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Productive Management of Honeybee Colonies in the Northern States

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SUMMARY

The basic requirements for productive colony management in beekeeping are large food reserves of pollen and honey at all times and ample room for these food reserves, brood rearing, and the storage of surplus honey. In the Northern States the equivalent of not less than two 10-frame hive bodies should be used to house the colony during the winter, and not less than 5 during the active season. Young productive queens from good stock are essential. The queen should be supported by a large population favorable to the time of the year.

The colony to be overwintered should have a gross weight of not less than 130 pounds and consist of a laying queen supported by 8 to 10 pounds of bees that emerged after August 20. The hive should contain not less than 40 pounds of honey in the upper body, with pollen and some empty cells in the center, and 20 to 30 pounds of honey and as much pollen as conditions permit in the lower body. A location giving maximum exposure to sunlight but protection from wind is desirable.

During the active season the object is to build maximum populations for the honey flow and maintain them throughout the season. The most populous colonies produce not only the most honey per colony but the most honey per bee. Brood rearing is the basis of colony development and the maintenance of maximum populations during the flow. It is dependent upon the queen's capacity to lay

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eggs, the supporting population's ability to maintain favorable temperature and feed the brood, reserves of pollen and honey, and space in the proper position for expansion of the brood nest.

Manipulations that maintain the most favorable organization of hive equipment for maximum brood rearing and honey storage will help to insure strong colonies and minimize swarming. The maintenance of a reserve of young productive queens in nuclei makes it possible to replace inferior queens promptly. The development of colonies inadequately provisioned with pollen can be increased by feeding pollen supplemented with 75 percent of soybean flour. Efficient management requires the proper timing of colony development so that maximum populations will coincide with the available nectar flows.

The beekeeper should be familiar with sources of pollen and nectar within his locality, their time of bloom, and relative importance. The selection of stock and equipment and the location and size of the apiary are individual problems subject only to the certain standards or principles discussed. An analysis of the economics of each beekeeping enterprise will prove helpful in developing efficiency in management. Increasing colony yields is the most effective means of lowering the cost of honey production.

INTRODUCTION

The trend in beekeeping practice during recent years has been toward the extensive operation of more hives of bees on an apiary basis, with less attention to individual colony management and performance. As a consequence most commercial apiaries are reporting average yields approximately one-third those obtained from their maximum-producing colonies. The most effective means of lowering the cost of production is through increased colony yields.

The behavior of bees is instinctive and constant, regardless of the geographical location. The main differences between the beekeeping problems of one locality and those of another are due to differences in pollen and nectar resources and their time and period of bloom. In the northern half of the United States commercial beekeeping is devoted largely to the production of extracted honey from white and alsike clover, yellow and white sweetclover, and alfalfa, all of which belong to the same family, Leguminosae. Changes in agricultural practice, together with the rapid spread of sweetclover, have tended to unify problems of commercial honey production throughout the region so that similar beekeeping practices can be applied.

Only a small portion of the nectar resources of this vast region are utilized, because a large number of colonies are not strong enough to produce a maximum crop. In a few favored areas having long honey flows commercial honey production is highly developed. However, in most areas that support a well-developed agriculture honey crops equal to those now produced in the best areas can be obtained under an intensive system of colony management. Likewise, the more highly developed beekeeping areas can return larger crops, as evidenced by the yields obtained from the best colonies. The nectar resources of any locality or season can be judged more correctly by the yields obtained from high-producing colonies than from average yields. The closeness to which the average yields approach the maximum indicates the degree of success a beekeeper attains through his management practice.

This circular provides information on principles and practices that will give the maximum returns for each colony. Management practices are confined to the production of extracted honey, although the principles apply equally to chunk-comb or comb-section honey production. Methods of handling the honey crop are not considered. No attempt is made to include all the well-known facts concerning bee life; neither are the advantages and disadvantages of the many specialized plans of management favored by individual beekeepers discussed. A vast beekeeping literature covers these subjects satisfactorily.

FUNDAMENTALS OF PRODUCTIVE BEEKEEPING

Certain fundamentals must be understood if a maximum honey crop is to be obtained under any system of management. Foremost of these is the influence of colony populations on honey yields. Colonies with maximum populations produce not only more honey per colony but also more honey per bee than smaller colonies. One full-strength colony containing 60,000 bees normally produces 50 percent more honey during a 2-week honey flow than 4 small colonies each with 15,000 bees.

Colony populations are balanced by the colony's capacity for brood rearing, the time required to develop brood, and the length of life of the adult bees. Good queens seldom lay more than 1,500 eggs per day. Twenty days are required for the brood to mature. Adult bees live from 4 to 6 weeks during the active season, and their longevity is influenced greatly by the intensity of brood rearing. Bees in a small colony that rear a proportionally large amount of brood have shorter lives than bees in a more populous colony. The amount of brood reared is influenced by the queen's egg-laying capacity, the colony population, the supply of both pollen and honey, and the available comb space and its position. While under favorable conditions the queen lays more eggs in a large colony, the ratio of the number of cells of sealed brood to the population decreases 10 to 14 percent for each increase of 10,000 bees. For example, a colony with 10,000 bees may have 8,500 cells of sealed brood or a ratio of 85 percent, while a colony with 40,000 bees may have 18,000 cells of sealed brood or a ratio of only 45 percent. These conditions limit the normal populations to a maximum of 50,000 to 60,000 bees.

The population of the small colony increases more rapidly because proportionally more bees engage in brood rearing, whereas the large colony produces more honey because a larger percentage of its bees are available for field work.

Sufficient time must be allowed for building maximum populations for any honey flow. From 5 to 6 weeks are usually required for strong overwintered colonies, consisting of 25,000 to 30,000 bees and 5 to 8 frames of brood, to reach maximum strength, whereas colonies developed from package bees require 10 to 12 weeks. Too often colonies are developed during the honey flow rather than for the flow.

Good honey flows are often not recognized, because colony populations are too small to show gains in surplus honey. Large colonies will produce a substantial crop when the main honey flow lasts 10 to 30 days, whereas colonies that are small at the beginning of the flow make good yields only when it extends over 2 to 3 months. A long flow is characteristic in some sweetclover districts. Because the smaller colonies rear proportionately more brood, they are able to make good yields later in the flow. However, colonies that are large at the beginning of the flow will maintain efficient honey production throughout the flow if they are headed by good queens and are properly managed. All colonies must be populous at the beginning of the flow if the beekeeper is to realize a maximum crop from either a short or a long flow.

The accepted commercial standard of 100 pounds of surplus honey per colony is not a desirable basis for judging the efficiency of any plan of management, for colonies that are of maximum producing strength throughout the flow may yield several times this amount. Only the best colonies should be used to judge the honey resources of any season or locality. Colonies that are maintained in two-story hives the year round, provided with 60 pounds of honey in the fall, and supered with three additional hive bodies for surplus during the honey flow will usually produce a crop of honey. However, management for maximum honey production requires a thorough understanding of fundamental practices and the colony's relation to the natural resources and other environmental factors.

PRINCIPAL HONEY PLANTS IN THE NORTHERN STATES

Sources of Surplus Honey

A location suitable for honey production must have one or more species of plants that yield plenty of nectar from which honey of good marketable quality is produced. It is hazardous, however, to depend entirely upon a single source of nectar, especially one having a short period of bloom. Weather conditions may prevent one source from yielding whereas other sources may produce a crop.

White and alsike clovers produce enormous quantities of nectar under favorable soil and weather conditions. These clovers normally secrete nectar for 2 to 6 weeks in June and July, but they suffer heavily during drought periods or from late-winter and early-spring ice storms. Frequent rains in June will prevent the bees from working the clovers during their peak of bloom. Regions that formerly produced principally clover honey are becoming more dependable for honey production with the wider use of sweetclover in agricultural practice. Alfalfa is replacing red clover to a considerable extent in many places, and during drought years, when the clovers are poor, it occasionally yields enough nectar to make a crop.

The different varieties of yellow and white sweetclover provide the longest period of bloom of any major honey plant. In some localities there is an almost continuous succession of bloom from June until frost. With such crops the hazards from inclement weather are therefore minimized. Most sweetclovers are biennial, blooming only in the second year. When once established, however, both first- and second-year plants are usually present at the same time. Yellow sweetclover comes into bloom first, and it is soon followed by the early varieties of white sweetclover, such as the Grundy County. The early varieties usually mature within 4 to 6 weeks, but about the time they are in full bloom the common white sweetclover begins and normally lasts throughout July and August or until killed by frost. Several varieties of annual white sweetclover are being used now, and they begin to bloom in August.

Sweetclovers are grown for soil improvement, pasture, and seed production. When used in agricultural programs, they spread rapidly to roadsides and waste areas. Sweetclover areas may change frequently with changes in agricultural practices and the varieties used, but in combination with white and alsike clovers, alfalfa, or both, the sweetclovers greatly increase the beekeeping resources of a locality. Many beekeepers have underestimated the value of the early sweetclovers, because their colonies have been too weak to show the substantial gains in honey usually obtained from the later varieties.

