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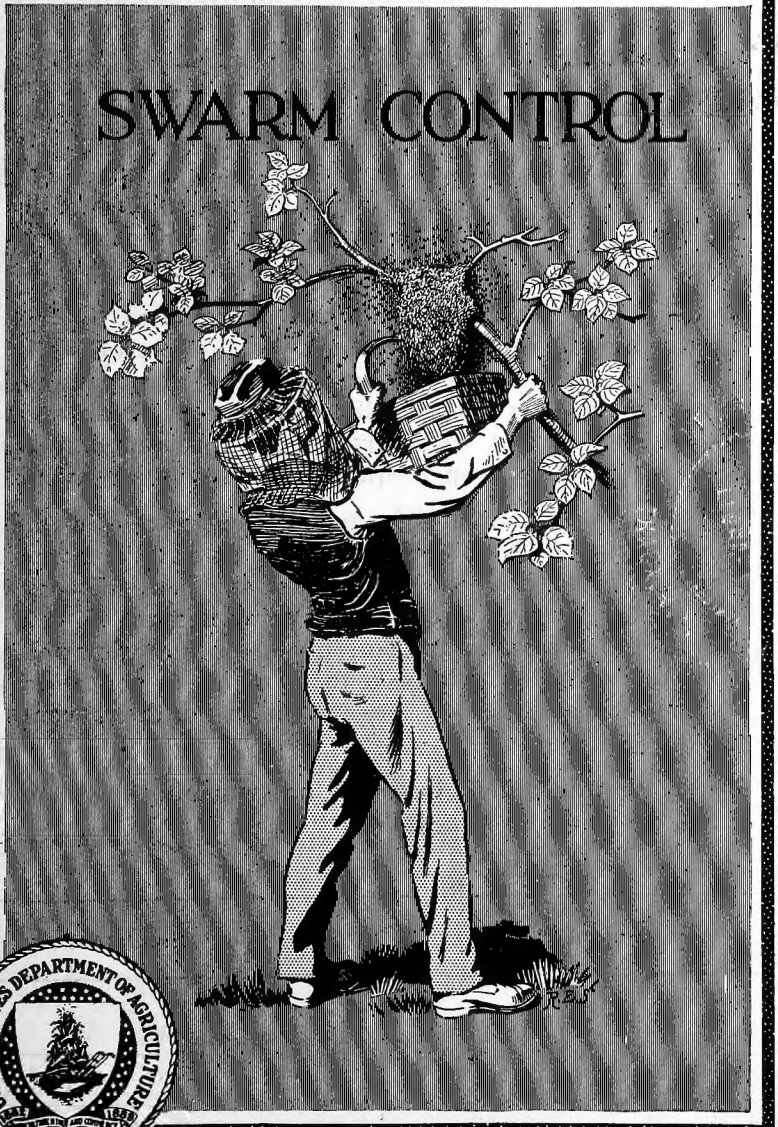
# U. S. DEPARTMENT OF AGRICULTURE

## FARMERS' BULLETIN No. 1198

# SWARM CONTROL



WHEN honey is produced on an extensive scale it becomes necessary to distribute the colonies of bees in several apiaries to avoid overstocking. A serious problem when bees are kept in outapiaries is the control of swarming.

Swarm control is less difficult in the production of extracted honey than in that of comb honey. It is less troublesome in some locations than in others and during some seasons than during others. The reasons for these differences are important in the devising of measures for swarm prevention.

The tendency to swarm can be reduced by the introduction of superior stock, by the use of well-arranged hives and good combs, and by management which prevents a congestion of bees in the brood nest. Swarming, therefore, can be prevented to a large extent by proper equipment and management.

The conditions which reduce the congestion in the brood nest (preventive measures) are at the same time the conditions which induce the bees to work with the greatest energy in gathering nectar. When remedial measures are employed, the manipulation is such that the colony is thrown into a condition comparable either to the swarm or to the parent colony in nature.

These and other phases of the swarming problem are discussed in this bulletin.

Washington, D. C. Issued June, 1921

# SWARM CONTROL

By Geo. S. Demuth, formerly *Apicultural Assistant, Bee-Culture Investigations, Bureau of Entomology*

CONTENTS



## SUCCESSION OF EVENTS IN NATURAL SWARMING

A COLONY of bees that is normal and prosperous increases its brood in the spring as its adult population increases, either until all the space available for brood rearing is occupied or until the queen reaches the maximum of her capacity in egg laying. At first only worker brood is reared; but as the colony increases in strength the rearing of drone brood is begun, thus providing for male bees in anticipation of swarming. Finally, when the brood nest becomes crowded with emerging and recently emerged young bees and the combs are well filled with brood, if nectar in sufficient quantity is available, several queen cells are started and eggs are placed in them, this being the first definite preparation for swarming. About nine days from the time the eggs are laid the queen larvae have developed to the point at which the queen cells are sealed, and this is about the time the swarm usually issues. The exact time of the issuing of the swarm depends to some extent upon the weather, issuing sometimes being postponed by inclement weather and sometimes, especially in the case of Italian bees, being hastened by extremely hot weather.

In nature there is a marked slowing down in work of the colony after the queen cells have been started preparatory to swarming, especially during the last few days previous to

Fig. 1.—Swarm clustered

the issuing of the swarm, when the field workers in increasing numbers remain in the hive instead of work-

ing in the fields. In some cases in nature the instinct to gather nectar is almost entirely subordinated for several days at this time, the swarming instinct apparently becoming dominant. In well-managed colonies this is not universally true.

When the swarm issues, a varying proportion of the adult bees, together with the old queen, fly from the hive, leaving in the original hive a greatly reduced number of adult worker bees, a large number of unemerged young bees, and several unemerged young queens. Some of the drones accompany the swarm, but many of them remain in the hive. After circling in the air the swarming bees form a dense cluster (fig. 1) on some convenient support, and after an interval they break the cluster and fly to a chosen abode for the inauguration of a new colony. After establishing themselves in a new home the bees begin almost immediately to build comb, the queen begins to lay eggs, and three weeks later young bees begin to emerge from the cells.

About a week after the issuing of the prime swarm the first of the young queens in the parent colony emerges from her cell. Instead of destroying the other young queens and establishing this first emerged young queen as the new mother of the colony, the bees usually swarm again about eight days after the prime swarm has issued, this afterswarm being accompanied by one or more young queens. Other afterswarms, each one smaller than the preceding, may issue with an interval of one or two days between until the colony is so reduced in numbers that further swarming is given up and all but one of the remaining young queens are killed. About 10 days after emergence the surviving young queen usually begins to lay, and normal brood-rearing is again established in the parent colony after an interval of at least 16 days during which no eggs have been laid. Each afterswarm establishes itself in a new abode, begins building its combs, and the young queen begins to lay about 10 days after emergence. If sufficient food is available such colonies may build up to normal strength for winter. This is the natural method of reproduction of colonies in the honeybee.

## OBJECT OF SWARM CONTROL

Swarm control is one of the most important factors in the recent development of commercial honey production on an extensive scale. It was practically unknown until within comparatively recent years. Formerly a colony swarmed when it got ready, and no attempt was made to foretell, forestall, or prevent the act. It was necessary to watch the bees constantly during the greater part of the day while the swarming season lasted to prevent the escape of issuing swarms. When a swarm issued it was hived in a separate hive, and in due time the parent colony sent out one, two, and often three or more afterswarms, thus dividing the original colony into several parts, each of which was too small for profitable honey production, except during an occasional season of abundance or in an especially favorable locality. The issuing of these prime swarms and afterswarms was looked upon as a part of the annual program of the bees.

Gradually methods were devised for the prevention of afterswarms, and systems of management were worked out whereby the actual working force of the colony is not divided by the issuing of the prime swarm. During more recent years methods have been devised by which swarming is either prevented entirely or the act of swarming is anticipated by the beekeeper, which permits the control of swarming without constant attendance. This has made it possible for a beekeeper to operate a series of apiaries without an attendant in each to watch for and hive the issuing swarms.

The beekeeper's problem at the beginning of the honey flow is twofold: (1) To prevent a division of the working force of the colonies; (2) to stimulate the storing instinct to the utmost degree throughout the honey flow. A division of the working forces or a subordination of the storing instinct at this time will cause a loss in the crop. Swarming can be prevented in many ways, but great care is necessary to avoid causing a subordination of the storing instinct, thus reducing the crop of honey, because the bees work with less vigor.

In extracted honey production it is now possible practically to prevent swarming in certain regions where the character of the honey flow, its duration, and the time of its occurrence with reference to the advancement of the season are such as to discourage swarming, but this is by no means

true for all regions. In comb-honey production it is possible greatly to reduce swarming by modern swarm preventive measures, but under some conditions in certain localities there are seasons when swarm control is still, as in the past, one of the greatest problems of the comb-honey producer.

## FACTORS INFLUENCING THE TENDENCY TO SWARM

Swarming is a fundamental instinct in the honeybee and can not be easily eliminated. Just what it is that brings uppermost the swarming instinct when conditions are favorable is not positively known, but it is well known that certain factors contribute to the tendency to swarm, and if care is taken to prevent their development in the colony this tendency is greatly reduced.

Colonies in the same apiary during the same season do not all behave alike as to swarming. Usually some colonies make no effort to swarm even during seasons when swarming is general; other colonies yield readily to ordinary preventive measures, while still others are so determined to swarm that gathering and storing are to a large extent subordinated until swarming is past. This variation may be partly due to a difference in hereditary characteristics and partly to a difference in the hives and the combs; but when these are nearly uniform throughout an apiary there is still a great variation in the tendency to swarm due to a difference in the distribution of the bees within the hive, a congestion of bees within the brood nest being highly conducive to swarming while a distribution of the bees to parts of the hive other than the brood nest, so that only enough bees are left there to care for the brood, usually results in no swarming. When young bees are emerging daily in great numbers, as during the spring brood-rearing period, they become the chief offenders in producing a congested condition within the broodnest, on account of their habit of remaining on the brood combs for some time after emergence before going to other parts of the hive or to the field.

In some cases failing queens may be superseded during the swarming season, and swarming may result from the presence of queen cells begun in response to the supersedure impulse. Throughout this discussion of the factors which influence the tendency to swarm only those which lead to the issuing of normal prime swarms are included. Swarming brought on by supersedure of the queen, by the emergence of several young queens as in afterswarms, and swarming out because of hunger or advanced stages of brood diseases, may be considered as abnormal, so far as the cause is concerned, when compared with normal prime swarms.

### INFLUENCE OF HEREDITY

The variation as to swarming in different races of bees, and even within the race, has suggested the possibility of producing a nonswarming strain of bees. Considerable effort has been expended in this direction by breeding only from those colonies which show the least disposition to swarm, on the theory that the swarming instinct can be bred out. It is not possible to measure accurately the progress that has been made in this direction, largely because the breeder, during years of careful selection in breeding, may at the same time have modified his methods unconsciously, so that the bees swarm less because of better management. Considerable progress may have been made in reducing swarming by the elimination of undesirable stock, and it certainly is advisable to select as a breeding queen one whose colony shows little tendency to swarm, other factors being equal. It is a good rule to replace the queen of every colony that persists in swarming without sufficient cause by a young queen reared from the best breeding queen available. There is, however, no reason to expect that swarming will ever be eliminated by breeding alone.

### INFLUENCE OF THE HIVE AND COMBS

Some of the variation among colonies in the tendency to swarm is due to a difference in the hives and the combs. The size and shape of the brood chamber, the character and arrangement of the combs, the facility with which the bees can ventilate every part of the brood chamber and supers, and the ability of the bees to control the temperature of the air within the hive during hot weather are important factors which influence the tendency to swarm. Various hives, therefore, have been devised with the view of eliminating swarming.

