees should be kept moving from the time it is loaded until destination is reached because the bees increase action as soon as the truck is stopped and may overheat and suffocate in a few minutes, provided the temperature and humidity are high.

It is well to place the unloaded bees in staggered rows or else place the hives in pairs, several feet apart, to diminish the danger of drifting. It is better also to open the entrances during the night to give the bees a chance to quiet down before daylight. Otherwise they may fly in the air confusedly and "drift" to neighboring hives. If the entrance must be opened in the daytime a little loose grass or twigs placed over the entrance lessens the danger of the bees drifting.

In locating bees, either for a permanent apiary site or for a temporary stay in the orchard, it is well to select a southern slope and a wind-protected spot, if possible, to encourage optimum flying. If it is impossible to find a wind-protected spot, it will pay to erect a temporary wind break such as snow fence or even shocks of corn placed about the hives to break the wind.

It is not wise to attempt to move strong colonies of bees when the temperature is higher than 80° F., particularly if the humidity is high.

Bees can be moved a few feet or a few rods, either a few inches a day or by moving them to a new location at least two miles away to be left there at least a week and then moved back to the new location. Apparently bees remember their old location four or five days so that if they are removed to a new location beyond their old flying radius and left there a week they forget their former location when returned to that vicinity. To move them from near the buildings to a place a few rods away in the orchard without first moving them at least two miles away into the country for a week would mean that many of the bees would return to the spot where the hives formerly had been near the buildings instead of returning to the new location in the orchard.

Remember that it is necessary to obtain a permit from the State Department of Agriculture, Lansing, to move bees.

Clipping Queens—By the time that it is warm enough to commence unpacking, a honey-flow from dandelion and fruit-bloom will usually be in progress. This is the time to clip queens. The presence of a honey-flow is desirable to minimize the danger of "balling" the queen as a result of the unusual disturbance.

The work of queen-clipping is slow, tedious and trying to the eyes. Nothing is accomplished by hurrying, however. Probably the best procedure is to remove the hive cover and inner cover, using the least smoke possible. The hive-cover, placed on edge, may be used as a seat for the beekeeper during the close inspection of combs necessary to find the queen.

Remove a comb of brood from the center of the broodnest, slowly and quietly and, before examining the removed comb, make a hurried

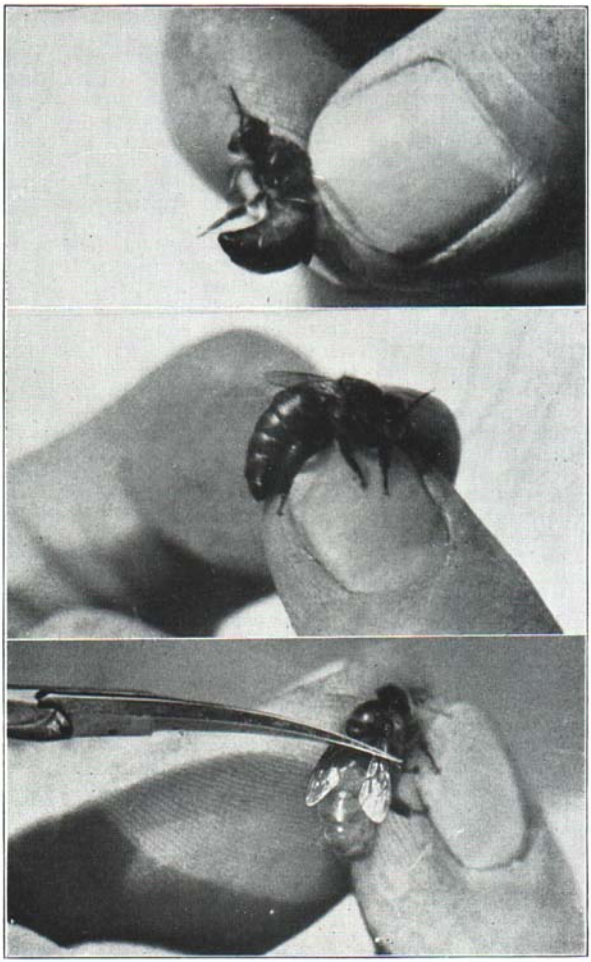


Fig. 11. Queen-clipping. Top view is of the first position; center, of the second position; bottom, of the third position.

inspection of the exposed surfaces of the adjoining combs in the broodnest. Frequently, if the queen happens to be on the comb removed when the hive is opened, she will cross over to an adjoining comb as the removal takes place. Therefore, a quick inspection of the exposed surfaces of the combs adjoining the one removed may save further search for the queen, whereas, if the removed comb is examined first, the queen may have found her way to still another comb by the time the next is examined. If, after examining all combs in the broodnest, the queen is still at large the best thing to do is to return all combs to the broodnest, close the hive and allow the colony to readjust itself.

When the queen is found, she is clipped as follows: Carefully grasp the queen by both pairs of wings with the thumb and forefinger of the right hand. Place the queen on the forefinger of the left hand and with the left thumb hold the three left legs securely. If but one leg is held, the queen is likely to twist around and tear the leg off. Such a queen will be superseded because of the injury. While the queen is quiet, clip off one pair of wings with a pair of small manicuring or dissecting scissors. If the beekeeper makes a practice of clipping queens only in the spring, and clips but one pair of wings at a time, the clipping will also serve as an age record.

Before trying to clip queens, the beginner should clip a number of drones and then, to develop the proper touch, should clip several workers, after which he is reasonably certain to be able to clip queens without injuring them.

With experience, the beekeeper becomes adept in finding queens. Good eye-sight and close concentration are necessary. All unnecessary vibration, smoke or hasty movements decrease the probability of finding the queen quickly. Black queens are especially difficult to find because of their hasty movements and quick response to smoke and vibration. Sometimes these black queens will successfully evade the beekeeper several times and are found only after the bees are shaken through a queen-excluder. Sometimes black queens will leave the combs entirely and will be found in one corner of the hive-body under a ball of bees or even out on the entrance board.

Italian queens are more sedate and quiet in their movements, and occasionally will continue their work of egg laying even after the comb is removed from the hive. At the time of clipping, a record should be made of the age of the queen, either by writing on the inner cover or on a special record blank for the purpose. This will facilitate the work of requeening later in the season.

MANIPULATION OF THE BROODNEST PREVIOUS TO THE MAIN HONEY-FLOW

If the beekeeper allows his colonies to remain packed until danger of frost is past, the strongest will probably need immediate attention, if swarming is to be avoided. The first indication of overcrowding in the broodnest is the bulging of the tops of the combs with honey. This extension of honey cells with fresh wax makes the top of the comb lighter in color, with the result that the experienced beekeeper can tell

at a glance that the broodnest is becoming crowded. If the bees are not given additional room for brood-rearing, preparations for swarming will result.

In the past it has been the custom of many beekeepers to place a super on the hive as soon as the broodnest becomes crowded. In comb honey production, particularly, this practice will usually result in swarming. Because the main object of the beekeeper should be to develop the maximum population in the colony by the time the main honey-flow begins, any division of strength such as results from swarming, will defeat this end. Because the basic cause of swarming is the sensation of strength of numbers which usually results from overcrowding of the broodnest, the most sensible manipulation for a full broodnest is to provide additional space for brood-rearing. Therefore, it has become customary to allow the queen to use either a standard broodnest together with one shallow hive-body, or two standard broodnests, or one large broodnest of the "Jumbo," "Modified Dadant" or "Dadant" type, previous to the advent of the main honey-flow. In fact many beekeepers are making use of the so-called "large hive" for a broodnest the year around.

If the colony has been wintered in a standard broodnest with a shallow hive-body above, the queen usually commences to lay in the top portion, in the spring, because the winter cluster works its way toward the top and rear of the hive during the cold months. In case the combs in the lower broodnest are perfect and provided the colony is well packed, the queen may, after filling the shallow hive-body with brood, go below into the deeper chamber and commence to lay. Whether the queen "goes below" to lay of her own accord depends not only on the condition of the combs in the lower broodnest but also upon the vigor of the queen herself. If the queen does not commence laying in the lower chamber after unpacking, the beekeeper will need to reverse the position of the hive-bodies, placing the shallow broodnest containing brood on the bottom-board, the deep chamber being placed on top of the shallow. The reason for this manipulation is that it is the tendency for both worker bees and the queen to work upward in the hive. Therefore, the queen will commence laying in the deep chamber much sooner after it is placed above the shallow one than she would if the deep chamber is allowed to remain below. Of course, if the queen has already commenced to lay in the deep chamber at the time of unpacking, it will not be necessary to reverse broodnests.

If the colony has been wintered in two standard hive-bodies, the upper chamber will probably become crowded at the time of unpacking or shortly thereafter. In this case the proper manipulation is to reverse the position of the brood-chambers, as before mentioned, and for the same reason. The queen is much less likely to commence laying eggs in the lower chamber of a broodnest composed of two deep hive-bodies, than she is in the lower chamber of a broodnest composed of one deep and one shallow hive-body. For that reason the customary manipulation for colonies wintered in a full two-story broodnest is the reversing of the broodnests as soon as the upper broodnest becomes crowded, provided danger of freezing weather is past.

If the colony has been wintered in a single standard broodnest of the Langstroth type, as soon as the broodnest becomes crowded addi-

tional room is given by adding a standard hive-body containing either drawn combs or full sheets of foundation. In this case, and in the case of reversing the brood-chambers of a two-story colony, the queen will be encouraged to commence laying in the upper story much sooner if the two center combs in the upper hive-body are replaced with two frames of emerging brood with the queen, from the lower broodnest. These combs of emerging brood, supply young bees for the upper broodnest and attract many other bees upwards also. This manipulation, commonly called "raising brood," is very efficient in "baiting" bees upwards into the newly added brood-chamber and should be regularly practiced.

The manipulation is of special importance if the newly added hive-body contains foundation. Unless the bees are baited upwards with frames of emerging brood, the foundation may go unnoticed by the bees until the broodnest below becomes so crowded that swarming preparations are commenced. The two center frames of foundation removed to make room for the two frames of emerging brood, should not be placed in the center of the broodnest below, especially in cool weather, but rather should be placed just outside of the outside combs containing brood in the lower chamber, one sheet of foundation on either side of the broodnest. Although the foundation is not so likely to be drawn out by the bees in this position, nevertheless, when foundation is placed in the center of a broodnest in the spring, it may have the same effect as a division board. That is, queen cells may be built in one portion of the broodnest.

Of course, the bees will not draw out foundation readily unless there is a honey-flow in progress and if foundation is placed in the hive in the absence of a honey-flow the bees will chew holes in it instead of making the foundation into combs. This is especially true if the foundation contains supporting wires.

In districts where dandelions are plentiful and where they yield considerable nectar, beekeepers who need additional combs would do well to give the bees foundation instead of drawn combs during the dandelion flow, because dandelion honey is of poor quality for eating purposes, but makes tough, strong combs. If the need for partially drawn combs is imperative they can be obtained in emergencies by alternating sheets of foundation with frames of brood in extra strong colonies for a period of two or three days during dandelion and fruit-bloom. In this short-time, strong colonies will commence to draw out the foundation, making cells one-third to one-half inch deep. These combs, although not fully drawn, are much more valuable than plain foundation.

Following the period when dandelions and fruit trees bloom, there is a period of from two to three weeks before the bees commence to collect nectar from white or alsike clover. It is during this period that the population of the colony should be increasing most rapidly. In fact if colony development is checked for any reason at this time, the beekeeper cannot expect to get the maximum crop of surplus honey from the colony.

Before worker bees are ready to become nectar carriers, they must spend a period of from 10 to 19 days in the hive gaining strength, cleaning house, learning to fly, learning the location of their hive, secreting

wax and building comb, nursing the larvae and attending the queen, serving as tank bees and possibly in guarding the hive. The amount of surplus honey which any colony will gather depends not only upon the total number of bees in the colony but also upon the proportion of field workers to the number of hive bees whose duties have just been mentioned, for the bees will not store surplus honey in the supers until there are sufficient nectar carriers to bring in more than enough nectar to care for the needs of the broodnest. Since the development of the worker bee requires 21 days from the egg stage to the adult, brood-rearing should progress at the maximum rate for a period at least six weeks in advance of the commencement of the main honey-flow.

Toward the latter end of this period of heavy brood-rearing, the daily emergence of thousands of worker bees, which, during the beginning of their lives move about on the combs rather slowly, getting in the way, filling the spaces between combs and shutting off the required amount of air circulation, naturally results in the commencement of swarming preparations.

Swarm Control Measures—In order to control swarming efficiently, the beekeeper must have a thorough knowledge of the factors which

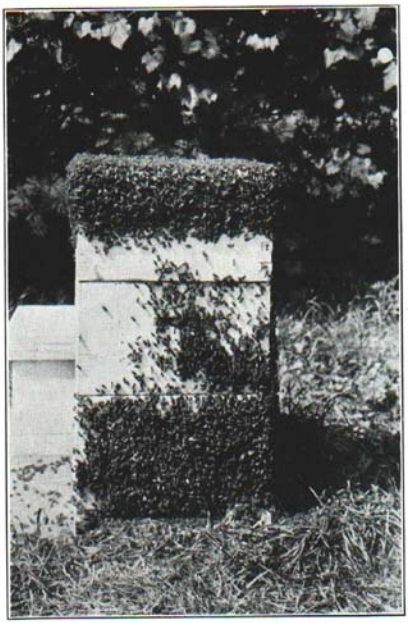


Fig. 12. A strong colony overflowing with bees.

tend to cause preparation for swarming. The writer has attempted to classify, in chart form, some of the various influences which may lead to preparation for swarming. A careful study of this chart should enable one to determine the factors which may influence any particular colony to commence swarming preparations.

Swarm control measures are either preventive or remedial in nature, depending on whether the beekeeper performs the manipulation before the time when the colony commences to prepare to swarm, or waits until after queen cells have actually been started. Obviously the preventive measures, if successful, are more desirable because then the development of the colony and the collection of nectar continues uninterrupted. Whereas, if the colony makes preparations to swarm, a certain amount of time is lost, even though the beekeeper may prevent the swarm from leaving the hive, or may keep it from absconding after it has left the hive.

Usually, all swarm control measures, whether preventive or remedial, depend on one of the three basic principles:

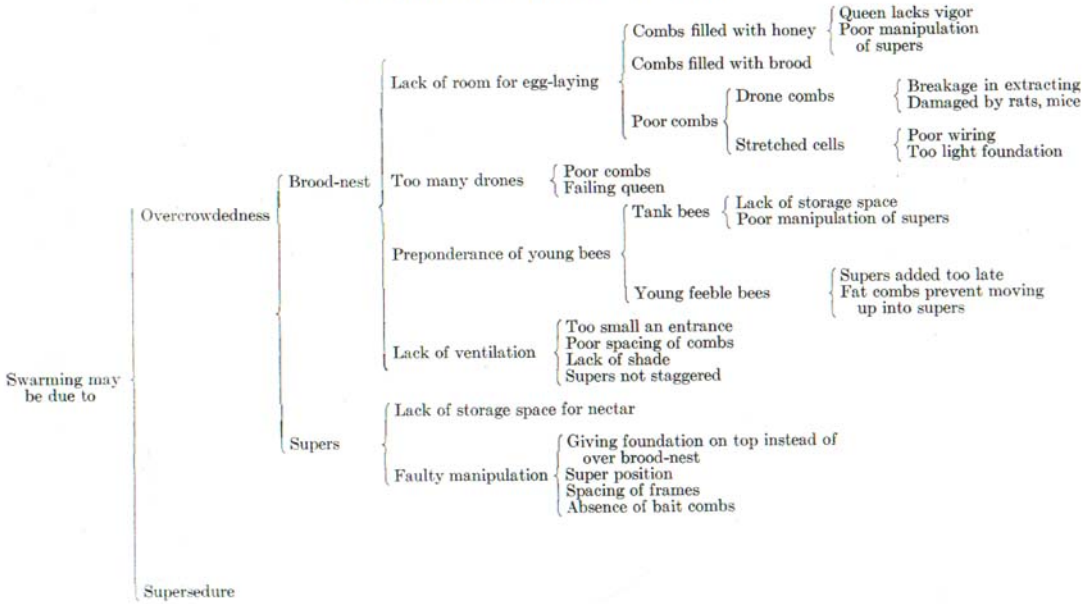
1. The removal of the queen.
2. The removal of brood.
3. The separation of the queen from the brood.

However, it is generally admitted that colonies headed by young, vigorous queens are less likely to swarm than colonies headed by two-year-old queens. Consequently, annual requeening in itself is a valuable preventive measure. It is possible that there is a difference in tendency toward swarming between colonies of the same strength, receiving the same manipulations. Breeder queens should be selected with this quality in mind. Furthermore, because available space for egg-laying is an important factor in the control of swarming, colonies in large hives such as the "Jumbo," "Modified Dadant" and "Long Idea" types and also those colonies in standard hives in which two hive-bodies are used for a broodnest previous to the main honey-flow, are much less likely to swarm than those colonies in which the capacity of the broodnest is restricted to the equivalent of eight or ten standard combs. In fact extracted-honey producers who requeen annually, and who provide plenty of space for egg laying in the broodnest, previous to the main honey-flow, find that, as a rule, less than 10 percent of the colonies prepare to swarm.

Inasmuch as preventive measures are applied before preparations for swarming are begun by the bees, the efficiency of the measure applied is sometimes left in doubt, because it is always possible that the colony would not have tried to swarm, in any case. In either case, the desired results are obtained. Virtually all direct attempts to control swarming are remedial measures, because most beekeepers make no special effort to prevent swarming other than those included in their regular system of management, such as the raising of brood by the Demaree plan for extracted-honey production. It should be noted that most successful systems of management include manipulations which tend to prevent swarming to a large extent.

For instance, at the time when the colony is most crowded with bees, that is, just previous to the commencement of the main honey-flow, in the Demaree plan, the queen is placed in a hive-body containing

SWARMING TROUBLE CHART



drawn combs or full sheets of foundation with one comb of brood in the center, and the broodnest in which the queen was laying, at the time, is placed above a super or queen-excluder, as indicated in the chart. This manipulation exemplifies the principle of the separation of the queen from the brood.

In the Miller plan, at the commencement of the honey-flow, the queen, together with all of the oldest brood, is placed in the lower hive-body, the surplus brood with enough bees to care for it being placed on a new hive stand at one side. Two comb-honey supers are then placed above a queen-excluder on the old stand. Should preparations for swarming follow, a manipulation commonly called "Shook Swarming" may be applied to the colony. This consists of placing the queen, with one frame of brood, in a new hive-body on the old stand, the remainder of the hive being filled with full sheets of foundation. The bees in the old broodnest are shaken off the combs at the entrance of the new hive on the old stand. Enough bees are left with the frames of brood to protect it. This surplus brood may be used for increase by placing it on a new stand or it may be used to strengthen weak colonies; or at the end of 21 days, when all the brood have emerged, the young bees can be united to the parent colony. The underlying principle of this swarm control measure is the removal of brood from the broodnest.