Honey crops from alfalfa are large under favorable conditions, but alfalfa is much less dependable than sweetclover. Alfalfa secretes nectar most freely in climates characteristic of the plains, especially at altitudes above 1,000 feet and when grown under irrigation. The practice of cutting alfalfa for hay during the early stages of bloom frequently prevents a full honey crop from being harvested. However, alfalfa is a major source of honey in some areas, and because it is grown in many separate fields cut at different times within intensively farmed areas, the nectar yield from a single cutting of alfalfa may cover a period of 1 to 3 weeks. Honey flows from alfalfa may be obtained from one to four cuttings, depending upon the environment and the length of the growing season. Alfalfa grown for seed may produce an excellent flow lasting 4 to 6 weeks.

Pollen and Nectar Sources for Building and Maintaining Colonies

Productive colonies require large quantities of pollen and honey to insure maximum populations during a major honey flow. Each colony requires 40 to 60 pounds of pollen and several hundred pounds of honey a year for rearing brood and feeding the adult population. Many plants contribute pollen and nectar before or after the major honey flow to meet these requirements. Early-spring sources of pollen are just as essential for colony development as nectar sources are for a honey flow. A continuity of bloom between plant species throughout the growing season is desirable.

The approximate blooming time for each of the more important pollen- and nectar-producing plants is shown in figure 1.[1] The beginning of plant development may vary from 1 to 5 weeks between the southern and northern limits of the plant's range, and as much as 3 weeks even within a single State. Moreover, a season may be 10 days to 2 weeks earlier or later than is normal for any locality. For early plants the time of bloom shows greater spread due to latitude or other regional differences than for later blooming plants. For example, maples may bloom 4 weeks earlier in northern Indiana than in northern Michigan, but white clover may begin blooming only 7 to 10 days earlier.

The value of any plant in honey production is determined by its time of bloom as well as by the quantity of pollen or nectar produced. Soft maple and willows might be unimportant if they bloomed after May 1, but, blooming just prior to dandelion and fruit bloom, which marks the start of the growing season, they are extremely valuable for

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[1] For a complete list of bee plants for each State see OERTEL, E. HONEY AND POLLEN PLANTS OF THE UNITED STATES. U. S. Dept. Agr. Cir. 554, 64 pp., illus. 1939.

advancing colony development. Unsettled weather may prevent the bees from working willows every day, but the relatively long blooming period sometimes enables them to collect enough pollen to meet the colony's brood-rearing requirements.

The first four plants shown in figure 1 are important primarily for pollen, but all of these sources, especially dandelion and fruit bloom, occasionally yield considerable nectar. The next six plants are major sources of surplus honey, although the sweetclovers also enable colonies to accumulate pollen reserves. Corn is strictly a source of pollen: 1 acre may yield 300 pounds, but the bees work it for only a short period each day and seldom accumulate reserve pollen. The last five plants are valuable for their pollen, and any one or several of them together may yield sufficient nectar for colonies to store their winter honey supply. A few plants that are important in some areas or seasons are omitted, and some plants, such as raspberry, basswood, buckwheat, heartsease, and Spanish-needles, are restricted to certain localities.

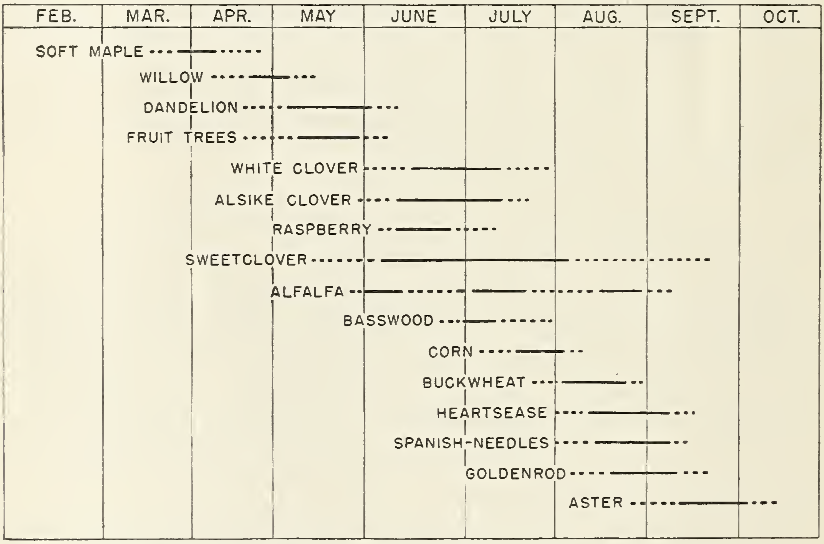

FIGURE 1.—Blooming periods for the more important plants yielding pollen and nectar in the Northern States. The solid lines indicate the normal blooming periods, and the broken lines show the extreme limits due to differences in season or locality.

If the beekeeper is to manage his colonies so that they will collect the maximum quantities of pollen and nectar, he must understand the effect of the various weather factors on the condition of the plants and on the activity of the bees. He can best obtain this knowledge by studying the official weather forecasts for his area in relation to the blooming dates and abundance of bee plants, the activity of his bees, and the colony gains, and by keeping records over a period of years. Maintaining a strong colony of bees on platform scales and recording the daily or weekly changes in weight will provide an index of the honey flows. A small or even an average scale colony will not provide a satisfactory honey-flow record, for the same reason that average yields are not so significant in judging beekeeping resources as maximum yields.

Ample reserves of pollen and honey make the colonies practically independent of early-spring sources of pollen and nectar. These sources do, however, help to maintain the food reserve, and apiaries should be located where they can take advantage of them. The locality may provide sources of food in the spring, but unfavorable weather too often prevents the bees from working the flowers.

NECTAR SECRETION AND THE HONEY FLOW

Beekeepers usually think of nectar secretion and the honey flow as synonymous; yet there is an important difference. A honey flow represents the relation between the colony and the available nectar supply. A honey flow that enables colonies to maintain their weight or to increase 1 to 3 pounds a day constitutes a light honey flow, colony gains of 5 to 10 pounds a day represent a good honey flow, and colony gains of 12 to 20 or more pounds a day a heavy honey flow.

A general understanding of the conditions affecting nectar secretion is necessary for effective colony management. Nectar secretion is determined by many factors pertaining to the plant in relation to its soil and climatic environment. The clovers, sweetclover, and alfalfa grow best in fertile limestone soil. Nectar secretion is heaviest when these plants show vigorous growth under favorable soil and moisture conditions, being intensified by a hot, dry atmosphere and abundant sunlight during the blooming period. Hot days followed by cool nights seem to be best. Therefore, nectar secretion is usually greatest in northern latitudes and at high altitudes. Severe droughts, plant diseases, or heavy insect infestations may shorten the honey flow, but they seldom are responsible for a complete crop failure where colonies are in good condition throughout the season.

LOCATION AND SIZE OF APIARIES

Apiaries should be located where there are ample acreages of major honey plants within 2 miles, and where natural vegetation is rich in pollen and secondary honey plants throughout the growing season. However, since a 2-mile radius includes more than 8,000 acres of land, there will be ample pasture for 50 colonies if only 1 percent of this area supports plants producing pollen and nectar. In some regions it is advantageous to choose a permanent site rich in pollen sources and then move the apiary for the main flow to a temporary location rich in major honey plants.

Apiaries should be placed in well-drained locations sheltered from prevailing winds. In many western areas artificial windbreaks are made by building slab fences or by interlacing brush into wire fences. Two windbreak fences 15 to 20 feet apart are more effective than a single fence. Apiaries should be far enough away from cultivated fields and homesteads so that bees will not prove hazardous to horses or a nuisance to people not concerned with their management, although, as far as possible, near enough to avoid being molested by pilferers. They should be fenced to exclude livestock. They must be accessible by truck under most weather conditions. Open areas within wood lots, which permit the colonies to be in full sunlight during most of the day, are preferred to shady locations. Sunlight stimulates the bees to fly earlier and later in the day during the summer and to take cleansing flights more frequently during the winter months. Trees and brush surrounding the yard will cause the bees to fly higher when leaving and returning to the apiary, and thus reduce the risk of their becoming a nuisance to activities on farms nearby. A source of water for the bees is essential; if no stream or pond is available, water should be provided in the yard.

Every effort should be made to avoid areas where American foulbrood is known to be prevalent. Commercial beekeepers will wisely not establish apiaries nearer than 4 miles to another commercial yard, not so much to avoid overstocking the territory as to reduce the danger of contracting American foulbrood or, more often, the fear of contracting the disease. This policy, of course, cannot apply to home apiaries maintained on neighboring farms. Individual beekeepers may find it advantageous to operate several apiaries separated by only 1 or 2 miles. Commercial operators should assist the beekeepers having a few colonies in their vicinity, both in the control of American foulbrood and in management problems.

Hives should be arranged in the yard for convenient manipulation. Provision for a truck to be driven close to them will reduce labor in carrying equipment, and a gate at each end of the yard will facilitate handling of the truck. Hives that face south, southeast, or east receive maximum stimulation from the early-morning sunshine, but for winter cleansing flights hives facing south have a distinct advantage.

The desirable number of colonies for an apiary yard is determined by several conditions. Small yards require more travel per colony, but they can be managed with less difficulty from robbing bees, and they permit closer control over outbreaks of disease. Small yards distribute the bees more uniformly over a given territory to take advantage of the natural pollen resources. There seems to be little danger, however, of overstocking any first-class beekeeping territory during the major honey flow. A few beekeepers have maintained 200 to 400 colonies in one yard successfully over a period of years.

It is generally good practice to establish apiaries of such a size that during most of the active season the work, including travel, can be handled on either a half-day or a full-day schedule. This means yards of 40 to 70 colonies for a half-day and 80 to 125 colonies for a full-day schedule, according to the size of the crew and the equipment used.

