FARMERS' BULLETIN 1039
United States Department of Agriculture

COMMERCIAL COMB-HONEY PRODUCTION

COMB-HONEY PRODUCTION for the general market should be attempted only in locations furnishing a rapid honey-flow of white honey.

Hives, sections, and supers should be accurately made and the parts should be interchangeable. All apparatus should be prepared well in advance of its use.

To produce a large number of workers for the spring honey-flow, each colony during the late summer and autumn should have a good queen, an abundance of food, and sufficient room both for the stored food and for brood-rearing, that the bees constituting the winter colony may be reared. Ample protection against cold and wind, with enough winter stores of good quality to last until spring, is necessary. In spring an abundance of stores, room, and protection is necessary for heavy brood-rearing, to replace winter losses, and produce the excess in population necessary for best results during the honey-flow.

Great skill is required during the honey-flow to prevent a division of the working force of the colonies by swarming and also to prevent a subordination of the storing instinct because of the crowded population of the colonies.

Preventive and remedial measures for swarming permit the beekeeper to operate a series of apiaries in different locations without the necessity of an attendant in each during the swarming season.

The proper expansion and arrangement of room in the supers is an important factor in maintaining a dominance of the storing instinct.

After the honey is removed from the hive it should be prepared carefully for market by proper cleaning of the sections, and especially by grading and packing in strict conformity with established grading rules.

These and other features of comb-honey production are discussed in this bulletin.

Contribution from the Bureau of Entomology,
L. O. HOWARD, Chief.
Washington, D. C. June, 1919

COMMERCIAL COMB-HONEY PRODUCTION.[1]

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CONTENTS.

COMB-HONEY PRODUCTION CALLS FOR SPECIALISTS.

THE PRESENT TENDENCY in beekeeping is decidedly toward the production of extracted honey instead of comb-honey. The recent expansion in commercial beekeeping since the passage of the Pure Food Law is a large factor in bringing about this change. Since it is no longer necessary to market honey in the combs to convince the consumer as to its purity, comb-honey must now appeal to him largely because of its finer appearance.

Well filled sections of comb-honey with delicate white comb and perfect cappings are obtainable only during a rapid honey-flow of sufficient duration to insure their completion. The production of comb-honey, the appearance of which is sufficient to justify its extra cost, requires a combination of conditions that are peculiar to rather limited areas, outside of which the beekeeper will find it decidedly advantageous to produce extracted honey.

Comb-honey production should not be attempted in localities where the honey-flow is slow or intermittent, where the character of the honey is such that it granulates quickly in the comb while it is on

[1] This bulletin is a revision of Farmers' Bulletin 503, by the same author, entitled "Comb Honey," published in 1912.—EDITOR.

the market, where the honey is dark or "off color," or where honeys from various sources are mixed if these different sources produce honey of different color or flavor. Local market conditions in some instances may of course be such as to make it seem advisable to produce comb-honey in limited quantities in a locality that is not well suited to comb-honey production, but the beekeeper who expects to produce comb-honey for the general market should first be sure that his is a comb-honey locality.

While the professional beekeeper is thus curtailing the production of indifferent grades of comb-honey, bee diseases are rapidly eliminating the careless producers. From the present indications, therefore, it would seem certain that there must be a gradual elimination from the markets of all inferior grades of comb-honey. This should mark a new era in the production of the best grades of comb-honey in the localities that are peculiarly adapted to comb-honey production. The beekeeper who is thus favorably located will do well to consider the possibilities of future market conditions for a fancy grade of comb-honey.

The following discussion is necessarily but a brief outline of modern apparatus and methods and of course can not in any sense take the place of the broad experience necessary in profitable comb-honey production. It is assumed that the reader is more or less familiar with the more general phases of beekeeping. (See Farmers' Bulletin 447.)

APPARATUS FOR COMB-HONEY PRODUCTION.

SHOP AND HONEY-HOUSE.

The arrangement and location of the shop and honey-house will depend upon local conditions and circumstances. The usual mistake is in constructing these too small. In the North the shop and honey-house are usually built over the wintering respository or cellar. Since rats or mice would do great damage to the contents of such a storehouse, the construction should be such as to exclude them. If a concrete foundation is used and the sills are embedded in a layer of "green" mortar, no trouble of this kind should be experienced. If a series of outapiaries are operated for comb-honey, the supers, extra hives, etc., are usually kept in one building located near the home of the beekeeper. This serves as a central station and storehouse, the supplies being hauled to and from the apiaries as needed.

The honey room should be so located that it will receive the heat from the sun, preferably an upstairs room immediately under the roof. The room should be papered or ceiled inside to keep out insects and to permit fumigation and should contain facilities for artificially heating in case continued damp or freezing weather should

occur before the honey is marketed. The honey room should be provided with ample floor support for the great weight that may be placed upon it.

HIVES.

A beehive must serve the dual purpose of being a home for a colony of bees and at the same time a tool for the beekeeper. Its main requirements are along the line of its adaptation to the various manipulations of the apiary in so far as these do not materially interfere with the protection and comfort it affords the colony of bees. Since rapid manipulation is greatly facilitated by simple and uniform apparatus, one of the fundamental requirements of the equipment in hives is that they be of the same style and size, with all parts exactly alike and interchangeable throughout the apiary.

In this country the Langstroth (or L) frame ($9\frac{1}{8}$ by $17\frac{5}{8}$ inches) is the standard frame and throughout this bulletin frames of brood will be discussed in terms of this size of frame. The advantages of standard frames and hives are so great that the beekeeper can not afford to ignore them for the sake of some slight advantage of another size.

There is, however, a difference of opinion as to the number of frames that should be used in a single hive body. The wide variation in the building up of colonies previous to the honey-flow in different localities and seasons, the race of bees, and the skill of the beekeeper are all factors entering into this problem, which make it improbable that beekeepers will ever agree fully on this point. The races that build up more rapidly in the spring are, of course, other things being equal, able to use to advantage a larger brood-chamber than the races that are more conservative in brood-rearing. It is also noticeable that, within certain limits, as the beekeeper's skill in building up his colonies for the honey-flow increases, the size of the brood-chamber best adapted to his purpose is increased. In other words, while the careful and skillful beekeeper may succeed in having large brood-chambers well filled with brood at the beginning of the honey-flow, the less skillful beekeeper under similar conditions may be doing well to approximate this condition with a much smaller brood-chamber.

For comb-honey production the brood-chamber should be of such size that by proper management it may be well filled with brood at the beginning of the honey-flow, so that the brood and surplus apartments may be definitely separated. This, of course, does not apply to extracted honey production. A brood-chamber may be considered too large if by proper management it is not on an average fairly well filled with brood at the beginning of the honey-flow, and too

small if it provides an average of less room than the colony is able to occupy with brood previous to the honey-flow. Unless the bee-keeper practices feeding, a brood-chamber that does not contain sufficient room for both winter stores and brood-rearing during late summer and autumn may also be considered too small. It may be well to note that by this standard if the brood-chamber seems to be too large the fault may lie in the management during the previous autumn, winter, and spring. Of course the brood-chamber that is barely large enough for one colony will be too large for another in the same apiary, or the character of the season may be such that all brood-chambers may be too large for best results one season and too small the next, so an average must be sought. While good results may be secured by the use of any of the sizes in common use, any great departure in either direction from the size best suited to conditions of a given locality necessitates an excessive increase in labor to give best results. There is at the present time a strong tendency toward the use of the standard 10-frame hive.

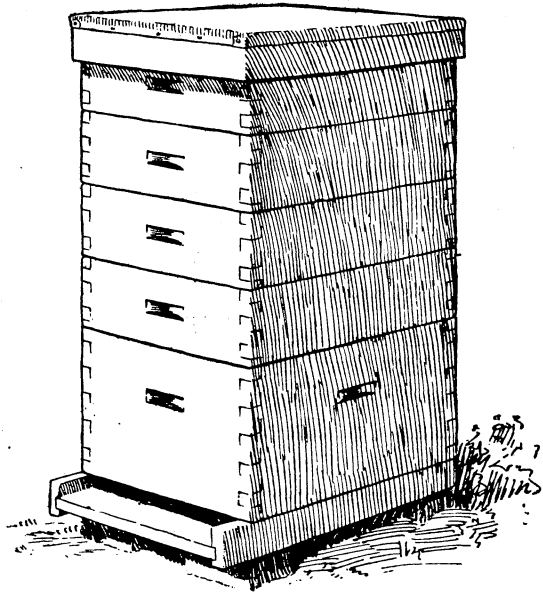

Fig. 1.—A 10-frame hive with four comb-honey supers.

The comb-honey producer is more exacting as to certain details in construction of hives than is the producer of extracted honey. The spaces[1] above and between the top bars of the brood frames must be accurate or they will be bridged with burr-combs and brace-combs and these filled with honey. Burr-combs and brace-combs make the removal and readjustment of the super and the handling of frames a slow and disagreeable task, to say nothing of the waste of material, which should have been placed in the sections in the beginning. The use of the slatted honey-board, while preventing brace-combs between itself and the super, does not prevent the building of burr-combs and brace-combs between and above the top bars of the frames. This trouble

[1] A beespace, or that space in which bees are least inclined to put comb or propolis, is perhaps a scant one-fourth inch. In hive construction one-fourth or five-sixteenths inch is usually used.

is largely eliminated by proper spacing. Most hive manufacturers at present are making the top bars of the brood frames of such width that the space between them is from one-fourth to five-sixteenths inch, with the same spacing above them. The difficulty, however, is in maintaining this spacing with any great degree of accuracy. Self-spacing frames[1] are a partial solution of this difficulty. In some localities, however, the ordinary self-spacing frames are so badly propolized as to render their removal from the brood-chamber difficult as well as materially to interfere with the proper spacing. The advantages of such frames are then nullified, while their disadvantages are retained or even intensified. In such localities metal spacers having but small surfaces of contact are sometimes used. Some beekeepers prefer omitting the spacers entirely. However, some of the difficulties arising from the use of self-spacing frames are the result of carelessness on the part of the operator in failing to crowd the frames together properly when closing the hive after having handled the frames.

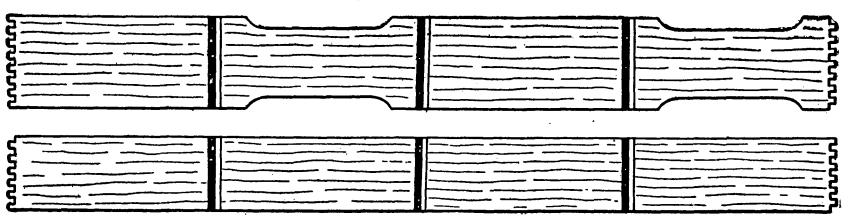

FIG. 2.—Beeway and plain sections, unfolded.