#### SIZE OF THE BROOD CHAMBER

Usually there is more swarming from hives that have small brood chambers than from those that have

large brood chambers. Under favorable conditions a good queen will increase the number of eggs which she lays in the spring, as the number of workers to take care of the resulting brood increases, until 70,000 or more cells may be occupied with brood at one time. If the room for brood rearing is all occupied at any time before the maximum is reached, the colony may prepare to swarm, providing other conditions are favorable. To prevent swarming from this cause, therefore, it is necessary either to use a brood chamber containing sufficient room for the spring brood rearing or to give an additional brood chamber during the spring if a small hive is used. So far as swarming is concerned, it is necessary to have a large brood chamber only during the short period when brood rearing is heaviest. Large hives, however, do not of themselves entirely prevent swarming.

### CHARACTER OF THE BROOD-COMBS

The combs of the brood nest should be suitable for the rearing of worker brood throughout except for a few cells of drone comb in the lower corners of some of the frames, which can not be entirely eliminated. It is quite possible to have a brood chamber of ample size for the maximum amount of brood, but at the same time to have the brood-rearing space so reduced by imperfect combs that, so far as swarming is concerned, the effect is the same as if the brood chamber were much smaller. Imperfect cells and drone comb within the brood chamber not only reduce its capacity for worker brood but such imperfect comb may act as an obstruction to the queen in expanding the brood nest in the spring. If combs unsuitable for brood rearing are between the combs already occupied with brood and the perfect combs beyond, the imperfect comb stands in the way of a free expansion of the brood nest, the queen may confine her work to but one side of the hive at a time, and swarming may follow. When two stories are used early in the season to supply the necessary brood-rearing space, it is important that combs which have perfect worker cells to the top bar be used at least in the lower hive body to permit the queen to work readily through both stories. When combs having several rows of imperfect cells next to the top bar are used, the queen may be partially confined to one or the other of the hive bodies because of the space which intervenes between the available worker comb in the two hive bodies. The partial confinement of the queen to one or the other of the two brood chambers in this way may be equivalent to the use of but one brood chamber, so far as available room for the queen is concerned.

As a swarm-preventive measure it is important, therefore, that all the combs used in the brood chamber be suitable for the rearing of worker brood throughout practically their entire area. Such combs can be provided only by the use of full sheets of foundation in the brood frames, together with special care in wiring the frames, imbedding the foundation, and having the combs built under favorable conditions. In extracted honey production much can be done to improve the character of the combs used in the brood chamber by sorting out all imperfect ones for use only in the supers. Some beekeepers use special methods of wiring the frames by which the stretching of cells in the upper portion of the combs may be largely overcome. If brood is extended in new combs to the top bar of the frames during the first season, the combs are so strengthened by the cocoons that there is less tendency for them to stretch subsequently and cause misshapen cells in the upper portion.

Good combs, so arranged that the brood nest may be expanded without interruption until the maximum of the spring brood rearing has been reached, go a long way toward the prevention of swarming. Nevertheless, for reasons given later, these do not of themselves insure that there will be no swarming.

### SPACE WITHIN THE HIVE

Space that is not occupied by comb, especially within the brood chamber, may influence the tendency to swarm. A deep space between the bottoms of the frames and the floor of the hive is undoubtedly advantageous in hot weather. This space may be as much as seven-eights inch, with little or no trouble from the bees building comb below the frames unless they are badly crowded for room. Some beekeepers use a space 2 inches deep or more, but put under the frames a slotted rack to prevent the bees building comb there. This affords a large amount of room for the field bees during the night and also provides abundant opportunity for ventilation during the heat of the day.

Some extra space can be provided within the broodchamber by spacing the brood frames farther apart. The bees will increase the thickness of that portion of the combs which contains honey, but they do not increase the thickness of that portion which contains brood, and the spaces between the combs are accordingly wider within the brood area. If the frames are spaced too far apart, however, the bees may build a thin comb between. Combs are usually spaced from 1⅜ to 1½ inches from center to center. The principle of wider spacing of brood combs has been utilized in the construction of a nonswarming hive in which the combs are separated about an inch and slatted frames are inserted between the combs to prevent the bees from building in this space, but such hives have not come into general use.

### VENTILATION

Large entrances reduce the tendency to swarm by adding to the comfort of the bees during hot weather. Bees need much more ventilation during the honey flow, when they are more active than at other times. It is sometimes advantageous to push one of the supers or the cover forward or backward on the hive far enough to make an opening for additional ventilation. Some beekeepers bore a hole an inch or more in diameter in one end of each super. These holes can be closed easily with a metal slide or a cork when not needed. It is usually not advisable to attempt to give ventilation in or between comb-honey supers because the bees are slow to seal honey adjacent to such openings, but ventilation may be given between the first comb-honey super and the brood chamber by sliding the lower super forward far enough to form an opening for ventilation at the back.

The location of the apiary should be such that there is a good circulation of air throughout the yard. Apiaries are sometimes located in hot nooks, where there is little circulation of air, and this usually results in an abnormal tendency to swarm.

### SHADE

Protection of the hives and supers from the direct rays of the sun during the hottest part of the day should decrease the tendency to swarm. Covers made of a single thickness of lumber, if unprotected, may cause great discomfort to the bees and may compel them to leave the supers during the heat of the day, which is a condition favorable to swarming. To prevent this, shade boards large enough to project beyond the edges of the hive (fig. 2) may be used over the covers. These should be adjusted with one edge even with the north side of the hive so that the extra width projects on the south side, and there should be a space between the hive cover and the shade board to permit a circulation of air. The double covers which have an air space between the inner and outer parts afford more protection from the sun's rays than do single covers. But these do not shade the sides of the supers.

FIG. 2.—Shade board projecting beyond the hive on south side

The hives, supers, and covers should be painted white, because the white surface better reflects the sun's rays. If no shade board is used the covers should be repainted frequently. Other things being equal, it is to be expected that the tendency to swarm will be greater when dark or weather-beaten hive covers are used than when newly painted white covers are utilized, unless shade boards are used over them.

The beekeeper who is much troubled with swarming can not afford to neglect the character and the arrangement of the combs, the size, shape, and construction of the hives, or even the color of the hives, if he desires to prevent swarming to the fullest extent, though the total prevention of

swarming can not be expected from the character of the hives and combs alone.

### INFLUENCE OF LOCALITY AND SEASON

During some seasons few, if any, colonies attempt to swarm, whereas during other seasons and under similar management a majority of the colonies may prepare to swarm, especially if comb honey is being produced. Generally speaking, bees are expected to swarm less during seasons of meager supply of nectar, whereas many swarms are expected in seasons of plenty; yet bees often swarm freely when nectar is not abundant and but little when it is abundant. The tendency to swarm, therefore, is not necessarily directly connected with the quantity of nectar available during the swarming season if a sufficient supply of food has been available previously to enable the colony to build up to swarming strength.

Furthermore, in some regions swarming may be troublesome during most seasons, even after years of careful selection in breeding, together with the best of equipment and management, whereas in other regions bees of almost any strain, when ordinary precautions as to equipment and management are taken, are practically nonswarming year after year. Why do bees swarm freely one season and refrain from swarming the next, if both seasons are prosperous, and why do bees in one region habitually swarm excessively, while bees of the same strain, in the same kind of hives, and under similar management, but in another region equally good, swarm little, if any? The answers to these questions are apparently closely connected with the rapidity with which the bees build up in the spring, together with the character of the honey flow and the weather conditions during the swarming season.

### INFLUENCE OF CHARACTER OF SPRING BROOD REARING

Throughout the entire country there is a definite period during fall and winter when brood rearing is entirely suspended in all normal colonies. When brood rearing begins again in the spring, if sufficient food is available, the amount of brood is usually increased until a certain maximum is reached, after which brood rearing declines. When spring brood rearing is most extensive the queen may lay more than 3,000 eggs daily, but she does this during a short time only. There is, therefore, a well-marked period of extensive brood rearing in the spring. Apparently this spring expansion of brood rearing is stimulated by the oncoming of spring following the period of little or no brood rearing. It is stimulated also by early incoming pollen and nectar, but may occur even when these are lacking, provided a sufficient quantity of honey and pollen is stored in the hives and water is available. In this respect the spring period of extensive brood rearing differs greatly from other periods of more or less extensive brood rearing, since after the first great expansion in brood rearing the presence of honey stored in the hive is not a sufficient stimulus to cause the bees to rear brood extensively.

In all regions swarming may be expected within a well-defined "swarming season" which coincides roughly with the period of maximum brood rearing. When there is a well-marked secondary expansion in brood rearing later in the season it may be accompanied by a secondary swarming season. When the primary period of maximum brood rearing is prevented because of extreme weakness of the colony, or a dearth of food, swarming may simply be postponed until a later honey flow and may then be expected as during the normal swarming season. If no period of extensive brood rearing takes place during the season there is usually no swarming. Differences in seasons and differences in localities may modify the rapidity with which brood rearing is carried on, so that the maximum amount of brood may be greater in certain years than in others and greater in certain localities than in others.

Other things being equal, the tendency to swarm is the greatest in those localities in which, on account of climatic conditions and available food, the bees increase brood rearing most rapidly in the spring. In any locality the tendency to swarm is greatest during those years when, because of favorable conditions, the bees build up in the shortest interval in the spring. Among the colonies in the apiary the tendency to swarm is greatest in those colonies which reach their peak of brood rearing most rapidly. When colonies of bees build up so rapidly in the spring that a maximum of 60,000 to 70,000 cells of brood is reached, they have during a certain period a large proportion of

recently emerged and emerging bees. Such colonies are in the best possible condition to gather and store a crop of honey if the honey flow begins at about the time they reach their maximum in brood rearing, but they are strongly inclined to swarm.

When brood rearing is conducted moderately, colonies may have as many workers when they reach their maximum strength, but they do not have as large a proportion of young bees at any time as those which build up more rapidly. Thus, two colonies at the beginning of the honey flow may be equally strong as to the number of bees but differ decidedly as to the average age of the bees, and, other things being equal, the tendency to swarm is greater in the colony having the larger proportion of recently emerged and emerging bees.

### INFLUENCE OF YOUNG BEES

The fact that the tendency to swarm is greatest at about the time the bees are rearing the greatest amount of brood has led to the belief that swarming is caused by the presence in the hive of a large proportion of young bees not yet old enough for field work. The measures in common use for the prevention of swarming tend to obviate this predominance of young bees or to relieve the crowded condition resulting from their presence within the brood nest, and the successful remedies for swarming are those which correct this unbalanced condition in the population of the colony. Natural swarming itself removes the excess of young bees and brings about a condition in which none of the workers need be unemployed if there is a honey flow. It is probable that the bees too young to work in the fields contribute to the tendency to swarm by their persistence in remaining for several days within the brood nest near where they emerged from the cells, instead of going to the more remote and less congested parts of the hive, and in this way they produce a crowded condition within the brood nest.

The sensation of strength in the colony is evidently not in proportion to the number of bees within the hive but depends largely upon their distribution. Even weak colonies may become crowded and swarm if most of the bees of the colony confine themselves to the small area occupied by brood, because this area is surrounded by sealed honey or imperfect combs, or because the more remote portions of the hive are so unattractive that the colony does not expand its activities beyond the brood area in proportion to the increasing numbers of oncoming young bees. On the other hand, a strong colony which rapidly expands its work into remote parts of the hive may apparently entirely escape the sensation of great strength because of the better distribution of the bees.

The distribution of the young workers during the first two weeks of their lives when they are emerging at the rate of 3,000 or more per day undoubtedly has much to do with the tendency to swarm. It is, therefore, highly important that those parts of the hive outside of the brood area be attractive and easily available for the oncoming young bees, so that they will expand into and occupy the more remote portions of the hive instead of crowding the brood nest.