SELECTION OF PRODUCTIVE STOCK

Three principal races of honeybees are now in general use—Italian, Caucasian, and Carniolan—together with their hybrids. All three races apparently are adaptable to the climatic conditions found in the northern honey-producing regions. Most bees belong to the Italian race or are Italian hybrids. The Italians vary in color from dark, three-banded, leather-colored bees to the light-golden strains. The Caucasians and Carniolans are dominantly black with gray pubescence. The tendency for Caucasian bees to use propolis in excess is their most distinguishing characteristic. There are greater variations in production efficiency between strains of bees within these races than there are between the three races.

Stock should be selected for production efficiency regardless of race or color. Uniformity in color indicates uniformity in breeding. Good stock will be capable of producing colonies of maximum strength by the time the main honey flow begins and of maintaining maximum populations. Prolific queens producing large brood nests of good quality must be the first consideration in selecting stock. A prolific queen will require from 12 to 18 standard frames, depending upon the amount of honey and pollen in the hive.

Stock producing brood of even moderately poor quality should be discarded. The brood quality can be judged better from the unsealed larvae than from the sealed areas. Spotted brood is produced by poor queens, and is due either to low egg viability or to irregular egg laying. A good queen may have an inferior brood nest when the colony is deficient in either pollen or honey. Heavy collections of pollen and nectar may cause the bees to compete with the queen for empty cells within the brood nest. The brood will appear better when the queen is restricted to one brood chamber than when she can occupy the recommended double-brood-chamber hive. Figure 2 shows the extreme difference found in the quality of brood.

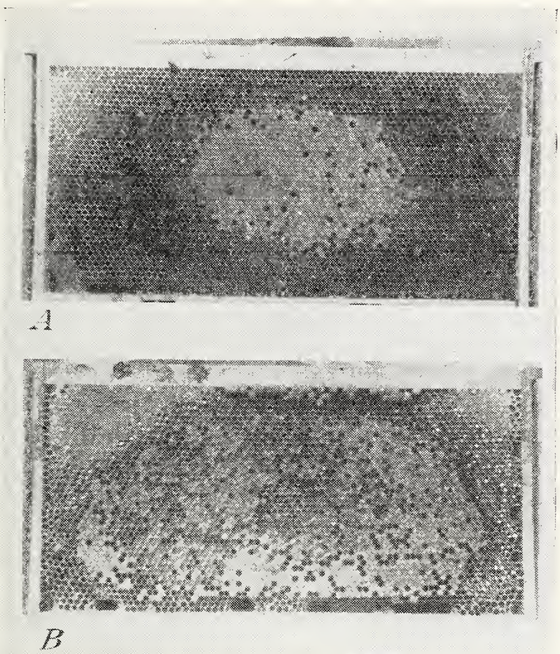

Figure 2.—Quality of brood from different stocks: *A*, Brood of good quality; *B*, brood of poor quality.

Bees that are vicious should be eliminated, for the tendency to sting bears no relation to production efficiency. Bees of any race or strain will sometimes sting, but cross bees slow up colony management and may prove a nuisance in a community. Good stock will respond to smoke and be reasonably quiet on the combs during manipulation.

Differences in the swarming tendencies of strains or races are not well established. Under extracted-honey production swarming is a minor problem, and is usually controlled by proper management. Differences in ability to winter also are minimized by proper management.

Other qualities that may sometimes characterize a superior bee include resistance to American foulbrood and other diseases, large body size and carrying capacity, longevity, minimum supersedure of queens, a tendency to fly at low temperatures, and a tendency to collect relatively large quantities of pollen. Any stock of the three races mentioned which is capable of building maximum populations usually will not be seriously troubled by European foulbrood under proper management.

Not all strains of bees are equally productive: yet no one strain can be recommended as the best. Beekeepers desiring new stock should obtain queens from several queen breeders. When a satisfactory line of stock is found, queens can be reared in the apiary, or breeding queens can be sent to a breeder in the South who is equipped to raise queens. Further selection will help to maintain or improve the stock over a period of years.

HIVE EQUIPMENT

The management practices described in this circular are based upon the use of the standard 10-frame Langstroth hive. Any size or style of hive equipment with flexibility for arrangement will enable the beekeeper to obtain maximum crops when enough units are provided to meet the colony's optimum space requirement.

The equivalent of five 10-frame standard hive bodies should be the minimum equipment for each producing colony. Two hive bodies, designated as brood chambers, should be used throughout the year, and three full-depth hive bodies should provide super room for surplus honey. Where honey flows are intense and the climate is moist, four supers will meet colony requirements better by providing more space for unripened honey. Beekeepers having some 10-frame shallow hive bodies can profitably place one of them under the two full-depth brood chambers for the storage of reserve pollen. Two and a half, or even three, hive bodies for year-round use can be employed in simplifying colony management.

For beekeepers who prefer smaller hive units, either nine or ten standard 10-frame shallow supers or seven or eight 11-frame Modified Dadant supers are recommended for use both as brood chambers and as supers. For this type of equipment four 10-frame of three 11-frame shallow supers should be used as brood chambers for year-round equipment.

An apiary in which first-class hive equipment is used is shown in figure 3. Good hive equipment simplifies some phases of management, but it is not so important as the colony in the hive.

Full sheets of comb foundation are necessary for the protection of good combs. Plain medium brood foundation should be supported by at least four horizontal wires well embedded, while wired foundation should be supported by two horizontal wires. Electrical devices that supply 3 to 6 volts to heat the wires are most satisfactory for embedding the frame wire into the foundation.

MANAGEMENT PRACTICES

The most productive colonies are those that have a good queen and ample pollen, honey, and hive space at all times. The beekeeper should use a year-round plan of management favorable to the colony, rather than a program of arbitrary seasonal management. Normal queenright colonies consume more pollen and honey than subnormal colonies, but they also gather more from minor sources to offset the greater consumption. Such colonies are stronger during surplus flows and yield maximum crops.

The established beekeeper should prepare for a crop about a year in advance of the honey flow. Reserve honey and pollen must be obtained to carry the colony through dearth periods, including the winter, when plant life is dormant. A colony to be overwintered must rear sufficient brood to provide a cluster of 8 to 10 pounds of young bees which emerge between August 20 and the early part of October. Because a colony must have a good queen after the first of August to accomplish this, August 1 has long been considered the beekeeper's "New Year."

FIGURE 3.—An ideal apiary, with uniform colonies in first-class hive equipment, well located with respect to wind protection, exposure to sunlight, and a source of water.

The theory that, because it takes 5 weeks for field bees to develop after the eggs are laid, reduced brood rearing or a queenless condition during a flow lasting 5 weeks will yield a larger crop is not supported by actual returns. The superior working morale of normal colonies enables them to store more surplus honey. There is a sharp drop in the amount of honey stored by colonies that have been queenless for more than 2 weeks. The resulting decline in population may prevent them from wintering properly or making productive gains from later flows.

Winter Requirements

Strong colonies headed by good queens and provided adequate stores of both honey and pollen are capable of surviving the severe northern winters in good condition. Protection from prevailing winds and a moderate amount of hive insulation are both beneficial in reducing the consumption of stores.

Winter losses are usually estimated from the number of colonies that fail to survive. These losses average 15 percent, and they sometimes reach 50 percent. Actual winter losses may be much greater, because the surviving colonies are below the optimum condition.

Whether a colony survives the winter in good condition is determined more by its make-up than by the kind or amount of protection. A good colony normally requires 60 or more pounds of well-ripened honey and the equivalent of 3 to 6 frames of pollen. The stores must be in the normal position and accessible to the cluster throughout the winter. A 2-story, 10-frame hive, or its equivalent, is necessary to provide room for this amount of food and clustering space for the bees. Normal 2-story colonies, together with their food supply, should have a gross weight of not less than 130 pounds.

The upper story should contain not less than 40 pounds of honey, preferably in dark brood comb. There should be 3 or 4 full combs of sealed honey on both sides of the hive. The remaining combs toward the center should contain approximately 10 pounds of honey, as much pollen as possible, and a small area of empty cells for the active center of the cluster. The lower hive body should have 20 to 30 pounds of honey, with the heaviest combs near the outside and combs of pollen in the middle.