SECTIONS.

Two general styles of sections (fig. 2) are in common use, differing in the method of spacing (figs. 3 and 4)—the beeway section, in which the spacer is a part of the section itself, and the plain section, in which the spacer is a permanent part of the separator. Each style has its advocates and each offers some advantages.

Some of the advantages of the plain sections are: (1) They are more simple in construction, therefore costing less. (2) The edges being plain with no insets, the plain sections are more easily cleaned of propolis when being prepared for market and are especially adapted to cleaning by machinery. (3) By leaving the spacers in the super, sections of the same honey content occupy less space in the shipping case, thus reducing the cost of packages. (4) The plain section is adapted to an arrangement permitting freer com-

[1] These are so constructed that the end bars are one-fourth or five-sixteenths inch wider than the top bars throughout a portion of their length or furnished with projections of metal fitted to the edges of the frame. In either case the adjustment is such that when the frames are crowded together in the hive the spaces between the top bars will be correct.

munication lengthwise of the row of sections, especially at the corners (p. 10).

Some of the advantages of the beeway sections are: (1) The honey is somewhat less liable to injury by handling. (2) Being wider at the corners where folded, they are stronger. (3) Some markets, being accustomed to the larger cases necessary to contain a given number of beeway sections, object to the smaller package containing the same number of plain sections, simply because it is smaller.

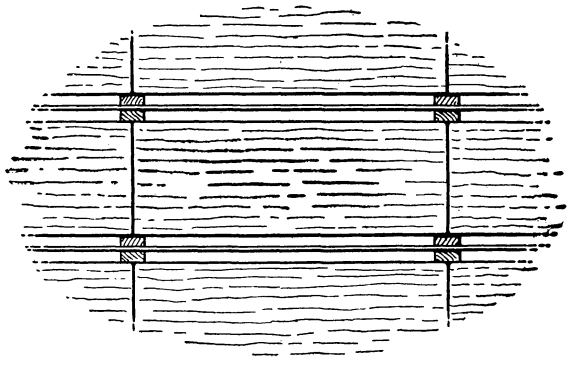

FIG. 3.—Plain section in super, showing method of spacing.

Sections of various dimensions are in use by beekeepers, but the sizes in general use are the 4¼ inches square and the 4 by 5 inches. Some producers prefer the 4 by 5 sections because of the more pleasing appearance of the oblong package. The standard widths of the 4¼ by 4¼ inches section are 1⅞ inches in the beeway style and 1½ inches in the plain section. The extra width in the beeway style is for the purpose of spacing and does not add to the thickness of the comb. The 4 by 5 is 1⅜ or 1½ inches wide in the plain style and not much used in the beeway style. The 1⅜ width of the 4 by 5 section contains practically the same amount of honey when filled as the 4¼ by 4¼ by 1½ plain or the 4¼ by 4¼ by 1⅞ beeway, assuming, of course, that all are used with separators and filled under like conditions. Since there are well-defined limits as to the thickness of the combs most profitable to produce, the area of one comb surface in a section weighing about a pound is usually from 16 to 20 square inches, the exact size and shape being an adaptation to given space in the super. The thinner combs, showing more comb surface, have the appearance of being larger and the honey in them may be ripened

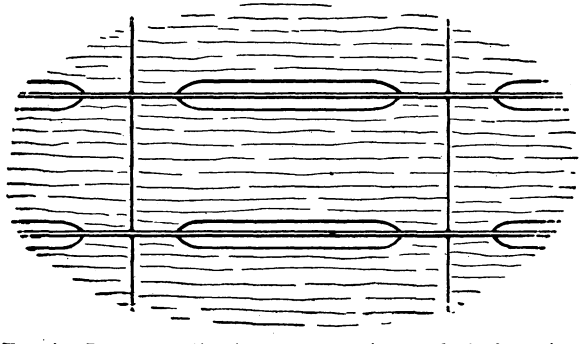

FIG. 4.—Beeway section in super, showing method of spacing.

sooner and possibly better than in thicker combs. They, however, require more foundation for each pound of honey produced and a slightly greater amount of wax, in proportion to the honey, to complete them. Also the thinner the comb the greater the difficulty with the sheets of foundation swinging to one side on account of uneven work on the two sides or because the hives do not stand level.

SUPERS.

The main points of difference between the various types of comb-honey supers are in (1) the method of supporting the sections, (2) the amount of protection afforded to the outside of the section, and (3) the degree of free communication from section to section within the super.

Sections are supported either by means of cross supports under the ends of the sections or by a slat of proper width supporting each

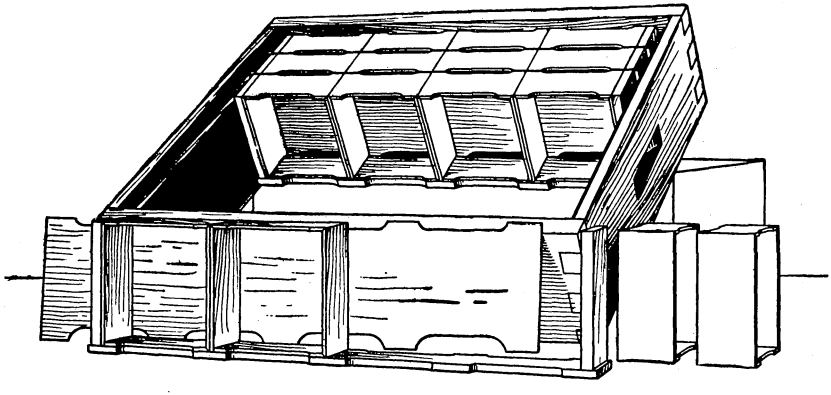

FIG. 5.—Super with section holder for beeway sections.

row of sections. The T super, so called from the shape of a cross section of the strip of tin used to support the sections, is illustrative of the first, while the supporting slats, section holders (figs. 5 and 6), and wide frames are illustrative of the second type of support.

The T super and others of this type offer no protection against propolizing to either the top or bottom of the sections; the section holder or slat (figs. 5 and 6) protects the bottom, while in the wide frame the entire outer surface of the sections is protected except at the edges. Supers which protect the sections most completely are more complicated and expensive, and require more labor to clean them of propolis and to fill them with sections. On the other hand, sections of honey produced in properly constructed wide-frame supers are much more easily cleaned of propolis, and ordinarily present a neater appearance when packed for market.

The use of closed-top sections (1-beeway) and solid separators, making each section a separate compartment with openings for the

bees at the bottom only, illustrates one extreme, while the sections with openings on all four sides (4-beeway) used without separators illustrate the other extreme as to free communication from section to section. Between these extremes are various intermediate types.

It would be desirable so to adjust the sections that when filled with honey a row of them would, so far as the bees are concerned, be equivalent to a single comb, that the bees might have the same free access to the outside row of cells from all sides as they do to the other cells and might pass up or down from any section and the full length of the row, as well as around the ends. While, under the same conditions, such free access to the outside row of cells from all sides would result in the sections being slightly better filled than with the ordinary adjustments, such an arrangement presents some mechanical difficulties and would add considerably to the first cost of the supers. If separators were not necessary, such an adjustment

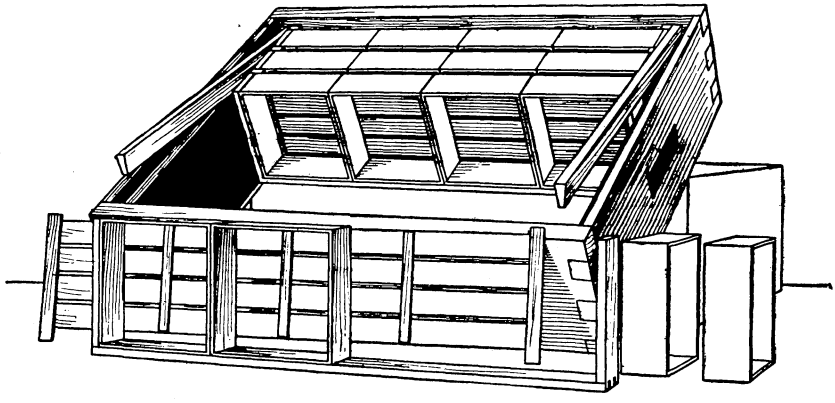

FIG. 6.—Super with section holder for square plain sections.

of sections could be readily accomplished. In Europe a type of separator having transverse openings corresponding to the upright edges of the sections is used to give free communication lengthwise of the row of sections. In this country some such separators are used as well as a separator made of wire cloth so spaced between the rows of sections as to give free communication along the rows, as well as from one row to another. These, however, are not widely used in the United States.

The plain section, when used in connection with the "fence" separator (fig. 6), having the upright posts considerably shorter than the height of the section, offers a fair compromise as to free communication within the super. Most of the comb-honey produced in this country, however, is produced in sections which offer no communication from section to section lengthwise of the super, being produced in the regular 2-beeway section, having openings at the top and bottom only (fig. 5).

SEPARATORS.

Separators are made of strips of tin or wood and are used between the rows of sections to compel the bees to build the combs straight and all within the section. The thicker the combs the greater becomes the necessity for separators. While an expert can produce uniform comb-honey without separators during a heavy honey-flow by using narrow sections, it is usually not advisable to do so on account of the resulting large percentage of imperfect combs, especially during poor and indifferent seasons and at the close of any season. The use of separators results in a much more uniform product.

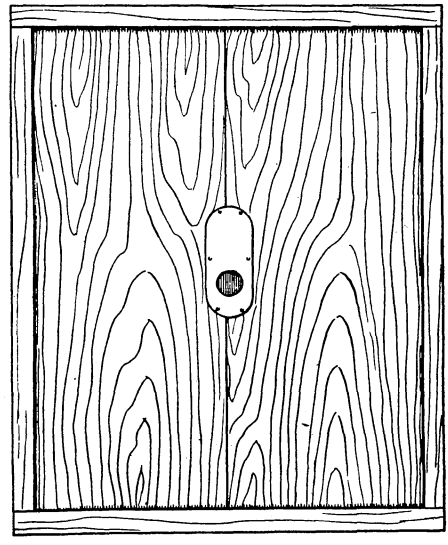

FIG. 7.—Bee escape board for removing bees from supers. (Phillips.)

SHALLOW EXTRACTING SUPERS.