### INFLUENCE OF HONEY FLOW

A colony of bees that is approaching its maximum of strength at the beginning of or during the honey flow, having many young bees recently emerged, may be able to send but a comparatively small number of workers to the field because most of them are too young for field work. In this case the brood nest is crowded with these unemployed young bees during the heat of the day, and the added prosperity of the honey flow may quickly bring on the swarming tendency. On the other hand, a colony that has passed its maximum of brood rearing some time previous to the honey flow, having comparatively few emerging and recently emerged young bees, but most of its workers old enough to work in the fields, may send such a large proportion of its workers to the fields when the honey flow begins that most of the workers are out of the hive during the heat of the day and swarming may be given up. The advent of the honey flow, therefore, may have an opposite effect as to swarming upon colonies which are equally strong in number of bees but different as to the age of the workers. This may explain the variation observed in various regions as to the effect of the honey flow on swarming.

### INFLUENCE OF WORK IN SUPERS

The giving of additional room and employment to attract the unemployed bees out of the brood chamber is of great importance in the expansion of the activities of the colonies and has

a direct bearing upon an advantageous distribution of bees throughout the more remote portions of the hive.

Usually the tendency to swarm is stronger during the early part of the honey flow if the colonies are strong in young bees at that time. It is important, therefore, that each colony expand into and occupy promptly the first super that is given. To accomplish this it is necessary that this first super be attractive to the young hive workers. If supers, either for comb honey or for extracted honey, containing only foundation, be given to a strong colony just before the honey flow the bees will not take possession of them and begin work on the foundation to any extent until the honey flow has begun, and meanwhile the colony is crowded for room. The addition of this room with only foundation, therefore, does not affect the distribution of the bees until they take possession of and occupy the super, while in the meantime conditions for swarming may develop rapidly. On the other hand, if a super of empty combs be given to a strong colony previous to the honey flow, the younger bees in great numbers immediately take possession of the added super and begin to repair the comb and to prepare it for use. If the colony is strong these bees do not merely explore the super but actually occupy it, the brood chamber, therefore, being relieved of many thousand young bees that are not yet old enough for field work.

In either comb-honey production or extracted-honey production, if the colonies are not strong when the first super is given they may refuse to expand into and occupy it or they may take possession of only a small portion of it. Such colonies usually store any honey they may accumulate at this time in the combs of the brood chamber adjacent to the brood, and if in this way they surround themselves with honey and seal it they are not inclined to pass this finished work readily to expand into the supers beyond. In this way they may block off and occupy only a small portion of their hive and crowd this limited area even though empty combs are used in the supers above, whereas strong colonies readily expand beyond such barriers. For this reason it is sometimes more difficult to prevent swarming in colonies of medium strength than in strong ones. Any barrier of any kind between the brood nest and the supers becomes especially objectionable in colonies of deficient strength. Some strains of bees are more inclined to limit their activities to a portion of the hive in this way than other strains, and may be more inclined to swarm for this reason.

The first super usually should be given before the bees need it, and especially in extracted-honey production it should be given as soon as the bees are strong enough to occupy it, in order to furnish a place outside of the brood nest for the multitude of oncoming young bees. This first super for extracted-honey production should be supplied with empty combs, or at least half of its frames should contain empty combs. If no empty combs are available for this purpose, some of the combs of brood should be put into the super to start work there promptly and distribute the bees over greater surface. The first comb-honey supers are usually put on a little later than supers for extracted honey and should contain some sections in which the combs are already built, which were saved from the previous year. These combs usually induce the bees to occupy the super earlier than when only foundation is used in the sections.

As work progresses in the first super and the cells are being built out to full length, the room that can be occupied by bees decreases, making it necessary, if the super has been completely occupied, for some of the bees to go elsewhere. When the honey is finally ripened and sealed, few bees remain in the supers. Therefore, if a second super is not given until the first one is finished, most of the super workers are forced to go back into the brood chamber. In the meantime there is no place for the oncoming young bees to take up inside work before they are old enough to begin to work in the fields. The super workers, forced out of the super back into the brood chamber, added to those emerging rapidly in the brood chamber, give a large number of bees there which must remain unemployed until they are old enough for field work, thus causing a condition highly conducive to swarming. There is, therefore, a critical period not only just before the bees take possession of the first super of the season, but to a certain extent just previous to the giving of each additional super.

During the early part of the honey flow when swarming is imminent additional supers should be supplied as the bees need them, before any of the workers are crowded back to the brood chamber. If the honey flow is good, the additional supers should be given

as fast as the bees can be induced to occupy them, in order that the expansion of the work and the room in the supers shall keep pace with the oncoming of the young workers. Each newly added super should be so accessible, comfortable, attractive, and advantageously placed that young bees will come up and occupy it at once, which they may fail to do if newly added supers are too hot, too cold, too remote, difficult to ventilate, or otherwise unattractive. Supers should be snug and warm during cool weather and protected from too much heat during hot weather. During the latter part of the honey flow, as the swarming season begins to wane, the bees may be crowded as to super room to induce them to finish the work well and concentrate the honey in fewer supers, but by this time there is less danger of swarming.

### SPACE FOR THE EVAPORATION OF NECTAR

Super room should be adequate not only for the storage of ripened honey but also for the distribution of the thin incoming nectar throughout a large surface of comb with but a small amount in each cell, to facilitate the evaporation of water from the nectar. A large amount of comb surface is needed for this purpose in regions where the nectar is especially thin when it is first brought in. In arid climates not so much extra room is needed for the evaporation of nectar as in humid climates. When all the cells available for ripening nectar are in use during a heavy honey flow a slowing down of the work of the colony must follow, for the bees will not fill the cells full of raw nectar. When nectar is thin and abundant, the evaporating space may all be in use before much honey has actually been stored, which may result in a stagnation of the work of the colony, and in turn may increase the tendency to swarm. For this reason it is usually necessary to give more supers during the honey flow than are actually filled with ripened honey.

### TIERING UP SUPERS

In producing comb honey if the honey flow is good and swarming is imminent each newly added super may be placed immediately above the brood chamber; that is, between the brood chamber and the supers in which work has already been started. This induces the bees to begin new work promptly and takes additional thousands of young bees out of the brood chamber into the supers. (See Farmers' Bulletin 1039.) In extracted-honey production when empty combs are used in the supers it is not so essential to place the newly added ones below those already on the hive, but to do so undoubtedly entices more bees out of the brood chamber than when they are placed on top of the other supers. Shallow extracting supers are usually tiered up in the same manner as comb honey supers, each newly added one being placed below the supers already on the hive during the time that swarming is imminent. If full-depth extracting supers are used, half of the combs may be removed from the middle of the partly filled super and empty combs or frames of foundation taken from the new super may be put in their place. The partly filled combs that were removed are then placed in the middle of the new super, after which it is placed on top. This process may be repeated if necessary as often as it is desirable to give additional room close to the brood chamber.

Great care should be taken, especially in comb-honey production, to discontinue such a rapid expansion of super room in time to have the work well finished. During the latter part of the honey flow empty supers may be added on top of those already on the hive in either comb-honey or extracted-honey production, to prevent too much incomplete work at the end of the honey flow, for at this time there is less probability of swarming than earlier in the season.

In regions where the swarming season occurs during the honey flow it is of great importance that every condition possible be provided that will entice the younger bees from the brood chamber into the supers and the field bees from the brood chamber to the fields. If the brood nests can thus be kept free from too many unemployed bees during the swarming season there should be little inclination to swarm.

### INFLUENCE OF IDLE FIELD BEES

The brood chamber may be congested with bees, however, and swarming may sometimes occur apparently through no fault in the distribution of young bees within the hive, since a crowded condition may be brought about or intensified by the field bees as a result of certain pe-

culiarities of weather conditions and honey flow.

The presence of a large number of field bees within the hive during the swarming season evidently greatly increases the tendency to swarm. When the field bees are out of the hive the colony is relieved of their presence during the heat of the day when they would add most to its sensation of strength. If, however, because of some fault in the management, because of adverse weather conditions, or because the flowers yield nectar erratically, the field bees remain in the hive, they add greatly to the crowded condition of the brood nest, and, therefore, increase the tendency to swarm.

It is well known that the advent of a honey flow and active work in the field greatly stimulates the activities of the bees within the hive. Thousands of younger bees or hive workers now begin the tasks of preparing empty combs for incoming nectar, or for brood rearing, building new comb, transferring nectar or honey, and ripening the new nectar, but there is apparently a rather delicate balance between the work inside the hive and the work in the field, for if the work inside the hive is interrupted in any way the work of the field bees slows down accordingly. Therefore those factors already discussed which tend to produce congestion and idleness among the young workers within the brood nest during a honey flow quickly add greatly to the number of unemployed bees by causing the field bees to remain in the hive instead of going to the fields.

If for any reason the expansion of the activity of the hive workers is interrupted a stagnation of the activity within the hive must follow, which in turn causes more and more stagnation in the field work. Such a condition may arise if the young bees do not readily enter and occupy the first super that is given, if additional room is not given promptly to keep pace with the increasing number of oncoming young bees, if all the available space for evaporating nectar is in use, if the hive workers are driven out of the supers into the brood chamber by heat or lack of ventilation, if the newly added supers are too remote or otherwise unattractive, or if so much of the work is being finished that the new and unfinished work is less than that needed to employ most of the hive workers. When the field workers stay within the hive in increasing numbers during a honey flow, preparation for swarming is the usual result. In this way a slight interference with the activities of the hive workers may quickly develop into a serious condition which might easily have been avoided if taken in time.

When the field bees are confined to their hives by several days of rain just previous to or during the swarming season, the result may be a greatly increased tendency to swarm. Sometimes two weeks of rain at about the time of the normal swarming season is followed by intense swarming. When the field bees remain in their hives a part of the time during the honey flow because the flowers yield nectar erratically the tendency to swarm may be greatly increased. The presence of the great mass of field bees within the hive during the heat of the day from any of these causes must add greatly to the tendency to swarm, especially when the bees crowd in great masses in the space below the frames and in the lower portion of the brood chamber, as they usually do when they are in their hives temporarily during the honey flow.

In extracted-honey production it is not difficult by good management to prevent a crowding of the brood nest during the honey flow by either young bees or field bees, except in the last two cases mentioned. Both of these conditions are frequently encountered, especially in the northeastern portion of the United States in the clover region. There is, of course, no way by which the field bees can be prevented from staying in their hives in either case, even if it were desirable to do so, but by providing a deep space below the frames and an abundance of ventilation, together with adequate protection from the direct rays of the sun, the discomfort of the colony brought about by the field bees within the hive during the day may be considerably relieved.

To prevent swarming to the greatest extent it is necessary to induce most of the hive workers to leave the brood nest early in their lives to take up work in the supers, so that the bees of the hive are distributed over a large comb surface, which in turn should stimulate the field bees to go to the field in greater numbers. During the heat of the day no more bees should remain within the brood chamber than are needed for the work to be done there. Such a distribution and employment of the hive workers usually induces the field workers to put forth the greatest energy in gathering nectar.

## NATURAL SWARMING

After having used all the known preventive measures, there will still be some colonies that attempt to swarm in certain locations in some seasons, even in extracted-honey production, and in comb-honey production a large percentage of colonies may attempt to swarm. In either case, but especially in extracted-honey production, some of these swarms are probably a result of the imperfect application of preventive measures in time to prevent the beginning of the series of events which lead up to the actual issuing of the swarm. Except in certain localities, the beekeeper whose equipment and management meet the requirements previously outlined in this bulletin as swarm preventive measures should be troubled little by swarming if extracted honey is being produced.