The bees will occupy the upper story during the coldest part of the winter. The cluster will cover considerable honey, provided there is

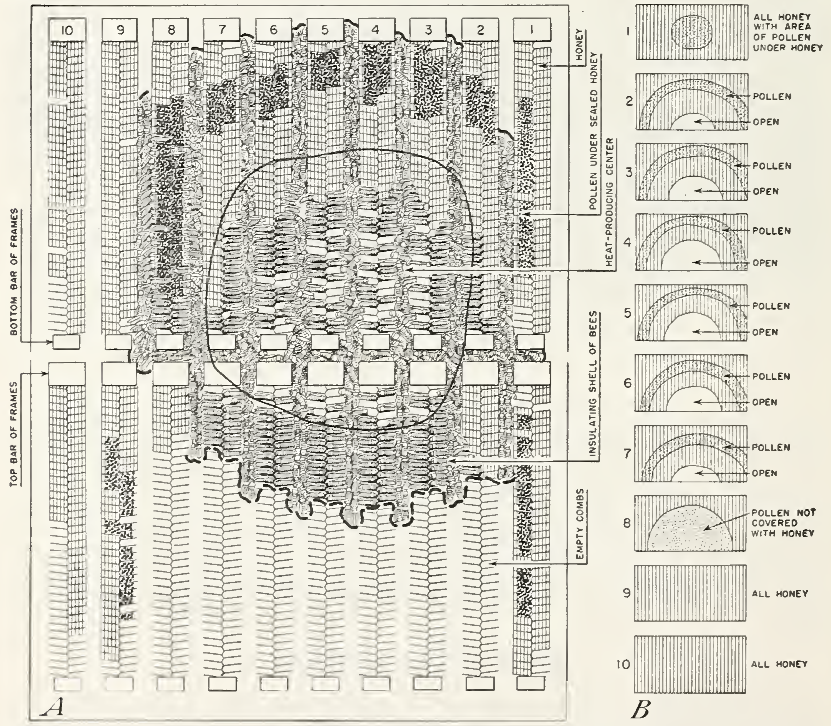

Figure 4.—*A*, Diagram of the winter cluster as seen through a vertical section of a two-story hive cut across the middle of the cluster. *B*, Face view of frames of upper hive body. The numbers indicate the position of the frames. Note how the bees concentrate between combs and in open cells to form a compact insulating shell around a much less compact heat-producing center. The band of pollen covered with honey indicates an accumulation of reserve pollen before the honey flow.

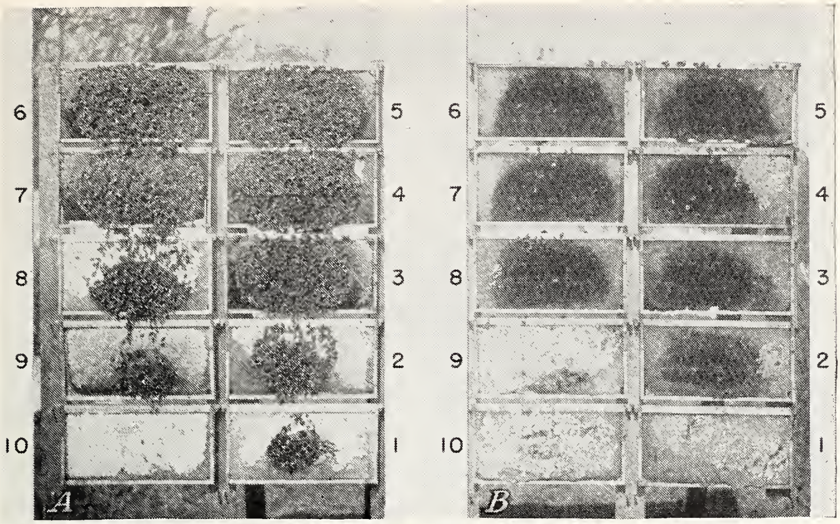

FIGURE 5.—Photograph of a winter cluster from a two-story hive with the frames spread out so that the bees are on the side of each comb facing the center of the hive: *A*, Upper hive body; *B*, lower hive body. The numbers indicate the position of the frames as shown in figure 4. The bees were killed with cyanide when the temperature was 6° F. Approximately one-third of the bees fell off when the frames were removed from the hive, especially those covering sealed honey in frames 1, 2, 8, and 9.

an open center 3 to 5 inches in diameter nearly free of honey. The bees will move honey to the upper combs when temperatures permit. The organization of the winter cluster in relation to its stores is illustrated in figures 4 and 5.

The lower entrance should be reduced to about ⅜ by 3 inches with an entrance cleat. An upper entrance in the form of a 1-inch auger hole just below the upper handhold is coming into general use. The lower entrance allows dead bees to be removed readily and thus keeps molding of combs at a minimum, while the upper hole serves as a flight entrance and an escape for moisture-laden air.

A location exposed to sunlight and sheltered from prevailing winds is the most economical protection that can be given colonies. For additional protection the hives may be wrapped with tar paper or slater's felt, or they may be packed with chaff, leaves, or shavings. The customary method of packing is illustrated in figure 6.

The cluster protects itself from external temperatures by forming an insulating shell of bees 1 to 3 inches deep to conserve the heat produced by the more active bees in the center of the cluster. It contracts as the air temperature falls, reducing the surface exposed to radiation and increasing the concentration of bees to produce heat energy. A temperature is maintained in the center sufficient to conduct heat to the surface bees so that their temperature will not fall below approximately 45° F., although the temperature in the hive a few inches outside the cluster may fall to zero or below. Hive insulation allows the cluster to contract more gradually when there is a sudden drop in the external temperature, and gives it more time to organize its position in relation to the stores, so that fewer bees are left stranded.

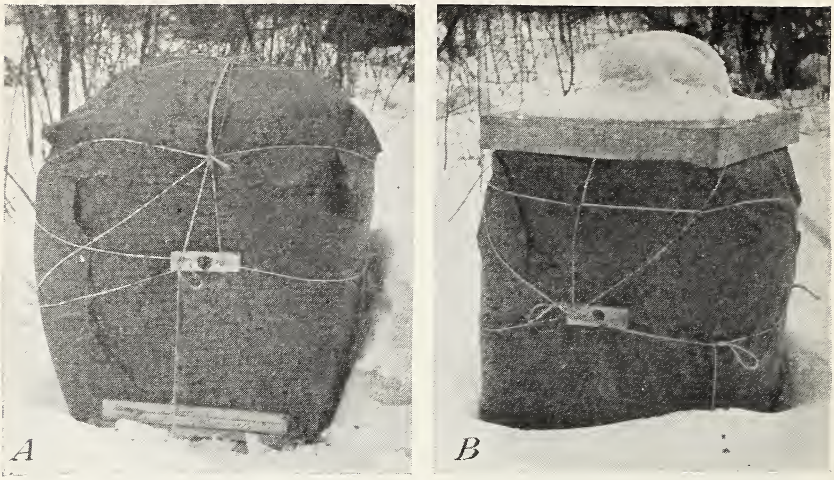

FIGURE 6.—Colonies prepared for winter with tar-paper hive packing: *A*, Hive packed with metal cover on the hive; *B*, hive packed with metal cover over the packing.

The cluster does not heat the unoccupied space in the hive. During a protracted cold period the temperature of this space will become almost as low in the packed as in the unpacked hive. Too much packing will prevent the colony from responding to warm periods during the day, which would allow the cluster to shift its position on the stores or even allow the bees cleansing flights.

The cluster itself must protect the colony against low temperatures, and the organization of the colony in relation to its food supply will determine whether or not it winters in good condition. Good colonies can be wintered successfully in uninsulated hives (fig. 7), although they may consume 5 to 10 pounds more honey than similar colonies that are packed. Colonies that have consumed less than 50 pounds of honey are seldom in optimum condition at the beginning of the active season. The question of whether to insulate the hives is therefore an economic problem involving packing costs balanced against saving in stores.

It is good beekeeping practice to take winter losses in the fall. Colonies that are not in condition for wintering should be united with good colonies or killed to prevent needless consumption of stores. The combs of honey and pollen can be used in starting new colonies with package bees the following spring.

Pollen Reserves and Supplements

The size and quality of the surviving populations in overwintered colonies are proportional to the amount of their pollen reserves if they entered the inactive season with normal populations, good queens, and adequate honey stores. Colonies provided with ample pollen begin rearing brood in January, and so replace their fall population with young bees by the time new pollen is available in the spring (fig. 8). This brood rearing prevents spring dwindling and often provides colonies strong enough to replace the stores consumed during the winter with nectar produced by willows, dandelions, and fruit bloom.

Colonies unable to rear brood for lack of pollen may not collect sufficient nectar to maintain their weight during these early honey flows, and they seldom reach maximum productive strength by the time the main flow begins.

To be available for brood rearing, winter pollen reserves must be within the cluster. Once they have stored pollen in the comb, the bees do not move it as they do honey.

Beekeepers are inclined to take for granted that their pollen reserves are ample, when as a matter of fact colonies deficient in these reserves are found throughout most of the honey-producing regions. The winter pollen reserve is the one important factor over which the beekeeper has little control. He can replace poor queens, by good man-