Some comb-honey producers add to their equipment one shallow extracting super for each colony. These may be used for the following purposes: (1) To keep the brood-chamber free of honey before the beginning of the main honey-flow; (2) to use at the close of the honey-flow instead of the last comb-honey super; (3) to use during any honeyflow of inferior honey or honeydew; (4) to use during poor seasons when first-class comb-honey can not be produced; (5) to use as a food chamber to avoid feeding.

OTHER APPARATUS.

Among the other apparatus sometimes needed in commercial comb-honey production are a honey-extractor, wax press, bee-escapes, and escape boards (fig. 7), queen-excluding honey-boards, feeders, tools, etc. Ordinary friction-top pails with small perforations in the cover make excellent feeders. These are filled with sirup, then inverted and placed directly on top of the brood frames inside an empty hive body. Tin pans may also be used as feeders by providing some sort of float, such as grass or leaves, to prevent bees from drowning in the sirup.

In addition to these appliances, if the hives are single-walled, winter packing-cases are necessary when the colonies are wintered out of doors.

PREPARING SUPERS.

FOLDING SECTIONS.

Section presses and foundation-fasteners may be combined in one machine by which the section is pressed together square and the foundation is fastened by a single operation, or they may be separate machines requiring that each section be handled twice before being placed in the super. Ordinarily the one-piece sections must be dampened before folding, as otherwise the breakage is considerable and the sections are greatly weakened by folding. A crate of sections as it comes from the factory may be dampened by removing one side so as to expose the V-shaped grooves, then directing a small stream of hot water or steam into these grooves. Care should be taken that only the thin portion where the section is folded be dampened.

FASTENING FOUNDATION IN SECTIONS.

The use of comb-foundation in full sheets filling each section as nearly as possible is considered a necessity in the production of fancy comb-honey. This foundation should be as thin as can be used without being gnawed or torn down by the bees. The sheet of foundation is usually fastened centrally at the top of the section, leaving only enough space at the sides to allow it to swing freely without binding and about three-sixteenths inch at the bottom to allow for stretching while being drawn out. To secure better attachment of the comb to the bottom of the section, a bottom starter about five-eighths inch wide may be used. In this case the top starter should reach to within three-sixteenths to one-fourth inch of the bottom starter. In some localities the character of the honey-flow is such that little is gained by the use of the bottom starter, while in other localities it is difficult to produce honey that will stand shipment well without it.

The various types of apparatus usually used for fastening foundation in the sections make use of a heated metal plate which, after melting the edge of the sheet of foundation, is withdrawn, allowing the melted edge to be brought quickly in contact with the section. This fastens one edge of the sheet of foundation firmly to the wood. Foundation-fasteners employing this principle may be simply a hand tool consisting of a metal plate of proper size provided with a handle, the operator transferring the tool from the source of heat to the edge of the foundation. Or the principle may be incorporated in a more or less complex machine which provides for the maintenance of the proper temperature of the heated plate, its movement to melt the edge of the foundation, and a proper support for the section and foundation during the process. For the purpose of securing better filled sections of honey various methods of attaching the sheet of foundation to the sides as well as the top of the section have been

devised, but are not extensively used by producers. Among these methods are fitting the sheet of foundation in place, then directing a fine stream of melted wax along its edges, or the use of split sections in which a sheet of foundation is continuous through a row of sections, extending through their sides and top.

Some super construction is such that the sections may be placed directly in the super by the operator who puts in the foundation. This work is usually done during the winter months when the bees require no special attention. Enough supers should be provided to take care of the largest possible crop, even though it is not often that all are used the same season. The beekeeper who is operating several apiaries can not afford to take time to prepare supers for the bees during a good honey-flow. Supers of sections thus prepared in advance should be kept clean by storing them in piles and keeping the piles covered from dust.

MANAGEMENT OF THE BEES.

It is important to note that four essential factors enter into the securing of a crop of honey: (1) A sufficient amount of bloom of healthy and well-nourished nectar-secreting plants growing in soil to which they are adapted and within range of the apiary. (2) Weather conditions favorable to nectar secretion and bee flight. (3) A large number of workers in excess of those needed for the routine work of the colony. (4) Conditions of the colony making the storing instinct dominant. If any one of these factors is absent, the effect of the other three is immediately nullified, and the amount of honey secured will vary as these factors are present at the same time in greater or less degree or as the time during which they are all present is longer or shorter. It is therefore possible to have each of these factors present at some time during the season without securing a crop of honey. The period during which they are all present at the same time is usually quite short.

Grouping the first and second factors, we have a combination usually spoken of as the locality and season. These factors are largely beyond the control of the beekeeper except that (1) he may choose a location in which both are usually present at some time or times during the season, (2) he may take advantage of the plants of several locations by practicing migratory beekeeping, or (3) he may improve a given locality by directly or indirectly increasing the amount of nectar-secreting plants, such as buckwheat, alsike clover, sweet clover, or alfalfa.

In the third and fourth factors we have conditions capable of being brought about by management and for which the beekeeper is more directly responsible. The beekeeper's skill therefore lies in

supplying and maintaining these factors throughout the short period during which the bees may store more than they consume. In order to do this he should know which plants may be expected to furnish the nectar for his crop of honey, that his various operations may be properly timed. It should be noted that the shorter the duration of the honey-flow, the greater becomes the necessity of having the colonies in proper condition at its beginning and keeping them so until its close.

Nectar may be available in abundance and the weather may be ideal for gathering and storing, yet no honey can be produced if there is not a large force of workers in each colony, in excess of those needed for colony maintenance, to gather and store the honey crop. Furthermore, nectar may be abundant, weather conditions ideal, and the colonies strong, with the results in honey secured meager or none at all because the beekeeper has failed to keep the forces of each colony together and the storing instinct dominant. It is a common occurrence among inexperienced beekeepers to have the colonies become strong enough to work in the supers only after the flowers have ceased blooming or to see strong colonies during a good honey-flow doing nothing in the supers simply because conditions are not such as to make the storing instinct dominant.

So far as the skill of the beekeeper is concerned in the production of the crop of honey in a given location, every manipulation of the season should be directed (1) toward securing the greatest possible number of vigorous workers at the proper time, and (2) keeping the entire working force of each colony together and contentedly at work throughout the given honey-flow.

SECURING WORKERS FOR THE HONEY-FLOW.

The management directed toward securing workers for the honey-flow begins during the previous late summer and early autumn. It includes (1) providing favorable conditions for the production of the bees that constitute the winter colony; (2) conserving the energy of these bees during the broodless period of winter, when they can not well be replaced by further brood-rearing; and (3) building up the population of the colony after the adversities of winter so that the maximum strength is reached at about the beginning of the main honey-flow.

The function of the beekeeper is first to see that each colony is in normal condition and headed by a good queen in time to produce the bees that form the winter colony and then to supply any deficiency in **food, protection,** and **room for both brood-rearing and stores** that may exist at any time during the three periods mentioned above.

Food, protection, and room are the three requirements for colony existence and prosperity. Most failures to have colonies profitably

strong at the beginning of the honey-flow are due to negligence on the part of the beekeeper in supplying, in advance of the needs of the colony, any deficiency that may occur in one or more of these requirements.

PRODUCTION OF BEES FOR THE WINTER COLONY.

Fall stores and room.—During late summer and early autumn, when the bees are reared that make up the winter colony, a deficiency in either stores or room for brood-rearing may so restrict the production of young bees that their number may be too low for successful wintering. Colonies that are abundantly supplied with stores and have sufficient brood-rearing space at this time usually continue to rear sufficient young bees even in the absence of a fall honey-flow or any stimulative feeding. This is especially true if the queens are young.

Winter stores.—Before the beginning of cold weather each colony should have available at least a sufficient quantity of stores to supply the needs of the bees until late spring. In the northern States, where bees wintering out of doors do not have frequent flights or where bees are wintered in the cellar, it is exceedingly important that the winter stores be of the best quality, such as honey which contains the minimum amount of gums or a sirup made of granulated sugar. If inferior honey is present in the brood-chamber when brood-rearing ceases in the fall, the defect may be remedied by feeding at this time about 10 pounds of heavy sugar sirup to each colony. This will be stored where it will be immediately available for winter consumption, thus leaving the inferior stores for spring consumption when they do no harm. (See Department Bulletin 93 and Farmers' Bulletin 695.) Any deficiency in either quantity or quality of winter stores should be supplied immediately after brood-rearing ceases or earlier.

CONSERVATION OF ENERGY OF WINTER COLONY.

Winter protection.—During the broodless period of winter the life of the worker bees must be greatly prolonged in order that the colony may survive. The energy of the bees must be so conserved that they will live six months or more instead of six or eight weeks, as in the active season. Bees live most slowly when they are broodless, undisturbed, and have a temperature within the hive of 57° F. to about 65° F. When the temperature within the hive goes below 57° F. the bees become more active in order to maintain the minimum of 57° F. within the cluster. When the temperature within the hive goes above about 65° F. the bees begin some of the activities similar to those of the summer season. (See Department Bulletin 93, Temperature of the Honey Bee Cluster in Winter.) For best results in wintering, it is necessary therefore for the beekeeper to provide

abundant protection against cold and wind either by wintering the bees in the cellar or by protecting them out of doors. (See Farmers' Bulletin 695.)

INCREASE IN POPULATION.

During spring, while still anxious that bee-energy shall not be wasted, the beekeeper desires that it be spent judiciously in brood-rearing. For best results the maximum of colony strength should be reached about the time the honey-flow begins.

In most localities suitable for the production of comb-honey there is during the season but one honey-flow that furnishes any considerable surplus suitable for comb-honey, with perhaps minor honey-flows either meager in quantity or furnishing honey unsuitable in color. Furthermore, in these localities the main honey-flow usually occurs so early in the season that only those colonies provided with the best environment are able to build up to profitable strength to take advantage of it. In other localities the main honey-flow may occur later in the season or the season may furnish a series of important honey-flows with sometimes long intervals between them. Each type of location furnishes its own modification of the problem.