### CORRECTION OF CONGESTION BY SWARMING

The conditions within the brood chamber are changed greatly by swarming, both in the swarm and in the parent colony. In the swarm there are no very young bees and, of course, no emerging bees during the first three weeks. The workers of the swarm that are not needed for the work inside the new hive are old enough for work in the fields, and when most of the bees of a colony can go to the fields for nectar during the heat of the day a surprisingly large number may be massed together in one hive without causing a stagnation of their activities. When the first young bees begin to emerge three weeks later the daily emergence of young is small in comparison with that of a colony during the spring brood-rearing period; therefore the swarms usually do not become greatly congested with young bees again during the same season. Swarms that are hived in an empty hive on a new location seldom swarm again the same season, especially where the season is short, but if they are hived on empty combs or combs containing honey or a little emerging brood they may do so. Even when most of the workers of both the parent colony and the swarm are reunited, or when two or more swarms are hived together in one hive, the bees are usually satisfied without further swarming if plenty of room is given in the supers.

The parent colony loses most of its field workers and the queen when a swarm issues, but it has a large amount of brood and several queen cells usually sealed or nearly ready to be sealed at the time of the issuing of the swarm. When the young queens begin to emerge about a week later, if the beekeeper does not interfere, the colony may cast one or more after-swarms, each accompanied by one or more of the recently emerged virgin queens. When there are no longer sufficient bees left to divide up among the emerging queens, all but one of the young queens are killed, this surviving one in the normal course of events later becoming established as the new mother of the parent colony. The rapid emergence of young bees soon restores the parent colony to good strength, but when swarming takes place during the honey flow the parent colony may not recover sufficient strength in field workers to take an important part in gathering the season's crop of honey. After the young queen becomes established a parent colony seldom swarms again the same season, even though it may become quite populous and the season may be prosperous.

Thus neither the swarm having the old queen and the older bees in establishing itself in a new home, nor the parent colony having the young queen in reestablishing itself in the old home, is inclined to swarm again the same season. In each case there is an interruption in the emergence of young bees. These are important facts in the control of swarming.

### INFLUENCE OF YOUNG QUEENS

The fact that parent colonies seldom swarm again the same season has led to the belief that colonies having young queens do not swarm the first summer of the queen's life, but while such colonies are less inclined to swarm the use of young queens can not be depended upon except under certain conditions. If a young queen is introduced into a colony previous to the swarming season after a period of queenlessness, so that there is a period of 10 days during which no eggs are laid, there is usually no attempt to swarm again during the same season, especially if this interval of no egg laying occurs late enough so that the young queen is not able to reach her maximum of egg laying before the close of the honey flow. If, however, the old queen is removed from a colony previous to the swarming season and a young laying queen is introduced at once without an interval of no egg laying, the tendency to swarm may be reduced little, if

any. The condition of the colony brought about by a period of queenlessness is apparently a greater factor in reducing the tendency to swarm than the age of the queen, for if the old queen is removed or caged within the hive for 10 days and then reintroduced, no queen cells being permitted to mature in the meantime, the bees give up swarming frequently for the remainder of the season. Colonies which have both a young queen and the interval of queenlessness usually may be considered safe from swarming again the same season, especially in the North. Such colonies are comparable to the parent colony in nature.

### VARIATION IN TIME OF SWARMING SEASON IN RELATION TO THE HONEY FLOW

Since the time of the swarming season is apparently determined largely by the great expansion of spring brood rearing, it does not necessarily coincide with the main honey flow of the season, although the honey flow may greatly modify the tendency to swarm (p. 7). The time of the swarming season with reference to the time of the main honey flow is a factor of importance in choosing the proper management of colonies that swarm or prepare to swarm.

(1) In some localities, particularly in some of the Southern States, the main honey flow may not occur until six or eight weeks after the swarming season. The colonies may reach their maximum strength during the spring brood-rearing period and swarming may be stimulated by a light honey flow. There may be considerable swarming even when the colonies are securing no more than a living from the fields, and sometimes bees may swarm even when it is necessary to feed the newly hived swarms to prevent starvation. If there is a complete dearth of nectar at this time, however, the bees usually give up swarming and greatly reduce their brood-rearing activities. Such colonies after having reached their maximum strength in the spring are not inclined to rear brood extensively again until the honey flow begins. Under these conditions the colonies arrive at the beginning of the honey flow with a large proportion of old bees and usually do not swarm during the honey flow unless it is of sufficient duration for the bees to fill their hives again with brood and to become crowded with young bees before its close. Swarming is not difficult to control under these circumstances unless the bees are gathering a little more than a living at the time of the swarming season, and usually the addition of an abundance of room in the form of empty combs with the brood extending through two or more stories of the hive will practically prevent swarming under these conditions.

When swarming occurs six weeks or more previous to the beginning of the main honey flow, both the parent colony and the swarm should be given every advantage to enable them to build up again to full strength, so that both may gather a full crop. In such a locality, if natural swarming is permitted, all afterswarming should be prevented (p. 14). It is better, however, to divide the colonies, some time before they have reached their maximum in spring brood rearing, into two parts, supplying the queenless portion with a young queen, thus postponing the maximum egg laying on the part of the old queen until later. This division prevents swarming during the normal swarming season, and, if adequate stores are supplied, should result later in two colonies in splendid condition for the honey flow. Colonies should not be divided previous to the honey flow, however, unless this can be done at least five or six weeks before the beginning of the main honey flow, for this much time is needed for them to build up to full strength.

Another plan for controlling swarming so long previous to the main honey flow is that of keeping the colonies below swarming strength by removing some of the bees, to be sold as package bees, where the beekeeper is so located that he can sell them profitably and does not desire to make further increase.

Some beekeepers who are located where the honey flow occurs some time after the swarming season are able to move their colonies to other locations which furnish a honey flow at this time, thus bringing the honey flow and the swarming season together.

(2) When the honey flow occurs during the swarming season, as in the clover region of the Northern States, the tendency to swarm is usually strong, while the main honey flow is usually short. Under these conditions the colonies should not be permitted to divide their working forces by swarming, but most of the bees should be massed during the honey flow, either in the swarm or in the parent colony. In regions where the swarming season and the honey flow coin-

cide, swarming is more difficult to control, especially if the field bees are confined to their hives a part of the time during the day by showers or by erratic yielding of nectar (p. 10), and the greatest precaution as to preventive measures is necessary. Remedial measures applicable here are discussed later in this bulletin.

(3) When the main honey flow of the season occurs previous to the time the bees are in condition to swarm, the full crop can not be harvested because the colonies must utilize the honey flow for building up to full strength. This condition is found in many localities in which the main honey flow occurs quite early, if the management is not directed toward the early development of the colonies. The obvious remedy for this condition is a change in the management which may enable the bees to become sufficiently strong in time for the honey flow. (See Farmers' Bulletins Nos. 1012, 1014, and 1039.)

### HIVING NATURAL SWARMS

The beekeeper who is operating but one apiary and expects to be present during the swarming season usually prefers to take precautions to prevent swarming as much as practicable, then hive the swarms that issue, rather than to examine all the colonies each week to anticipate swarming. If outapiaries are being operated, or if the beekeeper is away from home during the day, natural swarming should not be permitted.

When natural swarming is permitted, the work of hiving the swarms is easier if the queens' wings are clipped[1] previous to the swarming season. This does not prevent swarming but it does prevent the swarm from leaving and averts the necessity of taking swarms down from tall trees or other inaccessible places, since a clipped queen can not go with the swarm and the bees will return to the hive. If by chance another swarm having a queen that can fly happens to be out at the same time and unites with the queenless one, the swarm can not be expected to return. The best time to clip the wings of the queen is usually during some early honey flow, like that from fruit bloom, before the colonies have become very populous. In the production of extracted honey and when the best swarm-control measures are employed, the clipping of the queens' wings is unnecessary and the practice is becoming less common.

Swarms that issue during the honey flow or just previous to the beginning of the honey flow should not be placed in a new location separated from the parent colony, since to do so would divide the working force of the colony, but the parent colony should be moved a short distance to one side and the new hive for the swarm put in its place. In this way the field force is all given to the swarm, which now becomes the producing colony.

The hive of the parent colony should be moved while the swarm is out, the new hive put in its place, and the partially filled supers transferred from the parent colony to the new hive, which is then ready to receive the swarm. The hive entrance of the parent colony should be turned away from its former position (fig. 3) in order that the swarm may be hived in the new hive without a part of the bees entering the hive of the parent colony. It is sometimes advisable to cover the old hive with a cloth while the swarm is being hived if bees attempt to enter it.

If the queen's wings have not been clipped, the swarm after having clustered may be shaken into a basket or a light box, which may be attached to the end of a pole, if need be. They should then be dumped immediately

[1] To find the queen, take out one or two of the outside combs from the side of the hive next to the operator. If the queen is not on these combs, set them aside in order that the remaining combs may be more readily examined. If robbers are troublesome these combs must be put into an empty hive or a light box that will hold two or three frames and kept covered while they are out of the hive. As each of the remaining combs is removed from the hive, glance quickly over the exposed side of the next comb in the hive to see if the queen is there. If she is not there, turn the comb just removed to examine the other side and proceed in this way until the queen is found. As the combs are examined they are placed back into the hive on the side nearest the operator in order to maintain an open space between the combs already examined and those yet to be examined. This work should be done rapidly and no more smoke should be used than is necessary for rapid work. If the bees are inclined to be nervous and run on the combs it is necessary to watch for the queen in the spaces between the lower edge of the comb and the bottom bar of the frames, and also on the bottom sides of the hive, for if the queen becomes frightened she may run off of the combs into these spaces.

When the queen is found she may be picked up by taking hold of her wings with the thumb and forefinger of the right hand. She is then transferred to the left hand and held lightly either by the thorax or by her feet. The right hand is now free to pick up a pair of small sharp-pointed scissors and clip off the major portions of the wings on one side. The queen is now transferred back to the comb by taking hold of the remaining wing.

in front of the prepared hive, which should be arranged so they will not crawl under it, but can readily enter (fig. 4). A wide board, a cloth, or a newspaper may be used for a bridge to the entrance. If the bees do not begin to enter the hive at once, some of those nearest the entrance may be pushed in with a brush or a large feather. If some start to run away from the entrance they may be gently brushed toward it. The bees should

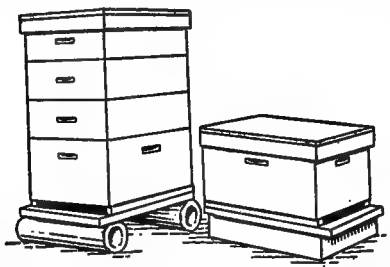


FIG. 3.—While the swarm is out, the hive of the parent colony is turned away, the new hive put in its place, and the supers transferred to the new hive, which is now ready to receive the swarm

not be permitted to crawl up the sides of the hive and cluster outside, but all should be induced to enter.

If the queen's wings are clipped, the operator should be ready to watch for and catch the queen while the swarm is issuing. When the queen is found she should be placed in a wire-cloth cage and put on the shady side of the hive until the swarm returns. The swarm may return and enter the new hive without clustering, in which case the cage containing the queen may be thrust part way into the entrance of the new hive, but the queen should not be released among the returning bees until after many of them have entered the hive, because the bees may again take wing if the queen is released too soon. If the bees cluster where they are readily accessible, it may not be advisable to wait for them to return of their own accord, since other swarms may issue and several of them join the cluster. They may be handled in hiving the same as though their queen were with them. A wire-cloth cage large enough to be set over a hive (fig. 5) is sometimes useful if many swarms issue at one time, for one of these may be placed over any colony just starting to swarm to catch the swarm as it issues, thus preventing the confusion usually brought about when several swarms unite.