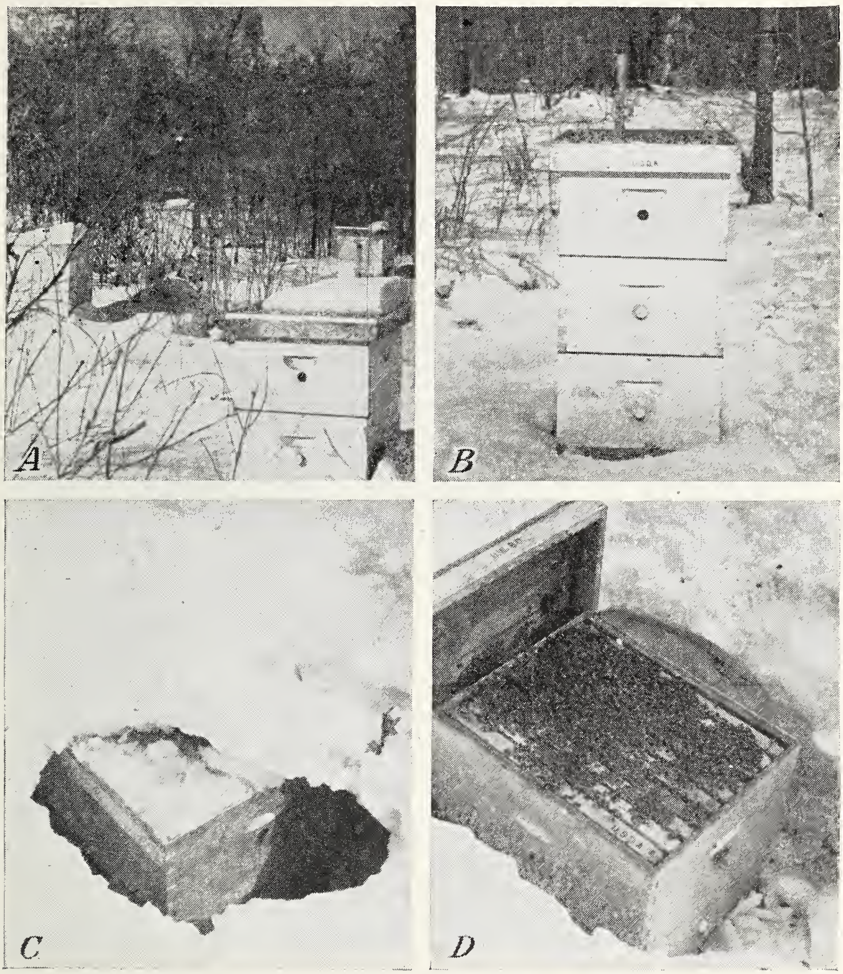

FIGURE 7.—Colonies wintered without hive insulation: *A*, Unprotected two-story hives; *B*, unprotected three-story hive; *C*, unprotected hive buried under a snowdrift from January 14 to March 15, when 18 inches of snow was removed to show the air pocket around the hive where the snow had melted; *D*, the same hive with cover removed shows an excellent cluster. This colony had brood in three frames and many newly emerged bees.

agement he can build large populations, and by feeding sugar he can overcome a deficiency in honey stores, but for pollen he is dependent upon the natural resources of his locality.

The amount of reserve pollen required by a colony depends upon the time early sources will be available in the spring and in what quantity. Inclement weather in the spring may hinder the collection of pollen even though the vegetation could provide a good source. In a locality that provides fairly dependable sources of pollen early in the spring, early brood-rearing requirements are normally met by the equivalent of three to six well-filled combs of reserve pollen in the fall. Larger reserves will produce stronger colonies during some seasons.

Among colonies in the same apiary the amount of reserve pollen may range from none to more than the colony can use. When disease is absent, pollen reserves may be equalized between colonies by the exchange of combs. Colonies that are queenless when the flora is producing pollen abundantly accumulate large reserves because they are not using it to feed brood.

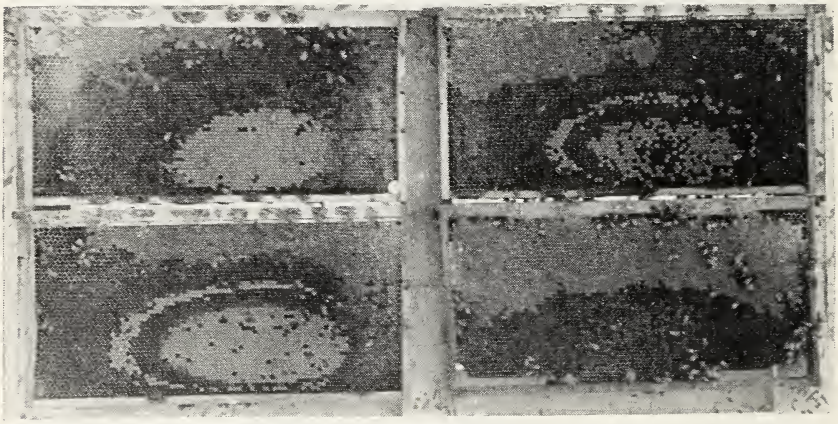

FIGURE 8.—Brood nest of an unprotected colony in midwinter. On October 7 this colony had 9 pounds of bees, 400 square inches of reserve pollen, and an abundance of honey. It was wintered in a three-story hive without hive insulation. On February 10, when this photograph was taken, it contained three frames of brood and a few eggs in the fourth frame.

To obtain surplus pollen for overwintering, it sometimes may be profitable to dequeen a few colonies during periods of heavy pollen collection, even though honey production is sacrificed. In localities where fall pollen reserves are negligible and spring sources are not dependable, it may be good practice to dequeen colonies after the main honey flow. The bees may be destroyed after all the brood has emerged, and the combs of honey and the reserve pollen saved until spring to support early brood production in new package colonies.

Where pollen reserves are inadequate, bulk pollen supplemented by soybean flour may be used to advance early brood production. Pollen supplements, however, are not equal to natural pollen reserves, since it is impractical to supply the colony's requirements in the fall.

A pollen trap (fig. 9) may be installed on the hives of approximately 2 percent of the producing colonies to collect bulk pollen for stimulating brood production in the entire apiary the following spring. The trapped pollen must be removed every 1 to 3 days and air-dried for storage. Therefore the use of pollen traps is limited to home apiaries.

Colonies are able to rear more than six times the amount of brood from a given quantity of pollen when it is added to three times its weight of soybean flour and mixed with heavy sugar sirup (2:1) to form a doughlike cake. These cakes may be fed advantageously beginning March 15 to April 1 and continuing until pollen collection

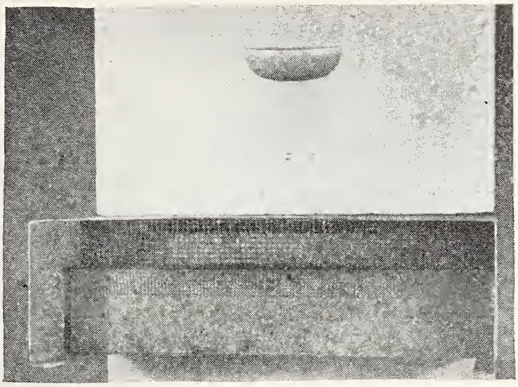

FIGURE 9.—A pollen trap, consisting of a grid made of 5-mesh hardware cloth, which scrapes the pollen from the bees' legs as they enter the hive; a tray covered with 8-mesh hardware cloth, supported beneath the grid to receive the pollen; and a storm shield supporting both the grid and the pollen tray while excluding rain from the tray.

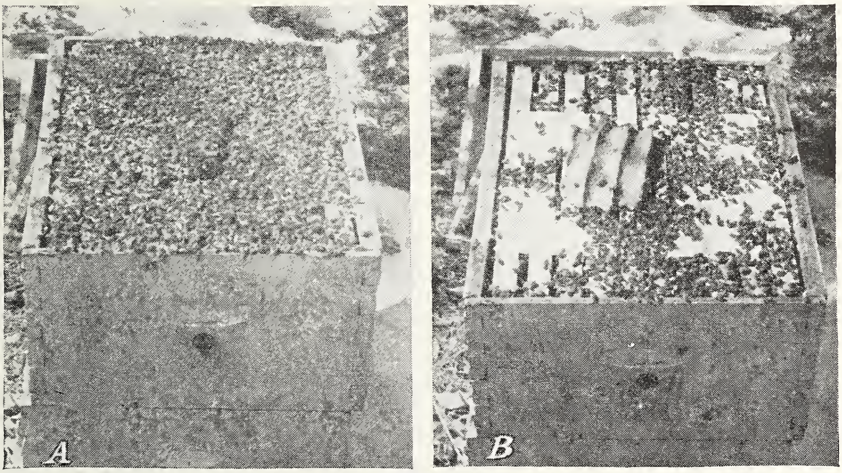

FIGURE 10.—Feeding cakes of pollen and soybean flour: *A*, Colony feeding on cake, showing large population; *B*, cake showing the feeding channels after the bees were smoked down and the cake was turned over for photographing.

from the field is adequate to support brood rearing. A cake one-half inch thick weighing about 1½ pounds should be placed on the top bars directly over the cluster and covered with paraffin paper to prevent drying (fig. 10). The inner cover of the hive should be inverted to provide space for the cake. The amount fed should be regulated so that it will be consumed in 2 weeks. Before a cake is entirely consumed a new one should be provided to prevent the loss of partially developed brood.[2]

Colony Manipulation During the Active Season

Throughout the active season colony management should be directed toward maintaining conditions favorable for maximum brood rearing and honey storage. This can be accomplished when prolific queens are supported by large populations, reserve pollen and honey, and ample hive space organized to satisfy the normal behavior of the colony.

Colony manipulations should be made at more or less regular intervals to provide or readjust the hive space to permit brood rearing and honey storage. The normal behavior of the colony is to expand the brood nest upward in the hive. Reserve pollen is placed in empty cells within and around the brood nest in a narrow band. Excess pollen is more likely to be stored in combs immediately below the brood nest, whereas honey is usually stored around and immediately above the active brood nest, where the queen is laying. During periods of heavy yield, honey and pollen will be stored in any available space within the hive. However, unless room is provided in a normal position for an expanding brood nest and the storage of honey and pollen, the colony will not maintain maximum brood rearing, and if the space is severely restricted the colony will prepare to swarm. Swarm preparations reduce the colony's storing morale, while actual swarming, by dividing the working population, may result in the loss of the honey crop.