Spring stores.—When brood-rearing is resumed in the spring the consumption of stores is greatly increased over that of winter and as spring brood-rearing approaches its maximum the daily consumption of stores increases until an enormous quantity of honey is used for this purpose. At this time there is great danger of the colonies running short of stores, especially if no nectar is being brought in from the fields. Colonies that run short of stores during the spring rear brood sparingly and are so severely retarded in development that they usually attain profitable strength too late for the honey-flow. All colonies should be so abundantly supplied with stores for winter that there will be plenty left for early spring brood-rearing. If this was not done an early spring examination of all colonies is necessary to find which need more stores. Any deficiency in stores should be supplied immediately by inserting frames of sealed honey saved from the previous year or by feeding sugar sirup. Each colony should have at this time at least 10 to 15 pounds of honey in excess of their daily needs. Some beekeepers practice feeding each colony a small amount of sugar sirup daily to stimulate brood rearing. This should not be done during early spring, but under some conditions may be profitable during the few weeks just previous to the beginning of the honey-flow. Extensive producers, however, usually prefer to give 10 or 15 pounds of sealed honey or to feed an equal amount of sugar sirup at one time to colonies that are short of stores in the spring.

Spring protection.—A good hive that conserves the heat of the colony is a great help in early brood-rearing. Some beekeepers who winter their colonies in the cellar in single-walled hives find it profitable to put them into winter packing-cases after they have been removed from the cellar. When colonies are wintered out of doors in winter packing-cases, it is well to leave them packed until late spring. In the Northern States double-walled hives are especially advantageous during the spring if bees are wintered in cellars. A location for the apiary that is well protected against cold winds is also of great importance in spring brood-rearing.

Room for spring brood-rearing.—There should be no restriction whatever in the room for brood-rearing up to the time of putting on the supers, just previous to the honey-flow, for a crowded brood-nest at this time tends to diminish the number of workers available for the honey-flow as well as to encourage swarming.

If the space for brood-rearing should be restricted by too much early honey in the brood-chamber, some of the heaviest combs should be removed and empty ones given instead, or an extra brood-chamber containing empty combs may be given. In localities where considerable early honey is gathered the brood-chamber may be kept almost free of honey by placing an extracting super over each colony at the beginning of such a honey-flow. This super should not be removed until the comb-honey supers are given, for the honey they contain may be needed later in brood-rearing.

Should the brood-nest be restricted by a small brood-chamber, more room may be given either by removing some frames of brood from the stronger colonies, exchanging them for empty combs taken from colonies less strong, or adding another brood-chamber filled with empty combs. The former method has the following advantages: (1) After being built up to approximately the same strength, most of the colonies will be ready for a given manipulation at the same time, thus facilitating the work of the beekeeper. (2) It requires a smaller stock of extra brood-chambers and combs, at least previous to the honey-flow. (3) The brood is in a more compact form, which is a very desirable condition in comb-honey production. (4) When properly done, the total number of young bees reared in a given time is probably considerably greater, owing to the fact that none of the colonies is strong beyond the capacity of the queen, the workers of the entire apiary being so distributed that all the queens are utilized to the best possible advantage. (5) When the honey-flow begins the colonies are ready for the supers without additional labor, such as removing extra brood-chambers, sorting combs of brood, etc. In equalizing colonies combs of emerging brood with the adhering workers, *without the queen*, are usually drawn from the strongest colonies and given to colonies less strong, but *never to very*

weak colonies. The weakest colonies are left until the last, then built up quickly, provided there is time enough to have all the hives well filled with brood. If this is not possible the very weak colonies can more profitably be used for purposes other than comb-honey production. Another plan of equalizing is that of shaking bees from combs taken from strong colonies at the entrance of colonies less strong. The older bees at once take wing and return to their hives, while the younger bees enter the weaker colony. The operator must, of course, be sure that the queen is not on the comb thus shaken.

Some of the advantages of using a second brood-chamber, thus building up the colonies as individuals, are: (1) The labor required is considerably less, fewer visits being required, so that this method is particularly adapated to outapiary conditions. (2) It is possible to determine with much greater accuracy which colonies show the most desirable traits for breeding purposes. (3) It can be more safely practiced if brood diseases are imminent.

THE CRITICAL PERIOD IN SPRING BROOD-REARING.

With the single short major honey-flow, which is characteristic of most localities that are suitable for comb-honey production, the entire honey-crop may be gathered and stored by the workers that are reared within a period of six or eight weeks. Except when the honey-flow is of considerable duration, the eggs that produce the workers that gather the crop are laid before the honey-flow begins, since those that develop from eggs laid later are not ready for work until after the close of the honey-flow. On the other hand, the workers that emerge six weeks or more previous to the beginning of the honey-flow will have died of old age or are too old to be of much value during the honey-flow.

This limits the time of the production of the bees that actually gather and store the honey-crop to a certain definite period, which puts an importance upon brood-rearing during this time far above that of any other period during the year. All the other bees that are reared during the entire year may be considered by the beekeeper as useful only inasmuch as their labors contribute to the rearing of an enormous quantity of brood within this critical period of brood-rearing and to the maintenance of the normal strength and the existence of the colony during the remainder of the year.

Colonies that are not strong enough to care for a large amount of brood during this, the most important period of brood-rearing, must utilize the honey-flow to build up to maximum strength and are therefore unproductive this season.

Colonies that are strong enough for heavy brood-rearing at the beginning of this critical period are frequently rendered unproduc-

tive for the season by a cessation or restriction of brood-rearing during this period caused by insufficient stores or insufficient room. Such colonies begin the harvest with old, worn-out workers, and usually give poor results. This may explain to some extent the belief among beekeepers that colonies may become strong too early. It is therefore highly important (1) that each colony be in a normal condition at a period six or eight weeks previous to the honey-flow, and (2) that brood-rearing be at its maximum for the entire period of six or eight weeks during which the brood is reared to produce workers that will be available for the honey-flow.

To have colonies sufficiently strong in time for the critical period of brood-rearing involves the management of the previous late summer, autumn, winter, and early spring. To keep brood-rearing at its maximum during this period requires only the presence of favorable conditions which if not already present are easily supplied by the beekeeper during the short period when the workers that gather the honey-crop are reared.

An abundance of stores in excess of the immediate needs of the colony, **sufficient room** in the form of empty worker-combs for the heaviest possible brood-rearing, and **a good queen** are the most important factors to insure unrestricted brood-rearing during this, the most important period in the year's cycle of brood-rearing. It is not sufficient to have only enough stores to maintain the colony at this time, since, long before there is actual danger of starvation, brood-rearing is greatly reduced or even suspended, and some of the immature young are carried out of the hive. Any possible deficiency in either stores or room should be supplied promptly by the beekeeper in advance of the immediate needs of the colonies.

USING AVAILABLE WORKERS TO BEST ADVANTAGE DURING THE HONEY-FLOW.

Brood-rearing, which is of primary importance during the preceding period, becomes of secondary consideration at about the beginning of the honey-flow, because this is nearing the limit beyond which time the resulting bees develop too late to take part in gathering and storing the crop of honey.

At this time, therefore, there is a radical change in the purpose of the manipulations. Instead of continuing the expansion of the brood-chamber, the policy of the beekeeper should now be rather a concentration of the workers and brood. There is perhaps a limit to the number of workers that profitably can be kept in a single hive and set of supers, but this limit is seldom reached, the usual mistake being in having too few. Each colony should have its brood-chamber well filled with brood in a compact form and be so crowded

with young and vigorous workers that they will immediately occupy the supers when the honey-flow actually begins.

The brood-chamber of colonies occupying more than one hive body should at this time be reduced to one, any extra brood being used in colonies having less than one brood-chamber full of brood. After this operation, should there still be some colonies left with the brood-chamber but partly filled with brood, they should be filled with combs of brood and adhering bees (without the queen) drawn from some colony or colonies too weak to work well in comb-honey supers.

This massing of the workers in strong colonies, so essential to the production of a fancy grade of comb-honey, renders necessary extremely careful and skillful management, since the efforts of the beekeeper may still be nullified in either of two ways:

(1) The bees, by swarming, may divide their forces into two or more parts, neither of which would be ready to work in the supers until the season was much advanced or perhaps closed entirely, or (2) being defeated in their effort to swarm or from lack of convenient storage space, etc., they may do very poor work even during a good honey-flow simply because the conditions of the colony are such that the storing instinct is not dominant.

To bring about the best results in comb-honey, the entire working force of each colony must be kept undivided and the means employed in doing so must be such that the storing instinct remains dominant throughout any given honey-flow.

Any increase made before or during the honey-flow[1] is made at the expense of the surplus honey unless it be made with brood that would emerge too late for the young bees to be of use during the honey-flow (p. 24). In general, however, increase may be made at much less expense by setting aside some of the colonies for that purpose. To keep the forces together and satisfied, with the storing instinct dominant during a good honey-flow, is the most difficult problem with which the producer of comb-honey must deal.

SWARMING—PREVENTIVE AND REMEDIAL MEASURES.

Colonies do not all behave alike as to swarming. (1) Certain colonies go through the season with apparently no thought of swarming. Such colonies do the very best work in the supers, and their number can be increased by skillful management. (2) Other colonies start queen cells preparatory to swarming, but can be persuaded to give it up by such mild measures as destroying the queen cells and

[1] In localities where the main honey-flow is so late that colonies may be divided long enough before the honey-flow so that both colonies may be built up to proper strength in time to take advantage of it, of course increase previous to the flow would be advisable. This condition is rare in comb-honey localities.

perhaps removing a few frames of brood. (3) Certain colonies are determined to swarm and, unless the honey-flow ceases, nothing short of swarming or some radical manipulation will satisfy them. (4) A certain percentage of queens fail during the honey-flow, and swarming may occur in connection with the supersedure. Such colonies usually do very poor work in comb-honey supers.

The beekeeper can do much (1) toward increasing the percentage in the first group and discouraging those of the second—*preventive measures*—and (2) toward making the most of the colonies under the third and fourth groups—*remedial measures.*

Some effort has been made toward the final elimination of swarming by breeding from colonies showing the least disposition to swarm. Although after years of selection bees continue to swarm when conditions are favorable, many practical beekeepers testify to having greatly reduced the percentage of swarming colonies by years of careful selection and breeding. It certainly would seem advisable to replace the queens of all colonies which persist in swarming with young queens reared from colonies less inclined to swarm. The swarming problem has also been attacked from the standpoint of the hive and mechanical attachments.

More attention has, however, been paid to the prevention and control of swarming by manipulation than along either of the other lines, probably because proper manipulation gives immediate results and is now available as a means of preventing the losses due to swarming. The success in swarm control attained by the best beekeepers is a result of some effort along all three of the above lines at the same time.