## PREVENTION OF AFTERSWARMS AND DISPOSITION OF THE PARENT COLONY

By this method of hiving swarms the bees are soon at work again with renewed energy in the same set of supers which a short time previously they were so eagerly deserting. The field force has not been reduced, the returning field bees from the parent colony all entering the new hive, since it is located where the old one stood. Frequently such colonies store even more honey than colonies that do not attempt to swarm. As soon as the swarm is established in the new hive the entrance of the parent colony should be turned back toward its former position (fig. 6), and a day or two later it should again be turned, so that the two hives now stand side

FIG. 4.—Swarm entering new hive

by side, having their entrances close together (fig. 7).

If extracted honey is being produced the parent colony and the swarm can be reunited a day or two later by first destroying all the queen cells in the parent colony, then placing the hive body containing it (without bottom or cover) on top of the supers on the new swarm in the same manner as an additional super. In this way the parent colony and the swarm are in the same hive, forming a single colony, the queen and the new brood chamber being below the

supers and separated from them by a queen excluder while the parent colony is above the supers. Nine or ten days after the swarm has issued any queen cells that the bees may have built in the parent colony during this interval should be destroyed. Under certain conditions, not yet fully explained, this has not been found necessary if the parent colony is separated from the swarm by at least two full-depth extracting supers, but with less than this distance between, such colonies may swarm when the young queens in the parent colony begin to emerge.

If increase is desired, this brood chamber may be taken away a week after the swarm has issued, to form a new colony. In this case the queen cells should not be destroyed. If too many bees cling to the old brood chamber the bees from all but three or four of the combs may be shaken into the supers in order to strengthen the swarm and also to make the parent colony too weak to cast an afterswarm. The combs containing

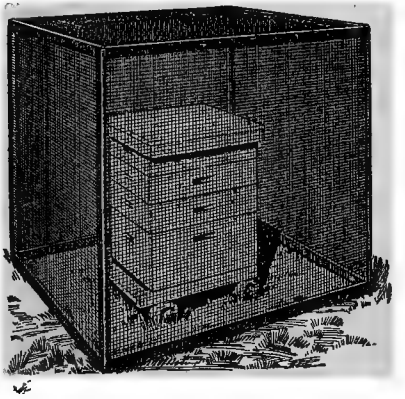


Fig. 5.—Cage arranged to catch issuing swarm. Especially useful when several swarms issue at about the same time

the best queen cells should not be shaken because of the danger of injuring the immature queens. If some combs having queen cells are shaken the cells should be destroyed to prevent the emergence of any injured queens. If choice queen cells from a breeding queen are available, all the cells on the combs from the parent colony should be destroyed and one of the choice cells should be given.

When comb honey is being produced the parent colony can not well be united with the swarm directly in this way, but it should be left beside the swarm six or seven days, for on the eighth day the parent colony would normally cast its first afterswarm. It should then be moved away and given a new location well separated from other colonies in another part of the apiary. This should be done when the young bees that have learned to fly during the week are flying freely, preferably early in the afternoon, and the hive should be carried away and placed on its new stand so carefully

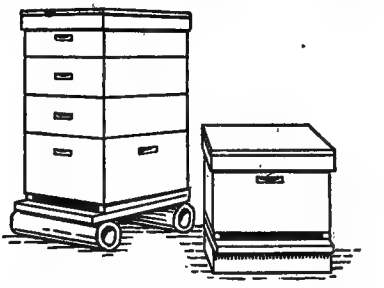


Fig. 6.—After the swarm has entered the new hive the hive of the parent colony is turned toward its former position

that the bees are not disturbed, in order that they will go to the fields without noting the change in their surroundings. If this is done carefully, all of the field bees when returning from the field will return to their former location, where they must enter the other hive and unite with the swarm. This adds a large number of young workers to the swarm, where they are of the greatest value at this time, and at the same time so reduces the number of bees in the parent colony that afterswarming is given up.

The successful prevention of afterswarming by this method depends upon the completeness of the reduction of the population of the parent colony just before the time for the issuing of the first afterswarm. If anything should prevent this reduction at the right time, such as confinement of the bees to the hive for a day or two by bad weather at the time the parent hive is moved away, or the emergence of the young queens earlier or later than expected, colonies treated in this way may have enough bees when the first young queen emerges to send out an afterswarm. Under such conditions it may be necessary to shake the bees from several of the combs of the parent colony, uniting them with the swarm at the time the hive is moved away, to be sure of a depletion of the parent colony sufficient to prevent

afterswarming. Usually, however, this method can be depended upon without opening the hives to note the advancement of the queen cells or to shake out any of the bees.

If no increase is desired the parent colony may be moved to the opposite side of the swarm instead of to a more distant location, and it can be united with the swarm at the close of the honey flow. In doing this it may be necessary to place the parent colony some distance beyond the swarm and turn its entrance away from that of the swarm, temporarily to keep the returning young bees from finding their hive, as they may do if it is placed on the opposite side with its entrance close to that of the swarm.

FIG. 7.—A day or two later the hive of the parent colony is placed close to that of the swarm. Seven days later it is removed

### INTERRUPTION OF WORK IN SUPERS UNDESIRABLE

When swarms are hived during the honey flow in the manner described above, it is important that conditions within the new hive be such that the energy of the newly hived swarm is directed from the beginning chiefly to the work in the supers instead of to work in the new brood chamber. This is especially important during a short honey flow, for the season may close before profitable work in the supers is resumed if the colony first fills the brood chamber. Furthermore, a temporary cessation of work in the supers while the new brood chamber is being filled may result later in a stagnation of the work of the colony, brought about by a concentration of work in the brood chamber. This applies particularly to comb-honey production, since in extracted-honey production there should be little if any interruption of the work in the supers after the swarm has been hived, unless the swarm is unusually small or unless the new brood chamber is unusually large. The furniture used in the new brood chamber, the size of the new brood chamber, the number of bees in the swarm, the attractiveness of the supers (p. 7), and the character of the honey flow all affect the continuity of the work in the supers when a swarm is hived.

### INFLUENCE OF FURNITURE USED IN THE NEW HIVE

The brood chamber in which a swarm is to be hived may be furnished with (1) frames that are empty except a narrow strip of foundation about an inch in width to guide the bees in comb building, (2) frames containing full sheets of foundation, (3) frames containing full sheets of foundation, together with one or more frames filled with comb, (4) combs of unsealed or mostly unsealed honey, (5) combs of emerging brood in which no eggs have been laid for at least 10 days (usually taken from a parent colony 10 days after the swarm issued, first having all queen cells destroyed), and (6) empty combs. There is a great difference in the work in the supers after the swarm is hived, depending upon which of these is used. The least interruption in the work in the supers usually occurs when only narrow strips of foundation are used in the frames in the new brood chamber, and the greatest interruption in the work in the supers usually occurs when a full set of empty combs is used. As to the degree of interruption of the work in the supers, the other combinations of furniture occupy an intermediate position between these two extremes, usually in the order named. When either narrow strips of foundation or full sheets of foundation are used in the frames in the new brood chamber and the supers are transferred to the swarm at the time of hiving, there being no vacant cells in the new brood chamber and comb building being in progress in the supers, the incoming nectar is taken to the supers. Under these conditions there is practically no interruption in the work in the supers, the work in the brood chamber usually being carried on slowly for some time, especially if only narrow strips of foundation are used. In sharp contrast with this, if a full set of empty combs is used in the new brood chamber when the swarm is hived, the work in the supers is usually neglected, the energy of the colony being directed chiefly to filling the brood chamber with honey and brood, but after these combs have been filled such colonies usually work indifferently in comb-honey supers.

A single empty comb together with frames of foundation affords such a limited number of empty cells immediately available within the brood chamber that its use does not tend to reduce the work in the supers materially and it affords storage space for incoming pollen which might otherwise be carried to the supers. The use of a single empty comb also greatly reduces the tendency to swarm out (p. 17). When combs of honey which are mostly unsealed are used, the bees may begin to transfer this honey into the supers almost immediately after being hived. When combs containing only sealed and emerging brood together with honey and pollen are used, there are so few vacant cells that these are usually prepared to receive the eggs as the queen resumes egg laying, so that most of the incoming nectar must be taken to the supers. As the remaining brood emerges the vacated cells are usually prepared for eggs until toward the close of the honey flow.

The furniture used in the new brood chamber also has an influence upon the tendency to swarm again the same season. When the bees build a set of new combs from narrow strips of foundation or full sheets of foundation they rarely swarm again, but when swarms are hived on combs of emerging brood, empty combs, or combs of honey, sometimes many of them may attempt to swarm again the same season if the honey flow is of considerable duration. As to the effect upon this tendency, the various combinations of furniture for the new brood chamber usually stand in the following order, increasing through the series: (1) Narrow strips of foundation, (2) full sheets of foundation, (3) full sheets of foundation together with one or more empty combs, (4) empty combs, (5) combs of honey, and (6) combs of emerging brood.

Although narrow strips of foundation stand first, both as to forcing immediate work in the supers and as to reducing the tendency to swarm again the same season, their use is open to the serious objection that so much drone comb is usually built that many of the combs built in this way are not suitable for subsequent use in the brood chamber. Some comb-honey producers, however, use them, then at the close of the honey flow unite the parent colony and the swarm, placing the brood chamber of the parent colony above that of the swarm; then in the fall the lower brood chamber may be removed and the now empty combs cut out to be rendered into wax. Many comb-honey producers prefer to use full sheets of foundation in all the frames or in all but one of the frames of the new brood chamber for hiving swarms.

When either narrow strips of foundation or full sheets of foundation are used in the new brood chamber, a queen excluder should be used when the supers are transferred from the parent colony to the swarm at the time of hiving, and precautions should be taken also against swarming out (p. 17).

### CONTRACTION OF THE BROOD CHAMBER

If the new brood chamber is contracted so that little work is required to fill it and so that most of the bees of the colony are crowded into the supers, the work in the supers should continue without interruption after a swarm has been hived. It was formerly a common practice to reduce the new brood chamber to five or six Langstroth frames by inserting division boards at the sides of the hive to fill out the remaining space. This should not be done until two or three days after the swarm has been hived, for contracting the brood chamber at the time of hiving the swarm may cause the bees to swarm out.

Contraction of the brood chamber forces the bees to do most of their work in the supers; therefore a good crop of honey may be obtained in this way even during a short honey flow, but after the honey has been removed from the hive at the close of the season such colonies are practically without stores and should either be reunited with the parent colony or supplied with a sufficient quantity of honey for fall and winter stores. This can be done easily by leaving for the bees a second hive body with combs which are practically filled with sealed honey.

Combs of honey and combs containing only sealed brood, together with honey and pollen in the new brood chamber, have an effect similar to that of contraction of the brood chamber. Combs with most of the honey sealed should not be used for this purpose unless they are placed at the sides, since such combs in the middle of the new brood chamber may cause a stagnation of colony activity (pp. 7 and 8).

### SWARMING OUT

After a swarm has been hived it sometimes deserts the new hive or "swarms out." This may occur the day the swarm is hived, or the next

day, and sometimes even on the third day after hiving. It may occur either with natural swarms or with artificial swarms. Swarming out apparently is often caused by a lack of room in the new hive or by discomfort from some other cause, though occasionally a newly hived swarm may leave the hive when no cause for their dissatisfaction is apparent. This trouble may be prevented or greatly reduced by placing an empty hive body, without frames, below the new brood chamber for two or three days, by providing ample ventilation and shade for the new hive at the time of hiving the swarm, and by using one or more empty combs which have been used previously for brood rearing in the new brood chamber instead of frames of foundation exclusively. Combs of unsealed brood are not recommended for this purpose. Entrance guards or queen traps may be placed on the entrance of the new hive for a few days to prevent the escape of the queen, if newly hived swarms are inclined to swarm out, but the trouble usually can be prevented by making provision for the comfort of the bees, especially for the first day or two.