An overwintered colony should have 7 to 10 pounds of young bees reared late in the winter and early in the spring and 6 to 8 frames of brood 5 to 6 weeks prior to the main honey flow. Colonies wintered without pollen reserves may have from 2 to 5 pounds of old bees, which die off rapidly when new pollen stimulates brood production. Unless favorable weather permits continuous pollen collection, these populations may dwindle to a point where they no longer can be built up into producing colonies.

The normal organization of an overwintered colony is shown in figure 11, *A*. Early in the spring practically all the brood is located in the second brood chamber. Some of the reserve honey left in the lower brood chamber in the fall has been moved up, since honey below the brood is not in the normal position.

Colony development can be advanced by interchanging the two brood chambers (fig. 11, *B*). If this is done early in the spring before danger of cold weather is past, some honey should be placed in the upper hive body directly above the brood nest. When the queen occupies the upper hive body, the bees will move up honey whenever temperatures permit.

Colonies lacking adequate pollen reserves should be provided with cakes of pollen and soybean flour from the middle of March until pollen collection from the field is sufficient to support normal brood rearing. Any combs containing pollen should be placed as close to the brood nest as possible. Methods of partially overcoming pollen

[2] For further details see Schaefer, C. W., and Farrar, C. L. THE USE OF POLLEN TRAPS AND POLLEN SUPPLEMENTS IN DEVELOPING HONEYBEE COLONIES. U. S. Bur. Ent. and Plant Quar. E–531. 7 pp., illus. 1941. [Processed.]

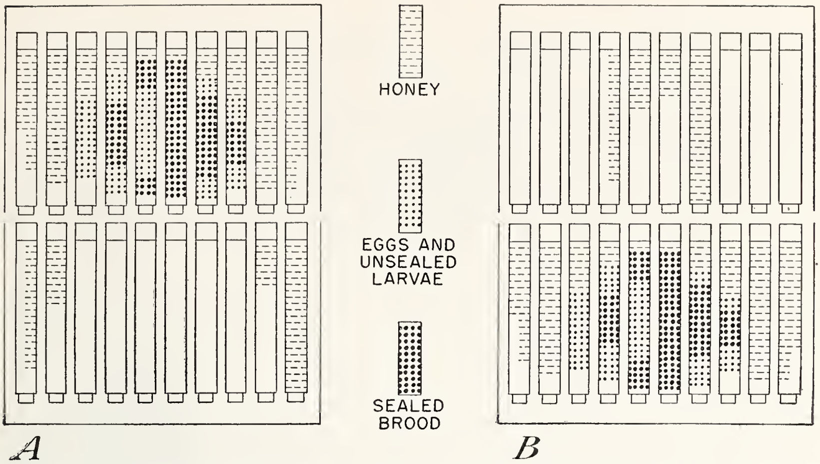

FIGURE 11.—Spring manipulation of an overwintered colony, showing position of honey (broken lines), eggs and unsealed larvae (small dots), and sealed brood (heavy dots): *A*, Organization of hive about April 1; *B*, brood chambers interchanged to allow upward expansion of the brood nest.

shortages have been discussed under Pollen Reserves and Supplements, p. 14.

Under no circumstances should honey stores be allowed to run short. A large reserve of honey is the most practical method of feeding colonies, but those low on stores must be fed sugar sirup (2:1). When drawn combs are available, the sirup can be fed most easily by filling both sides of three to five combs for each colony. A drawn comb will hold 3 to 4 pounds of sirup. When new colonies are started on frames of foundation, the inverted-pail or division-board feeder must be used. These methods of feeding bees are illustrated in figure 12.

About the time fruit trees or dandelions come into bloom, the two brood chambers should be interchanged again. Good colonies usually require a third set of empty drawn combs at this time. These combs

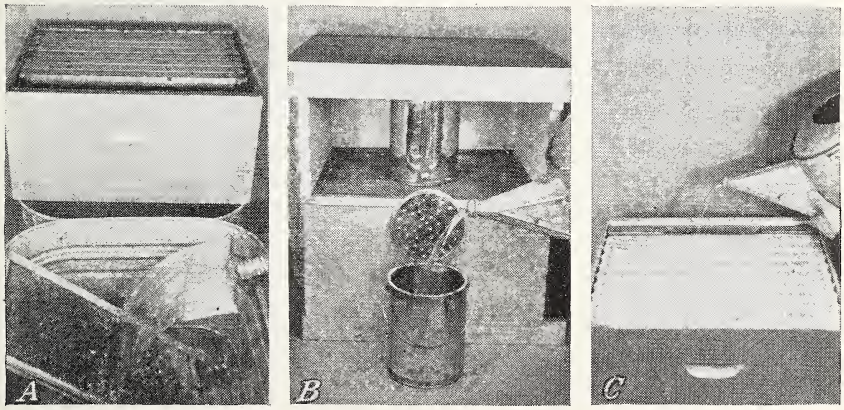

FIGURE 12.—Methods of feeding colonies: *A*, Filling drawn combs with sugar sirup; *B*, inverted-pail or pepper-box feeder (the lid is perforated with small holes about the size of a standard frame nail); *C*, division-board feeder.

provide clustering space for the bees, even though no appreciable amount of honey may be stored. Strong colonies sometimes fill their brood chambers and nearly a super of honey from fruit bloom or dandelions.

Throughout the growing season the brood chambers should be interchanged whenever the queen requires room for the upward expansion of her brood nest. When the main honey flow is on, a fourth, fifth, and even a sixth set of combs may be required to hold the incoming nectar and the honey until it is thoroughly ripened. Nine frames may be used

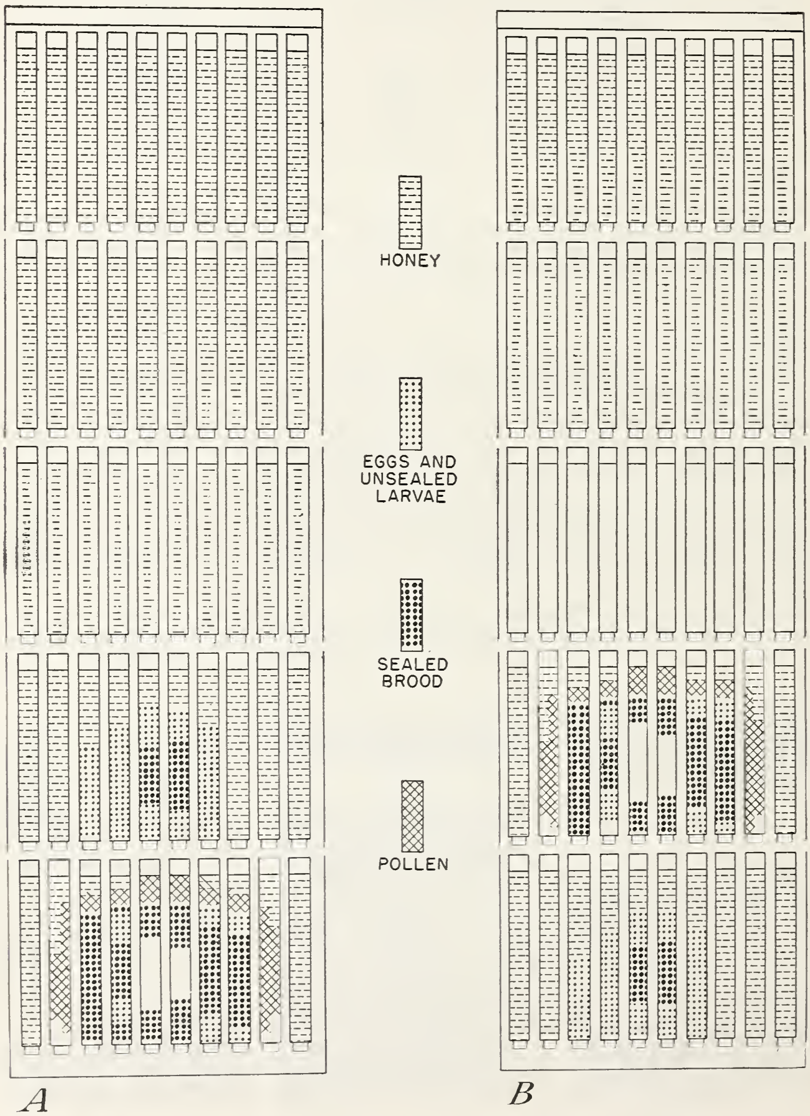

FIGURE 13.—Diagram of colony organization during the honey flow: *A*, Before manipulation; *B* after manipulation.

in the supers to obtain thicker combs to facilitate uncapping, if care is taken to space them uniformly.

The normal organization of a fully equipped colony during the main honey flow before manipulation is shown in figure 13, *A*. When the second brood chamber is well filled with young brood and honey and the third hive body (first super) is one-third to one-half full of honey, the colony should be reorganized as shown in figure 13, *B*. This organization should be maintained by colony manipulations at intervals of 7 to 10 days.

After manipulation the queen will occupy the second brood chamber, where space is made available by emerging bees. The young brood in the lower chamber will mature to the sealed and emerging stage, and considerable honey will be moved from between the two brood nests to the supers above or around the brood nest in the second chamber. Honey will be stored chiefly in the empty super placed above the brood nest, but ripened honey will be added to complete the partially filled supers in the top of the hive. As soon as the top supers are finished, the honey should be extracted and the empty combs returned for refilling.

The colony organization shown in figure 13, *B*, draws bees from the brood nest in which the queen is laying to care for brood in the lower chamber and to finish the top supers. The colony is not restricted either in brood production or in honey storage, and the population is distributed throughout the hive, so that the swarming impulse is reduced to a minimum. Successful practice is dependent upon a proper timing of manipulations which will obtain this organization.