Some of the important preventive measures are (1) the introduction of young queens (preferably reared from selected stock); (2) an abundance of empty comb in the brood-chamber at all times previous to the honey-flow; (3) prompt work in the supers at the beginning of the honey-flow induced by using "bait sections" or extracting combs in the first super given, thus tiding the colony over one of the critical periods; (4) a judicious manipulation of the supers during the honey-flow (p. 33); (5) the use of more nearly perfect worker-combs in the brood-chamber, since drone-comb and imperfect cells have the effect of contracting the brood-chamber, thus bringing about a crowded condition; (6) an abundance of ventilation during the honey-flow, obtained by means of a large entrance or by raising the hive above the bottom-board by means of small blocks; (7) protection of the hive from direct rays of the sun during the hottest portion of the day by some means such as a double cover or shade-board; (8) the removal of one or two frames of brood and the substitution therefor of empty combs or sheets of foundation; (9) the

destruction of all queen cells provided they contain only eggs or very small larvæ.[1]

After having taken all precautions to prevent swarming there will be some colonies that will attempt to swarm when producing comb-honey. During poor seasons of course the percentage may be quite low, but during good seasons the conditions are sometimes such that a majority of the colonies may make an effort to swarm. Swarming colonies, however, may be so managed that a division of the working force is prevented without subordinating the storing instinct. When this is done practically as much surplus honey is secured as from colonies that make no attempt to swarm. If but a single apiary is being operated and the beekeeper is present during the swarming season, the bees may be permitted to swarm naturally without loss to the beekeeper; but if several apiaries are being operated, it is more economical to employ some method by which swarming may be anticipated by visiting each apiary at given intervals during the swarming season instead of having an attendant at each.

TREATMENT OF NATURAL SWARMS.

Natural swarms may be managed (1) by allowing them to cluster naturally, then hiving them in the ordinary manner; (2) by the clipped queen method; (3) by the use of queen traps (fig. 8; see Farmers' Bulletin 447, p. 28); or (4) by use of the swarm catcher.[2]

To keep the forces together (1) the swarm without the queen may be returned to its hive, the queen cells destroyed a week later, and the colony afterwards requeened (p. 29); or (2) the combs of brood may be removed from the hive while the swarm is out, after which the swarm with the queen is returned. The former method is useful under some conditions, but the latter is the one usually preferred.

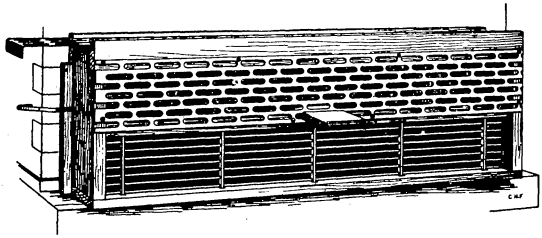

FIG. 8.—Drone and queen trap on hive entrance. (Phillips.)

When the swarm is hived back without the brood on its old location in this manner, the colony does not lose any of its field-bees and

[1] If queen cells are well advanced, their destruction usually has little or no effect as a swarm preventive measure. While destroying queen cells in their early stages can not be relied upon as a preventive of swarming, beekeepers who practice examining the brood-chambers once a week for queen cells during the swarming season are usually surprised at the number of colonies that can be induced to give up swarming and turn their attention to storing in this way. Such a result at least partly compensates for the large amount of labor required for these weekly examinations.

[2] This is simply a wire-cloth cage large enough to be set over the hive or be fitted over the entrance. If the attendant is provided with a number of these catchers he can avoid the usual confusion ordinarily occurring when several swarms issue at about the same time. After being caught in this manner the swarms may be hived at the convenience of the beekeeper.

is back at work with renewed energy in the same set of supers it was but a few minutes before so eagerly deserting. Instead of removing the combs from the brood-chamber the usual practice is to remove the entire brood-chamber and substitute another the external appearance of which is the same, then transfer the supers to it. This method of swarm management keeps the bees, queen, and supers together and is one of the most satisfactory known. It is not, however, adapted to outapiaries or any apiaries not having an attendant, and requires considerable time in watching for and hiving swarms.

FIG. 9.—Colony before swarming; supers in place.

USING THE REMOVED BROOD TO BEST ADVANTAGE.

The disposition of the brood that is left when a swarm issues should be such that (1) no "afterswarms" (swarms resulting from the emergence of a plurality of virgin queens) are permitted to issue, and (2) the emerging workers may be used to the best advantage.

"Afterswarming" may be prevented (1) by breaking up the parent colony before any of the young queens emerge, using the unemerged brood elsewhere, (2) by destroying all queen cells but one before any young queens emerge, or (3) by greatly reducing the population of the parent colony[1] just before the young queens emerge.

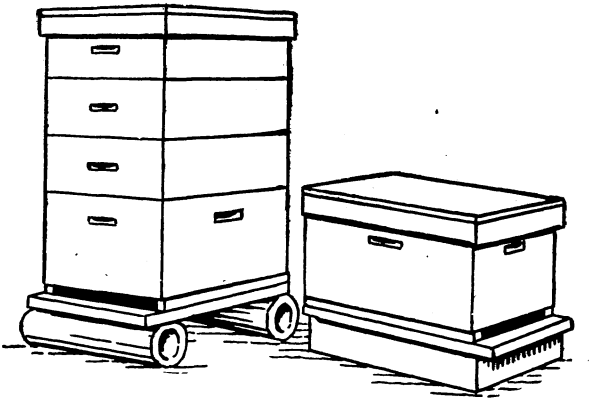

FIG. 10.—Hive of parent colony turned 90° from former position.

If swarming occurs at a time when the resulting young bees can take part in gathering and storing the crop of honey, the usual practice is to allow the brood to emerge in a separate hive and later to add the resulting young bees to the colony from which it was taken. Under such circumstances this reenforcement of the swarm is especially desirable, since otherwise its forces are constantly diminishing during the 21 days (the time required for worker-brood to develop) imme-

[1] The term "parent colony" is applied to the one in the hive from which the swarm has issued.

diately following the removal of all of its brood. The brood, however, may be used anywhere in the apiary and should be placed where the resulting bees will be most needed.

When hiving natural swarms on the old location as suggested above, the old brood-chamber is provided with a bottom and cover and set aside, usually with its entrance turned away about 90° from its former position (fig. 10). This is to prevent any field bees returning to the parent colony. A day or so later it is turned about 45° toward its former position (fig. 11), and as soon as the bees have this location of the entrance well marked the hive is placed parallel to the hive on the old stand (fig. 12). So far as the bees returning from the field are concerned, these two colonies are now on the stand.

One week after the swarm issues, or just before the parent colony would cast a second or "afterswarm," choosing a time when the bees are well at work in the fields, the parent colony is moved to a new location some distance away. This should be done carefully without jarring the hive in order that the bees shall continue going to the fields without noting the change of location. When properly done the bees from this hive return from the fields to the old location and enter the other hive, which now receives the entire field force of both colonies. This so depletes the parent colony just at the time the young queens are emerging that "afterswarming" is usually prevented.

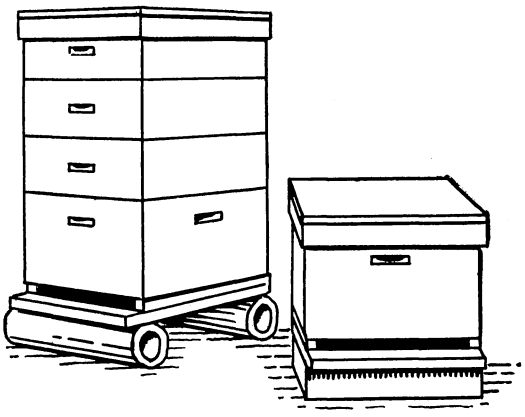

FIG. 11.—Hive of parent colony turned back to 45 degrees from former position.

Instead of moving the parent colony away, the bees may all be added to the swarm by shaking them from their combs, and the combs then distributed among nuclei previously prepared. By successive additions of frames of brood these nuclei are finally built up into full colonies and "afterswarming" is prevented.

If increase is not desired, the bees may be added to the swarm on the old stand as before, and after 10 or 15 days the combs of the parent colony still containing some unemerged brood may be used on which to hive another swarm. Before being used for this purpose the bees are of course shaken from these combs and added as before to the swarm on the old stand.

If the honey-flow is of long duration or conditions otherwise such that the storing colony may prepare to swarm again, the brood-

chamber of the parent colony may be left by the side of the swarm until the young queen begins to lay, then restored to its original position on the old stand and the supers transferred to it. The brood-chamber containing the old queen is moved to one side, its flying bees thus being induced to enter the hive containing the young queen. The two colonies may afterwards be united when the old queen has been killed. If, when using this plan, a virgin queen or a ripe queen cell is given the parent colony just after the swarm issues, this colony is ready to be restored to its original position on the old stand about a week earlier than if left to requeen itself.

WHAT TO USE IN THE BROOD-CHAMBER WHEN HIVING SWARMS.

(1) **Narrow strips of foundation,** 1 inch or less in width, are sometimes used in the frames of the brood-chamber when hiving swarms. When the brood-chamber contains only these narrow "starters" and the supers are transferred from the parent colony to the new swarm at the time of hiving, the incoming nectar must be taken to the supers, since there are no cells below in which to store it. Under these conditions, work in the brood-chamber goes on slowly, the work of the colony being chiefly in the supers. Colonies that construct a set of new combs in the brood-chamber and have sufficient room in the supers seldom attempt to swarm again the same season. The greatest objection to the use of these narrow strips of foundation is the excessive amount of drone-comb usually built when anything less than full sheets of foundation are used, especially if the queen is old or the brood-chamber large in proportion to the size of the swarm.

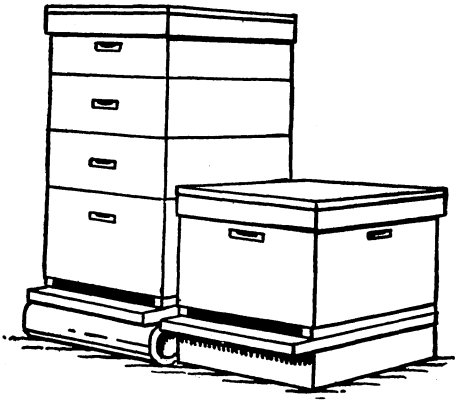

FIG. 12.—Hive of parent colony turned parallel to former position.

(2) **Full sheets of foundation** in the brood frames result in straight combs having the maximum number of cells of the worker size. They are more expensive than the narrow strips and allow a more rapid building of comb in the brood-chamber, which under some conditions is considered a disadvantage. The exclusive use of either narrow strips or full sheets of foundation in the brood-chamber when hiving swarms necessitates the use for a short time of a queen-excluder if the supers are transferred from the parent colony to the swarm at the time of hiving, since otherwise the queen would probably enter the sections and a brood-nest be established there.