When artificial swarming is practiced (p. 19) in comb-honey production, swarming out can be prevented by taking away the combs of brood in two installments, with an interval of three or four days between. In the first operation half or more of the brood should be taken away and frames of foundation given in their place, and three or four days later all the remaining combs of brood should be removed.

### UTILIZING THE PARENT COLONY FOR PRODUCTION

In the usual plan for hiving natural swarms, the swarm is used as the producing colony, the parent colony being deprived of most of its bees to give greater strength to the swarm. The massing of most of the bees of both the swarm and the parent colony into one hive is necessary for best results when swarming occurs during the honey flow and especially so when the honey flow is short. It is, however, sometimes desirable to mass the bees together in the parent colony instead of in the swarm. This may be accomplished by returning the swarm without the queen to the hive from which it came. Seven days later all but one of the queen cells should be destroyed, the remaining cell being left to requeen the colony.

Great care must be taken in destroying the queen cells to be sure that only one is left, for if more than one queen cell is left the colony may be expected to swarm soon after the first young queen emerges. It is usually necessary to shake most of the bees from each comb as the combs are examined for queen cells in order to be sure that no queen cells are overlooked. The comb containing the queen cell that is to be left should not be shaken, since if this is done the immature queen may be injured.

It sometimes happens that some colonies treated in this way will swarm soon after the young queen emerges from the one cell that was left, leaving the parent colony greatly depleted in bees and hopelessly queenless. Again, the queen may fail to emerge, in which case, unless a queen or another queen cell is supplied promptly, the colony, being hopelessly queenless, works with reduced energy and later, of course, would become depleted. For these reasons some beekeepers prefer to destroy all the queen cells five days after the swarm has issued, then again five days later, at which time a young laying queen is introduced by means of an ordinary introducing cage.

By hiving the swarm back into its own hive without the queen and permitting the colony to rear only one young queen, or leaving them queenless 10 days and then introducing a laying queen, the colony is left in a condition comparable to the parent colony in nature, except that it retains all of the workers instead of losing the bees of the swarm. Such colonies usually do not swarm again the same season. This method does not require extra hives and equipment, but it probably involves some loss in the less energetic work while the colonies are queenless.

## TREATMENT TO ANTICIPATE SWARMING

The emphasis given to the care of natural swarms on the preceding pages is largely for the purpose of bringing out the principles which underlie the successful methods used to anticipate swarming. Commercial honey producers who operate several apiaries can not afford to permit natural swarming but must use some system by which swarming can be controlled by visiting each apiary at certain intervals and applying remedial measures if preventive measures are not sufficient. Producers of extracted honey who have good combs, good equipment, and a good strain of bees

usually can control swarming to a sufficient degree, in many locations at least, by ordinary preventive measures and good management, so that it is not necessary to examine every colony once a week to see if preparations for swarming are being made. In some locations, however, the swarming tendency is so strong (p. 6) that the greatest skill in the application of preventive measures is not sufficient to prevent loss, and some remedial measure must be applied.

Comb-honey producers in regions suitable for commercial comb-honey production (see Farmers' Bulletin 1039) find that although preventive measures may greatly reduce swarming it is usually necessary to treat many of the colonies for swarming during ordinary seasons, while during occasional seasons it may be necessary to treat most of them.

Swarming can be anticipated by creating conditions within the hive comparable either to those of a recently hived swarm or to those of the parent colony, and it is not necessary to wait until the swarm actually leaves the hive to do these things. In either case the necessary steps can be taken at the convenience of the beekeeper before the colony casts a swarm. To anticipate swarming, the beekeeper, therefore, as the first step, either takes away the combs of brood and arranges for the establishment of a new brood nest, or he takes away the queen and destroys all queen cells, if any are present. In some cases the removed brood is not taken entirely away from the colony but is separated from the queen and the new brood chamber by means of a queen excluder, and in some cases the queen is not taken from the hive but is caged within the hive during the required interval, then released among the combs of brood. The subsequent behavior of the colony is practically the same as that of a natural swarm in the one case and that of the parent colony in the other.

In the operation of out-apiaries or of any apiary in which an attendant is not present the beekeeper should use every precaution to prevent swarming (pp. 3–10); then, as the swarming season approaches, it may be necessary for him to examine the strongest colonies to determine if queen cells are being built. If any such are found, it now becomes necessary either to begin a systematic examination of each colony every week or 10 days during the swarming season for indications of preparations for swarming and to treat those colonies which need treatment, or to treat all of the colonies, whether or not preparations are being made for swarming. Much will depend upon circumstances as to which of these plans is more desirable. The uncertainty of weather conditions during the early honey flow in many parts of the country makes it difficult in comb-honey production to devise any system that will work out advantageously year after year by which all the colonies can be treated at the same time. In extracted-honey production, however, this may well be done.

If the plan of examining each colony for queen cells once a week is to be carried out, the queen cells in colonies which contain only eggs or small larvæ are destroyed, since some colonies will give up swarming when this is done. If the queen cells are well advanced, containing large larvæ, the colony should be treated at once, since the removal of such queen cells can not be expected to deter swarming. When destroying newly started queen cells in this way most of the bees should be shaken from the combs as they are examined, to be sure that none are missed, since if but one queen cell is left the destruction of the remainder of the cells would have no effect upon the preparations for swarming.

The methods given in the following paragraphs are illustrative of different types of remedial measures. The various methods here outlined are by no means equally suitable for every locality or every season in a given locality. It is necessary for each beekeeper to work out a system for swarm control to meet the requirements of his particular locality and season. The underlying principles, however, are the same throughout the multitude of methods, and the following outlines are given to illustrate the principles involved, rather than to indicate definite systems to be followed.

### CREATING CONDITIONS COMPARABLE TO THE SWARM [2]

1. Shake the bees from their brood combs back into the brood chamber,

[2] Colonies that are building queen cells in preparation for supersedure should not be subjected to this treatment, but the failing queen should be removed, the queen cells destroyed, and the colony treated as a parent colony (p. 23). Such colonies can be distinguished from normal colonies which are preparing to swarm by the imperfect work of the queen, the smaller number of queen cells, and the general condition of the colony as to population and proportion of emerging bees.

placing the combs of brood in an extra hive body as the bees are shaken from them and putting in their places frames of foundation and one empty comb, or whatever is to be used in establishing the new brood nest as in hiving swarms (p. 16). To avoid the necessity of finding the queen, the combs should be shaken or brushed sufficiently free of bees to insure that the queen is left in the hive when the brood is all taken away. If extracted honey is being produced, put a queen excluder over the brood chamber, replace the supers, and finally place the hive body now containing the removed brood on top as though it were an additional super, first destroying all queen cells if any have been started. Ten days later again destroy all queen cells that are built on the combs of brood now above the supers.

To accomplish the same thing without shaking the bees from the combs, find the queen and place her, together with a comb of brood and adhering bees, in an extra hive body which is filled with frames of foundation or empty combs as described above. Lift the original brood chamber from the bottom board and put the extra hive body now containing the queen in its place. Put the queen excluder and the supers in place and finally place the original brood chamber above the supers, first destroying all queen cells, if any have been built. Ten days later destroy all queen cells in the original brood chamber. When a comb of brood is placed in the new brood chamber in this way, care must be taken that it does not contain any queen cells, and if preparation for swarming is general in the apiary it is not advisable permanently to leave this comb in the new brood chamber, because if preparation for swarming has already been in progress the bees sometimes start queen cells on this comb of brood and later cast a swarm. When the bees are inclined to do this, the frame of brood should be removed a few days after the treatment.

As the brood emerges in the original brood chamber the vacated cells are filled with honey during a good honey flow and the former brood chamber now becomes a super. If it contained some inferior honey when it was put above, which would reduce the quality of the crop, it may be better to reserve these combs of honey for winter stores. If increase is desired, this upper hive body of emerging brood may be removed from the hive a week or 10 days after it was put up and used to form a new colony. When this is done, the queen cells should not be destroyed, unless it is desirable to give this new colony a queen cell reared from better stock (see p. 3). If a queen excluder has not been in use previously, it will be more difficult to find the queen as well as to destroy the queen cells.

When comb honey is being produced the procedure is practically the same, except in the disposition of the brood that is removed. This can not well be placed above the comb-honey supers and the emerging bees added to the colony, as when producing extracted honey, but the emerging brood may be placed in a separate hive located by the side of the original hive (fig. 7), so that a large number of the emerging bees may be united later with the swarm when they are old enough for field work, simply by moving the hive to another location while these young bees are at work in the fields (see p. 15).

When the brood is removed in comb-honey production it is necessary, therefore, to leave enough bees with the brood to care for it. This can be done by placing the hive body which contains the brood back on the hive immediately after the shaking is complete, but placing it above a queen excluder until enough bees return to these combs to care for the brood before it is established as a separate hive. Another way to do this is to find the queen before shaking any bees from the combs, then transfer two or three combs to the extra hive body without shaking off the adhering bees, in order to have bees enough in this hive to care for the brood, the queen, of course, being put back into the brood chamber on the old stand. In either case, if increase is made from this removed brood, these new colonies should be supplied with good queen cells, since when artificial swarms are made in this way conditions often are not as favorable for the development of a good queen as in the case of the parent colony in natural swarming.

2. Use two hive bodies for brood rearing previous to the swarming season. For extracted honey, add supers of empty combs above these two hive bodies as soon as more room is needed and do not use a queen excluder (fig. 8, *A*). Under these conditions the queen usually abandons the lower hive body as the season advances (fig. 8, *B*). Ten days or more after she has abandoned it, when all the remaining brood in this hive body will have been sealed, find the queen,

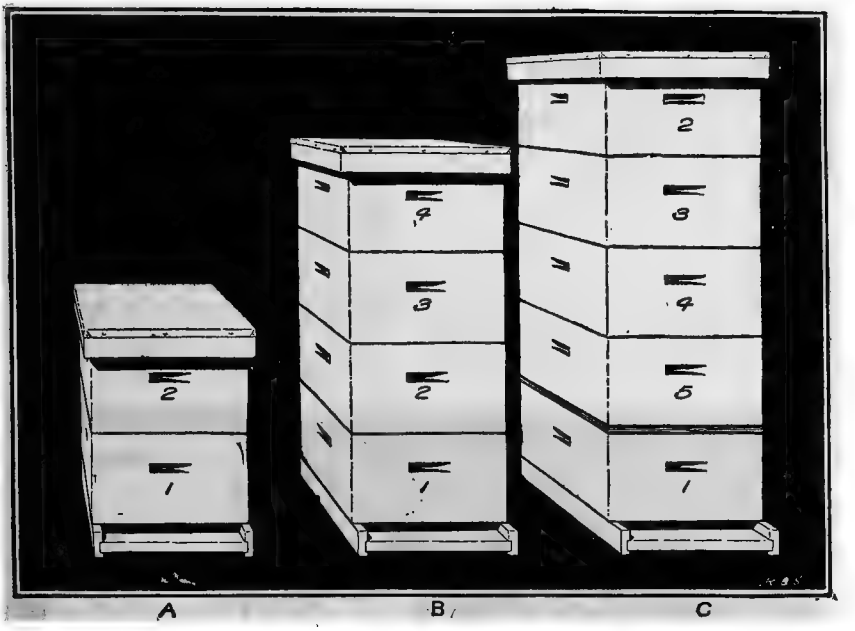



FIG. 8.—Creating conditions comparable to a swarm. Plan 2 for extracted honey. *A*, Brood in both hive bodies in the spring. *B*, Supers *3* and *4* are added as more room is needed, queen usually abandoning lower brood chamber (*1*). *C*, Queen placed below excluder in lower hive body (*1*) after all brood in this chamber has been sealed. Empty super (*5*) is added and brood (*2*) is placed on top


FIG. 9.—Creating conditions comparable to a swarm, but later comparable to a parent colony. Plan 2 modified for comb honey. *A*, Brood in both stories in the spring. *B*, Queen excluder inserted 10 days previous to honey flow. *C*, Queen transferred to brood chamber from which she has been excluded at beginning of honey flow. In the illustration it is assumed for convenience that the queen was confined to *2* when the excluder was inserted, which is here shown at the right as a separate hive supplied with a ripe queen cell. The queen may have been confined to *1* instead, in which case she is transferred to *2*, which is left on the old stand, and the queen cell is given to *1*, which is placed at one side. *D*, The brood chamber containing the young queen (*2*) is substituted for the one containing the old queen (*1*) after the young queen has begun to lay

put her into the lower hive body, and confine her there by means of a queen excluder (fig. 8, *C*). Place the supers directly above the queen excluder and finally place the hive bodies recently occupied by the queen on top of the supers. Conditions now are similar to those present when a swarm is hived on frames containing none but emerging brood together with pollen and honey and the parent colony is placed on top of the supers (p. 14). Ten days later the queen cells that have been built in the meantime usually should be destroyed, though this is not always necessary (p. 15).