The use of queen excluders between the brood nest and the supers is not essential, provided the interchange of brood chambers is properly timed. The queen will normally utilize the space available in the second brood chamber before moving into the first super.

When freshly extracted combs are returned for refilling, they should be placed above partially filled supers until they are cleaned up and contain some honey. During the main honey flow, however, the first super above the brood nest should not be allowed to remain there until finished, for the brood nest will be restricted with honey, and too much restriction will reduce the colony population either for the latter part of a long flow or for overwintering.

It is good practice to top-super during the last 2 weeks of the honey flow, and allow the super above the brood nest to be finished in that position, thereby forcing more honey into the brood chambers for winter. In localities having comparatively short honey flows top-supering with drawn combs during the entire flow is feasible, but where sweetclover, alfalfa, or fall flora extend the honey flow, production may be curtailed or the condition of colonies for overwintering affected.

In localities where considerable dandelion or other strong-flavored nectar is available before the main honey flow, the colonies should be crowded a little temporarily to concentrate and force the sealing of this honey. The strong-flavored honey may be removed and extracted, or, when hive equipment is plentiful, stored until it can be returned to the colonies for use in brood rearing. Although interchanging the brood chambers forces the bees to move honey from between the brood nests, they move very little honey that has been sealed in the outside combs. It is more practical to obtain a full crop even at the risk of a slight blending of strong honey with the choice.

When a beekeeper is starting or expanding his apiary, he must use frames of foundation in place of drawn combs. The problems of management are increased when less than three hive bodies of drawn combs are available for each colony. New colonies started entirely on foundation should be fed liberally with sugar sirup (fig. 12) until two hive bodies of combs are drawn or until a honey flow makes feeding no longer necessary.

Foundation should not be given except when a honey flow is on, for the bees may damage it before the flow. Strong colonies, however, often require supers to provide clustering space before the honey flow, and they can be provided only when drawn comb is available. When combs are not available, strong colonies may be held back until the honey flow by using their young bees to strengthen retarded colonies, or they may be supered with foundation and fed just enough thin sirup (1:2) to keep them drawing the foundation.

When adding the first super of foundation, it is good practice to exchange one or two frames with frames of honey from the brood nest, preferably unsealed honey, to bait the foundation. As soon as the bees begin to draw the foundation, the bait combs may be returned to the brood chamber if the new combs do not contain brood. Similarly, if foundation must be used in the second brood chamber, bait combs should be taken from the first brood chamber and foundation put down outside the brood nest but adjacent to unsealed larvae. As more room is required, other supers with foundation should be added above the second brood chamber and beneath partially filled supers. During a moderate honey flow the new supers may be baited by exchanging combs from the super above, but during a good flow the upper super serves to draw bees into the new foundation.

The best combs are obtained when foundation is drawn in supers rather than in the brood chambers. The bees attach the new comb to all sides of the frame when drawn in the supers, whereas they leave openings along the ends and bottom bar in the brood chambers. If queen excluders are used, supers with foundation should be placed directly over the second brood chamber with the excluder beneath the partially filled supers above. After the bees have partially drawn the foundation, the excluders may be put down. Queen excluders cause the bees to store more honey in the brood nest, a tendency that is aggravated when foundation is used.

Inspection for Disease

Colonies should be inspected frequently for disease. Strong colonies are likely to rob early in the spring, and they may rob diseased colonies within a radius of 2 or even 5 or more miles. It is unsafe to assume that colonies are free of disease because no disease was found on the previous inspection, since a new infection may break out at any time, particularly during the spring or late in the fall. Colonies infected with American foulbrood should be burned immediately. When an abnormal brood condition cannot be identified, assistance should be obtained from the State apiary inspector, or a sample of the dead brood sent to the Division of Bee Culture, Beltsville Research Center, Beltsville, Md.

Increase and Swarming

An increase in the number of colonies during a honey flow, whether through swarming or division, is usually made at the expense of the honey crop. However, in localities having either a long or a late major honey flow, both the number of colonies and the honey crop may be increased by dividing strong colonies early to make medium-strength colonies, which can build up to maximum strength for at least part of the main flow. An increase made after the crop is produced too often is followed by a loss, because the bees do not reach proper condition for successful wintering.

When colonies have filled their hive space with brood, bees, or honey, it is normal for them to prepare for swarming. Colonies allowed to swarm divide their population, lowering the production efficiency of both the parent colony and the swarm, which often results in a crop failure. Since egg laying is curtailed 7 to 10 days prior to swarming, there is a further loss of bees which might participate in the honey flow.

Since it is desirable to avoid any condition or combination of conditions that will prevent normal expansion in brood rearing or honey storage, it can be seen that swarm control is an essential part of efficient colony management. Under extracted-honey production swarming is usually brought about by crowding. Strong colonies may become congested prior to the honey flow when drawn combs are not available for the clustering of bees above the second brood chamber. During a heavy flow colonies not strong enough to force the bees to occupy the super may store too much honey in the brood nest; consequently brood rearing becomes restricted. Such colonies, when supered with foundation, frequently do not draw the new combs fast enough to hold the incoming nectar, and more honey is forced into the brood nest. Colonies supered with foundation are more likely to swarm than those abundantly provided with drawn combs.

Occasionally the comb space for brood rearing provided by two brood chambers becomes temporarily restricted with pollen. The use of three brood chambers is the logical solution to this problem. It would be fortunate if the accumulation of pollen required the use of larger hives more often.

Supersedure of a failing queen just before or during the honey flow is frequently a cause of swarming. The colony may swarm with the old queen or, if she is lost, a swarm may leave when a virgin queen takes her mating flight. Several days of inclement weather during a good honey flow may induce swarm preparation, because the field bees are forced to remain in the hive.

Maintenance of the organization shown in figure 13, *B*, is in itself an effective means of swarm control. More drastic changes in the organization will often reduce the production efficiency of the colony. Poor or failing queens should be replaced promptly with good young queens. It is far better to prevent the swarming impulse from developing than to attempt to destroy it when once started.

Colonies can be examined for evidence of swarm preparation by tipping up the brood chambers. A large percentage of the queen cells built under the swarming impulse will be located along the lower edge of the combs. If such cells are in evidence, the combs must be removed and all the queen cells destroyed before the brood nest and the super space are reorganized.

There are many methods of swarm control having some merit, but the most widely used manipulation is the Demaree system or modifications of it. The colony is divided when it practically fills two brood chambers. The queen is confined by a queen excluder to the lower chamber, which is provided with one or two frames of brood plus empty combs. Supers are placed above the excluder and the remaining brood is placed on top. This manipulation temporarily unbalances the colony by reducing egg laying, because the majority of young bees remain with the brood nest at the top of the hive, but it is better than allowing the colony to swarm. "Demareed" colonies are sometimes given an entrance into the upper brood nest, where a young queen is allowed to develop and mate. The brood produced by the young queen may offset the temporary loss in production efficiency if there is a long honey flow.

Colonies strong enough to fill two hive bodies 3 or more weeks before the main honey flow may be divided temporarily into two equal units. The brood chamber, containing most of the young brood and the queen, should be set on the bottom board and a set of empty combs added directly above. The inner cover, with the escape hole screened, is placed over these, and the chamber containing sealed and emerging brood with adhering bees is set on top. The top chamber must be provided with an entrance and both units supplied with honey. The queenless unit may be allowed to raise a queen if mature queen cells are available (supersedure or swarm cells or those obtained by grafting), or, better, a laying queen can be introduced immediately. The old queen will not restrict her egg production as under the Demaree plan, because she will have the support of more bees, and the introduction of a young queen to the top unit will greatly increase the brood production. The top colony may even require comb space for expansion.

At the beginning of the honey flow the brood nests of the double colony can be united back to the normal colony arrangement, when the young queen in the upper chamber will usually replace the old queen. This type of division, accompanied by requeening, not only prevents swarming but also increases the population for the honey flow. In localities providing a long flow the divided colonies may be operated under the two-queen system of management instead of being united at the beginning of the flow. The two-queen colonies maintain larger populations and therefore yield larger honey crops.

Package Bees

For increasing the number of colonies in an apiary, the use of package bees from the South is recommended. Only rarely is it possible to build two productive colonies for a June honey flow from one overwintered colony. Temporary increase, described above, made for the purpose of requeening or swarm prevention, is useful in increasing the honey crop rather than the number of colonies.

A package colony should not be expected to yield as much honey as a good overwintered colony. Under favorable conditions, however, it may produce from 100 to 250 pounds of surplus honey above its winter requirements.

Package colonies are considered by some beekeepers to have a phenomenal capacity for rapid development. This is not true, for package colonies are subject to the same limitations as are overwintered colonies. However, a colony started with a 2-pound package of young bees and a young queen develops faster than a poorly wintered colony containing old bees or a poor queen.

Package colonies usually require 10 to 12 weeks to reach the maximum population. Package bees are of value only for the brood they will rear, and since most of the original bees die during the third week the 2-pound package supporting a good queen will develop a full-strength colony in practically the same time as a larger package. Attention should be given to the quality of the stock and the provision of ample pollen and honey for uninterrupted brood rearing.