(3) **Full sheets of foundation** and **one empty comb** may be used in the brood-chamber to avoid the use of a queen-excluder. This empty comb also serves as a storage place for pollen that may be gathered before the other combs of the brood-chamber are constructed. Otherwise this pollen may be stored in the sections. It is also probable that fewer colonies will "swarm out" or desert their hives when hived in a brood-chamber containing one or more empty combs than when foundation only is used. A disadvantage of this plan is that the cells in the upper portion of the comb may be so elongated as to interfere with the complete drawing out of the foundation in the adjacent frame. Empty combs can not well be used in connection with narrow strips of foundation, since their use favors the construction of drone-comb.

(4) **Empty combs in all the frames** are sometimes used with the idea of saving the bees the work of constructing a new set of combs. Under some conditions this is false economy and gives poorer results than starters or foundation. With very strong colonies, or with the brood-chamber contracted to five or six frames, empty combs in the brood-chamber may give good results. Medium colonies on a full set of empty combs are inclined to store the honey in the brood-chamber and neglect the supers.

(5) **Combs of honey** are sometimes used on which to hive swarms. In some instances the beekeeper uses frames of foundation or empty combs above the brood-chamber previous to and during the first few days of the honey-flow for the purpose of discouraging swarming and afterwards uses these partly filled combs on which to hive swarms. This honey is rapidly carried above, and stored in the sections, in order to make room for the queen.

(6) **Combs of brood** in which no eggs have been laid during the previous 10 days or 2 weeks may be used. Such combs are usually available toward the close of the swarming season from colonies that have swarmed 10 days or 2 weeks before. This plan is especially desirable when the beekeeper runs short of hives during the swarming season. In some localities, however, the character of the honey-flow is such that the colonies may later again prepare to swarm when hived on either empty combs, combs of honey, or combs of emerging brood.

EXTREME CONTRACTION OF THE BROOD-CHAMBER WHEN HIVING SWARMS.

Some beekeepers contract the brood-chamber, when hiving swarms, to five or six frames, the remaining space being filled by means of division-boards or "dummies." This reduction in the capacity of the brood-chamber results in practically all the honey being stored in the supers and also restricts brood-rearing at a time when the resulting bees develop too late to become gatherers. This is espe-

cially adaptable to locations furnishing an early honey-flow of white honey followed by a later one of darker honey. The white or more marketable honey is stored in the supers and later the brood-chamber is expanded and provisioned for winter with the less desirable honey. Some beekeepers accomplish a somewhat similar result by hiving two swarms together in a single hive body.

When practicing contraction it is best to give the full amount of room at the time of hiving the swarm and to reduce the space three or four days later, since otherwise the bees may "swarm out" because of their cramped quarters. Since contraction of the brood chamber is but a temporary expedient, it should not be continued beyond the time that its use is of advantage. After such extreme contraction the resulting colonies may well be united with the parent colony for winter after killing the old queen.

TREATMENT TO ANTICIPATE SWARMING.

Swarming may be anticipated and the actual issuing of the swarm prevented by various methods. The fact that bees usually indicate their intention to swarm about a week in advance, by the construction of queen cells, enables the beekeeper to control swarming by examining each colony once a week during the swarming period and forestalling the colonies that are making preparations to swarm. If he does this the beekeeper may operate a series of apiaries by visiting each at certain intervals, thus eliminating the necessity of an attendant in each apiary during the swarming season.

The prevention of a division of the population of the colonies at this time is so opposed to the usual behavior of the bees that any interference to this end on the part of the beekeeper may result in a subordination of the storing instinct, and the colony may refuse to work well even during a good honey-flow. It is necessary, therefore, for best results, that the operation to prevent a division of the working force of the colony be in harmony with the instincts of the bees. The conditions created by the beekeeper for this purpose, therefore, may well be expected to simulate to some extent the conditions present in natural swarming.

There are two well recognized sets of conditions under which colonies preparing to swarm may be expected to be satisfied without dividing their forces and without a further attempt to swarm during a considerable period, usually during the remainder of the honey-flow. These are (1) conditions similar to those present in a swarm that has been hived in an empty hive and compelled to build a set of new brood-combs and (2) conditions similar to those present either in the parent colony after a young queen is established as the new mother of the colony, or in the colony that has just superseded its queen after an interval of queenlessness.

Beekeepers have learned to depart considerably from these two sets of conditions without provoking further attempts to swarm provided the honey-flow is short in duration. For instance, empty combs or even combs containing none but emerging brood may be used successfully in the brood-chamber when hiving swarms (p. 26) and the emerging bees from the parent colony may be added to the swarm (pp. 23–24) if the honey-flow is short in duration, but if the honey-flow is prolonged such colonies may again prepare to swarm. Also when creating conditions comparable to the parent colony or the colony that has just superseded its queen, the same queen may be returned to her colony after a period of 10 or 15 days of queenlessness instead of permitting but one young queen to emerge and waiting for her to mate and begin to lay as is the case under more nearly natural conditions. Any great departure, however, from the conditions naturally present in these cases may result in further preparation to swarm, if the honey-flow is of considerable duration.

All successful remedial measures for swarming, whether applied after the colony has acquired the "swarming fever" or applied to all colonies alike previous to the swarming season, have one factor in common—**a temporary disturbance in the continuity of the emergence of young bees.** The methods employed fall under three general headings: (1) Removing the queen from the hive. (2) Removing the brood from the hive. (3) Separating the queen and brood within the hive.

The following methods are given for the purpose of illustrating the various types of remedial measures. It is not to be understood that all the methods given are equally adaptable to any locality or season, but it is hoped that, presented in this way, the beekeeper may more readily see the principle underlying each plan as well as the basic principle underlying all the plans and thereby be better enabled to elaborate a system of control to meet his particular requirements.

REMOVING THE QUEEN.

The temporary removal of the queen from the colony for from 10 to 15 days and the return of the same queen is a method which has been used in swarm control. Of course, no queen cells should be permitted to develop in the meantime. Such colonies may prepare to swarm again, especially if the period of queenlessness is not more than 10 days. The method is a valuable one, however, and may be used at any time during the season on colonies making preparations to swarm. If a young queen just beginning to lay is given to the colony after the proper interval instead of the old queen being returned, there is less danger of further preparation to swarm. The following are illustrative of the various adaptations of requeening in connection with a period of no brood-rearing.

(1) Just previous to the honey-flow and at about the time that heavy brood-rearing is no longer desirable, remove the queen from each colony. (*a*) Eight or ten days later destroy all queen cells but one and allow the colony to requeen itself, or (*b*) destroy *all* queen cells 8 or 10 days after removing the queen, then after 3 to 6 days supply each colony with a "ripe" queen cell (one in which the queen is ready to emerge), a virgin queen, or a young laying queen. It is usually desirable that the interval of queenlessness be as short as possible without defeating its purpose. Some beekeepers give a young laying queen 10 days after removing the old one, or a virgin queen or a ripe queen cell considerably earlier, sometimes even at the time the old queen is removed, while others prefer a period of at least 14 days before giving either a laying or a virgin queen. However, colonies with virgin queens sometimes swarm even though no other queen cells or larvæ from which to rear a queen are present. Another objection to the use of queen cells or virgin queens for this purpose is that some of the queens fail to emerge and some virgin queens fail to mate, thus leaving the colony hopelessly queenless. For these reasons, some prefer to have the young queens mate and begin to lay in "nuclei" (very small colonies) before introducing[1] them in the strong colonies. This method may be used for the entire apiary at the beginning of the honey-flow or it may be applied only to those colonies making preparations to swarm.

(2) Use two hive bodies as a brood chamber before the honey-flow, uniting if necessary to secure strong colonies. At the beginning of the honey-flow divide each colony, leaving the field-bees and most of the brood on the old stand in one hive body, placing the queen, remaining brood, and enough bees to care for it in the other hive body, which is set beside the first. The supers are of course given to the queenless colony on the old stand, which after the proper interval of queenlessness is allowed to requeen itself or is requeened by the beekeeper as in (1) above. The colony containing the old queen may then be moved to a new location for increase.

(3) Ten days before the honey-flow is expected to begin, put most of the brood into a single hive body, on this a queen-excluder, and over this a second hive body with a frame of brood and the queen, the other combs of this set being empty except perhaps for a little brood and honey. Nine or ten days later remove the upper story, supply it with a bottom-board and cover, and place it close beside the original hive. Destroy queen cells if any are present in the queenless portion which remains on the old stand, give a ripe queen cell, virgin queen, or a young laying queen, and put on the supers. The brood-chamber containing the old queen may later be removed for increase and its flying bees thus united with the storing colony (p. 24).

[1] These young laying queens may be introduced into the colony by the ordinary caging method (Farmers' Bulletin No. 447, p. 42).

By any of these methods there is a break of 10 to 15 days in the continuity of brood emergence in the brood chamber left on the old stand and the colonies are requeened with young queens—each a strong factor in swarm control and which, when combined, should with rare exceptions result in no swarming the same season. Requeening each colony with a young queen early in the season may greatly reduce the percentage of colonies that attempt to swarm but can not be relied upon as a method of complete control, since during a good and prolonged honey-flow quite a number of such colonies prepare to swarm. If each colony is requeened with a young queen at the beginning of the honey-flow, *after having been queenless for 10 or 15 days*, there will probably be very little if any swarming during an ordinary season. This method is not in general use among beekeepers, largely because of the difficulty in so timing the operation that there will be no loss.

REMOVING THE BROOD.

Since removing the brood brings about conditions quite similar to those of natural swarming, such a management of the colonies is practically identical with that of natural swarming. The use of the brood that is removed (p. 23), the question of what should be used in the brood-chamber instead of the removed brood (p. 25), the contraction of the brood-chamber (p. 26), etc., have been discussed under natural swarming and need not be repeated here. While some of the plans using this principle may be applied to all the colonies in the apiary before swarming actually begins, the usual practice is to apply them only to colonies that are making preparations to swarm. It should not be used on weak colonies, on colonies having a small percentage of sealed and emerging brood and few young bees, on colonies in which the queen is failing, or on any colonies during a very poor season. Under any of these conditions it is usually better to discourage swarming by destroying queencells (p. 22), or by removing one or two frames of brood, and if some remedial measure is finally necessary such colonies may be requeened after an interval of queenlessness. On the other hand, for strong colonies having a high percentage of sealed and emerging brood and a good queen the method usually gives excellent results, since by its use the workers, queen, and supers are kept together during the honey-flow. The following are some of the various plans employing this principle of swarm control:

(1) Find the queen and put the comb on which she is found to one side, then shake the bees from most of the other combs into or in front of their hive. As the combs of brood are removed put frames containing either narrow strips of foundation, full sheets of foundation, or combs into the hive and replace the supers. If narrow strips of foundation are used it is necessary to place a queen-

excluding honey board between the brood-chamber and supers until the brood nest is well established. When most of the shaken bees are in the hive, place the queen among them. Put all the combs of brood and the few bees remaining thereon into another hive placed close beside the shaken colony (fig. 12, p. 25). Enough bees should be left on the combs to care for the brood; usually two combs are not shaken at all, but placed in the other hive with all the adhering bees. For further disposition of the combs of brood see page 23.