The removal of the queen to control swarming, although effective, requires a great deal of work at a busy season. With this method, when queen-cells appear, the queen is killed or removed from the colony. Seven to ten days later all queen-cells but one are removed or if the beekeeper has been rearing queens elsewhere from selected stock, all queen-cells are killed and a ripe queen-cell, virgin, or laying queen of the beekeeper's own selection is given the colony. The whole operation is much more easily described than performed. It is sometimes difficult to find the old queen in a crowded hive. It is also difficult and tedious work to find and destroy every queen-cell from seven

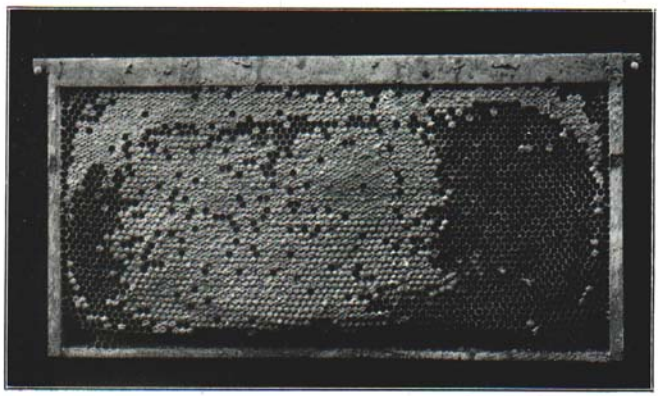


Fig. 13. A comb filled with brood.

to ten days later. However, annual requeening is made a certainty by this method and swarming is really prevented.

There are many variations in the method of application of these three basic principles of swarm control, but the effectiveness of all swarm control measures depends upon the employment of one or more of them.

Should a swarm issue as a result of negligence on the part of the beekeeper, the situation may be handled as follows:

The queen, being clipped, cannot fly and will be found in the grass near the front of the hive or on the lighting-board itself. The swarm will cluster on some nearby object. While the swarm is clustering, cage the queen, remove the broodnest and supers from the old stand and put in their place a hive-body containing drawn combs, or a hive-body containing full sheets of foundation with one drawn comb or frame of brood in the center. Replace the supers on the new hive, on the old stand, place the caged queen at the entrance and set the old hive-body containing the old broodnest about five feet from the old stand with the entrance pointing at a 90-degree angle to its former position. When the swarm commences to return to the old stand, release the queen and allow her to run in with the bees. The swarm will remain on the old stand now that the conditions within the broodnest have been changed by removing the brood. The field bees which remained in the hive when the swarm issued and which were moved to a new location with the old broodnest, will all return to the swarm on the old stand since that is the only location that they know. Thus if the old broodnest is allowed to remain near the old stand with its entrance pointing away at a 90-degree angle for about a week, the swarm on the old stand will be strengthened and the parent colony will be weakened to the point that no after-swarming will take place. During the week the entrance to the parent colony can be swung around to the same direction as the entrance to the old stand. This has a tendency to weaken the parent colony still further. At the end of the week, the parent colony can be removed to some other location in the apiary. When first placing the parent colony on a new stand at right angles to the old stand, remove all queen cells except one, as an added precaution against after-swarming.

By handling the swarm in this manner, the field bees, which are the nectar carriers, are all persuaded to remain at home on the old stand with the result that the swarm on the old stand stores surplus honey. The parent colony becomes "increase" but retains enough bees to store sufficient honey for winter. When a swarm is hived on a new stand, the working force is divided so that usually neither colony gathers much surplus honey.

The method of handling swarms just described is particularly suited to comb-honey production. In extracted-honey production the broodnest may be made acceptable to the returning swarm by raising brood according to the Demaree plan, leaving the queen below on drawn combs or on full sheets of foundation, with one comb of brood in the center. It is not necessary to destroy the queen-cells on brood-combs placed above a queen excluder, because the virgins which hatch will not be able to get through the queen-excluder to mate, and will "worry" themselves to death trying to get out.

MANAGEMENT DURING THE MAIN HONEY-FLOW

The discussion of manipulations performed during the main honey-flow, which in Michigan commences about June 15, varying with the season, should be read in conjunction with a study of the Beekeeper's Guide showing the four types of systems of management with approximate dates.

The location of the beekeeper with respect to latitude and altitude will make it necessary for him to adjust the dates given to suit his local conditions. The chart is arranged on a basis of the average season for central southern Michigan. Localities in extreme southern Michigan may be from seven to fourteen days earlier. The season in northern Michigan and especially in parts of the Upper Peninsula may be ten days to two weeks later than the chart indicates.

The commercial beekeeper will find that daily records of the gain or loss in weight of an average colony, kept on a set of accurate scales throughout the active season, will be of great assistance in determining the dates for the commencement and close of the main honey-flow. If records of weather conditions are kept in conjunction with "scale-hive" records, over a period of years, many worth-while deductions may be made. Toward the end of the honey-flow, the beekeeper is sometimes in doubt as to whether additional super room should be given. A noticeable daily gain in weight of the "scale-hive" would show the need of additional storage space. In fact, throughout the season, a study of the "scale-hive" records gives the beekeeper an insight into the current activities and needs of the bees.

The population curve on the chart is based on the activity of an extra strong colony. Many colonies never reach a maximum strength of 100,000 bees. But the record crops of honey are produced by the colonies which are over-flowing with bees. Every commercial beekeeper should aim to obtain the maximum population of field workers by the time that the main honey-flow commences. This requires careful planning in advance, and unless the beekeeper has some definite idea of how strong the colony should be to store the maximum of "surplus," he may perform some manipulation which will prevent the development of maximum strength.

There has been a change in opinion as to what constitutes a strong colony. Some have thought that when the queen has filled a single broodnest, the colony is ready for supers. Such a colony is apparently strong but may not contain more than 40,000 bees. The colony whose queen utilizes from 12 to 16 combs for brood-rearing at one time will need two hive-bodies for a broodnest and will naturally develop a much stronger colony. Some beekeepers have made a practice of removing brood from such extra strong colonies for use in building up weaker colonies, apparently believing that such a colony might get too strong. The most successful beekeepers, however, hesitate to take brood from strong colonies, especially if there is any likelihood that the maximum population will not be reached by the time the main honey-flow commences.

It is always difficult to gauge the development of the colony so that maximum strength will be reached exactly when the honey-flow com-

mences. Each season varies somewhat and weather conditions may delay the honey-flow unexpectedly. In this case the danger of swarming is increased, on account of the "loafing" tendency. On the other hand if the honey-flow is a week early, the colony may not be at its best in ability to take advantage of the available nectar, since a considerable portion of the population may be made up of "hive-bees" which are not yet old enough to become field workers.

It is not probable that any beekeeper can apply the manipulations indicated on the accompanying Beekeeper's Guide in their successive order on all colonies in any apiary. However, this is the ideal toward which one should work. The variation in vigor and prolificacy of queens, the variation in population in spring due to wintering conditions, lack of an adequate system of management and occasional accidents all tend to prevent an equal rate of development in all colonies in any apiary. Nevertheless the evenness of development of colonies in any apiary is a good indication of the ability to the beekeeper. If beekeeping could be reduced to an exact science it should be possible to examine any colony in an apiary and from its condition, diagnose the needs of the entire apiary. To approach this ideal requires

Fig. 14. It is advisable to record the daily gain or loss in weight of an average colony throughout the active season. A study of such records over a period of years gives average dates for beginning and close of nectar flows which helps the beekeeper plan his work.

the adoption of a system of management which will insure doing the right thing at the right time.

Hive records of some sort are of great assistance. However, the better the system of management, the less is the need for individual hive records. An apiary containing colonies of uniform strength should require the same manipulations throughout, and in this case, one record for the entire apiary should be sufficient. Under actual conditions this is seldom possible and so beekeepers are accustomed to keep individual hive records of major operations at least. The objection to the keeping of records in a book, is that the beekeeper may arrive at the out-yard and discover his book has been left at home. The loss of the book, would be a still greater calamity. A very convenient place to keep hive records is right on the honey board itself. When removing the cover the beekeeper sees at a glance what manipulation was performed last. In this case, of course, it is well to have corresponding hives and honey-boards numbered alike. To manage out-yards efficiently, the beekeeper will find that during each inspection it will be well to list all material needed for the next trip. If this practice is followed, no time is lost on account of forgetting to load some items of equipment needed, thus saving a return trip.

SYSTEMS OF MANAGEMENT

The Michigan Plan

To simplify the labor of packing the bees for winter and as an insulator against the cold of winter and heat of summer, a chaff-tray with a burlap bottom, equivalent in size to a standard hive body, is used for top packing. This chaff-tray is used over an inner cover throughout the year.

The inner cover is inverted at packing time to allow clustering space above the frames. When a two-story broodnest is used during winter for strong colonies the upper story should be solid honey. Medium-strength colonies may be packed in a single story broodnest well supplied with honey.

The ¾-inch depth side of the bottom board is used for winter. The winter entrance given is ⅜ inch x 5 inches. It is desirable to turn the entrance block opening upward.

No side packing is used, other than a single wrap of 15-pound asphalt felt paper, 36 inches wide, for two-story-plus-chaff-tray hives, and 30 inches wide for single-story-plus-chaff-tray hives.

Hives are packed singly, or in groups of two or three, late in October or early in November. After the customary spring check for food and presence of sufficient bees and brood, colonies are unpacked when entrance activity indicates possible over-crowding within.

At the time of unpacking, strong colonies have usually occupied the entire upper hive-body. If danger of frost remains and the queen has not already commenced to lay in the bottom hive-body, it is safer to try to coax the queen into the lower hive-body by putting down two combs of emerging brood than to take chances on having brood chilled by reversing the broodnests before the last of May.

However, if the colony is so strong that queen cells are being started, indicating swarming preparations, it is desirable to reverse the broodnests at unpacking time in mid-May and "raise" two combs of emerging brood to encourage immediate occupancy of the upper empty broodnest.

Such manipulation should control the swarming impulse normally evidenced by strong colonies in mid-May. If the queen immediately commences rapid egg-laying in the upper broodnest, there should be no further swarming preparations until the upper broodnest is fully occupied with brood and nectar.

Strong colonies, particularly during weather favorable for nectar secretion from fruit bloom and dandelion, may become over-crowded following the manipulation just described. Should they commence queen-cell construction, a third hive-body of dark, drawn comb may be inserted between the two already established broodnests with two or three combs of emerging brood placed in the middle of this comb space to encourage immediate occupancy by the queen and bees.

This may be looked upon as an emergency operation to check swarming preparations in extra strong colonies during mid-May, but is standard practice for strong colonies in late May and early June to provide "parking space" for the multitude of newly emerging bees. Should the colony gather little nectar during May there is little danger of swarming preparations, even in very populous colonies, but if the colony is strong enough to occupy three hive-bodies, it is safer to use the third hive-body of comb space than to try to house the bees in two hive-bodies uncomfortably.

It is not good policy to allow bees to acquire the swarming impulse at any time because it requires extra effort on the part of the beekeeper to counteract this impulse once it is started.

The date of the beginning of the nectar flow from clovers varies with each season. By keeping one average strength colony on a set of platform scales the beekeeper can determine much by the daily gain or loss of weight regarding the activity of the colony. When an average colony on scales commences to gain steadily from two to five pounds per day, it is time to restrict the broodnest and add supers. Until this time the queen is given free range of the two or three hive-bodies comprising the broodnest.

The manipulation of restricting the broodnest and adding supers is carried out as follows: Remove the cover, chaff-tray and inner cover and place them on the ground at one side or behind the colony; make certain that the smoker is emitting cool, white smoke which will be effective in controlling the bees. Gently smoke the bees down out of the top hive-body. This work is accelerated by the removal of No. 1 and No. 2 combs on each side of the broodnest where there is the least likelihood of injuring the queen by the removal of the combs.

These combs are shaken free of bees into the hive-body from which they were removed and for convenience the combs may be leaned against the outside of the bottom of the hive. The remaining combs in the hive-body are then spread apart, and smoke is gently driven down in the combs to start the bees moving downward. Then each comb is given a short, stiff-arm shake to remove the remaining bees.

It is not necessary to remove the combs from the hive-bodies to

accomplish the purpose of this manipulation, namely, to drive the queen below. When the bees have been smoked and shaken down out of this upper broodnest, it may be placed on the upturned cover at the rear of the hive.

The same operation is repeated with the middle broodnest, if the colony is three stories high. As before, remove the outside two or three combs, watching carefully to see whether the queen is on them as they are removed. Should the queen be noticed she may be placed in the bottom broodnest immediately, but she is seldom seen during the manipulation.

As soon as the bees have been smoked and shaken down out of this broodnest, the broodnest is removed and placed on the first broodnest on the upturned cover behind the hive.

The purpose of the entire manipulation so far has been to drive the queen down into the bottom broodnest. Most of the bees also have been driven down in the operation. It is not necessary to use enough smoke to demoralize the bees completely in order to accomplish this objective. Cool, pleasant smoke from burning sumac, beeswax and propolis, applied gently, hurries the bees downward.

The broodnest remaining on the bottom-board is now examined to make certain that there is ample room for the queen to lay for two weeks. There must be no queen cells left in this broodnest and if there is much brood present, one should remove all but one comb of emerging brood, thus giving the queen a "clear" broodnest.

If there is no brood in this bottom broodnest, a comb of emerging brood may be placed in the center, making certain that no queen cells with eggs or larvae are left.

After this examination a queen-excluder is placed above this lower broodnest, two supers of combs or one super of foundation being placed above the queen-excluder, and the two removed broodnests are returned to their former respective position above the super or supers.

Fig. 15. Alsike clover fields provide much nectar during June and July.

The inner cover, chaff-tray and cover are then placed on top of the hive.

The colony is now swarm-proof for a period of eight days unless the beekeeper has overlooked queen cells in the lower broodnest or unless the issuing of a swarm in a nearby colony induces the issuing of a swarm in the colony just manipulated.

On the eighth day following this manipulation the beekeeper returns to add more supers and to check the condition of the broodnest. The record of the average hive on scales in this or adjoining apiaries greatly aids the beekeeper in estimating how many supers the apiary will require. The beekeeper removes the cover, the chaff-tray and inner cover of the colony to be examined, placing them back of the hive. It is not necessary to remove the combs from a hive-body to determine the condition. By tipping the hive body upward, smoking gently from beneath, the beekeeper can see from below how much honey and nectar have been stored in the combs, how much storage space remains, and whether queen cells are present. If queen cells are present, they may be destroyed, but that is unnecessary because the virgin queens remaining after emerging and fighting among themselves will kill themselves trying to get through the queen-excluder below.

Provided the nectar flow has been steadily increasing, the top hive-body should be ½ to ⅔ full of nectar and honey, the remainder being emerging brood. The hive-body will contain queen-cells if eggs and larvae remained at the time of the last manipulation unless the queen was not placed below the excluder as intended. If no queen cells are found above the queen-excluder and the presence of eggs and young larvae indicates the presence of a queen above the queen-excluder, the beekeeper should check the broodnest beneath the queen-excluder for the presence of a queen. In rare cases, namely in supersedure, a queen might be found both above and below the excluder.

If no eggs and larvae are present below the queen-excluder, check the broodnest below the queen-excluder for the presence of queen cells, remove them, if present, and repeat the original operation to drive the queen down into the lower broodnest. In actual operation the queen will be found below the queen-excluder in at least 95 percent of the colonies so manipulated.

The upper broodnest may contain ⅔ nectar and honey and ⅓ emerging brood. The broodnest beneath will be largely brood since the queen was occupying this broodnest eight days ago when she was driven down into the bottom broodnest.

If two hive-bodies of comb were added for supers and the nectar flow has been heavy, these super combs will be ⅔ to ¾ full of nectar with some sealed honey possibly in the tops of these combs. As each hive-body is examined by "tipping" it is placed on the upturned cover at the rear of the hive. The queen-excluder is removed from the lower broodnest and the broodnest examined for the presence of queen cells and to determine whether sufficient comb space remains to provide ample egg-laying room for the queen for the next 10 days.

In normal seasons the swarming impulse will be now passing or passed, yet if queen-cells containing eggs or larvae are found in a crowded broodnest, either swarming or supersedure preparations are indicated. The activity of the queen during this period is very sig-

nificant. Queens which show indications of failing at this time should be promptly replaced, preferably with a young laying queen. A "ripe" queen cell from selected stock may be used. Queens which continue to lay rapidly after being driven down into the lower broodnest seldom try to swarm. There seems to be a direct relation between the rate of egg-laying in the broodnest during this period and the rate of storing nectar in the supers. Colonies in which queens have "loafed" after being driven down into the lower broodnest seldom need additional storage space on the next inspection even though the nectar flow has been favorable. Colonies having queens which rapidly expand the new broodnest with eggs may need one or two additional supers.

Should the broodnest be overcrowded, remove two, three or four combs of brood, replacing with either combs or foundation, preferably combs, placing this brood above the queen-excluder in the center of a super of combs or foundation. One or two supers are added at this time, depending on the daily gain in weight of the hive on scales. At this time the beekeeper's good judgment and ability to read the signs and indications of flora and weather conditions will enable him to better judge whether the colony needs one or two additional supers. The supers and broodnests are replaced on the hive above the newly added supers in their former positions and the hive is closed by replacing the inner cover, chaff-tray and cover.

During the period in which the manipulations are being applied some beekeepers prefer to "top super" instead of placing additional supers directly above the queen-excluder and beneath the partly filled supers. If "top-supering" is practiced to avoid the extra labor of lifting the partly filled supers and to prevent the additional disturbance of the colony caused by removing partly filled supers care should be taken to make certain that additional supers are given as soon as the bees commence to whiten the tops of the combs in the supers occupied. If the bees are allowed to become overcrowded before additional supers are added on top swarming may result.

Provided no developing queen cells were left in the broodnest the colony is again swarm-proof for eight days. Experienced beekeepers will be able to tell from a hasty examination of supers and broodnests in several strong colonies whether it will be necessary to manipulate every hive on the next visit or whether it will be merely necessary to add another super on top of the hive. If danger of swarming is largely passed, and if all colonies are energetically working as evidenced by heavy entrance activity and field flight, together with appreciable scale hive gain in weight, it is better not to disturb or demoralize the colony unless necessary to add more supers at this time.

If ample comb space was left in the broodnest for the queen on the previous visit there is seldom need to disturb the broodnest. If broodnest inspection is desirable, a hive-lifter to enable the beekeeper to lift all the supers at once avoids disturbance and demoralization. The importance of avoiding disturbance when bees are gathering nectar rapidly cannot be over-emphasized. A colony which might gain 12 pounds on a favorable day if unmolested, will gain but two or three pounds if badly smoked and demoralized during manipulation.