The installation of packages must frequently be delayed until it is reasonably certain that the bees can collect pollen from the field. If enough honey and pollen can be provided, package colonies established 10 to 12 weeks before the flow can be developed to full strength under almost any weather conditions. When reserve pollen is not available, however, it is safer to delay their installation until the beginning of dandelion bloom. Packages established later under favorable conditions will be stronger, although not at full strength at the beginning of the flow, than those established early without adequate pollen to support brood rearing.

The spray and direct-release method of package introduction [3] allows the queens to begin egg laying about 3 days earlier than the older cage-release method. Less labor is required in installing packages and, because of thorough feeding and early egg laying, the loss of queens during introduction is reduced to a minimum. By this method the packages are sprayed with sirup at frequent intervals before they are taken to the apiary. Combs are set out of each hive to provide space for shaking the bees. Just before shaking, the package is sprayed again until the bees are wet with sirup to prevent flight. They are jarred down into one end of the cage, and the screen is cut to permit the rapid shaking of bees into the hive. The bees should be spread out in the bottom of the hive to allow the combs to be replaced. The queen is then sprayed with sirup and released on the combs by pulling off the wire from her cage. The hive is covered, and the entrance is kept small until a larger one is required for the free flight of the bees.

Whenever possible, each package colony should be provided with 20 to 30 pounds of honey, reserve pollen combs or cakes of pollen supplemented with soybean flour, and drawn combs. If no reserve honey is available, from four to six drawn combs can be filled with sugar sirup (2:1) by the method of feeding shown in figure 12, *A*. When the packages must be installed on foundation, the method shown in figure 12, *B* or *C*, should be used until the foundation has been drawn into combs and reserve stores are accumulated. Three-pound packages have some advantage over 2-pound packages when foundation must be used, because they draw comb more rapidly and more bees are available to collect pollen needed for brood rearing.

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[3] FARRAR, C. L. NEW RECOMMENDATIONS FOR THE INSTALLATION OF PACKAGE BEES, USING A SPRAY AND DIRECT-RELEASE METHOD. U. S. Bur. Ent. and Plant Quar. E-427, 7 pp., illus. 1938. [Processed.]

Packages released by the spray and direct-release method can be examined safely for acceptance of queens after 3 days if the colonies are manipulated with care. Many of the queens begin laying in a few hours, and all good queens will lay in less than 1 day. If the cage-release method is used, the examination should be delayed for 8 to 10 days, because a nonlaying queen just out of the cage may be balled by her bees when the colony is disturbed. About one-fourth of the queens introduced by the cage-release method require more than 5 days to begin laying.

Good packages that have been provided with ample honey and pollen and are headed by productive queens will need no attention for about 4 weeks, and then a second set of brood combs should be added. Queens may be lost or superseded during the first 6 weeks, however, and it is desirable to check the colonies for laying queens at frequent intervals.

The principles of management for package colonies are the same as those for overwintered colonies. Since good packages usually develop more uniform colonies, their use simplifies apiary management.

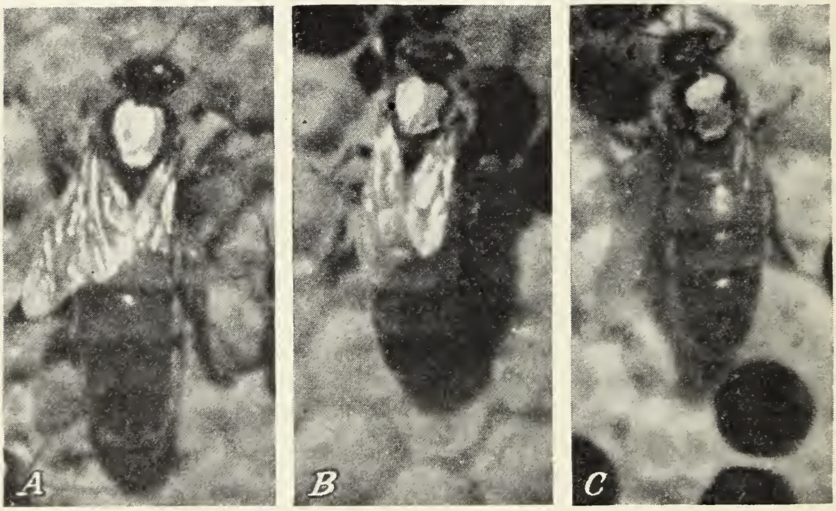

FIGURE 14.—Three types of queens varying in size and body conformation: *A*, Type of queen normally giving high production; *B*, medium slender queen; *C*, small, stubby queen. Most stubby queens are small in the head and thorax and appear more closely coupled than the queen in *C*. Note paint on thoraces.

Queen Rearing and Introduction

Poor queens are responsible for many low colony yields, but good queens may be handicapped by improper colony management. The introduction of a young queen does not insure a productive queen; therefore, annual requeening is not recommended. The beekeeper should be prepared to replace poor queens at any time during the growing season with a minimum loss of egg-laying time.

Beekeepers should give attention to the selection of good stock for breeding purposes. Commercial queen breeders in the South are rendering an important service by making young queens available from March to November at a reasonable cost. The honey producer can select breeder queens of proved production which have other desirable characteristics as well.

Breeder queens from commercial apiaries should not be selected entirely on the basis of honey production. Certain colonies obtain large populations from drifting bees, which enable them to make large yields, but such colonies should not be credited to the queens. Breeder queens should definitely demonstrate their capacity for producing a large amount of brood of good quality. The bees should be uniform in size and color and of good disposition. The queens themselves will usually be large and active, and show no tendency to run off the combs when the hive is manipulated. Although desirable standards of body size and conformation have not been established, queens similar to type *A* in figure 14 generally head the best colonies. Queens of this type are well proportioned and large in all three body regions; the head, thorax, and abdomen are loosely coupled; they have a long, moderately tapered, and deep abdomen; and they stand high on the comb. The best small queens are less productive than the best large queens. Some productive queens make undesirable breeders because they have mated with inferior drones and their daughter queens are not uniformly productive.

The most successful method of replacing queens is to maintain laying queens in reserve nuclei (small three-frame colonies) and unite them to the colony after spraying both queen and bees. Queens introduced by this method will be accepted by full-strength colonies whether the bees from the nucleus are united or not. Strong colonies accept laying queens more readily than nonlaying queens. The introduction of laying queens provides a continuity of egg laying and increases the working population of the colony more rapidly. Nonlaying queens can be introduced more successfully to nuclei, where any loss is less serious than in a full colony.

The colony to be requeened must first be made queenless and any queen cells removed. With one comb set out of the brood chamber, the bees on the other combs should be sprayed with sugar sirup as the frames are moved across the hive. The bees in both brood chambers should be sprayed in this manner. The bees in the supers can be sprayed from beneath and from the top. The new laying queen can be sprayed and dropped into the brood nest, or combs containing honey can be set out to provide space for the frames of brood from the nucleus. Brood from the nucleus must be placed adjacent to the brood of the colony. Queen acceptance will be nearly 100 percent in either case, with no loss of egg-laying time. When the nucleus is united, the colony is strengthened as well as requeened. The queens alone are introduced when nuclei are required for additional reserve queens.

Nuclei for carrying extra queens can be prepared by using package bees. Nucleus hives holding 3 frames can be made by fitting 2 tight division boards into a standard 10-frame hive body with each section covered by a canvas flap or separate inner cover, or by constructing inexpensive 3-frame hives. A 2-pound package may be divided to provide bees for 3 nuclei. When package bees are used, the queens can be introduced by the spray and direct-release method.

It is good practice to maintain about 10 percent as many reserve queens as there are producing colonies. From 30 to 50 percent of the colonies may require requeening during the active season. The nuclei should therefore be requeened with young queens purchased from the South or with queen cells produced from the best stock available. The practice of uniting nuclei to colonies that require requeening and of making up new nuclei with package bees has considerable merit. The package nuclei accept either queens or queen cells better than cells having brood, and the requeened colonies benefit from the bees and brood that are united.

ECONOMICS OF COLONY MANAGEMENT

The business of beekeeping demands attention to the costs of producing honey. Surveys made in the Intermountain States, Oregon, and California between 1928 and 1939 indicate that the average cost of production was above the current commercial price received for the honey. As in many other branches of agriculture, the cash costs for producing a honey crop are less than half the true costs. The established beekeeper thus has been able to obtain a living even when his business has been operated at a loss.

In these surveys the colony yield was the basic factor influencing production costs. The cost of producing a pound of honey in the apiaries giving low yields was five to nine times the cost in apiaries with high average yields. When it is recognized that most apiaries show average yields only one-third as high as those obtained from the most productive colonies, the beekeeper is challenged to increase the efficiency of his management.

The principles and practices that will aid the beekeeper in obtaining maximum colony yields have been given in this circular. A simple system of accounting can be used to determine the cost factors and the efficiency of his management. The following items should be included in any accounting system: An inventory of the capital investment; interest and depreciation on the capital investment in hive equipment, buildings, machinery, and motor vehicles; man-hours of labor per apiary and per colony; travel costs per apiary and per colony; interest on the investment in bees; replacement costs for queens and losses from disease, wintering, pilfering, and so forth; cost of supplies other than those included in capital investment; miscellaneous costs for rentals, taxes, insurance, utility service, and office supplies; yields per apiary and per colony; returns on honey; and returns on byproducts. An analysis each year of the items of costs and returns will reveal the true cost of production, the profit or loss on the business, and the opportunities for economy or greater efficiency in management.

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