This plan is useful in extracted-honey production provided the honey flow is not greatly prolonged. It may not be sufficient completely to control swarming during a prolonged honey flow, since the colonies may later again prepare to swarm. For a long honey flow plan No. 3 may be preferable.

This plan does not lend itself readily to comb-honey production, because bees usually do not begin work well in comb-honey supers when two hive bodies are used for the brood (fig. 9, *A*), and the queen therefore may not abandon the lower hive body, as she does when extracting combs are used in the supers. For comb-honey production, however, a queen excluder may be inserted between the two hive bodies 10 days previous to the time of putting on the comb-honey supers, the queen being in this way excluded from one of them (fig. 9, *B*). After 10 days, by removing and examining a single comb for eggs and larvæ, it can be determined which hive body contains the queen. The queen should then be transferred to the hive body from which she has been excluded either by finding her or by shaking all of the bees, including the queen, from the combs. The hive body to which the queen has just been transferred is left on the old stand as the new brood chamber and the hive body from which she was taken is now removed and managed as a parent colony (fig. 9, *C*). This treatment may be sufficient when the honey flow is short in duration, but if the honey flow is long, swarming may be only delayed by this process. However, by giving a ripe queen cell to the parent colony soon after the division is made, then after the young queen begins to lay substituting the brood chamber containing the young queen for the brood chamber containing the old queen, conditions comparable to the parent colony (p. 23) are created (fig. 9, *D*). Such colonies, as a rule, do not attempt to swarm again the same season.

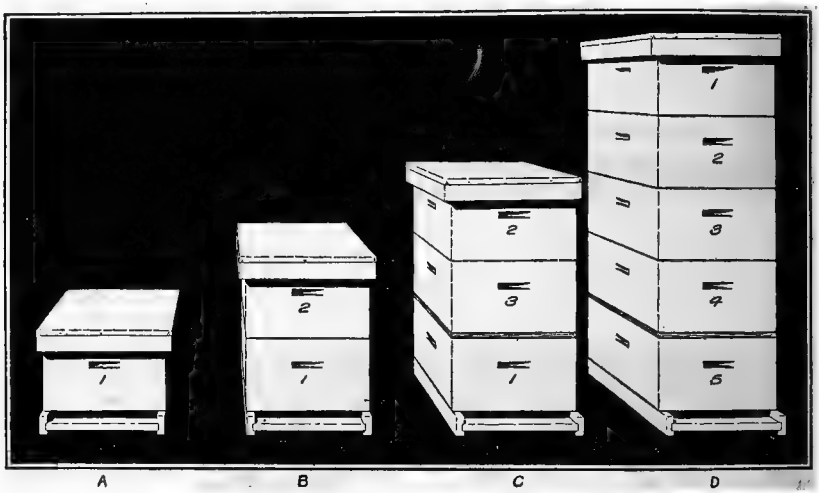



FIG. 10.—Creating conditions comparable to a swarm. Plan 3 for extracted honey. *A*, Colony in single story in early spring. *B*, Second brood chamber (*2*) is added when more room for brood rearing is needed. *C*, Ten days later the queen is placed below excluder (*1*), super (*3*) is added, and brood chamber (*2*) is placed on top. *D*, Ten days later the queen cells in brood chamber (*2*) are destroyed, the queen is placed in lowest hive body (*5*), which contains empty combs or combs and foundation, the queen being confined to this chamber by a queen excluder; empty super (*4*) is added and brood chamber (*1*) is placed on top

3. When the bees need more room for brood rearing in the spring, give a set of brood combs (preferably old, dark combs), placing them on top of the original brood chamber (fig. 10, *A*, *B*). If the colony is strong at this time the queen will enter this added brood chamber promptly, usually neglecting the lower hive body until the upper one is filled with brood, honey, and pollen. Ten days later, or at about the time of the beginning of the honey flow, the brood in the lower story should all be sealed. At this time transfer the queen to the lower hive body, either by finding her or by shaking the bees from the combs, from the upper into the lower hive body, and confine the

queen below by means of a queen excluder (fig. 10, *C*). If the honey flow is beginning, add a super of extracting combs (fig. 10, *C*), then place the recently used brood chamber on top as a third story. Ten days later destroy all queen cells in the queenless brood chamber, then shake the bees together with the queen from the combs in the lower brood chamber, placing the combs of brood into an empty hive body and giving back either empty combs or frames of foundation, together with one empty comb. Replace the queen excluder and the supers, adding an additional one if needed, and finally place the brood chamber containing the brood just removed on top of the supers (fig. 10, *D*). To avoid shaking, the queen may be found, and, together with a frame of brood, she may be placed in the extra hive body containing the empty combs or foundation, after which this extra hive body is put in place of the former brood chamber, and the former brood chamber is placed on top of the supers. This double treatment is not always necessary, but should completely control swarming in localities where the swarming tendency is strong.

This plan can be modified for comb-honey production if the colonies are strong by putting the queen down into the lower hive body after she has abandoned it long enough for all the brood to be sealed, removing the upper hive body entirely, the bees being shaken from the combs into the lower hive body, and one or two comb-honey supers being given. The brood that is taken away may be placed above queen excluders on another colony not now being used for comb honey. Six or seven of these brood chambers may be given to each colony that is used for this purpose. Ten days later treat each colony as in plan No. 1 above, substituting for their brood combs the combs of emerging brood that were removed before, first destroying all the queen cells, if any are present. The combs of brood that are removed during this operation may be put into a separate hive and handled as a parent colony (fig. 7) or disposed of in some other way. Thus the bees are shaken twice, with an interval of 10 days between, on combs containing none but emerging brood (p. 16).

### CREATING CONDITIONS COMPARABLE TO THE PARENT COLONY

1. When the bees begin to make preparations for swarming, find and remove the queen. If it is desirable to keep her, she may be placed in another hive, together with the comb of brood on which she was found, to form a nucleus, or she may be killed if not needed. If queen cells have already been started these should all be destroyed at the time the queen is removed. Ten days later again destroy all queen cells, being careful to shake most of the bees from the combs as they are examined to be sure that none are overlooked. Either at this time or a few days later introduce a young queen that has just recently begun to lay, by means of an ordinary introducing cage, which may simply be thrust into the entrance of the hive until the queen has been released.

Some beekeepers, instead of introducing a young laying queen, destroy all but one of the queen cells and permit the colony to requeen itself from this remaining queen cell, but in some cases such colonies will swarm soon after the young queen emerges from the cell, especially if the colony had made preparations for swarming before being treated (p. 18).

Instead of introducing a young queen, the original queen may be returned to her colony, the same care being used in introducing as with any other queen. It is not necessary to return the same queen, but a queen may be taken from any colony for this purpose. If the original queen is to be returned to the colony, she may simply be caged within the hive during the interval of 10 days instead of being taken from the hive, then a few days after the queen cells have been destroyed she may be released among the bees. Practically the same result can be accomplished without finding the queen, by shaking the bees together with the queen into the brood chamber, which is now left empty except for one comb. The queen should be confined to this nearly empty hive body by means of a queen excluder, the brood being placed above the excluder in another hive body (fig. 11, *A*, *B*). After the queen has thus been separated from the brood for 10 days the queen cells should all be destroyed and the extra hive body should be removed (fig. 11, *C*), the queen and the bees in this hive body being returned to the original brood chamber. When the old queen is returned to the colony in this way, however, the tendency to prepare for swarming again is considerably stronger than when a young queen that has just begun to lay is given. A colony to which a young queen is given after an interval of queenless-

ness of at least 10 days is more nearly like a parent colony in nature and usually does not prepare to swarm again the same season.

When two hive bodies are used for brood rearing previous to the honey flow, these two-story hives may be divided at the beginning of the honey flow, leaving most of the brood in the hive on the old stand, the queen and the remaining brood together with some adhering bees being placed in the other hive body, which is now supplied with a cover and bottom and set near the original hive. If any queen cells are present at the time the division is made, these must be destroyed. The supers are given to the now queenless colony on the old stand. Ten days later the queen cells should be destroyed and a young queen introduced, as described above. The two colonies may be reunited at the close of the honey flow if comb honey is being produced, or before the close of the honey flow if extracted honey is being produced.

2. If the bees have been wintered in a single brood chamber, give a second brood chamber when the colonies need more room in the spring, placing this second brood chamber on top. When old brood combs are used in this second brood chamber, the queen usually goes into it within a few days. After a week or 10 days divide the colony be removing the upper hive body, which usually at this time contains the queen, and place supers on the hive body which remains on the old stand. If the nights are cool, such a division may result in the loss of some brood in the brood chamber that is removed, for it is the youngest of the brood that is removed. After the brood is all sealed in the brood chamber on the old stand destroy all queen cells and introduce a young laying queen or permit this division to requeen itself by leaving one queen cell (p. 18). The two divisions may be left standing side by side in order that they may be reunited later. If extra covers and bottoms are not available, the division may be made by using an escape board as a cover for the hive on the original stand, having the bee escape removed and the hole for the bee escape entirely closed, the brood chamber containing the queen being on top of this escape board and the regular cover used over all. In this case an entrance should be provided for the upper hive body by pushing it forward on the escape board until an opening of sufficient size is formed. If extracted honey is being produced, this escape board may be removed before the close of the honey flow to unite the two divisions, in which case the bees will kill the old queen later, if not at this time; thus the colony is requeened without the necessity of finding the queen.