It may not be necessary to add more supers during the nectar flow from clovers, alfalfa, basswood, raspberry or milkweed. In areas where

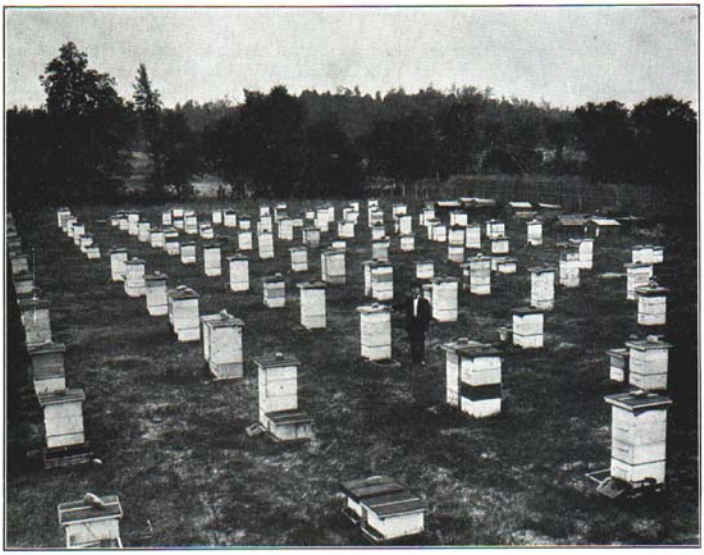


Fig. 16. A well arranged commercial apiary. Note the scale-hive in the right foreground. The trees and wind fence provide ample wind protection.

buckwheat yields it is advisable to remove the "ripe" white honey for extracting before the dark honey is mixed with it. It is well, however, to leave on the hive at this time, directly above the queen-excluder, the top hive-body which was originally the top broodnest since it may contain some off-color early honey from fruit bloom and dandelion which should be used for winter stores, the empty and unfinished supers being placed above this food chamber to house fall honey, if any.

The queen is confined to the single bottom brood-chamber until the end of the active season to make certain that she does not go up into the hive-body full of honey for winter food and start a new broodnest in late summer. When the broodnest is being arranged for winter in October, it is desirable that the upper hive-body be free from brood and contain full combs of honey.

While it is not unusual for queens which have laid eggs at maximum capacity during May, June and July to rest for a while in early August, this rest period must not be too long or the colony will not be in shape for winter in October. Therefore, all queens which fail to resume satisfactory egg-laying after a brief rest must be replaced with young, laying queens or the colony will not winter well.

Demaree Plan

This plan is used extensively by commercial honey producers, especially in the northern states where swarming is prevalent. Leading beekeepers have introduced variations of different kinds to suit their own conditions, but in general the plan is used as outlined hereafter. It must be emphasized that manipulations previous to the main honey-flow are for the sole purpose of obtaining the maximum population without swarming.

The use of the Demaree plan enables the beekeeper to control swarming almost entirely, and enables him to control the activity of the queen to a greater extent than is possible with the use of the so-called "large hive". On the other hand, the use of the Demaree system necessitates additional labor. To get the best results from this system, all equipment should be standard and interchangeable.

The raising of brood in the Demaree plan places a severe strain on the colony and unless the honey-flow is certain to last a sufficient length of time after the brood is raised to insure the building up of another broodnest below, the Demaree plan will be a failure. In other words, unless the honey-flow will continue at least from three to four weeks after one intends to raise brood, the plan should not be used. Strong colonies only should be Demareed.

Towards the beginning of the main honey-flow, about June 15, the upper story of the broodnest should be nearly full of honey and brood, since it has been used by the queen for approximately three weeks. That is, if the colony is strong and it has been possible to perform manipulations according to the schedule indicated on the chart. The lower part of the broodnest should be nearly empty inasmuch as the brood in it has been emerging during the three weeks just past. The queen is, therefore, placed in this lower broodnest. In this manipulation the finding of the queen is the main difficulty. To avoid wasting time, many beekeepers resort to the practice of shaking the bees off the combs of brood in the upper broodnest before the hive entrance. The upper brood-chamber is placed at one side on an up-turned cover. As each comb is removed from the upper broodnest it is hurriedly inspected and if the queen is found she is placed on the top bars of the combs in the lower broodnest and allowed to run down. If she is not found, the bees are shaken from the comb on an upturned honey-board in front of the entrance and allowed to run in. This operation is repeated until the queen is found, or until all combs of brood from the upper broodnest have been shaken. If the queen is not found at all it is presumed that either she has been overlooked or else has already gone down into the lower broodnest before the manipulation was made. However, it is well to note that she was not found so that on the next trip the beekeeper will look for eggs in the broodnest to make certain that the queen is present. Or, the same manipulation may be performed more rapidly as follows: One comb is removed from the upper broodnest and placed outside, on end, leaning against the hive. The rest of the combs are then shaken within the hive, all combs being placed in an empty hive-body after they are shaken. The comb that was removed is shaken last and placed with the rest of the combs in the new hive-body. The now empty body is removed from the hive.

A queen-excluder is then placed over the lower broodnest, a super containing drawn combs or full sheets of foundation is placed over the queen-excluder and the brood from which the bees have been shaken is placed above the super. If full sheets of foundation are used, two frames of sealed brood should be placed in the center as a bait, as mentioned on page 26. Although this is not necessary with drawn combs it is a great help in starting the bees into the super.

Young bees will find their way to the upper broodnest and "hover" the brood. In this way the young bees are more evenly distributed throughout the hive than would be the case if a super were added above the broodnest. Also the presence of young bees above and below the super, increases the likelihood that the super will receive immediate attention. In thus preventing "loafing," swarming danger is further diminished.

When the main honey-flow commences in earnest, strong colonies may be given additional ventilation. For that purpose some beekeepers use four inch-square blocks which are placed underneath the broodnest on the bottom-board, thus giving the bees an entrance in all directions. Better than the blocks are cleats or strips about one inch square and 20 inches long placed the long way of the bottom-board underneath the broodnest. Another method of increasing the ventilation is to move the super backwards one inch just above the queen-excluder. In case the bees still remain outside in the evening each super can be offset about an inch. This is called "staggering" and is not usually necessary in the North. If at any time during the honey-flow, robbing becomes dangerous on account of weather conditions, the hive-bodies should be immediately re-aligned and the entrance contracted.

At the next visit, which should be approximately one week later, about June 22, if the honey-flow has continued, the combs in the first super should all contain nectar. Furthermore, the tips of the cells at the top of the center combs should be "whitened" slightly. It is not likely that many cells will be sealed but this depends upon the strength of the colony and the amount of available nectar. At this time the beekeeper must judge, from his knowledge of his locality and from experience, whether the colony should be given one super or two to care for its needs during the following week. If the honey-flow is usually short and heavy, the colony will probably need two supers. If it is inclined to be slow, or if weather conditions are unfavorable, one super will suffice.

In this connection it should be understood that lack of sufficient room to deposit the nectar, one drop in each cell, not only costs the beekeeper honey, but also damages the morale of the colony. For if the colony were strong enough to maintain a field force of 30,000 bees and if each bee were to bring to the hive four drops of nectar during the day, this would make a total of 120,000 drops, or about 11 quarts of nectar which would weigh more than 22 pounds. "Scale-hives" have been known to gain this much in weight in Michigan from one day's work. During the following night the bees reduce this weight by evaporation. There are about 6,000 cells on two sides of a standard comb and therefore, it would require approximately 20 combs to hold this amount of nectar, one drop to a cell. If there are not sufficient

empty cells to permit the spreading out of nectar in this manner, then the "tank" bees, whose duty it is to relieve the field workers of their load of nectar and place it in the comb, are obliged to hold the nectar in their honey-stomachs until additional storage space is made available. Such conditions lead to "loafing," and once bees develop the "loafing" habit it is difficult to bring them again under the influence of the gathering instinct.

An understanding of these circumstances should also impress the beekeeper with the need for enough supers to care for the entire crop which any colony may be expected to gather during any particular honey-flow. The commercial beekeeper is usually too busy to stop to extract honey during the honey-flow, and furthermore, the honey should remain on the hive for some time after it is capped in the comb to "ripen" thoroughly.

Although it is not desirable to give colonies too many supers at once, if there is any chance that the colony will need two supers during the second week of the honey-flow, it would be better to give them the additional room rather than to crowd them. This applies especially to extracted-honey production.

On this visit, about June 22, it is also desirable to look in the broodnest for eggs, to make sure that the queen is present and laying. If no eggs are found below the queen-excluder, it is well to look in the hive-body containing the brood which was "raised" the week previous. The presence of eggs in the top hive-body means that the queen was not put below the queen-excluder as intended when the brood was "raised" and if so she should be found and put below the queen-excluder immediately, after making sure that no queen cells are present in the lower broodnest.

If the queen was put "below" on the previous visit, there will be queen cells in the broodnest which was "Demareed" or placed on top of the hive. Ordinarily beekeepers ignore these cells since the virgins which hatch will destroy themselves trying to get through the queen-excluder. Some beekeepers prefer to make "increase" of this upper broodnest, and in that case all queen cells are destroyed four days after the brood is raised, or in this case June 19, thus leaving only day-old larvae for queen cell material. Then when these selected cells are "ripe," or say on the third regular trip of inspection, about June 29, all cells but one are removed or destroyed, and the hive-body is moved forward three-fourths inch. This gives the upper hive-body an entrance to the rear but leaves none in front, so that the virgin queen may mate out of the upper hive-body and commence to lay. After she has started to lay in the upper hive-body, for example, about July 15, the upper hive-body may be set off to one side for increase, or the young laying queen may be used to requeen the colony, as desired.

This plan works best when the hive-body containing the queen cells and brood is removed from the broodnest by at least two hive-bodies of combs between. If only one hive-body of comb is between, virgins may disappear, and, also, sometimes lead a swarm from the upper entrance.

The objection to the use of this method for making increase is that it costs the beekeeper too much honey, because by the time the young queen has started to lay, all brood has emerged and the combs are full

of honey which can be taken as surplus if it is not set aside with the increase. Furthermore, if the parent colony is of poor stock, the beekeeper should kill all queen-cells seven days after first raising the brood and introduce a ripe queen cell or laying-queen of his own selection.

On the next visit, about July 1, the beekeeper must judge from weather conditions and the condition of the honey-plants, whether the colony will need one or two additional supers. At this time also the broodnest should be examined for the presence of queen cells. If queen cells are found, the bees and queen are shaken off the brood combs onto full sheets of foundation with one brood comb in the center, the brood combs being placed on top of the hive.

By this time the brood which was raised at the beginning of the honey-flow will have largely emerged and the combs should be filled with honey.

On the next visit, about July 8, the honey-flow may be virtually over, or the colony may require still another super, largely depending on weather conditions. If the honey-plants in the surrounding district are cut for hay, as in the case of alsike and white clover, it is likely that the honey-flow will be virtually over by July 8. However, in sweet clover and alfalfa districts, and where clovers are being grown for seed, the beekeeper may yet expect some honey. The "scale-hive" will indicate the possible need of an additional super.

On the next visit, about July 15 if colonies were supered on the last visit and the honey-flow is tapering off, it is time to commence to remove supers for extracting.

The Markham Plan

In the Markham plan a two-story broodnest is used throughout the year unless the bees are wintered in the cellar. If wintered out-doors in a two-story broodnest, at unpacking time, about May 15, the upper chamber of the broodnest should be crowded. Therefore, the two sections of the broodnest are transposed, the full one is placed on the bottom-board and the one that was below during the winter, together with the queen, is placed above. By the time when the main honey-flow commences, this upper chamber of the broodnest will again be full of brood, and the lower chamber, which was full at unpacking time, will be empty, the brood having almost entirely emerged in the meantime. Therefore, the two sections of the broodnest are again "switched".

By this method of manipulating the broodnest, the beekeeper can avoid swarming in virtually all colonies, and those colonies which persist in making preparations for swarming may be manipulated as follows: shake the bees off the brood combs in the upper broodnest onto full sheets of foundation, placing the full broodnest on top of the hive. Ten days later reverse the position of these two broodnests, returning the "raised" brood to its former location below the queen-excluder. The newly drawn foundation full of brood is then placed on top of the hive. This manipulation usually satisfactorily controls swarming.

As indicated in the Beekeeper's Guide, in the Markham plan, a queen-excluder is placed above the two-story broodnest, supers being added above. Although the Markham plan does not provide so even distribu-

tion of the young bees throughout the hive as does the Demaree plan, the manipulation is more "fool-proof," and does not place such a strain on the colony. On the other hand, the queen has a better opportunity to "loaf" in the Markham than the Demaree plan. The upper chamber of the broodnest should never be allowed to become so crowded that the tops of the combs are thickened sufficiently to check upward ventilation or passage of the bees, before being transposed.

At the beginning of the main honey-flow, then, about June 15, the two sections of the broodnest are transposed and a super is placed above the queen-excluder. On the next visit, about June 22, inspection is made to make certain that the queen is laying in the upper story of the broodnest, and supers are added as needed. Colonies making swarming preparations are manipulated as before mentioned.

On the next visit, about July 1, the broodnest is again inspected and if the top chamber is becoming crowded, it is transposed again, supers being added as needed.

Strong colonies having young vigorous queens may not need transposing because the queen is likely to go from one section of the broodnest to the other readily. By tipping up the top chamber of the broodnest and inspecting the lower edge of the combs it will be possible to tell whether transposing is necessary. Furthermore, if queen cells are present in the upper chamber they can be seen from below at the time of tipping in virtually every instance. If queen cells are present, all frames must be handled to make certain that all cells are destroyed.

On the next visit, about July 8, the broodnest is again inspected to make certain that the queen is laying in the upper chamber, and if the honey-flow is still in progress, additional super room is given.

On the next visit, about July 15, if the honey-flow is tapering off, no further supers will be needed, probably, and if the upper chamber of the broodnest is becoming crowded, it may again be transposed with the lower. At the same time the beekeeper may commence to remove supers for extracting.

If, during inspection of the broodnest, queen cells are found, they should be destroyed and three or four frames of brood may be removed and placed in the last empty super given, the brood being replaced by foundation or by empty combs.

The Miller Plan

In the Miller plan, a two-story broodnest is used to permit the maximum development of population previous to the commencement of the main honey-flow. It is not practical, however, to produce comb-honey on a colony having a two-story broodnest. Therefore, when the main honey-flow commences and supers should be added, the broodnest is restricted to one hive-body. This is accomplished by placing all of the oldest brood, with the queen, in the lower broodnest, setting the remaining brood with enough bees to protect it on a new bottom-board on a new location. Two comb-honey supers are then placed over the queen-excluder on the full broodnest on the old stand.

This extra brood, which is placed on a new location, may be used for any one of several purposes. If the beekeeper is certain that no disease is present, the brood can be used to strengthen weaker colonies.

Or the brood may be allowed to emerge for 21 days, at the end of which time there should be present a young queen just starting to lay. If the bees are of satisfactory stock this young queen can be used to requeen the parent colony from which the brood was taken. Or the new colony can be allowed to continue as "increase," or several new colonies may be united to make colonies strong enough to collect honey during the fall flow. The proper plan to use depends partly on the beekeeper's own wishes—that is, whether he desires to increase his colonies. It also depends upon whether the locality provides a fall flow of nectar.

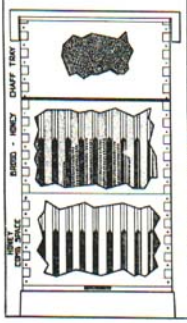
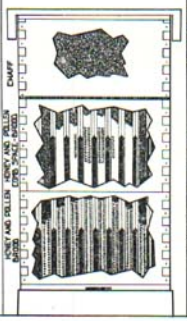
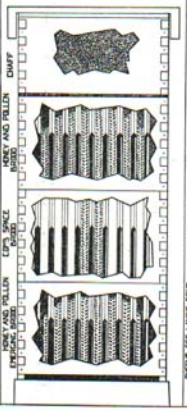
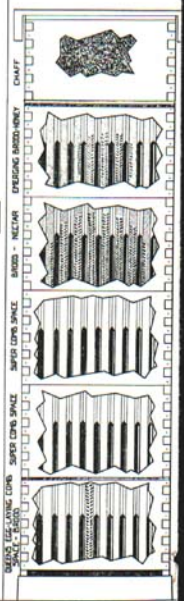
The restriction of the broodnest has the effect of "squeezing" the bees into the supers which replace the second story of the broodnest. Most comb-honey producers have difficulty in persuading the bees to commence working in comb-honey supers. Once they have started to work in the supers, however, they continue to do so under proper manipulation. As an added inducement to commence working immediately, the first comb-honey supers added should contain some sort of "bait". Unfinished sections, extracted and saved over from the previous season can be placed in the four corners of the super for this purpose. Shallow extracting-frames with thin super foundation for cut comb-honey, or with wired medium brood foundation, if they are to be extracted, placed one on each side of the comb-honey super, serve the same purpose. In either case the bees commence to work in the supers on the bait or in the shallow extracting-frames first, and then, once work is started, they continue. Without bait sections or shallow extracting frames the bees may ignore the comb-honey supers for several days, and then commence to "loaf" and remain out of the hive with the resultant preparation for swarming in most cases.

Should swarming preparations follow the restriction of the broodnest at the commencement of the honey-flow, remedial swarm control measures such as "shook swarming," or removal of the queen, or removal of several frames of brood, can be applied as described on page 30.

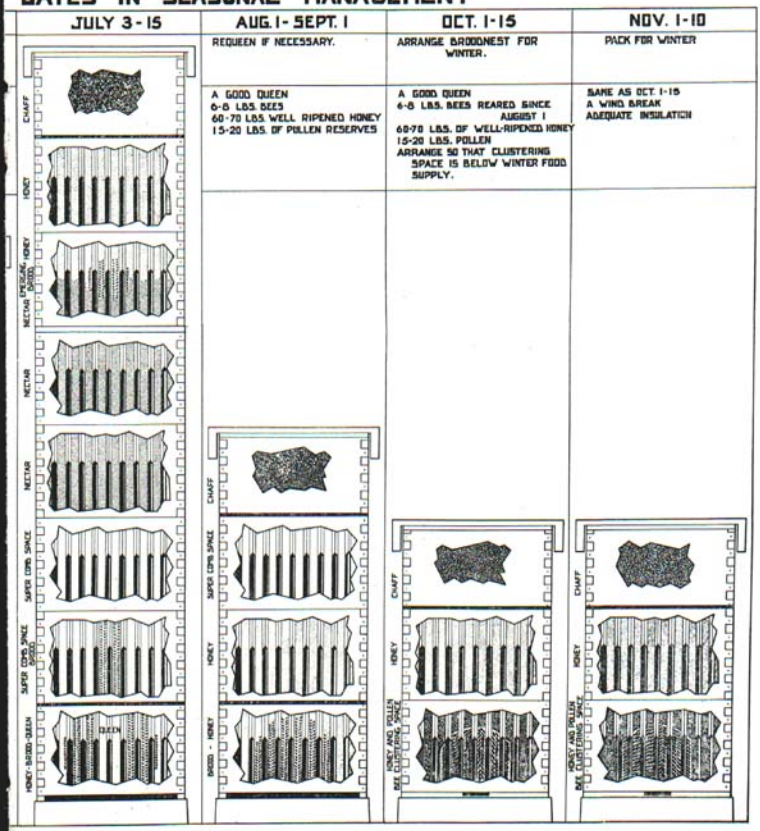
The manipulation of supers in comb-honey production is not a matter as easily regulated as in extracted-honey production. Whereas in extracted-honey production it is generally conceded that empty supers should be added directly above the queen-excluder, in comb-honey production the position of the empty super depends largely on the progress of the honey-flow. As long as the honey-flow remains steady, newly added supers are placed just above the queen-excluder. The super most nearly completed is placed directly above the new super, with other supers arranged above this, their order depending on their nearness to completion, the one in which least work has been done being placed on top. The numbering of supers in the chart explains this arrangement.