(2) Shake and brush *all* the bees from the combs to be sure that the queen is among them. Place the brood in a hive body over a queen-excluder on top of the forced swarm or on some colony not being used for comb-honey production that can spare enough bees to care for it. In a short time bees will pass through the excluder and cover the brood, after which the hive body containing it is removed, supplied with a cover and bottom-board, and placed at one side of the forced swarm so that the emerging bees may later be added to the swarm. Or after the shaking is complete, remove the forced swarm and put the hive body containing the brood temporarily back on the original stand to induce field-bees to enter it. Then in the evening set it aside and restore the swarm to its position on the old stand. These field-bees will be able to prevent the brood being chilled during the night, but in returning from the fields the next day will enter the hive on the old stand. In the meantime enough young bees will have emerged to care for the brood.

(3) Remove about one-half of the combs of brood, first being sure that the queen is not on any of them, and put frames of foundation in their place. Put the removed brood into an empty hive placed beside the colony (fig. 12, p. 25). After three or four days remove the remaining combs of brood, shake the bees back into the hive, and add this brood to that previously removed. When the brood is removed in this way in two installments, the bees are not inclined to swarm out as they sometimes do when all the brood is removed at one time.

(4) Use two hive bodies as a brood-chamber throughout the year except during the honey-flow. Have both as well filled with brood as possible previous to the honey-flow. About 10 days before the honey-flow is expected to begin, insert a queen-excluding honey-board between the two hive bodies. The queen is now confined to a single one of the hive bodies. After 10 days transfer the queen[1] to the other hive body placed on the old stand and put on the supers. Re-

[1] It is not necessary to find the queen, since the presence of unsealed brood indicates in which hive body she is confined. She may be transferred to the other hive body by shaking all the bees from the combs she is known to occupy in with the bees of the other hive body. In this case some bees are permitted to return to the shaken combs through a queen-excluder before this brood is set aside, to prevent its being chilled.

move the hive body in which the queen has been confined to one side of the colony on the old stand and supply it with a ripe queen cell (in a protector) or a virgin queen. When the young queen begins to lay, exchange places with the two hive bodies so that the one containing the young queen now becomes the storing colony, giving it the supers and field-bees. Move the hive containing the old queen to the other side of the colony on the old stand, so that the entire flying force of both are at work in the hive with the supers. At the close of the honey-flow the old queen may be killed and the two divisions reunited. The period of 10 days during which no eggs are laid in the hive body used by the storing colony at the beginning of the honey-flow should delay swarming at least until the young queen begins to lay. When the other hive body with the young queen is substituted, it has had a similar period of no egg laying in addition to having a young laying queen, each of which is a strong factor against further preparations to swarm.

Mechanical devices.—A number of mechanical devices have been described for shifting bees from one brood-chamber to another. These permit the bees to leave the hive when going to the fields and are so arranged that the returning bees are led to enter the new brood-chamber. This is accomplished by means of switches in the bottom-board or by a tube so attached that the entrance to the old brood-chamber is closed, allowing exit only through the tube which opens near the entrance of the new brood-chamber. The hives are so arranged that the bees returning from the field readily enter the new brood-chamber. The queen is found and together with a comb of brood and adhering bees is put into the new brood-chamber, and the supers are transferred from the old to the new brood-chamber. The young bees as they learn to fly are added to the swarm by the same device.

SEPARATING THE QUEEN AND BROOD WITHIN THE HIVE.

In some swarm-control methods neither the queen nor the brood is removed from the hive, but these are temporarily separated within the hive. These methods are ordinarily used only on colonies making preparations to swarm and are practically equivalent to the dequeening plan. The following methods make use of this principle of swarm control:

(1) Cage the queen and place the cage within the hive in the space either above or below the brood frames. Destroy all queen cells when the queen is caged and again nine days later. Liberate the queen 10 to 15 days after the time she was caged.

(2) Shake the bees into their own brood-chamber from all the brood-combs except the one which contains the least amount of brood, leaving the remaining space vacant. If the combs are shaken or brushed clean of bees the queen is now in the nearly vacant brood

chamber. Put on a queen-excluding honey-board and over this an extra hive body containing the removed brood. Fill the space left vacant in the upper hive body by means of a division board or a frame of brood or honey from some other colony and replace the supers above the brood. Destroy all queen cells at this time and again nine days later, when the brood and queen are put back into a single hive body as before.

With any of these methods the colony may rapidly restore former conditions, and may later again prepare to swarm, making a second treatment necessary. Generally speaking, when the honey-flow is short, less radical measures are required. Colonies that have been supplied with young queens after a period of queenlessness have one factor (the queen) changed with at least some degree of permanency. Colonies that have been compelled to construct a new set of brood-combs from narrow strips of foundation have the most radical change of conditions as to brood-rearing. Either of these changes alone is usually sufficient to insure no further preparations to swarm.

MANIPULATION OF THE SUPERS.

Proper manipulation of the comb-honey supers is not only a strong factor in the prevention of swarming but is also a stimulus to storing. The amount of room the colonies should have in the surplus apartment varies so much that the ordinary standard super is simply a unit in a large and flexible surplus apartment. If enough surplus room is given at the beginning of the season for the storage of the entire crop of honey, the space so given is too great for best results at the beginning of the honey-flow, and little of it is needed if the season is poor. If, on the other hand, a single super is given and no other added until the first is completed, the room in the surplus apartment decreases from the time the super is given until the combs are completely drawn out, when there is little space left between the combs, the bees being practically crowded out. Thus while the population of the colony is increasing their room is being diminished—a condition highly conducive to swarming and less energetic work. After the super is filled, it is some time before the honey is ripened and sealed, ready to be removed. During this interval, if no other supers are given, there is no place for storage of the incoming nectar, and the comb builders must remain idle or waste their wax in building burr-combs and brace-combs. To avoid loss in this way, empty supers are added as they are needed, and the comb builders move from one super to another as their work in each is completed. The surplus apartment, whether consisting of a single super or several supers, should at all times contain some space for the comb builders.

If the honey-flow is heavy and promises to continue, it is desirable not only to furnish sufficient room but to induce the bees to begin

work in as many sections as possible, giving large comb surface for the storage and evaporation of the thin nectar, thus in a measure approximating conditions in extracted honey production. There is a danger, however, that if the bees are induced to extend their work through too many supers, the sections when completed will be less well filled and therefore lighter in weight. Also, if the honey-flow should not continue as expected a rapid expansion of the surplus apartment results in a large number of unfinished sections.

The rapidity of the expansion of work in the supers may to some extent be regulated by the position of each newly added super. If a rapid expansion is desirable, the empty super is placed below the supers already on the hive, while if it seems best to crowd the bees somewhat the empty super is placed above those already on the hive. When the empty super is placed above the partly finished ones, the bees do not begin work therein unless they need the room.

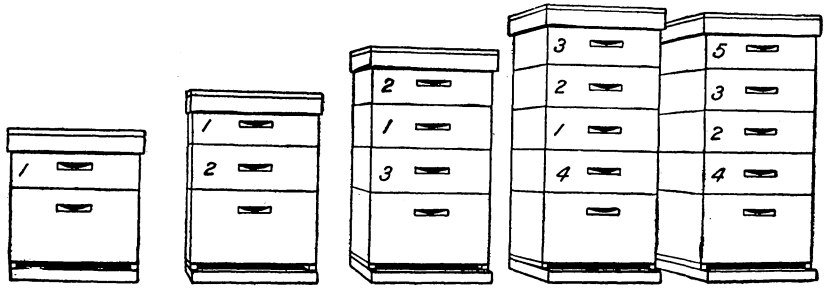

FIG. 13.—Arrangement of supers.

This practice is always advisable during a slow honey-flow or toward the close of any honey-flow, but when nectar is coming in rapidly it does not result in a rapid expansion of comb building sufficient to avoid a more or less crowded condition, which in turn causes a loss of honey and increases the probability of swarming.

When the empty supers are placed under the partly filled ones, work in them is commenced promptly, but this may be at the expense of the nearly completed sections, which by this plan are moved farther from the brood-chamber as each empty super is added. In the case of the super in which the honey is being sealed this distance is an advantage in so far as the whiteness of the cappings is concerned, but it may retard the completion of the work. An arrangement of the supers that to some extent avoids this objection is as follows:

Except toward the close of the season, place each newly added super next to the brood-chamber and keep the one nearest completion just above it with all others arranged above these two, the one in which least progress has been made being on top (fig. 13). Thus super No.

1 is raised up and No. 2 placed beneath it. When No. 3 is given, it is placed next to the brood-chamber, while above it is No. 1 with No. 2 on top. If No. 4 is given, it is placed next to the brood-chamber with Nos. 1, 2, and 3 in order above it. By this arrangement, if conditions justify doing so, strong colonies may be induced to expand their surplus apartment with great rapidity, since as soon as the foundation is well drawn in each newly added super it may be transposed to the top and an empty one put in its place. Such rapid expansion of work in the supers should not be attempted, however, except during a heavy honey-flow.

If early in the honey-flow the bees are storing rapidly, strong colonies should be given a second super as soon as work has been fairly begun in the first. Colonies of medium strength may of course be allowed to do considerable work in the first super before the second is given, while a weak colony may have sufficient room for comb building until the first super is almost completed. The first super should contain some empty comb when given to the colony, and each succeeding super should be given in advance of the time when the bees would be in any way crowded without it. At no time should all the sections be removed and new supers containing only foundation be given, but the surplus apartment should contain sections in all the various stages of development. In this way there is no break in the work in the supers, and the critical periods, so far as the super room bears upon the problems of swarming and energetic work, are largely eliminated.