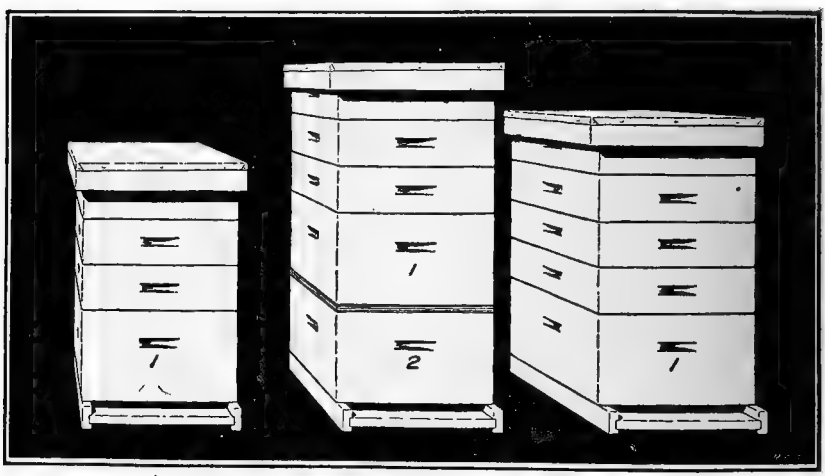



FIG. 11.—Creating conditions comparable to a parent colony. Plan 1 modified to return the original queen after her separation from the brood for 10 days. *A*, Colony preparing to swarm. *B*, Bees together with queen shaken from all but one of combs of brood, these combs being placed in second story (*1*) above a queen excluder, thus confining the queen in a nearly empty hive body (2) below the brood. *C*, Ten days later all queen cells are destroyed and the queen is returned to the brood, the extra hive body being removed

3. Use two hive bodies for brood rearing during the spring. Previous to the swarming season, insert a queen excluder between the two hive bodies to confine the queen to one of them. Ten days later divide the colony by removing the brood chamber which contains the queen, leaving the queenless portion on the old stand. To determine which hive body contains the queen, it is only necessary to remove one of the brood combs from the middle of the brood chamber to look for eggs or young larvæ, since in the brood chamber from which the queen has been excluded the brood is all sealed at this time. Supply the queenless portion with a young laying queen or a ripe queen cell. The two divisions may be reunited later or that portion containing the old queen may be moved to a new location for increase (p. 15) a week or 10 days after the division, whereupon the field bees from the removed hive will return to the hive on the old stand, thus strengthening the colony that is working in the supers. If extracted honey is being produced the division containing the old queen may be reunited with the other division two weeks later by placing the brood chamber above the supers, in which case the bees will probably kill the old queen later in the season if not at this time. By this plan it is not necessary to find the queen.

For comb-honey production this treatment may be applied at the time the first comb-honey super is given. This comb-honey super may be placed between the two hive bodies if preferred (fig. 12, *A*, *B*), to cause the bees to begin work in it more readily, the queen excluder being placed above the comb-honey super. An escape board without the bee escape should also be placed over the comb-honey supers to prevent the sections being soiled from the brood combs above and at the same time permitting communication between the two hive bodies through the hole in the escape board, or the queen excluder can be dispensed with by tacking a piece of perforated metal over the hole in the escape board. In this case the upper hive body usually should not be left for the full 10 days but the division may be made earlier to prevent the sections being soiled and to cause the bees to store incoming nectar in the sections, instead of in the upper brood chamber. After four or five days the presence of eggs and small larvæ indicates which brood chamber contains the queen, after which the division may be made at any time up to 10 days, the queenless division being left on the old stand. Ten days after the queen has been excluded from the brood chamber now left on the old stand, all queen cells should be destroyed and a ripe queen cell or a young laying queen should be given (fig. 12, *C*).


FIG. 12.—Creating conditions comparable to a parent colony. Plan 3 as modified for comb honey. *A*, Brood in both stories previous to honey flow. *B*, Comb-honey super and queen excluder inserted between two hive bodies at beginning of honey flow. It is not known at this time which hive body contains the queen. *C*, Hive body containing the queen (*2*) removed and established as separate hive. Queen cell is placed in *1*. In the illustration it is assumed that the queen was in *2* when the queen excluder was inserted in *B*. She may have been in *1* at that time, in which case, of course, this brood chamber is removed

### RADICAL CHANGES UNNECESSARY NEAR CLOSE OF SEASON

During the latter part of the honey flow colonies that are preparing to swarm may be induced to give up swarming much more easily than earlier in the season. In fact, as the season is drawing to a close colonies having sealed queen cells preparatory to swarming sometimes tear down such cells of their own accord and give up swarming for the season.

Natural swarms that issue near the close of the honey flow may be hived in an empty box, which is placed by the side of the parent colony for 24 to 48 hours, then hived back into their own hive. After the swarm enters the parent colony the queen cells are usually destroyed and the bees apparently are satisfied. If this is done earlier in the season, however, further swarming usually results.

Colonies that are preparing to swarm near the close of the season may be induced to destroy their own queen cells and give up swarming by moving the hive away and substituting another hive containing two combs of brood (some unsealed brood is necessary) without queen cells, the remaining space in the brood chamber being left vacant. The supers are then transferred to the prepared hive on the original stand, and the queen is left in the original hive which is set at one side or on top of the prepared hive (fig. 13, *A*, *B*). If the bees are well at work in the fields when this is done and the original hive is so located that the returning bees do not enter it, but enter the prepared hive, the original hive becomes so depleted of bees that the queen cells are destroyed and swarming is given up. The other division can not swarm because it has no queen. After four or five days the original hive may be restored to its former position (fig. 13, *C*) and the bees of the queenless portion shaken from their combs back into the original hive, thus reuniting the colony.

These cases may be useful near the close of the season or at any time if the tendency to swarm is not great, but neither of them can be depended upon during the height of the swarming season, for the conditions which were present previous to preparations for swarming are soon restored under this treatment.


FIG. 13.—Method for inducing bees to destroy queen cells and give up swarming. *A*, Colony preparing to swarm. *B*, Hive (*2*) containing two frames of brood (some of which is unsealed) is substituted for the original hive (*1*), which is now placed on top, no communication between hives *1* and *2* being permitted. *C*, Hive *2* is removed after a week or 10 days and hive *1* is restored to its former position

## THE CAUSE OF SWARMING

Although the cause of swarming has not been definitely determined, the one factor which is universally present in normal swarming is that of a congestion of bees within the brood nest. Other factors often mentioned as causing swarming are not universally present. Such a congestion of bees within the brood nest is usually brought about by a preponderance of recently emerged and emerging young bees, but the effect of such crowding may be greatly intensified by numerous factors in the environment, not universally present, which may be considered as contributing factors, but not causal. Whether a preponderance of bees too young for outside work or some other factor is responsible for swarming, this theory forms a good working hypothesis, since the successful preventive measures are those which reduce the congestion or alleyi-

ate its effects, and the successful corrective measures are those by which the balance in the proportion of hive bees and field bees is restored. In natural swarming as well as in the various methods that have been worked out to anticipate swarming, there is a break in the continuity of emergence of young bees within the hive, either at the time of the operation or a few weeks later. This reduction in the number of oncoming young bees is apparently an essential part of any successful treatment for swarming.

When a queen is being superseded during the swarming season the colony may swarm, even though it is lacking in a preponderance of young bees, which is present in normal swarming. In this case the presence of queen cells begun in response to the supersedure impulse apparently brings on the issuing of the swarm. Such swarming differs in many respects from normal swarming (p. 19).

When a queen is removed or is lost by some accident several queen cells are usually built, and when the young queens begin to emerge swarming may be expected even though the conditions conducive to normal swarming are absent. Such colonies apparently swarm because of a plurality of emerging queens, behaving in this respect like parent colonies in casting afterswarms and quite unlike the behavior in normal swarming.

## SUMMARY

Among the factors that contribute to the tendency to swarm are (1) those connected with inbred characteristics, (2) those connected with the size, shape, and arrangement of the hives and the character of the combs (immediate environment), and (3) those connected with the distribution of the bees as brought about by the peculiarities of the season, the locality, and the management (general environment).

**Inbred characteristics.**—Some strains of bees have a stronger tendency to swarm than others. To some extent, therefore, swarming may be reduced by careful selection in breeding.

**The hive and combs.**—Colonies of bees having large brood chambers are less inclined to swarm than those having brood chambers too small. Strong colonies having good queens may need 60,000 to 70,000 cells for the rearing of brood, during the period of extensive brood rearing in the spring, in addition to the cells used for the storage of honey and pollen.

Colonies of bees having good combs throughout are less inclined to swarm than colonies having poor combs. Inferior combs may greatly increase the tendency to swarm, both by reducing the amount of available brood-rearing space and by acting as barriers in the way of a free expansion of the brood nest.

Spaces for idle bees, especially within the brood nest, may reduce the tendency to swarm. Such space may be provided by wide spacing of the combs or by a deep space below the frames.

Colonies in hives which are well ventilated and well protected from the direct rays of the sun are less inclined to swarm than those in poorly ventilated hives exposed to the sun. Ample ventilation should be provided, hives should be painted white, and if the weather is hot during the swarming season shade boards should be used over the hives.

**Distribution of bees within the hives.**—Probably the greatest single factor in the cause of swarming is a congestion of unemployed bees within the brood nest or discomfort in this part of the hive from overheating and lack of ventilation. Colonies which build a barrier of sealed honey around the brood nest during the spring, thus confining their activities to this limited space, may be inclined to swarm even when there is an abundance of empty comb in other parts of the hive.

When the bees increase brood rearing in the spring so rapidly that young bees accumulate faster than they are able to take up work in the hive outside of the brood nest, the tendency to swarm is usually strong unless there is a dearth of nectar at this time. This condition brings on the normal swarming season, and great care is necessary to bring about a better distribution of the bees to prevent crowding the brood nest.

If to this condition there is added any factor which in any way interferes with the young bees leaving the brood nest to take up work in the supers, the congestion of bees within the brood nest is increased, since this condition causes field bees to remain within the hives when they should be at work in the fields. The giving of super room of such character and in such a manner that the increasing number of hive workers may be enticed from the brood nest and given work to do in the supers is of the greatest importance in the prevention of swarming.

If anything causes the field bees to stay in the hive during the day, the congestion and discomfort are greatly increased and these idle field bees may become a serious factor in increasing the tendency to swarm. In nature when a swarm issues, the overcrowding of the brood nest is largely relieved, both within the swarm and within the parent colony.

Some important swarm-preventive measures, therefore, are:

Careful selection of stock in breeding.

The use of brood chambers large enough during the spring brood-rearing period to hold the maximum amount of brood without crowding.

The use of good worker combs in the brood chamber to prevent a reduction of the available brood-rearing space.

The arrangement of the brood combs to avoid barriers in the way of a free expansion of the brood nest during the spring.

Providing extra space for the bees within the brood chamber by wider spacing of combs and a deep space below the frames.

The use of large entrances during the swarming season, especially when the weather is hot, and in some cases additional openings for ventilation.

Protection of the hives from the direct rays of the sun by the use of shade boards or double covers.

Painting the hives white, especially the cover, if a shade board is not used.

Management to prevent conditions favorable to the building of barriers of sealed honey around the brood nest, or the breaking up of barriers of this kind if they already exist.

Inducing the bees to expand into and occupy supers as rapidly as the honey flow will justify during the first half of the honey flow, or at the time the colony is rapidly expanding in numbers.

Providing additional space in the form of empty combs for the ripening of incoming nectar, so that the field bees can immediately dispose of the nectar they bring into the hive, to prevent the beginning of any stagnation of the activities of the colony.

Removing some of the emerging brood to reduce the number of emerging bees within the brood chamber, thus producing a better distribution of the bees throughout the hive.

The destruction of queen cells, providing they have been started but recently. Frequently, however, other cells are immediately started after the queen cells have been destroyed.

As a remedy for swarming the beekeeper relieves the congestion of bees within the brood nest by creating conditions comparable either to the swarm or to the parent colony in nature.

## KEEP BEES BETTER

THERE are in the United States probably 800,000 persons who own bees, but there are not enough who keep their bees efficiently and there are not enough who make beekeeping a specialty. Efficiency in beekeeping does not depend on expertness in planning or use of equipment, but depends on the study and effort which the beekeeper puts on the principles back of the various manipulations. The study of the bees themselves must not be neglected, for all beekeeping practice depends on a knowledge of bee behavior.

The Bureau of Entomology issues a circular, sent free on application, giving lists of bulletins, books, and journals on beekeeping.

The bureau desires to encourage efficiency in beekeeping and to that end endeavors to help all beekeepers who wish to keep more bees and to keep them better.

If your beekeeping questions are not answered in the department publications, the Bureau of Entomology will be glad, at any time, to render any assistance possible.

KEEP BEES BETTER

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