The object of this manipulation is to distribute the bees evenly, whose duty it is to build comb and ripen the honey, over as large an area as possible. However, this method of super manipulation will give best results only with strong colonies, and during a heavy honey-flow. When the beekeeper feels that the height of the honey-flow is past, his efforts should be directed toward manipulation that will persuade the bees to finish those supers which are already started before commencing on new ones. Therefore, the last super added is placed on

COLONY CONDITIONS AT CRITICAL

	APRIL 1-15	MAY 1-15	JUNE 1-15	JUNE 25-JULY 3
	EARLY INSPECTION. FEED IF NECESSARY.	UNPACK-REVERSE BROOD NESTS OR ADD COMB SPACE TO PREVENT SWARMING PREPARATIONS. FEED IF NECESSARY.	FEED IF NECESSARY. ADD COMB SPACE TO PREVENT SWARMING PREPARATIONS.	PUT QUEEN BELOW EXCLUDER. ADD COMB SPACE FOR NECTAR STORAGE.
REQUIREMENTS	A GOOD QUEEN 4-5 LBS. BEES 2-4 COMBS OF BROOD 30-40 LBS. HONEY OR SYRUP 10-15 LBS. POLLEN A WIND BREAK ADEQUATE INSULATION	A GOOD QUEEN 6-8 LBS. BEES 6-10 COMBS OF BROOD 25-35 LBS. HONEY OR SYRUP 10-15 LBS. POLLEN AMPLE COMB SPACE FOR EXPANSION	A GOOD QUEEN 12-20 LBS. BEES 12-16 COMBS OF BROOD 20-25 LBS. HONEY OR SYRUP 10-15 LBS. POLLEN AMPLE COMB SPACE FOR: BROOD REARING NECTAR STORAGE YOUNG BEE PARKING SPACE	SAME AS JUNE 1-15
				

DATES IN SEASONAL MANAGEMENT



the top of the hive where the bees will not commence to work until other supers are filled. As fast as supers are completed they should be removed from the hive to avoid "travel stain". However, the danger of "travel stain' is less during a heavy honey-flow, and at the same time, work is being done on several supers at once with the result that they are all completed at about the same time.

At the beginning of the main honey-flow, then, or about June 15, the broodnest is restricted as previously described, two comb-honey supers being placed on the hive above a queen-excluder.

At the next visit, about June 22, the broodnest should be inspected for signs of swarming preparations and if queen-cells are found containing larvae, some one of the remedial swarm control measures should be applied. The bees should have commenced working in the two comb-honey supers already on, and should need another. The beekeeper's experience and knowledge of his territory will be invaluable in deciding whether the bees need more room and if so how much. The new super is placed above the queen-excluder, the first super added being placed above it with number two on top.

At the next visit, or about July 1, if the colony was treated for swarming on the previous trip, the broodnest will probably need no further manipulation. If it was not treated, a careful inspection should be made of all combs for the presence of queen cells. Should queen cells be found this late in the honey-flow it would not be well to "shook swarm" the colony, placing the queen on full sheets of foundation, but rather some combs of brood should be removed from the broodnest or else the queen herself removed. If the honey-flow has been heavy, another super should be added above the queen-excluder, super number three being placed on top of the hive.

At the next visit, or about July 8, if the honey-flow has continued strong, the colony should need another super, added above the queen-excluder, super number four being placed on top of the hive. The first super added should be finished by this time and, if ready, may be removed. If the honey-flow appears to be checking, super number five should be placed on top of the hive instead of above the queen-excluder.

On the next visit, or about July 15, the condition of the honey-flow will regulate the manipulation of supers as before. By this time supers number two and three should be ready for removal.

As the honey-flow draws to a close, remaining supers are removed as fast as they are completed. Before being placed on the market, comb-honey sections should be cleaned and graded, and the net weight should be stamped on the section.

The Rasmussen plan for producing comb-honey avoids swarming as follows: At supering time or at the beginning of the clover honey-flow remove the queen on one comb of unsealed brood and two combs of honey, leaving six combs of brood in the bottom brood-chamber. Place two frames of foundation in the center of the six combs of brood. Place a queen-excluder over the bottom brood-chamber, then an inner cover with standard bee-escape hole (without bee-escape) over the excluder. Above the inner cover place the second broodnest, arranging the comb of unsealed brood with the queen in the center of the hive-body, the combs of honey at the outside of the hive-body with three

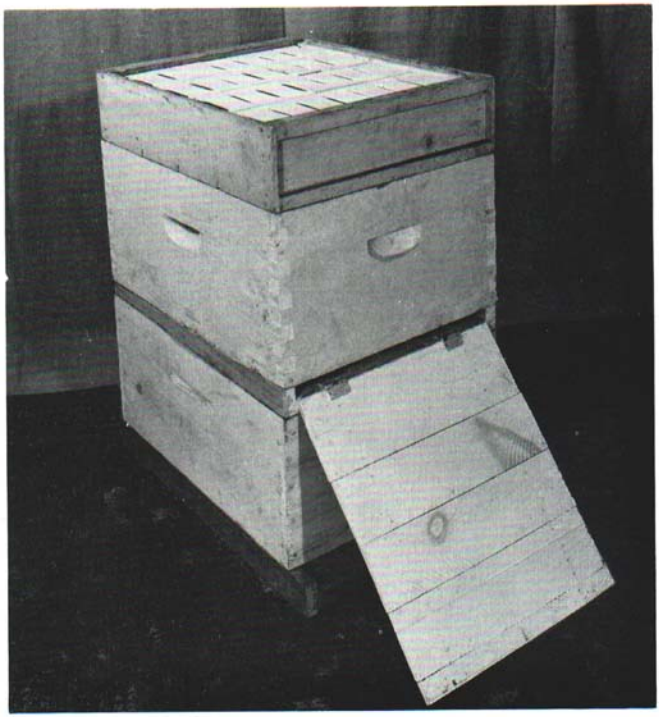


Fig. 17. A hive arranged to produce comb honey according to the Rasmussen plan.

frames of foundation at each side of the comb of unsealed brood with the queen. An entrance is provided above the separating inner cover. The lower entrance is screened. An alighting board is inclined from the ground to the newly provided entrance. (See Fig. 17.) A comb-honey super is placed above the upper brood-chamber. If the queen falters she is replaced promptly.

The brood in the lower brood-chamber emerges and the young bees join the queen above, passing through the queen-excluder through the hole in the inner cover. The emerging brood in the lower hive-body is replaced with honey by the bees. The lower brood-chamber serves as "parking space" for young bees and also as a food chamber from which the bees will remove honey to complete unfinished sections at the close of the honey-flow. It is important that the honey-flow continue uninterrupted for several weeks to obtain best results.

CUT COMB-HONEY

Cut comb-honey is comb-honey produced in shallow extracting frames on thin super foundation without supporting wires in the frames. The colony is managed in the usual manner until supering time. If 8- or 10-frame standard hives are being used for a broodnest, the Miller plan for comb-honey production may be followed. If large hives, such as the Jumbo or Modified Dadant, are being used for a broodnest, it may not be necessary to give additional comb space for egg-laying before supering. In this case shallow supers of foundation may be placed on the hive without further manipulation. No queen-excluders are used. The bees are encouraged to go into the supers if the first super added contains partially drawn combs held over from the previous season. Two shallow supers should be added at the beginning of the honey-flow and others may be added as rapidly as needed, directly over the broodnest. As in the production of comb-honey, the beekeeper must gauge the number of supers to be given by the daily gain in weight of a colony on scales and the expected duration of the honey-flow. As soon as the peak of the nectar-flow has passed, caution must be observed to see that supers which have been started are likely to be finished before additional storage space is given.

It is important that all hives be level when supers are added to avoid

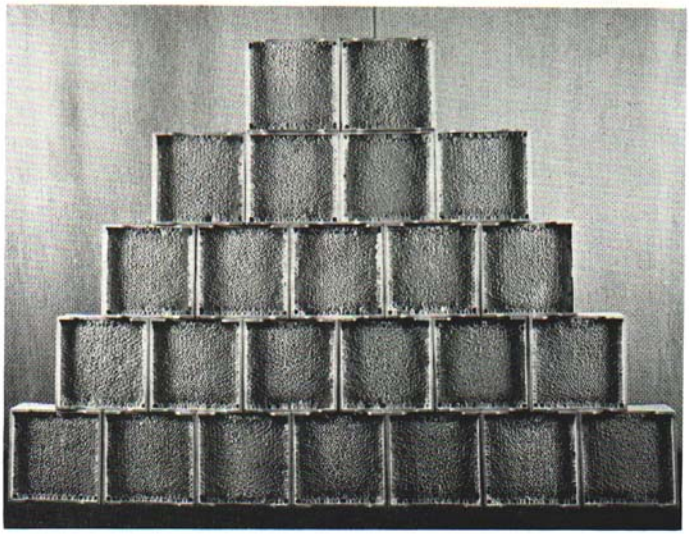


Fig. 18. Fancy comb honey produced according to the Rasmussen plan.

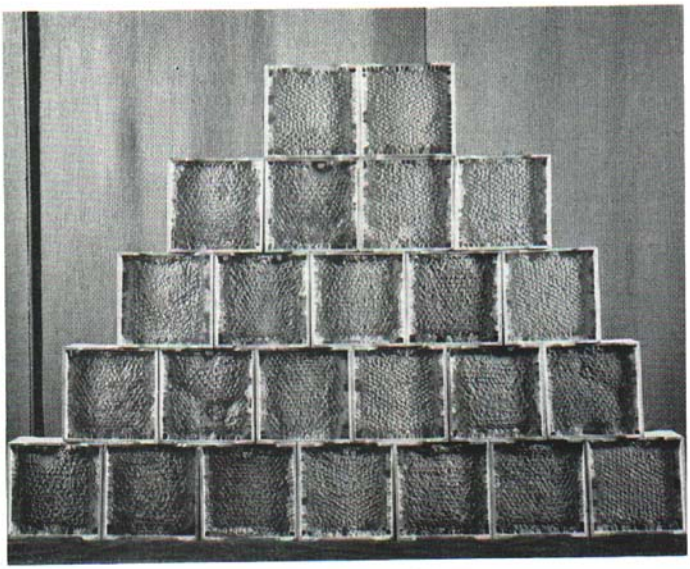


Fig. 19. U. S. No. 1 comb honey.

the construction of imperfect combs. It is desirable that the finished combs be of even surface and thickness, drawn clear to the bottom bar to yield full weight portions when cut.

Special equipment is available for cutting, draining, wrapping, and packaging cut comb-honey. The honey should be thoroughly warmed to 80° F. before cutting. The cutting knives should be thin, sharp and hot. All cakes should be cut straight on all four edges for best draining and appearance. Moisture-proof Cellophane should be used for wrapping the honey and the wrappers should be 4 inches longer and wider than the cake of honey to be wrapped. This will prevent leakage when folded.

This form of comb-honey production reduces swarming trouble and, in seasons of short duration of nectar flow, the beekeeper may extract partially filled combs instead of melting them as is necessary in section comb-honey production.

LARGE HIVES

The Modified Dadant Hive and the Jumbo Hive (For Extracted Honey Production)

General Characteristics—The broodnest of the Dadant hive has 11 Quinby frames. For convenience, the hive was "modified" by shortening it slightly to the length of the Langstroth hive so the same supers could be used for both. Frames of Langstroth length and Quinby depth are commonly called Jumbo and are used in 8- and 10-frame hives as well as in the Dadant hive where 11 of them are spaced 1½ inches from center to center.

In common with all hives having a greater capacity than the 10-frame Langstroth, it is classed as a large hive. At the time the term "large hive" came into use it had a real significance because it was directly in opposition to the principle of contraction then widely practiced. Modern beekeeping methods provide extra stories of room if one story is not large enough for maximum brood rearing. In other words, the big hive has become a principle of management rather than a piece of equipment and is universally accepted.

The feature of the Dadant hive, in contrast to the standard hive, is the fact that the brood frames do not serve as super frames. As a consequence, certain manipulations commonly practiced are not applicable to these hives. Any of the hives in common use today are capable of yielding the maximum crop of honey that a colony of bees can produce, **if properly handled.**

The Dadant Extracting Super—Frames are 6¼ inches deep, and can be uncapped at a single stroke of the knife and extracted at high speed. A super of this depth as wide as the Dadant hive is not too heavy to handle. A 10-frame standard super when well filled weighs 80 to 85 pounds, and slightly more than 60 pounds of honey may be extracted from it. The Dadant super well filled weighs 65 pounds and yields 50 pounds of honey. Because the combs uncap easily and withstand a high speed in the extractor, as many pounds of honey per day may be extracted from Dadant supers as from standard. Ten frames in the super spaced 1⅝ inches will be preferred by those who prefer a wide spacing for extracting combs.

Either the Jumbo or the Dadant brood-chamber may be large enough for the maximum work of a good queen, including an adequate store of pollen and some honey. The practice of raising combs of brood above is not feasible with this equipment. On the other hand, it may be true that a good queen does not need that sort of stimulation and a poor queen remains a poor queen in spite of it. The deep brood-chamber favors a large volume of brood in approximately spherical shape. The widespread use of the Demaree method of swarm control has tended to restrict the use of the Jumbo and Dadant hive because they are not adapted to this and similar manipulations by which brood frames become super frames.

If increase is desired and queen cells are started in a colony of good stock having a good queen, it is very satisfactory to proceed according to the Demaree method and a week later set off the old

brood-chamber with ripe queen cells for an increase. If it is preferable to weaken the parent colony as little as possible, the increase may be left with its entrance near the parent colony until the new queen has mated, then moved to a permanent stand so the field bees will join the bees on the old stand.

If the swarming impulse must be thwarted without increase a dequeening, re-queening method is the most practical for the Jumbo or Dadant hive.

The Jumbo or Dadant brood-chamber is large enough to hold adequate winter stores and at the same time afford space for fall brood rearing and the winter cluster. But the honey for winter stores will be present only if a late fall flow provides honey as brood rearing is restricted. Under the conditions usually prevailing over most of Michigan, the honey-flow stops so suddenly that the bees have no chance to fill the broodnest after brood rearing slackens. Therefore, single-story wintering requires that all supers be removed before the end of the honey-flow to crowd winter stores into the brood-chamber, and it is difficult to predict the date when the supers should be removed. A deficiency in winter stores can be made up by feeding. However, feeding for winter stores is a practice that is on the wane.

As with other hives, a food chamber is the easy answer to the problem of winter stores. For best results, it should be placed below the brood-chamber about the time egg-laying ceases. The bees will then move enough honey up into the deep hive to provide for their winter needs and arrange it in perfect order for a winter chamber. In the spring, the queen will start laying in the deep hive which will build up the colony at top speed because there will be no barriers to expansion of the broodnest. At unpacking time, the food chamber may be placed above the broodnest to be refilled, and will serve as the first super. Shallow food chambers on any style hive may be handled in the same manner.

For Comb-Honey Production

While the choice of hive for extracted honey production is based on relative convenience to the beekeeper, the situation in the case of comb-honey production is different because the brood is confined to a single story and the size of the brood-chamber may have a considerable effect on the yield of surplus honey. Here the Dadant hive loses the advantage of its special extracting super, but it saves labor when compared with a smaller hive where extra brood-rearing space is provided and removed before the honey-flow.

The Dadant hive is at a great disadvantage under conditions of a short honey-flow, particularly if the flow comes too early to allow the colonies to build up to maximum strength. With Langstroth hives, it is common practice to provide a second story for the spring build-up period. As the main honey-flow approaches, the best combs of brood are collected into one story and the other story replaced by the comb-honey supers. Ordinarily, work in the super starts at once, and frequently also preparations for swarming. The colony strength starts to decline, owing to the smaller amount of brood, unless the colony is fortified by exchanging frames of honey and young brood for emerging brood from another colony, a procedure that certainly increases

the yield from one but at the expense of the other. With the Dadant hive, dwindling because of diminished brood-rearing does not occur, but work in the supers (preparations for swarming) starts less promptly. If the honey-flow lasts beyond three weeks, the sustained strength of the colonies in the large hives may result in a larger yield; otherwise the early advantage of the standard hives is not likely to be overcome.

It is true that a good queen will keep a larger amount of brood in the big hive, but it does not follow that the big hive will be as well filled as would a smaller one. The outside frames and the corners will be used for storage of honey and pollen. This situation is no disadvantage, but because the bees work well only in the part of the comb-honey super that is directly above brood, a super less wide than the Dadant hive is best; a 10-frame super is sufficiently wide.

Conventional supering for comb-honey places the super being filled next to the broodnest and the one being finished above it, with those in intermediate stages above these two, possibly with an empty super for a "safety valve" on top of all. The deep brood frames have a tendency to have more honey next to the top-bars than do Langstroth frames. The presence of this honey between the brood and the super gives the first position on the Dadant hive some of the character of the second position on the more shallow hives. Therefore, to obtain sections equally well filled it is necessary to leave the super being filled in the first position longer—perhaps even until capping has begun on most of the sections. In fact, with the Dadant hives, it is usually best to leave the empty super in the "safety-valve" position until work in it is well-started. By that time the other supers on the hive will have combs drawn thick enough to make heavy sections when they are filled.

Queen Rearing

The ordinary equipment, common in every beeyard, is sufficient for the rearing of queens for home use, although beekeepers who wish to rear a large quantity of queens every season usually prefer to prepare special equipment and to adopt the methods of the professional queen-breeder.

Of first importance is the stock from which the queens are to be reared. In every apiary there are usually one or two colonies which produce an unusually large crop of honey. This fact alone is not necessarily sufficient to prove that the colonies should be used for breeding stock. Unless the queen is pure, and purely mated, as indicated by the evenness in color and size of her offspring and of her daughter's drones, then the beekeeper cannot hope to find her qualities transmitted to her offspring. Other qualities such as comparative gentleness of the workers, quietness on the comb, non-propolizing habit, size, wing-power, resistance to European foulbrood, a non-swarming tendency and possibly length of tongue, should all influence the beekeeper in his selection of breeding-stock. And since it is impractical, if not impossible, to control mating, attention should be given to the selection of the drones. By giving the most desirable colonies plenty of drone-comb and by restricting the amount of drone-comb in undesirable colonies, and also by trapping the undesirable drones themselves, any beekeeper may increase the probability of desirable mating.