During the latter part of the honey-flow the reasons for further expansion of the surplus apartment in excess of the immediate needs of the colonies (p. 33) no longer exist. At the beginning of a good honey-flow the beekeeper desires the maximum of new work consistent with well-filled sections, while toward the close of the honey-flow he desires the minimum of new work consistent with sufficient room. The precise period when further expansion of the surplus apartment is no longer desirable and a concentration of the work already begun should take place is sometimes difficult to determine, and to do so requires a thorough knowledge of the locality as well as good judgment on the part of the beekeeper.

It is usually desirable to remove the honey as soon after it is finished as can well be done. If it is left on the hives too long after it is finished, it may be discolored or "travel stained," while if it is taken off too soon some of the sections are not completed. It is desirable that the honey be removed by entire supers instead of by individual sections, therefore conditions should be made as favorable as possible for the completion of all the sections in a super without the more advanced ones becoming "travel stained." The bees are more inclined to stain the white surface of the combs toward the

close of the honey-flow or during a slow honey-flow. Trouble from this source is at such times intensified because of the uneven progress of work in the different sections, the more advanced sections therefore being sealed some time before the super is sufficiently advanced to justify its removal. Another form of discoloration is brought about by the honey being sealed in close proximity to old and dark brood-combs, in which case some of the darker wax from the old combs is sometimes apparently used for capping the honey.

During a good honey-flow all except the last supers may be left upon the hives until all or nearly all of the sections of honey are sealed, since (1) there is little trouble from "travel stain" when work is progressing rapidly, (2) all the sections in the super are ready to be sealed at about the same time, and (3) when there are several supers on each hive the one in which the honey is being sealed is at least one super removed from the brood-combs.

Toward the close of the honey-flow all supers having most of their sections finished should be removed and the sections sorted. The unfinished sections should be graded according to the degree of completion, and the various grades placed in supers and given to the colonies that are most likely to finish them. Every effort should be made at this time to contract the surplus apartment, concentrating the work upon the sections nearest completion. All supers in which work has not yet been started should be removed and as soon as possible the surplus apartment of each colony should be reduced to one super. Though little room is necessary during the close of the honey-flow, there should always be some room for the storage of new nectar until it is ripened. For such conditions extracting combs are valuable, since, instead of giving the last comb-honey super in which little work would be done, a set of extracting combs may be placed over the sections to afford room for the incoming nectar and comb surface for its ripening.

CARING FOR THE CROP.

REMOVING THE HONEY FROM THE HIVES.

If the honey-flow is of considerable duration the major portion of the crop is removed before the honey-flow ceases. At this time the removal of the finished supers is comparatively easy because the bees can readily be driven from them and also because the operator is not hindered in his work by robbing bees. At the close of the honey-flow all the supers remaining upon the hives should be removed promptly, since to leave them on would result not only in some of the honey being carried down into the brood-chamber but also in badly propolized sections. After the honey-flow has ceased, great care should be exercised to keep bees from robbing. The use of bee escapes (fig. 7, p. 11) greatly facilitates the removal of the honey at

any time, but their use is especially desirable in removing the honey remaining on the hives at the close of the honey-flow. By their use the honey may be removed and stored in the honey-house with little disturbance or excitement among the bees. The supers of honey should of course be taken directly to the honey-house or kept well covered[1] from robbers.

Before finally storing the supers of honey in the honey room those that are but partly filled may have their sections removed and sorted. The unfinished sections that can not be disposed of at a profit locally are usually put back into supers and the honey they contain is fed to the bees. This feeding is done simply by exposing the supers where the flying bees can have access to them. If there are few supers compared with the number of colonies they should be placed in piles and only a small entrance allowed, since if free access were given to a large number of bees they would tear the combs to pieces. When the bees have finished removing the honey from these unfinished sections the latter may be stored for future use as "bait" sections.

CARE OF COMB-HONEY.

In the honey room the supers of honey may be placed in piles in such a manner as to allow a free circulation of air between them. This may be done by "sticking them up" as lumber is piled to dry or by placing alternate supers crosswise, but the honey should not be exposed to the air in this way for long or much of its aroma will be lost. The air in the honey room should be kept as dry as possible. This is usually accomplished by means of a high temperature, the honey room being located on the sunny side of the building or directly under the roof. The windows should be opened only during dry weather. Ventilation of the honey room is of no value except when the air that is admitted contains less moisture than that already present. Otherwise ventilation may be a positive detriment. If a protracted period of rainy or damp weather should occur while the honey is in this storage it may be necessary to use artificial heat to dry the air in the honey room. Any great variation in temperature should be avoided, since it may cause a condensation of moisture on the surface of the cappings which will be absorbed by the honey.

Some beekeepers find it necessary to fumigate comb-honey to prevent damage by the larvæ of the waxmoth. For this purpose fumes of sulphur or disulphid of carbon may be used. If disulphid of carbon is used, great care should be taken not to bring it near a flame, as it is highly inflammable.

[1] Honey from outapiaries should be loaded for transportation in such a manner that the bees can not get at it, then before the horse is hitched to the wagon the load of honey should be drawn by hand some distance from the apiary if the slope of the ground will permit doing so. If this is not possible the horse may be attached by means of a long rope and the load drawn to a safe distance before the horse is hitched to the wagon.

SCRAPING PROPOLIS FROM SECTIONS.

Before being packed for market the sections of honey should be removed from the supers and the wood scraped free of propolis. A convenient bench should be provided for this work, with a large shallow box or tray to catch the propolis as it is scraped from the sections. This work is usually done by hand, though a few producers have designed and are using machines for this purpose.

GRADING COMB-HONEY.

The importance of properly grading and packing comb-honey does not seem to be well understood by the average beekeeper. Some extensive buyers of comb-honey find it profitable to regrade and repack practically all the comb-honey they receive before sending it out to their trade. The producer of this honey of course bears this extra expense by receiving a lower price for his honey. The lack of uniformity of grading is to some extent a result of differences of opinion as to what should be the standard for the various grades. Grading rules have been of material aid toward greater uniformity, but various producers may use the same set of grading rules with very different results. It would be well if a single set of rules were in use, since honey from various localities may be sent to the same market. The following grading rules were adopted by the National Beekeepers' Association, February 13, 1913:

Sections of comb-honey are to be graded: First, as to finish; second, as to color of honey; and, third, as to weight. The sections of honey in any given case are to be so nearly alike in these three respects that any section shall be representative of the contents of the case.

I. Finish.

1. **Extra fancy.**—Sections to be evenly filled, comb firmly attached to the four sides, the sections to be free from propolis or other pronounced stain, comb and cappings white, and not more than six unsealed cells on either side.

2. **Fancy.**—Sections to be evenly filled, comb firmly attached to the four sides, the sections free from propolis or other pronounced stain, comb and cappings white, and not more than six unsealed cells on either side exclusive of the outside row.

3. **No. 1.**—Sections to be evenly filled, comb firmly attached to the four sides, the sections free from propolis or other pronounced stain, comb and cappings white to slightly off color, and not more than forty unsealed cells, exclusive of the outside row.

4. **No. 2.**—Comb not projecting beyond the box, attached to the sides not less than two-thirds of the way around, and not more than sixty unsealed cells, exclusive of the row adjacent to the box.

II. Color.

On the basis of color of the honey, comb-honey is to be classified as: First, white; second, light amber; third, amber; and fourth, dark.

III. WEIGHT.

1. **Heavy.**—No section designated as heavy to weigh less than fourteen ounces.
2. **Medium.**—No section designated as medium to weigh less than twelve ounces.
3. **Light.**—No section designated as light to weigh less than ten ounces.

In describing honey, three words or symbols are to be used, the first being descriptive of the finish, the second of color, and the third of weight. As for example: Fancy, white, heavy (F–W–H); No. 1, amber, medium (1–A–M), etc. In this way any of the possible combinations of finish, color, and weight can be briefly described.

CULL HONEY.

Cull honey shall consist of the following: Honey packed in soiled second-hand cases or that in badly stained or propolized sections; sections containing pollen, honeydew honey, honey showing signs of granulation, poorly ripened, sour or "weeping" honey; sections with comb projecting beyond the box or well attached to the box less than two-thirds the distance around its inner surface; sections with more than sixty unsealed cells, exclusive of the row adjacent to the box; leaking, injured, or patched-up sections; sections weighing less than ten ounces.

After scraping the propolis from the wood, each section of honey may be placed in a pile with others of its grade. Some put the sections directly into the shipping cases as fast as they are scraped, but better grading can be done if each grade is put in a separate pile and the final grading all done by one person. By thus having a large number of sections in each grade from which to select there is greater opportunity for making the sections of honey in each case more nearly uniform as to weight and the various shades of finish. Such uniformity is especially desirable from the standpoint of the retailer. Sections containing only a few cells of pollen should be placed in a lower grade or sold as culls, while those containing a considerable amount of pollen should not be marketed in the form of comb-honey.

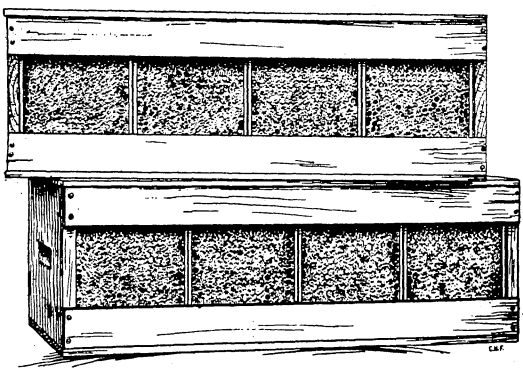

FIG. 14.—Shipping cases for comb-honey. (Phillips.)

PACKAGES FOR COMB-HONEY.

Comb-honey is usually packed in cases holding 24 sections (fig. 14). Other sizes are sometimes used to meet special market requirements. The markets have become accustomed to cases with glass fronts, by means of which the contents are displayed to advantage. However, in keeping with present practice in other package goods, considerable comb-honey is now placed on the market having each section inclosed in a carton.

MARKETING.

Many beekeepers are able to dispose of their entire output of honey in their local markets, sometimes creating quite a demand for their product by advertising. Comb-honey that is to be sent to a distant market should be shipped before cold weather, since the combs become extremely fragile when cold. Small lots should be crated in "carriers" holding several cases to prevent breakage by rough handling of individual cases, while in larger shipments the cases are simply packed in the car in such a manner that the individual cases can not be thrown about by the movement of the car.

The Bureau of Markets of this department has recently inaugurated a semimonthly Market News Service on honey. Beekeepers who desire information in regard to the wholesale honey market may receive this regularly on request.

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