For best results, the beekeeper should commence to rear queens toward the beginning of the honey-flow, since at this time, it is easiest to imitate the natural conditions under which queen-cells are normally produced, namely, the development of the swarming impulse or of the impulse to supersede or the condition of queenlessness.

The method which will be described for the rearing of queens without additional equipment, known as the Hopkins or Case method, is but one of several employing nearly the same principles. The Hopkins plan is very simple and when used intelligently, produces the most cells for the least effort.

When ready to commence queen-rearing for example about June 20, the breeder-colony is prepared by removing from the broodnest, temporarily, all available egg-laying space. An empty comb in which no brood has been reared, is then placed in the center of the broodnest and allowed to remain five days. At the end of this time the comb should be filled with eggs, many of which will be just hatching, and therefore of the right age for queen-cell material.

On the morning of the fifth day, a nurse-colony or cell-building colony should be prepared. A colony which is just preparing to swarm will serve the purpose admirably, or one that is trying to supersede its queen. But the best results will be obtained when a colony is specially prepared for the occasion. The cell-building colony must be full of young, over-fed bees and positively queenless.

To prepare this colony, several combs of emerging brood, without bees, may be put in a hive-body above a queen-excluder for three to five hours. These combs are to be "put up" in enough strong colonies to make up a total of at least fourteen combs of emerging brood. The colonies, from which the brood is selected for this purpose, should be overflowing with bees, or of swarming strength. Three to five hours after the combs of emerging brood have been "put up," they will be covered with young nurse bees, and the nurse-colony is then prepared by placing all of these 14 combs with their accompanying bees, in a two-story broodnest. It is essential to make certain that no queen or queen-cells are present in this nurse-colony. It is also well to put grass loosely in the entrance of the nurse-colony, to prevent the return of any bees to their former locations. Two combs containing nectar and a comb containing pollen should be placed in each brood-chamber of the nurse-colony. In addition, when the nurse-colony is made up, it is well to sprinkle the top bars of both sections of the nurse-colony with sugar syrup made of equal parts of sugar and water. It is also well to place at the entrance, a feeder containing one-to-one syrup to feed the nurse-colony as long as its members are working on the cells. The bees in this nurse-colony should be richly fed several days previous to and throughout the period that they are building cells.

Having made up the nurse-colony in the morning of the fifth day, in the afternoon, about 3 o'clock, the comb which was placed in the breeder-colony five days previous, and which now contains hatching eggs and day-old larvae, is prepared for the nurse-colony. The method of preparation of the comb, although simple, requires care. Because the tiny larvae are readily affected by excess heat, they should not be kept in the sunlight too long. If exposed to the wind they dry quickly. They should not be kept out of the hive more than 10 minutes at most. No

matter how carefully other directions are followed, if the larvae are damaged in preparation, the remainder of the process is wasted effort.

Observing the precautions mentioned, the comb of cell material is prepared for the nurse-colony by destroying every alternate row of cells with a match or toothpick. A match with a V-shaped point used as a plow gives good results. Every alternate row of cells, crosswise and vertically, on one side of the comb, is to be destroyed. The prepared comb is then taken to the nurse-colony, and placed, prepared side downward, directly over the top bars, over an empty frame or on blocks of wood to raise the prepared side of the comb at least one inch above the top bars. This space beneath the prepared surface is necessary to allow the bees to draw out the queen-cells. A piece of canvas or burlap is placed over the comb of cell material, with an empty super on top, filled with packing material to conserve the heat.

Two days later the beekeeper will be able to tell how many queen-cells to expect, for all that are to be finished will be started by that time. Under no conditions should the nurse-colony be jarred or bumped while the cell material is being cared for by the bees, since this might ruin all started cells. It is possible to get from 80 to 100 fine queen-cells from one comb of cell material by this method, if all conditions are ideal. Twenty to forty nice cells are commonly made.

When following this plan it is well to leave the cells with the nurse-colony until they are ripe. Ten days after the nurse-colony receives the cell material, the queen-cells will be "ripe," or ready to hatch within the next 24 to 48 hours. These "ripe" cells must be protected or removed before any of their inmates emerge, else all are likely to be destroyed by the first emerging queens.

Fig. 20. A four compartment queen-rearing nucleus hive.

If the colonies which are to be requeened are of hybrid stock, it is very desirable that the queen be mated to pure drones before "introduction"; otherwise little progress in improving the quality of the stock can be accomplished. Queen-mating nuclei can easily be made from standard hives by putting in either two or three partitions, (depending on whether the hive is eight- or ten-frame), thus dividing the hive into either three or four compartments of two frames each. Each compartment must be made "bee-tight" from the one adjoining, and each compartment must be given an entrance on a different side from that of the adjoining compartment.

Besides the entrance to the nucleus, which may be made by boring a five-eighths inch hole through the hive-wall, there should be another similar hole covered with wire-cloth to serve the purpose of ventilation. When the nucleus is made up and given a queen-cell the entrance is to be closed loosely with grass so that no bees will desert. Also it is well to make a gate of queen-excluder zinc to tack over the entrance to the nucleus in case of robbing. By tacking with one nail, the gate can be swung out of position or over the entrance as desired.

On the day that the queen-cells are "ripe," a nucleus may be made, in each compartment, by placing therein two combs taken from extra strong colonies, one comb of emerging brood with enough young bees to cover, but without queen or queen-cells, together with one comb partly filled with honey. The comb of brood is placed in the nucleus chamber next to the partition, and a queen-cell which has been cut out of the comb of cells from the nurse-colony, may be fastened to the comb of brood on the side toward the partition. Fasten the queen-cell in place by thrusting a toothpick through a portion of the comb which was cut out around the base of the queen-cell. If these nuclei are made from strong colonies, of swarming strength, and if plenty of nectar is being gathered at the time, cell protectors will not be necessary. If there is no honey-flow in progress when the nuclei are being made up, the colonies from which the nuclei are made should be fed for two or three days previous to the operation and the nuclei should be fed also. Otherwise the queen-cells will not receive proper attention, in fact the cells may be destroyed, or the virgin may not be accepted on emerging. Within two weeks after the ripe cell is placed in the nucleus the queen should have mated and begun laying eggs, and she can then be introduced into the colony which is to be requeened.

Much of the difficulty and labor of requeening comes from the work of finding the old queen. This work can be greatly facilitated by temporarily placing the broodnest, in which the queen is laying, on another bottom-board at one side of the old stand, during the middle of the day. In a few hours, the field-bees in the hive-body will have returned to the old stand, leaving only young bees with the queen, in which case she is usually to be found with ease. After finding and killing the old queen the broodnest is to be returned to the old stand, and the young queen introduced by any one of the following methods:

The Push-in-Cage Method—Home-made push-in-cages can easily be made from pieces of wire window screen about eight inches square. A "V" should be cut at each corner of the square piece of screen, each "V" being about one and one-half inches deep. The edges of the wire

screen are then bent downward to form a shallow box and then, by pulling or raveling out one-half of the lateral strands of wire, which were cut in making the "V" at each corner, a fringe of vertical wires is made on each side of the box, which can be pushed into a comb without greatly damaging the cells. In following this method, the queen to be introduced, is placed on old brood-comb containing honey and emerging brood, the cage being pushed into the comb, over the queen, care being taken to see that the cage goes into the comb as far as the mid-rib. The queen can lay eggs in the cells over which she is confined, and at the same time take on the odor of the hive. Frequently the bees themselves will release the queen during the next few days. If the queen is not released by the bees at the end of three days, the cage is removed.

The "Honey" Method—In an emergency a queen may be safely introduced by gently daubing her body with about a teaspoonful of honey from a comb in the hive to be requeened. In removing the honey from the queen's body the bees "accept" the new queen immediately.

The Wire-Cage Method—Inexpensive wire-cages may be purchased ready-made, or they may be made at home as follows: Obtain two blocks of wood each ⅜ inch thick by 1½ inches wide by 2½ inches long, and wrap a piece of wire-screen, 6 inches square, tightly around one block, fastening it securely with a tack. The other block is slipped into the open end of the tube of wire screen thus made, the loose end of the screen tube being wrapped with fine wire just tightly enough to allow the loose block to be removed when desired. To cage the queen, the loose block is removed, the cage being held in one hand, opening downwards, with the screen projecting above the hand. The queen is placed in the hand, below the cage, and seeing the light above, immediately crawls up into the cage. The cage is then closed with the loose block. This cage is narrow enough to be shoved in at the entrance of the hive, but it is preferable to place the cage between the center combs in the broodnest. After 24 to 48 hours the queen is released from the cage.

The Smoke Method—When queens are introduced by the smoke method, a return trip at the end of 24 to 48 hours is unnecessary, which makes the method particularly adapted to out-yard management. In the first place, the hive must be made air-tight by sealing with propolis, mud or grass, all cracks, crevices or knot-holes large enough for ventilation. A standard hive in good state of repair seldom needs attention. The smoker should contain plenty of well-lighted fuel and should be capable of emitting a cloud of thick, white, cool smoke. A wad of green grass packed in the top of the smoker will cool the smoke nicely. When ready, the hive entrance is contracted to an inch in width, and the bees are smoked until they can be heard to "roar" distinctly. A single-story hive usually requires 10 or 12 puffs of smoke. A taller hive requires more. The entrance is then closed completely, and the bees are allowed to roar for 10 to 20 seconds. The entrance is then opened enough to admit the opened end of the queen-cage. A puff of smoke will then drive the queen out of the cage into the hive while another three or four good puffs of smoke should complete the confusion. The entrance is again closed for from two to five minutes, depending on the size of

the colony and the temper of the bees. It is better to leave the entrance contracted for the remainder of the day if possible.

It is understood that the colony which is being requeened contains neither a queen nor queen-cells at the time. Otherwise a new queen will be immediately destroyed. It is convenient and customary to introduce the new queen as soon as the old queen has been killed. If this is not possible, and the colony remains queenless 48 hours or more, every comb must be carefully inspected for queen-cells before the new queen is introduced.

In all cases the colony should not be manipulated or opened within a week after introducing the new queen because a slight disturbance may cause the bees to "ball" their new queen.

Queen introduction is more successful during a honey-flow.

Space does not permit a discussion here of the commercial methods of rearing queens. Without experience, the beekeeper is more likely to have success with a method such as has been described. And before attempting to rear queens by the "grafting" method, one should carefully study the various books on the subject.

Increase

Increase can be classified as either natural or artificial. Natural increase or increase by swarming is undesirable if for no other reason than the fact that the beekeeper is not in control. Artificial increase may be made moderately without seriously injuring the prospects of a surplus honey crop, or if the sole object is to increase the number of colonies, a few colonies may be multiplied to many in one season.

If the primary object is to produce a crop of honey, then increase should not be made until the height of the honey-flow. But if the sole object is to increase the number of colonies, operations may be started during the fruit-bloom period in the spring. The latter method may be called "forced" increase.

For best results laying queens should be available when making increase. If "ripe" queen-cells are used to start the increase, the progress of the new colony is held up from ten days to two weeks whereas if the "increase" is obliged to rear its own queen from day-old larvae, at least three weeks are lost before the new queen will commence to lay.

"Forced" increase which is made at fruit-bloom time will require the purchase of laying queens or else the use of ripe queen-cells, because it is extremely difficult to rear queens in early spring in the North. Having the laying queen or ripe cell at hand, about May 15, one "increase," and possibly two, can be made from strong colonies. Two combs of sealed brood, preferably emerging brood, with adhering bees, together with two combs containing honey and pollen are placed in the center of a hive-body on a new stand, the brood in the center. A division-board on either side of the combs of honey will help to conserve the heat, the remainder of the hive being filled with drawn combs or full sheets of foundation, drawn combs being preferred. The laying queen or ripe queen-cells should be introduced between the two combs of brood. If enough emerging brood is present, another "increase" may be made at the same time, care being taken to make certain that the queen is not removed from the parent colony with either "increase".

If there are not enough bees on the combs to take care of the brood in the "increases" some young bees from the broodnest of the parent colony should be added. To obtain young bees for this purpose, a comb of brood, with adhering bees, is removed from the parent colony and shaken lightly. The bees which fall off will be mostly old bees and the remaining bees, which are mostly young ones, can be shaken into the increase, the brood being returned to the parent colony. The hive containing the "increase" can be placed in any position in the apiary. The entrance should be closed with grass for two or three days to prevent desertion by the older bees and should be contracted at all times to prevent danger of robbing.

It is of great assistance to both the parent colony and the "increase" to feed a five-pound pail of sugar syrup occasionally, especially if the honey-flow from dandelion and fruit-bloom is interrupted by adverse weather conditions.

Usually it will be well to wait until the beginning of the main honey-flow to take further brood for "increase" from the parent colony, but from that time on, an "increase" can be made once every two weeks until about July 15. If the colony is very strong the later "increase" should be made of three combs of brood instead of two. It is safer to make stronger "increases" and fewer of them. If the beekeeper is prepared to feed these "increases" as they need it, each should develop to wintering strength by September 20. If nectar is available from fall sources they may collect sufficient stores for winter food, otherwise they must be fed.

If a moderate amount of "increase" is desired in conjunction with a crop of honey, one of the two following methods is recommended. For real success with either method it is necessary to use dry, drawn combs and have on hand laying queens. In this case the beekeeper can rear his own queens by starting with the commencement of the main honey-flow, since the proper time to make increase by these methods is about a week before the close of the honey-flow, or about July 8, the date varying with the season and with the locality.

First Method—If the main nectar flow begins in mid-July from sweet clover and alfalfa, extra strong colonies may be divided in early May, giving a young laying queen to the new division. However, this practice reduces the possible crop from the alsike clover flow, which usually begins in mid-June. It is better to divide extra strong colonies in this manner than to allow them to swarm, and if the divisions do not reach desired strength by the opening of the nectar flow, their strength may be augmented with packages of bees in June.

This practice is not recommended for areas where the principal honey plant is alsike clover, but the manipulation is practiced by some of our successful beekeepers in the sweet clover and alfalfa districts.

If there is a possibility of a fairly continuous honey flow from mid-June to late August, it is doubtful policy to remove brood or bees for increase from the average strength colony. In fact, many beekeepers consider it to be better business to purchase package bees for increase rather than to jeopardize the gathering strength of strong colonies by removing bees.

If the main nectar flow begins in mid-July from sweet clover and

alfalfa, one increase may be made in early May from extra strong colonies by removing four frames of emerging brood and bees to be placed on a new stand, preferably in another apiary with a young, laying queen. This increase should be given a comb of honey, a comb of pollen, and the remainder of the hive-body filled with dark, drawn combs for best results. This increase is equivalent to a four-pound package of bees.

If the old queen shows indications of faltering, she should be replaced at this time also. Although this practice may reduce the possible honey crop from alsike and white clover which usually begins in mid-June, the combined egg-laying activity of the two queens may produce enough additional bees for the later honey flow to increase greatly the possible production of the original colony.

Second Method—In the Demaree, Markham, or Michigan plan, brood raised above the queen-excluder for the purpose of controlling swarming during June contains queen-cells ready to emerge ten days after the brood is raised.

At this time the hive-body containing this emerging brood and queen-cells may be set off on a bottom-board for an increase. It is preferable to remove this broodnest to another apiary to prevent the bees accompanying the brood from returning to their parent colony.

This new colony should contain four to six combs of emerging brood with accompanying bees and two or three combs of honey and pollen. All of the queen-cells but one may be destroyed at the time the increase is made, or if the bees are of inferior stock all queen-cells may be killed and a young, laying queen introduced.

While this method is rather costly to the parent colony, it is a very safe way to make increase.

Package Bees

The use of package bees has increased greatly in recent years. They will be most profitable in areas where the nectar flow commences in mid-June and continues until late August. The beekeeper should have sufficient hive-bodies of drawn combs for broodnest and super requirements. The site selected for installing packages should be wind-protected from the north, east and west, if possible. The erection of wind fence is profitable if no natural windbreak is available.

Packages may be had in 2-, 3-, 4-, and 5-pound sizes. For orchard pollination purposes, the 4- or 5-pound size is recommended and should be installed 10 days prior to the blooming period to obtain greatest pollenizing activity. For honey production purposes, the 2- or 3-pound sizes are most popular, particularly in areas having a 10 or 12 weeks nectar flow from alsike clover, sweet clover and alfalfa. Where the main nectar flow is from alsike, a 2- or 3-pound package may not reach maximum strength by mid-June and, therefore, the 4- or 5-pound size may be a better investment.

The packages should be ordered from a reliable shipper 30 to 90 days in advance of the desired date of arrival. Packages may be installed as early as April 10 and should not be received later than May 10 for honey production purposes. A few days before arrival the beekeeper should make arrangements with the local express agent to

receive notice by telephone as soon as the bees arrive. An extra day in the express office may harm the bees.

If a large portion of the bees in any package are dead on arrival, a "bad order" statement should be obtained from the express agent and forwarded to the shipper immediately, who will replace the loss promptly upon receipt of the bad order statement. In cool weather (40°–50° F.) the bees should be promptly taken to a room of from 60°–65° F. temperatures for feeding. If the temperature is high on arrival (60°–80° F.), the bees should be promptly removed to a cool, partially dark room, 50° F., for feeding.

Immediately uncrate the packages, lay newspapers on the floor to catch the drip of syrup, place the packages in rows in aisles 2 feet apart and gently sprinkle, spray, or paint the screen cages with sugar syrup made of equal parts sugar and water. Continue to apply the syrup until the bees refuse to take more. This may require a half hour or longer. If the temperature is high and the bees do not become quiet after this feeding operation, they may be lightly sprinkled with water.

If the outdoor temperature is severe (freezing or lower), the packages may be installed in hives in the warehouse where temperatures may be controlled. If normal spring temperatures prevail outdoors, the bees may be installed in the apiary at evening.

The work of installation is greatly aided by cool or inclement weather and a temperature of 50°–60° F. Cloudy or rainy weather is best. On warm, bright days bees should not be installed until evening. The hives in which the bees are to be placed should be arranged 6 to 10 feet apart in aisles 20 or 30 feet wide. Assemble the hives complete with full sets of combs or foundation, top, bottom, inner cover and chaff-tray, and install an entrance block with a ¾" x ⅜" opening in each entrance.

If the bees are to be installed on foundation, some type of feeder for use in each hive should be ready. The division-board feeder or a 10-pound pail, pepper box type feeder is satisfactory. If combs of positively disease-free honey are available, two or more combs of honey and pollen may be placed in each hive. It is important to provide a comb of pollen for each colony if available. If the beekeeper does not have combs of honey available or prefers to use syrup, a few combs in each hive may be filled with syrup made of two parts of sugar to one part water, with a sprinkling can or with a pressure sprayer before the package is installed. If many packages are to be installed, this work of filling the combs with syrup should be done the day before installation.

Before commencing to install the bees, it is well to have every hive completely set up as described, with feeder or combs of honey or syrup at hand. Next distribute the packages to the empty hives so that when the actual work of installation begins everything will be in readiness.

Remove the wooden cover over the tin feeder in the top of the package. Remove the feeder can and the queen-cage which is fastened in the top of the package. Check the condition of the queen and note whether the queen-cage is supplied with attendant bees and candy or whether the queen is alone and without candy. The latter is known as a "dry" cage and the queen may be released from a dry cage with the bees, whereas it is better to allow the bees to release the queen from

candy cages by "chewing out" the queen. As an added precaution, the hole in the "dry" cage may be filled with the fondant, the queen-cage being placed in the hive to be opened by the bees.

If the queen is dead, the cage and dead queen should be returned to the shipper immediately for replacement unless enough extra queens (5 to 10%) have been included in the shipment to compensate for such losses. If the queen is in a candy cage, fasten the wire supporting the cage to the end of the cage containing the candy, remove the pasteboard over the opening to the candy, place the cage among the bees while a handful of bees cluster around the cage. Then hang the cage by its wire to a small nail driven in the top bar of the center comb, allowing the queen-cage to hang in the middle of the hive, three or four inches below the top bar, with the screen of the cage facing either front or rear of the hive.

If the package is of the so-called "loose-queen" type in which the queen is shipped loose in the package, after removing the feeder can from the package the bees may be immediately installed. After removing five or six of the center combs from the hive, pry loose the strips of wood fastening the screen on one side of the package. Remove the loosened screen completely, shake the adhering bees into the hive, and then dump the entire package of bees into the center space between the remaining combs in the broodnest. After a few moments the bees will crawl up on the adjoining combs off the bottom of the hive, enabling the beekeeper to replace the combs previously removed without crushing the bees. The same procedure may be used for installing the bees if the package contained a caged queen, after the queen-cage has been placed in the hive as previously mentioned.

To avoid immediate confusion of bees in flight after installation, the work should be done in late afternoon or evening preferably on a cool or rainy day. It is also desirable to gorge the bees with sugar syrup immediately before they are released from the package into the hive.

It is best to avoid disturbing the newly installed package for two days or more, and then only on a warm day (65°–70° F.). Use no smoke in manipulating the hive; rather, sprinkle the bees lightly with sugar syrup to control them.

If ample food has been given (10–15 pounds), no further attention need be given the hive for a week except to check each entrance from outside to see that none is closed accidentally, which might cause smothering, especially with the four or five-pound size, and to see that no hive is robbed. If the queen was in a candy cage, three days after installation the beekeeper should very quietly open the hive without using smoke if possible, and see whether the queen has been released from the candy cage. If not, the opening through the candy may be made large enough with a match or nail so that the queen may come out herself. If the queen is already out of the cage, the cage is removed and the combs are moved together gently without jarring.

If the bees were installed on sheets of foundation, the supply of food should be replenished as rapidly as the bees empty the feeder, every third day if necessary, until approximately 30 pounds of sugar syrup have been stored by the bees. It is very important that the beekeeper avoid jarring the hive or smoking the bees when feeding, because any disturbance may cause the bees to kill their queen or com-

mence supersedure preparations. Much of the difficulty from supersedure of queens in package bees is due to improper installation and unnecessary disturbance of the bees during the first three weeks after installation. Therefore, it is important that the bees be quickly fed all necessary food to carry them over the first three weeks.

If the weather is favorable, temperature 65–70° F., little wind, and the bees are gathering nectar and pollen, the beekeeper may quickly and quietly examine each hive to determine whether the queen is laying. This work should be accomplished without the use of smoke if possible and without leaving the hive open more than two minutes. The danger of "balling" the queen will be greatly decreased if the beekeeper sprinkles the combs lightly with sugar syrup immediately upon opening the hive and again at the close of the examination. For this purpose either a sprinkling can or pepper box type feeder may be used. Avoid sprinkling enough syrup to run out the entrance. It is well to elevate the entrance of the hive one inch higher than the rear to avoid robbing of syrup which might run out the entrance. Queens which have disappeared should be immediately replaced unless the colony has been weakened by the drifting of bees to other hives. Drone-laying queens should be replaced.

Provided the weather remains cool several days after installation and particularly if the apiary site is well protected from wind, there should be little drifting. Those colonies which are either too strong or too week because of drifting may be equalized after the broodnest has become established, when the weather is favorable for manipulation.

If package colonies dwindle for two weeks or more, owing to "queen" trouble, it is best to destroy the remaining old, shiny bees and install a new package complete with queen rather than attempt to re-queen the colony with consecutive new queens.

Newly installed packages of bees which are to be moved to orchard sites for pollination purposes should either be moved immediately after installation or else after 10 days to avoid danger of the bees "balling" the queen. Any disturbance to the hive during the first few days after installation when the broodnest is first being established is likely to cause loss of the queen.

The beekeeper should make certain that the food supply does not decline below a minimum of three combs of honey or syrup. If the normal spring nectar flow fails to provide this requirement, the beekeeper should be prepared to feed sugar syrup. To obtain maximum increase in population during the latter part of May and early June, the bees may be fed a pint of sugar syrup every other day either in a feeder or by sprinkling can or dipper, the entrance being elevated to prevent the syrup from running out.

Strong packages may prepare to swarm as readily as over-wintered colonies with older queens. Previous to May 15, packages needing additional comb space should be given the additional hive-body of combs underneath the established broodnest. However, if foundation must be used to provide additional comb space, it should be given cautiously above the established broodnest, raising one or two combs of emerging brood to encourage immediate occupation of the hive-body of foundation by bees and queen.

After the package bee colony has become fully established in a

two-story or larger broodnest, it may be manipulated the remainder of the season according to one of the four plans outlined in the chart on seasonal management.

The Bartlett Method of Managing Packages

All colonies are killed in October and replaced with package bees in April. The packages are delivered via express or truck to the apiary about April 10-25. It may not be necessary to use feeder cans in the packages hauled by truck provided the bees are gorged with syrup before loading. The hives in which the packages are to be installed are equipped with five frames of honey and pollen in one side of the 10-frame hive-body. The package of bees is placed in the hive in the empty space, the top of the package being removed. Queens are shipped in dry cages without attendants and without candy. The queen-cage is removed from the package, the exit hole filled with queen-cage candy, the queen-cage being placed between the first and second combs away from the package. Part of the bees are shaken out of the package over the combs and queen. The package is then placed in the empty space in the hive for the remaining bees to leave, the inner cover and cover being replaced on the hive and the entrance contracted to one beeway the first day, two beeways the second, and ½ to ¾ inch the next few days. The colonies are not manipulated for 10 days. Then the empty package is removed and the hive-bodies filled with comb. Additional food is given the bees in the form of sugar syrup if necessary.

Until the colony becomes strong, the entrances are contracted. Plenty of syrup is given as needed, with either Miller feeders or friction-top pail, pepper-box-type feeders. As the colony becomes strong, comb space for brood-rearing and storage of nectar is added as needed.

To expedite the work of finding the queen, the queen may be dotted with white Duco on her thorax.

Because in northern Michigan egg production after July 10 is unproductive of nectar-gathering bees, the queen is caged in each colony the second week in July. At this time or just before a queen-excluder is placed directly under the broodnest, on the bottom-board, to prevent young queens from leaving the hive to mate. Otherwise, swarming may follow, or the newly mated queen may start a new broodnest to consume honey needlessly, inasmuch as the bees are to be killed in October. The queen-cells constructed by the bees after the queens are caged are not removed, but any queen-cells present when the queens are caged are destroyed.

The use of selected combs, as free from drone comb as possible, minimizes the danger of colonies suffocating from the accumulation of dead drones on the queen-excluder. Combs containing considerable drone cells may be used as super combs after the queens have been caged. All colonies should be opened from the top once or twice during the season to allow the drones to escape, and then closed again before the drones return. This is done to avoid unnecessary clogging of the queen-excluders.

To use this plan of management, the beekeeper must be willing to follow a close schedule of work and should be well informed on bee behavior and successful principles of apiary management.

Surplus honey is removed from the hive with phenol cloths as described elsewhere in this bulletin. About October 1 the bees in each hive are killed with Cyanogas administered with a powder gun. Immediately after the dead bees are removed from the hive, the brood-combs are stored in a bee-tight warehouse for sorting, and the brood-nests are made ready for the installation of packages the following spring.

EXTRACTING

It is well to commence removing the honey while there is yet some nectar being gathered by the bees, to reduce danger from robbing. If it can be arranged, honey should be extracted from the combs the same day it is removed from the hive.

For this purpose, bee-escape boards may be used to good advantage unless experience has shown that thieves are watching the honey crop. In this case it would be more profitable to brush the bees from the combs unless a guard could be stationed at the apiary.

The "ventilated" bee-escape board is efficient in removing bees from supers. This type of bee-escape board has also an advantage in that it keeps the honey warm after the bees have left the supers, which is an aid in extracting. It is usually not practical to try to "escape" the bees out of more than two supers at a time. It is customary to place the bee-escape boards under the supers, on the afternoon or evening previous to the day they are to be removed. During the night, the bees in the supers will pass downward through the bee-escapes, leaving the supers free of bees and ready for removal. There are exceptions to this rule, however. If the supers contain brood, as a result of the queen being allowed to roam the hive, the bees will not "escape". Or

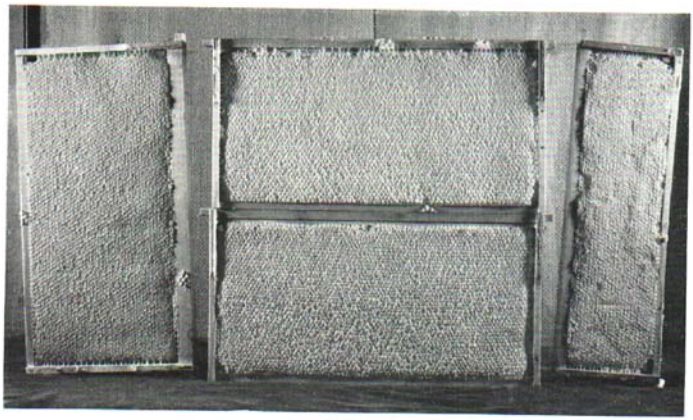


Fig. 21. Well-filled combs ready for extracting.

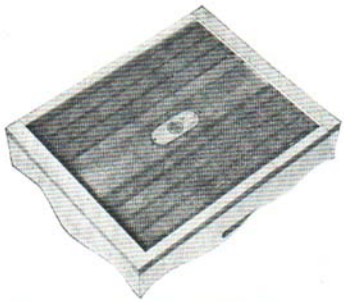


Fig. 22. A ventilated bee-escape board.

if wooden bee-escape boards are used, and the evenings are cool, sometimes the bees will cluster in the supers instead of escaping. Bees are more likely to go down through ventilated escape-boards in cool weather than through wooden ones.

Beekeepers in localities in which foulbrood is prevalent, will do well to inspect carefully the broodnest for disease before removing any supers. Another safeguard against wholesale spreading of disease is the numbering of supers and combs in the supers with the hive number, to insure the replacement of combs in their proper hive-bodies. Most beekeepers hesitate to use this system on account of the additional work necessary, but it is virtually the only means of preventing the interchanging of equipment at extracting time.

A rapid and efficient method of driving bees out of the supers is with the use of carbolic or phenol cloths. The fumes of phenol are an active repellent for honey bees. To avoid tainting the honey with the phenol, precaution must be taken to use only the pure commercial grade of phenol crystals, never the "crude". It is not safe to use carbolic cloths to repel bees from supers containing unsealed combs of honey. The carbolic cloth should not be allowed to remain on the hive more than 3 to 5 minutes and under no circumstances should any of the phenol **(a poison)** touch the honey; neither should the operator touch the phenol since it will destroy skin on contact.

The carbolic cloths are most efficient on warm, sunshiny days at a temperature above 80° F. A good method of procedure is to make trays 2 inches deep, the same outside dimensions as a super. Several thicknesses of cheesecloth are stretched over the top rim of the tray, and then an inner cover or piece of tarpaper placed over the cloth. Pure phenol crystals are liquefied by adding 10% water. The liquid phenol is then applied to the cloth in the tray by sprinkling with a quart bottle containing a simple, laundry sprinkler top. Never allow phenol to accumulate in quantities sufficient to drip off the cloth onto the honey.

After inspecting the broodnest carefully for disease, place the phenol cloth tray over the supers to be removed, first removing the food chamber which is to be kept on the colony for winter food, add a few

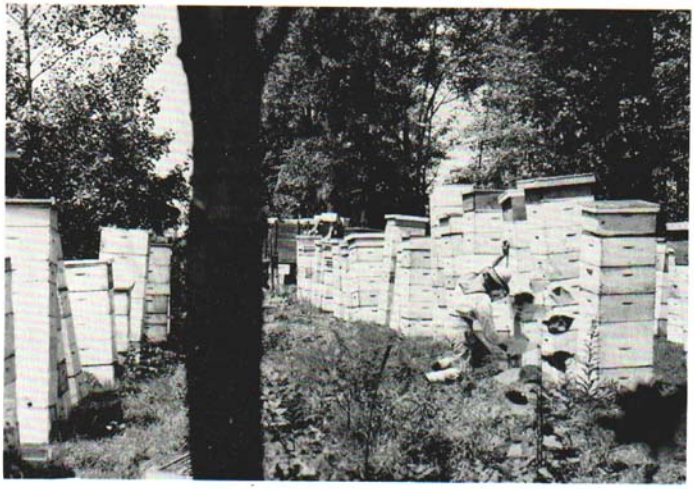


Fig. 23. Before removing full supers for extracting, they are numbered so they may be returned to the same hive if desired.

puffs of smoke to start the bees moving downward and allow the tray to remain over the supers just long enough to drive the bees down out of the top super. One operator may manipulate three to six carbolic trays and remove a super each two or three minutes. There should be no air leaks between the phenol tray and the super. It is not desirable to use the tray on a cool, cloudy day. To leave the tray on the colony long enough to drive most of the bees out of the hive so demoralizes them that they will do little work the remainder of the day. The phenol will drive bees out of supers containing brood, therefore the operator must make certain that no brood is present in the super before removing the super from the hive.

Toward the close of the main honey-flow, before all supers have been removed, the beekeeper should make certain that the colony has a sufficient supply of honey on hand to care for its needs for at least six weeks. In districts where sweet clover is grown extensively or where goldenrod, asters, boneset, heartsease or Spanish needle grow in quantity, this precaution is not so necessary but it is good insurance to leave the colony from 50 to 60 pounds of honey at this time.

In the Markham plan, using a two-story broodnest throughout the season, this matter is cared for automatically. For during the latter part of the honey-flow, brood-rearing checks somewhat, usually, with the result that considerable honey is stored in the upper broodnest.

In the Miller plan, additional stores and room for brood-rearing can best be assured by uniting back the colony made by restricting the broodnest at the beginning of the main flow. This means that the

colony will be run with a double broodnest for the remainder of the season, which does not permit the production of comb-honey during the fall-flow. But because amber and dark comb-honey do not sell well, and since it is not practical to attempt to produce comb-honey during a honey-flow as uncertain as the fall honey-flow is in many districts of Michigan, the use of the two-story hive is an advantage. Surplus honey is taken in shallow extracting-supers during the fall in this case.

Extensive commercial beekeepers, who operate out-yards, use one of two plans for extracting the crops. In the past many have practiced the use of portable extracting outfits, maintaining a small, sometimes portable, honey-house at each out-yard. When ready to extract, power extractor and equipment together with containers for the honey are taken to the out-yard, thus saving the labor of hauling the honey in the comb to the central plant.

In extracting in out-yards, the beekeeper has to contend with the difficulty of robbing, and has the additional labor of moving the extracting equipment from place to place. Furthermore, the same conveniences are not available at the out-yard, as in a well-equipped central plant. Consequently, the present tendency is towards distributing the out-yards around the central plant on good roads so that the honey can be brought home in the supers for extracting.

The use of a central extracting plant offers several advantages. The proper arrangement of the extracting equipment in the honey house, permits the extracting of more honey with less labor in a given time, than is possible when working with the portable extracting outfit. The use of a honey-pump or better still, the gravity system for conducting

Fig. 24. The numbered supers may be left behind the hives from which they were removed until colonies are completely checked, provided the bees are not robbing.

Fig. 25. An unloading dock saves much labor. A rubber-wheeled warehouse truck is used to load and unload supers.

the honey from the extractor to the storage-tanks, saves much labor. The use of storage-tanks of sufficient capacity to hold the total output for the day, and the use of a sufficient number of tanks to permit each day's extracting to settle for twenty-four hours, improves the quality of the honey for bottling purposes.

The extracting house should be bee-tight and rodent proof. The extracting room itself should be not less than 20 by 24 feet for greatest convenience, and should be well lighted. An arrangement which permits the unloading of the supers on a dock in an enclosed drive-way, as shown in the accompanying diagram, lessens the danger from robbing and saves labor. The unloading dock should be built level with the floor of the extracting room, and if possible, level with the bed of the truck, to save as much lifting as possible. It is of further advantage if the full supers are brought into the room near the extractor without the necessity of further handling until empty. Where the gravity system is used, instead of a honey-pump, the honey is allowed to run from the extractor into storage tanks in a room below. If the gravity system or a honey-pump is not used, the storage tanks should be arranged within easy reach of the extractor. Because honey is very heavy, all waste motion in the handling of it should be eliminated.

The type of extractor to use depends on the size of the outfit. Formerly the four-frame and eight-frame sizes were very popular. The recently developed radial type of extractor has certain advantages which appeal to many extensive honey producers.

The electric motor is desirable for power if electricity is available.

While the honey is being extracted, the temperature of the room should be uncomfortably warm for best results in getting all the honey out of the comb. If the honey is at all cool it will not only fail to leave the cells properly, but an unnecessary strain is placed on the comb, and the honey does not pass through the pump so readily. A leading

Michigan beekeeper has installed steam heat in the bottom of the extractor to warm the honey before it passes through the honey-pump.

One man working at full speed can uncap the honey fast enough to keep up with an extractor. The value of having perfect combs evenly filled with honey beyond the wood of the frame immediately becomes apparent at uncapping time. If it is necessary to make extra strokes with the uncapping knife in order to uncover wrinkles in the comb, the output of the uncapper is noticeably decreased. The recent improvements in foundation manufacture, and the use of the narrow bottom-bar frame improve the quality of the combs.

There are different types of strainers for use on storage tanks. Good results will be obtained from a sack of cheesecloth at least a foot in diameter and as deep as the storage-tank, held in position by some sort of rack on top of the storage-tank. If the level of the honey in the storage-tank is not lowered below the bottom of the strainer the strainer can be used for a much longer period of time than is the case when the scum is allowed to settle into the strainer.

A wooden box with a coarse screen bottom to support a cheesecloth sack strainer is serviceable but the strainer cloth must be changed frequently.

Whether the honey flows to the storage tanks by gravity or is pumped, it is a distinct advantage to pass the honey through a sump

Fig. 26. Full supers on platforms ready for uncapping.

or "honey-well" of 30 to 50 gallons capacity before pumping or straining, to remove coarse particles. Both pump and strainer will function more trouble-free after the removal of coarse bits of wax from the honey.

A metal cloth strainer made of concentric cylinders of screen of 30, 50 and 90 meshes per inch yields very clean honey but has difficulty with cold honey, and may need frequent cleaning if a large volume of honey is strained daily.

The cappings may be drained and whirled dry in baskets adapted to fit the extractor, or they may be melted as they fall from the uncapping knife in a cappings melter of the "Brand" type without appreciable change in quality, color, flavor or body of the honey. In using a cappings melter it is important that the cappings do not come in close contact with the heating element. The cappings must not pass downward through the heating element but around one end, to rise up under the heating coils. There must always be a "ceiling" of unmelted cappings beneath the heating element to avoid damaging the

Fig. 27. Uncapping into the cappings melter. In the foreground an uncapping plane, in the background a power uncapper. Note two "merry-go-round" comb tables within easy reach of uncappers.

Fig. 28. Extracting equipment. Note "wing" comb supports in first extractor. Note arrangement, comb tables near each extractor, honey piped through floor, motors mounted above extractors with V-belts, ample room to truck empty supers on platforms away from extractors.

honey. The accumulation of melted propolis must be removed several times daily. Best results are obtained when a large volume of cappings pass through the melter each hour of use, to keep the temperature of the honey below 140° F. A satisfactory cappings melter saves much time and labor in disposing of cappings.

Fig. 29. Honey storage and settling tanks, below extractors.

After extracting, combs may either be returned to the hive for cleaning and protection from wax-moth until fall or they may be stored in the honey warehouse. The safest place for empty combs is on strong colonies. If they are to be stored in warm weather in a warehouse, it is necessary to fumigate them to prevent damage by wax-moths. Calcium cyanide or Cyanogas is commonly used for this purpose, but the fumes are dangerous to the operator and to any animals or human beings exposed. Therefore, strict precautions must be taken to prevent accident. The fumigating room should be as nearly air-tight as possible. Commonly the supers to be fumigated are placed in stacks as high as convenient for the operator with about an ounce of calcium cyanide dust placed in each stack at the time of storage. Because calcium cyanide does not effectively destroy eggs of the wax-moth, the fumigation should be repeated twice at 10-day intervals. It would not be safe to attempt to fumigate a roomful of stacked supers by placing a quantity of calcium cyanide dust in the center of the room, unless the air were agitated with a fan for some time to obtain thorough circulation.

Carbon di-sulphide is another effective fumigant for wax-moths. The fumes are heavier than air and very inflammable, but are not so injurious to human beings or animals. One-half teacupful of carbon di-sulphide poured into a shallow dish at the top of each stack of supers will control the larvae and adult wax-moths, but will not destroy the eggs. Therefore, as with calcium cyanide, fumigation must be repeated to prevent damage to the combs later. Preliminary tests with methyl-bromide indicate its effectiveness in destroying eggs as well as larvae and pupae of the wax-moth. It is dangerous to human beings and animals

Fig. 30. Bulk extracted honey is usually stored for shipment in wooden or paper cases of five-gallon cans.

Fig. 31. Gothic type honey house. Note that two loading levels are available.

and should be used with full precaution in an air-tight room, protected against accidental entry by anyone, because the fumes are odorless.

Comb honey should be fumigated thoroughly as soon as it is removed from the hive, particularly if it is to be stored in a warm room.

MANAGEMENT AFTER THE MAIN HONEY FLOW

Where alsike and white clover provide the main sources of nectar the honey-flow may cease July 15 to August 1. In those areas of the State where large acreage of sweet clover and alfalfa are raised for seed the honey-flow may continue until late August when the weather conditions are favorable.

Requeening—At the close of the main honey-flow, the old queen, which has been working steadily throughout the season, invariably slows up egg-laying or stops entirely. If permitted, this checking of brood-rearing lessens the chances of collecting surplus honey during the fall honey-flow and leads to poor wintering.

It is difficult to stimulate an old queen to re-commence brood-rearing immediately at this time. However, a young queen invariably starts brood-rearing at a brisk rate shortly after being introduced, provided there are plenty of bees and stores in the colony. If, for any reason, the young queen is unsatisfactory, sufficient time remains to replace her without injuring the colony's development. If queen-rearing operations were commenced near the beginning of the honey-flow, for example June 20, the young queens will be laying nicely July 15.

The objections commonly offered to annual requeening are that it is too much work and that a queen is good for two seasons. The labor of finding the old queen can be reduced by setting the brood-nest in which the queen in laying to one side on a new stand for a few hours during the middle of the day. She may then be readily found and replaced by a young queen, the broodnest being moved back on the old stand at the same time. Or, if supers still remain on the hive above a queen-excluder, the queen may usually be driven up against the bottom of the excluder by smoking at the entrance before removing the supers. In this case the worker bees pass through the excluder into the supers to get away from the smoke and the queen will generally be found on the bottom of the excluder trying to get through also.

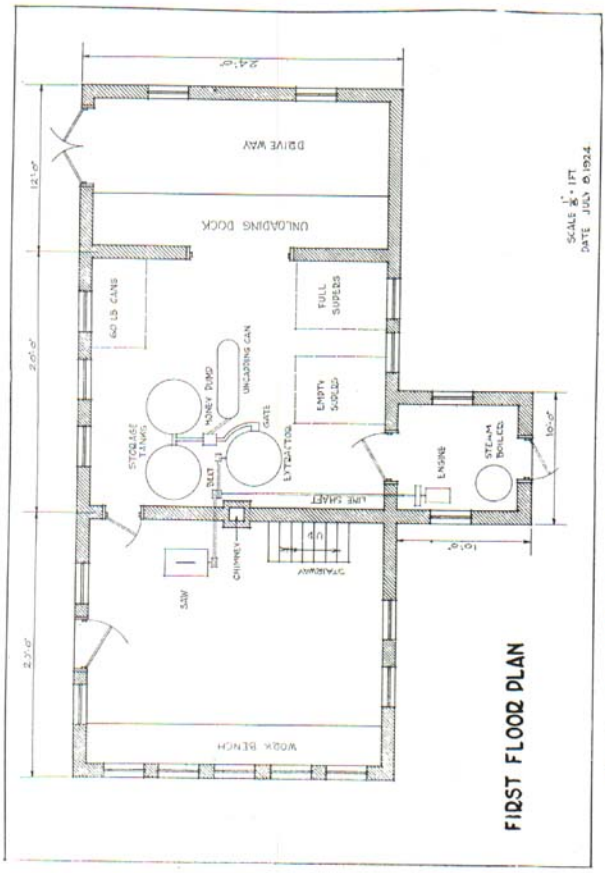


Fig. 32. Floor plan for those who wish to drive their truck into the honey house.

There is some question as to whether it is profitable to practice the use of queens for two years instead of one. It is certain that if queens are forced to lay at full capacity most of the time between April 1 and September 20, a certain percentage will "break down" and be superseded during the following season. Colonies with such queens, seldom produce much surplus honey. But the beekeeper spends as much or more time with these colonies than he does with producers. And if as many as 10 percent of the colonies headed by two-year-old queens, were to supersede previous to the main honey-flow, the loss of honey

crop and the extra labor required to care for these "failures" would amount to more than the cost of requeening the entire apiary.

Furthermore, young queens are probably more likely to rear brood under difficulties of adverse weather conditions in spring than are old queens. It is also probable that annual requeening decreases the swarming tendency. All of these arguments point toward the advantage of annual requeening.

Of course, those colonies which have been chosen as possible breeder stock should not be requeened. Vigor is a desirable quality and if a queen can stand the pace demanded for commercial honey production for two or even three years, her bees are also likely to be vigorous.

The beekeeper should not hesitate to replace those young queens which fail to meet requirements. If the newly introduced queen does not commence to lay satisfactorily within, say, two weeks after introduction, the colony should be requeened. For this reason the beekeeper should plan to have about ten percent extra queens to care for replacements and loss from introduction.

Preparation of the Colony for the Fall Flow—Following the close of the main honey-flow, there is usually a period when the bees collect little nectar in Michigan. This depends largely on locality, however. In districts where alsike clover is grown for seed or where sweet clover and alfalfa are plentiful, or in districts where surplus honey is taken from milkweed, basswood or firewood, this period of inactivity may diminish to a matter of days, but in the absence of these plants, especially in southern Michigan, this "rest" period is noticeable. The colony with an old queen, or the colony needing stores, will rear little brood during all this time. Usually successful wintering of the colony depends on the number of young bees reared between August 1 and

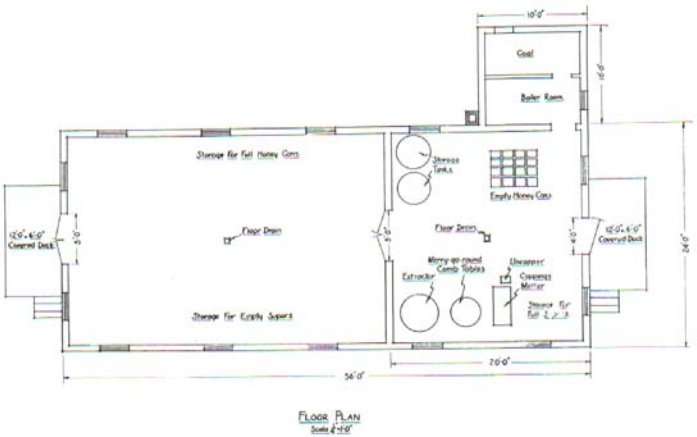


Fig. 33. Honey house plan for medium to large outfit desiring single-story building.

September 20. Therefore, the beekeeper must make certain that brood-rearing progresses continuously during that time. However, there is no other season of the year when the colony is so likely to be overlooked, mainly because the beekeeper is busy extracting his honey.

There is no better insurance for the prevention of loss during this period, than requeening combined with the leaving of fifty to sixty pounds of stores on the colony after extracting.

Beekeepers who winter their colonies in a cellar, usually practice the use of a single-story broodnest the remainder of the season after the main honey-flow. Those beekeepers who winter out-of-doors, who use a two-story broodnest following the close of the main honey-flow, may find it necessary to transpose brood-chambers by the time that the fall honey-flow from golden-rod, asters, heartsease, boneset, Spanish-needle, and other fall flowers commences. For, especially in the fall, bees seem to hesitate to store honey in supers placed above "fat" combs in the upper story of a double broodnest.

Stimulation of "Increase" If Necessary—"Increase" made sufficiently early in the season to get started under the influence of the main honey-flow may store sufficient honey in the broodnest to last until the fall flow commences. In districts where sweet clover and alfalfa are plentiful there may be sufficient nectar available from this source to provide food for maintenance during late July and August.

Because it is of prime importance that the queen in the newly formed colony expand the broodnest rapidly during this period, the beekeeper must see to it that progress is not hindered by lack of stores. If no nectar is available, the colony must be fed sugar syrup. About the easiest way to handle the situation is to place a shallow super of honey on the "increase" for food at the close of the main honey-flow.

If weather conditions are unfavorable to nectar secretion by the fall honey-plants, the increase will probably need still more food by

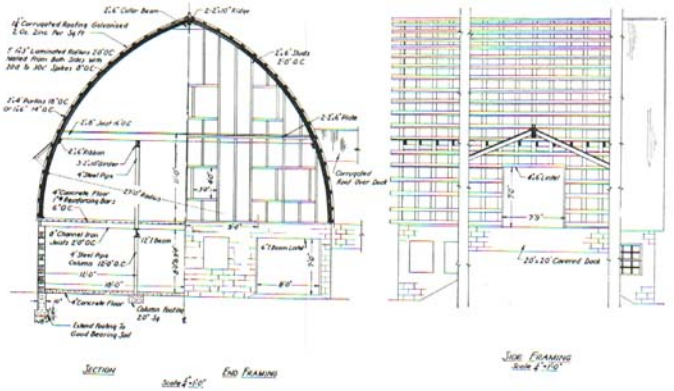


Fig. 34. Construction details of 36' x 60' Gothic type honey house.

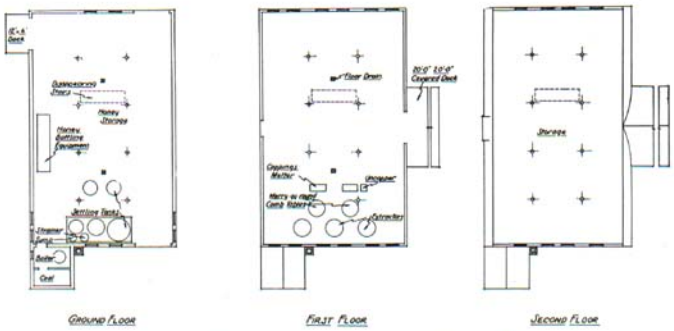


Fig. 35. Floor plan for 36′ x 60′ Gothic type honey house.

September 1. Otherwise, brood-rearing will be checked too early for best results in wintering.

"Increases" made late in the season, which for some reason do not build up satisfactorily, may be stimulated by occasionally adding a frame of emerging brood from an extra strong colony which is free from disease. Those "increases" whose chances of wintering successfully are doubtful, should be united to desirable strength by September 1 to stimulate late brood-rearing in the fall.

Manipulation During the Fall Honey-flow—In many sections of Michigan, the honey-flow from fall honey-plants is slow and uncertain. However, in districts where sweet clover, golden rod, boneset, aster, heartsease, Spanish-needle or fireweed are plentiful, and where climatic conditions are favorable to these plants, good yields are secured. The fall flow is neither heavy enough nor long enough to warrant the practice of "Demareeing," in fact the swarming tendency is so slight at this season that "Demareeing" is not necessary.

Honey produced in the fall is typically light amber in color with the exception of that from fireweed, sweet clover and alfalfa. Because dark comb-honey is in slight demand on the Michigan market, and the unsteadiness of the fall flow does not permit the production of comb-honey ordinarily, it is advisable for comb-honey producers to use extracting equipment for the surplus fall crop.

Supers should be added for the fall honey-flow according to the need for storage space as indicated by the whitening and bulging of combs as mentioned on page 38.

If weather conditions are favorable for nectar secretion and heavy brood-rearing, it may be necessary to again switch the two-story broodnest about September 1.

Towards the close of the fall honey-flow, emerging brood in the upper chamber of the broodnest is replaced with honey, with the result that by the time of the first heavy killing frosts, the upper chamber of the broodnest should be largely filled with honey.

Before removing the supers for extracting, the broodnest should be inspected for stores. If there is not already sufficient honey stored in the broodnest—the equivalent of 60 pounds—empty combs should be replaced with full super-combs to make up this amount. Probably the most satisfactory method of supplying winter stores is the use of the "food chamber" as mentioned previously.

When the fall flow is brought to an abrupt ending by an early frost followed by cool weather, some of the honey in the combs at the time of extracting may be unripe, causing trouble later from fermentation and granulation. Such honey is unsalable and should not be mixed with good honey but rather used for commercial purposes.

Preparation of the Broodnest for Wintering—While it is yet warm enough for bees to fly daily, some time between September 20 and October 10, the broodnest should be carefully examined for stores present. Not only should there be the equivalent of from 60 to 70 pounds of honey stored in the combs, but also this honey should be stored in the upper portion of the broodnest so that the winter cluster will form below the honey and toward the front of the hive. In a two-story broodnest the honey should be stored mainly in the upper chamber. If the lower chamber is full of honey and the upper chamber virtually empty, the bees will cluster on the empty comb, and, as the cluster works upward in winter, the bees may starve to death with honey in the lower chamber.

If it is necessary to feed sugar syrup to make up the required amount of stores, the feeding should be done while the weather is warm enough to permit the bees to store the syrup in the comb and seal it as they

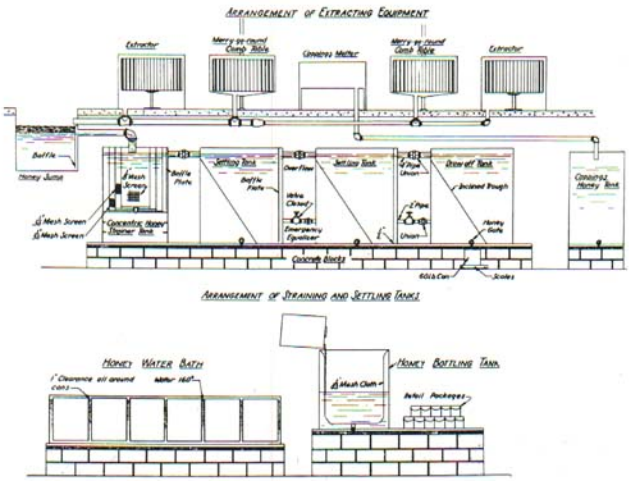


Fig. 36. Arrangement of equipment in 36' x 60' Gothic type honey house.

would honey. If the bees have collected fall stores from weeds such as asters, heartsease, Spanish-needle and boneset, it is a good policy to feed the bees an additional 10 pounds of sugar syrup before packing. The weed honeys, excepting golden rod, generally contain a high percentage of dextrin and are, therefore, unsuitable for good winter food. The 10 pounds of sugar syrup will be stored beneath the weed honey in this case and will be sufficient to maintain the colony during the first part of the winter when the bees cannot fly. This practice is especially desirable if the bees are to be wintered in a cellar, since in this case occasional cleansing flights on warm days in winter are impossible.

PREPARATIONS FOR WINTER

To "winter" successfully, by any method, the colony, on October 15 should contain (1) a young vigorous queen; (2) 35,000 to 50,000 young worker bees; (3) 60 to 70 pounds of good winter stores. There is some difference of opinion as to the most efficient method of supplying insulation against cold. The three leading methods are to be discussed.

In a Cellar—For best results, a specially constructed cellar, built after the plan indicated in Fig. 37 should be used. Ordinary house cellars may give good results, if specially prepared. If a house cellar is to be used, a special compartment should be subdivided off to provide a chamber completely dark, dry and having an even temperature of about 42° F.

As indicated in Fig. 37, arrangements should be made for drainage, if the level of the cellar-floor is likely to be lower than the level of the water-table in the spring. This matter is easily cared for if the cellar can be dug in the side of a sandy hill.

Beekeepers who have sufficiently large apiaries to warrant the building of a special cellar, usually plan to bring the bees home from the out-yards for "wintering". If the home-yard is large enough, it is a good plan to move home the bees from the out-yards early enough to permit fall feeding in the home-yard, thus saving time and labor.

In estimating the size of cellar required, one may allow not more than one and one-half square feet floor space per colony. Thus a cellar 20 by 24 feet in size will comfortably hold 325 to 400 colonies, depending on whether the hives are stacked four or five high in single broodnests. Because the cellar is a permanent fixture it should be built with future expansion in mind. If the beekeeper aims to increase his number of colonies to 1,000 it would be better to build a cellar in two compartments holding 500 colonies each, than to build one large room, because it is easier to control the temperature of the cellar when it is filled to the designed capacity.

Fig. 37 shows the proper depth for excavation. The outside ground-level should extend at least 3 feet above the inner ceiling of the cellar or about a foot above the upper level of the false ceiling which is to be filled with sawdust. Unless eavestroughs are used, the roof should project at least 2 feet to prevent the washing of the soil away from the cellar wall. This figure shows a two-compartment cellar, each

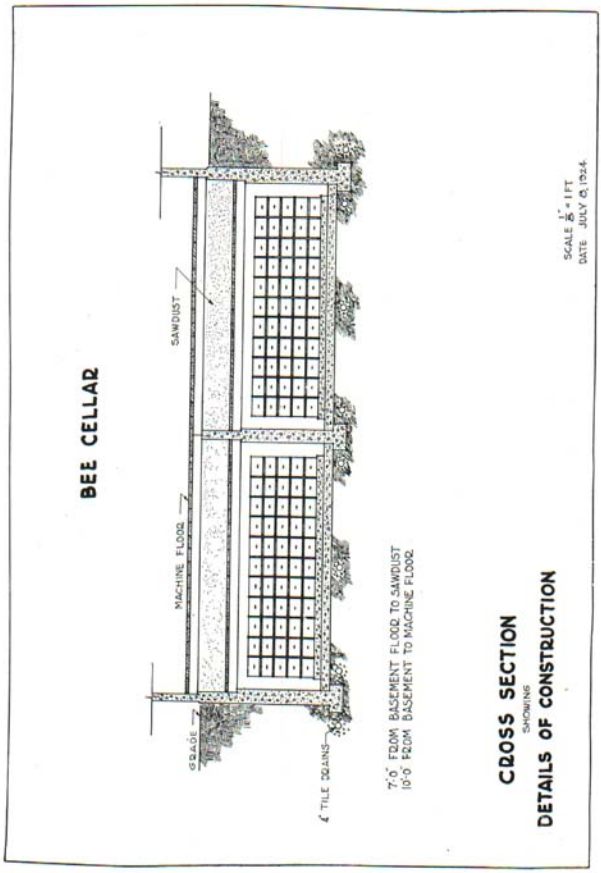


Fig. 37. Cross-section showing details of construction of a bee-cellar.

compartment of 20 by 24 feet, walls and floor being made of concrete. This cellar is designed to support a honey-house above.

Fig. 38 shows the arrangement of the ventilating system. Fresh air is brought into the cellar through a 4-inch tile extending underground for a distance of about 100 feet, to a vertical intake. Fresh air inlets are provided near the ceiling in the two corners opposite the partition and the ventilating chimney. The ventilating chimney, in this case, is made of brick, having outside measurements of 20 by 20 inches, and

inside measurements of 13 by 13 inches. It is 45 feet high. The flues or foul-air outlets are 8 inches by 12 inches at the base of the chimney, one opening into each compartment of the cellar.

This method of ventilation removes the heavy, foul air as it settles to the floor, without affecting the warm air at the ceiling. The fresh air inlets near the ceiling, in the corners opposite the ventilating chimney, insure an even distribution of fresh air throughout the room. If the ventilating system is functioning correctly, there should be sufficient draft through the flue at the base of the chimney to extinguish

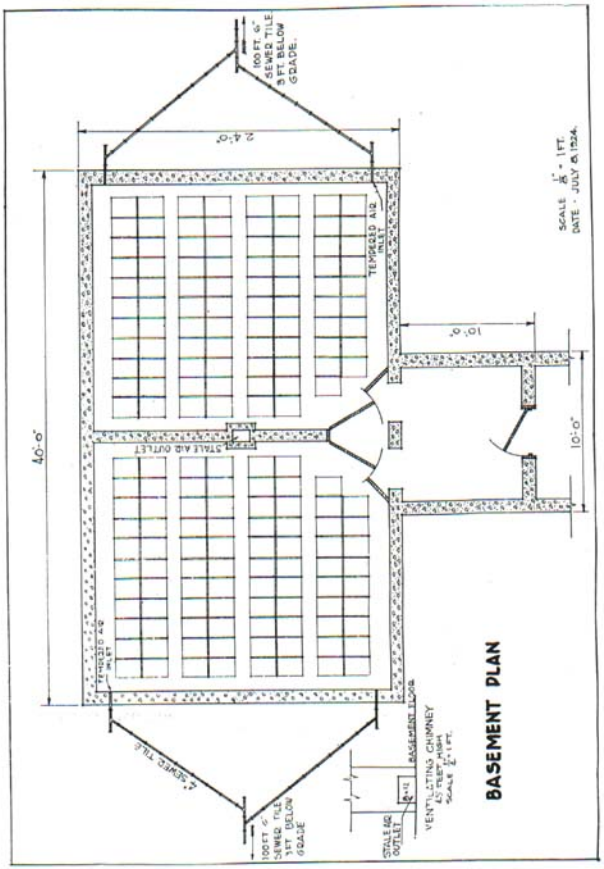


Fig. 38. Floor plan and arrangement of ventilators for a bee-cellar.

a match. Furthermore, in winter, the cellar ceiling will be dry, whereas, in the summer it will show condensation of moisture. The temperature of the cellar can be regulated somewhat by opening or closing the flue in the base of the chimney.

Fig. 38 shows the outside entrance to the bee-cellar. Notice the vestibule between the outside entrance and the inner doors to the cellar proper. This vestibule is essential in winter, to temper the air.

It is customary to move the bees into the cellar during the first cold weather following the last warm weather in November. By warm weather is meant weather warm enough for the bees to fly freely. This period usually comes just before or after November 20. Weather forecasts from the nearest weather bureau will assist the beekeeper in making preparations to move the bees in at the approach of the cold wave. The hives may be carried in singly or on carriers. Sufficient assistance should be obtained to move all of the bees into the cellar as quickly as possible. If the bees are not clustered tightly, a cloth placed over the entrance will prevent their escape while being carried. The full summer entrance is left open in the cellar.

Empty hive-bodies or other supports are placed on the floor of the cellar, the hives being piled one above the other in double rows side by side, and back to back, leaving entrances facing aisles to permit inspection at intervals during the winter.

A well-constructed bee-cellar needs little regulation during winter. No disturbance of any kind should be allowed. For this reason the cellar should be rodent-proof, both in the compartment where the bees are kept and in the false ceiling.

The temperature of the cellar should be maintained at 42° F. as nearly as possible. A higher or lower temperature will cause undue activity in the hive. On the occasional inspections, a flash-light may be used to examine the colonies from the entrance. It is not well to permit a group of people to enter a bee-cellar at any one time in winter because the disturbance and the heat radiated may raise the temperature of the cellar sufficiently to cause serious trouble later.

If the temperature of the cellar becomes too warm as a result of any disturbance, the bees may break cluster and spread over the front of the piles of colonies, forming a blanket of bees around the hives, or, many bees may fly from the hives, become lost in the dark, and die.

If the cellar is functioning properly, there will be very few dead bees on the bottom-boards of the hives or on the cellar floor. There should be no moisture on the bottom-boards or inner covers, and no spotting of the hives as a result of dysentery. The combs should not be mouldy in the spring, and no brood-rearing should be started while the bees are yet in the cellar. Colonies should not suffer from "spring dwindling" after removal from the cellar.

The bees are usually removed from the cellar during the forepart of April. If a disturbance has caused the bees to become restless and noisy previous to that time, however, the bees should be set out sooner. The hives should be carried out towards evening, and as they are being carried out, the entrance should be contracted to about one-half inch to diminish the danger of "drifting". It is well also to place some straw or dry grass over the entrance to encourage the bees to "orient" themselves before flying away.

Fig. 39. The wooden packing-case offers extra protection on sides and top.

After removal from the cellar, during the cool weather of early spring, colonies are greatly benefited by wind protection at least, and preferably by hive insulation as well.

In Wooden Packing-Cases—Bees wintered out-of-doors have the advantage over bees wintered in the cellar in that they can be placed in winter quarters earlier in the fall and allowed to remain there later in the spring. Best results are obtained from winter packing-cases when wind protection from the north and west is provided either by a natural wind-break or by a specially constructed barrier.

The Four-Colony Case—Using 13/16 inch tongued-and-grooved lumber, the dimensions are as follows:

Sides, 53⅝ x 35⅜ inches.
Ends, 44 x 35⅜ inches.
Bottom, 44 x 52 inches.
Cover, 50½ x 57 inches. (With a 2-inch telescoping rim around edge.)
Tunnel top, 6 x 16½ inches.
Tunnel bottom, 4 x 16½ inches. (With a ⅞-inch x 4-inch block between.)

The bottom rests on three 2 x 2 pieces, 51 inches long, nailed at the ends and middle of the bottom. The hives rest on two pairs of 2 x 4s, each 3½ feet long, and placed 10 inches apart, allowing 4 inches of bottom packing under the hives.

When assembling the various parts, at least one cleat is used at each end and one in the middle. The end cleats are arranged on the sides and ends so that the sides will overlap the ends. The tongued-and-grooved boards must not be drawn together too tightly or they will warp out of shape. If possible, the various parts should be made accurately enough to be interchangeable. Otherwise it is necessary to mark the parts of each case so that they will fit after being disas-

sembled for storage in summer. Hooks may be used to fasten sides and ends together, but screws are more permanent and satisfactory. The top should be covered with a good grade of roofing paper, and the rest of the case should be painted every alternate year.

The tunnel is made to fit in cross-wise between the hive and the end of the packing-case. The top, being 6 inches wide, will fit between the hive-body and the packing-case, over the projection of the bottom-board at the entrance; and the bottom, being only 4 inches wide, fits against the end of the bottom-board. The ⅞-inch cleat between top and bottom of the tunnel insures for the bees a space of 4 inches by 16 inches by ⅞-inch between the hive and the packing-case entrance in which to cool off should the temperature of the hive get too warm. An entrance ⅜-inch by 5 inches is made in the packing-case wall.

Sometimes it is difficult to place tunnels in packing-cases so that they fit perfectly. A piece of tin 8 inches wide and as long as the width of the hive, placed between the hive-body and the bottom-board at the rear, enables the beekeeper to adjust the position of either the hive-body or the bottom-board to fit the tunnel without danger of bees escaping at the back of the hive.

It is desirable but not necessary to have the bees remain on the same stands during the summer and winter when the four-colony case is used. The packing material should be fine and dry. Clover-chaff, planer-shavings, sawdust, wheat straw, powdered cork, dry forest leaves and other similar material will make good insulation from heat and cold.

This case is deep enough to allow the use of a double-story brood-chamber in winter with sufficient top packing, and the addition of another hive-body in spring before unpacking, if desired.

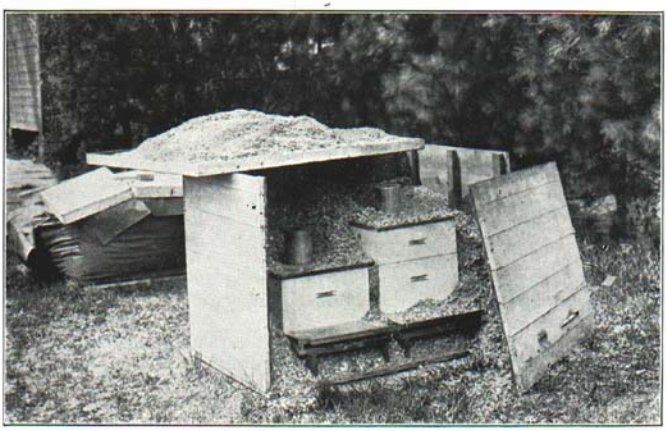


Fig. 40. Wooden packing-case opened to show interior arrangement. Note the pails inverted over the hole in the honey-board for feeding.

The Two-Colony Case—Using 13/16 inch tongued-and-grooved lumber, the dimensions are as follows:

Sides, 33 x 47¾ inches.
Ends, 33 x 32 inches.
Bottom, 34 x 48¾ inches.
Cover, 36 x 50 inches (with a 2-inch telescoping rim around edge).
Tunnel top, 6 x 16½ inches.
Tunnel bottom, 4 x 16½ inches (with a ⅞ x 4-inch block between).

The bottom rests on three 2 x 2 pieces, 48 inches long, nailed at the ends and middle of the bottom. The hives rest on two 2 x 4s, each 3½ feet long, placed 10 inches apart, allowing 4 inches of bottom packing under the hives.

As in the case of the four-colony case, when assembling the various parts, at least one cleat is used at each end and one in the middle. The end cleats are arranged on the sides and ends so that the sides will overlap the ends. The remainder of the directions for assembling the case are identical with those for the four-colony case.

"Asphalt-Paper" Packing-Cases with Side Packing — The asphalt-paper packing-case offers an inexpensive solution of the wintering problem for the many beekeepers who find the cost of making two or four-colony packing-cases prohibitive. In fact some of the commercial beekeepers who have been using the wooden cases have discarded them in favor of the asphalt-paper cases.

Wind protection from the north and west at least is essential for success with this method of packing.

Two hives can be packed together conveniently. If double-ply asphalt-paper is used, four colonies may be packed in a group, providing a special frame is made to support the paper.

The materials necessary to pack with are as follows: a supply of single or double-ply asphalt-paper or slater's felt 36 inches wide; a supply of lath or thin strips of lumber; a supply of lumber cut into three-inch strips an inch thick; a supply of insulating material such as is mentioned on page 86, and a hammer, saw, and supply of six-penny or eight-penny nails.

If desirable to use bottom packing, a frame 4 inches deep should be made the same size as the bottom-board and filled with packing material. This packing must not be exposed to moisture or it will be detrimental instead of beneficial. It is not customary to use bottom packing with the asphalt-paper method for that reason.

When ready to commence packing, the hives are arranged in groups of two or four, placed close together on an even base, so that the bottom-boards will all be on the same level. A rim is then made of the three-inch strips of lumber by cutting strips four inches longer than the combined length and breadth of the group of hive-bodies. The parts of the rim are assembled with the front strip resting on the projection of the bottom-boards to make a tunnel when the packing is completed, the strips along the side being placed beneath the front strip and the strip at the back being placed beneath the side strips. The rim is held together by one nail at each corner.

The purpose of the rim is to allow an additional three inches of space around the hive for insulating material.

Fig. 41. The four steps in preparing the asphalt-paper packing-case, using loose packing on sides and top.

After the rim has been assembled, sufficient asphalt-paper is cut from the roll to encircle the rim and over-lap about a foot. Asphalt-paper is placed around the rim on edge and the lower edge of the asphalt-paper is fastened to the sides of the rim by tacking lath around the rim outside the asphalt-paper. The overlapping edges of asphalt-

Fig. 42. Packing is simplified by using the chaff-tray and no side packing but a good grade of asphalt paper, or so-called 15-pound felt.

paper are then fastened or pinned together with nails. To reduce the cost of the asphalt-paper case, the 3-inch rim may be dispensed with, in which case the asphalt-paper is tacked against the sides and ends of the lower part of the hive itself.

If the hives are equipped with telescopic covers with inner-covers, the telescopic covers are removed. If no inner-covers are used the outer-cover is allowed to remain on the hive.

After the asphalt-paper has been attached to the rim the insulating material is poured into the packing-case slowly. The four corners of the case should be packed first and the operator should hold the asphalt-paper with one hand while packing with the other to prevent pushing the paper down over the rim. After the four corners have been packed, enough additional material is added to complete the filling of the sides and to cover the top of the hives with eight to twelve inches of insulation.

Fig. 43. A "cap" of asphalt paper is placed on top, the hive-covers being placed over the "cap".

The asphalt-paper projecting above the packing material is then folded down over the material, from the sides and ends, and the folds at the corners are pinned down, envelope fashion with nails. Another piece of asphalt-paper, long enough to completely cover the top and project over each end about a foot, is used for a cover. The corners of this cover are also folded and pinned down with nails to prevent the wind from blowing it off. If the hive covers were removed before packing they may be placed on top of the asphalt-paper cover to hold it down, the covers themselves being weighted down with stones or brick. If the hive covers were left on the hives, the asphalt-paper cover may be secured with strings fastened to nails projecting from the rim at the bottom, on front and rear.

An opening about ½ inch x 5 inches is then made in the asphalt-paper for an entrance for each hive. The regular entrance-block is

Fig. 44. Hive covers and "cap" are tied down with binder-twine. Note wind protection.

placed in each hive-entrance, inverted, before packing. If mice bother it is well to cover the entrance-block with tin to keep mice from chewing their way into the hive.

The asphalt-paper may be used for two seasons if it is removed carefully and allowed to remain in the sun long enough to warm up so that it will not crack when being rolled. Two-year-old paper can at least be used for making covers if it is not tough enough to use for the sides of the packing-case.

If early spring manipulations are necessary, the top packing may be placed in large gunny sacks in quantities sufficient to spread out as a blanket about 6 inches deep after the sack is tied. Thereafter, it is necessary only to remove the sack when making an inspection instead of scooping out the packing material each time.

When used properly, this method of packing is very efficient. Its inexpensiveness together with the fact that the material for making the cases can be stored without difficulty, account for the popularity of the asphalt-paper packing-case.

THE ASPHALT-PAPER PACKING-CASE WITHOUT SIDE PACKING

The following method is successful and very economical. Over a period of years the cost will be less than 10 cents per colony per year for materials.

Materials Needed:

1. A chaff-tray, made of an old super or of rough lumber, the same dimensions as a standard hive-body with burlap bottom, filled with fine planer shavings or fine chaff.
2. A supply of 15-pound asphalt felt paper, 36 inches wide, such as is used for built-up roofing jobs, which paper may be used for three years.
3. Lath, twine, 6 d. nails and a hammer.

Procedure—The inner cover may be removed or left on as desired. If left on, close the hole in the inner cover with a piece of lath or shingle or asphalt-paper to keep the bees from chewing through the burlap bottom of the chaff-tray. If the inner cover is removed, place one or two corn cobs or small sticks under the chaff-tray on top of the frames so the bees can pass over the top bars of the frames during winter. Put on the chaff-tray.

Level the hives and arrange in pairs or groups of three. The rear of the hives should be about an inch higher than the front.

Measure the distance around the hives and add 6 inches for lap. Cut a piece of the asphalt paper that length and place around the hives with the lap on the end away from the general direction of the wind. The hives should face south or east. Tack a lath against the bottom of the paper at the bottom of the hive on all four sides, leaving the nails projecting a half inch. Tack the front lath on first to avoid stinging. Tack a short lath along the lap, vertically. Fold in the top of the asphalt paper, envelope fashion, and place a piece of asphalt paper, cut 18 inches longer than the packing-case, over the folded top. Place the outside hive covers on top of this "cap" and securely tie the covers

Fig. 45. Colonies well prepared with bees and food, with a chaff-tray on top, in wind-protected locations, winter well without other protection.

down with binder twine. Cut an opening in the paper in front of the entrance to the hives. If the twine seems likely to slip off the covers, tie a half-hitch at each point where the twine crosses the packing-case, lengthwise and crosswise.

This packing-case uses no side packing except the single layer of asphalt paper, and no bottom packing. On sunshiny days in winter when the temperature is too low for bees to fly, the heat generated by the sun on the black asphalt paper is sufficient to cause the winter cluster to move to a fresh food supply, whereas too much side-packing may prevent this, and in long, cold periods the cluster may starve within a few inches of a supply of honey.

This packing-case is easily and rapidly applied. Two men can pack readily 100 colonies per day in this manner.

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