INTRODUCTION TO BEEKEEPING

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INTRODUCTION TO BEEKEEPING

By R. G. RICHMOND

A great number of inquiries are received annually at the Office of the State Entomologist, for information on bees, beekeeping and honey. This circular is prepared for the use of those who are thinking seriously of securing a few bees for pleasure or profit, and for those who have a few colonies but have had little or no previous experience with bees. To the commercial beekeeper, there is no new information contained herein, but merely an assembly of standard information and practices for the guidance of the beginner. It frequently happens, in any industry, that a beginner becomes a nuisance to established business by using bad practices. Usually this happens because of lack of knowledge and is not the result of a wanton desire to destroy or hamper the efforts of friends, neighbors or business associates.

Beekeeping in Colorado.—Honey production in this state is an old, established business. There are in the neighborhood of 100,000 colonies of bees in Colorado. The number of colonies owned or operated by single individuals varies from 1 to about 2,000. A colony of bees is commonly called a hive of bees. Individual owners produce, in Colorado, as high as 8 to 10 carloads of honey per year. A minimum carload is 36,000 pounds.

Information on Beekeeping.—This circular is merely an introduction to beekeeping and honey production. There is a great volume of other information on the subject. In order to point out for the beginner, some of that information, reference will be made in many cases to more extensive literature as we go along. Frequently there will appear numbers in brackets, thus (4) or perhaps (4 and 5). Turning to the back of this pamphlet, there will be found these numbers again and set opposite them will appear the name and description of further information on the subject being discussed. Also there will appear the agency or firm from which the pamphlet or book may be secured.

The Starting Point in Beekeeping.—It is good practice to start with only one or two colonies of bees. Occasionally people have started with larger numbers and succeeded, but only very occasionally. There are too many technicalities in the business to assimilate in a short time. Experience with one or two colonies will be less expensive and almost as instructive.

Usually a colony or two may be purchased from a nearby beekeeper. If there are no nearby beekeepers, it is a sign that
the territory is probably not suited to profitable honey production. It is preferable to buy bees from an extensive producer of honey. The reasons will appear later in this discussion.

In purchasing colonies from neighbor beekeepers, the former owner is usually willing to assist and advise in their movement and care. Bees should not be moved in winter or on hot days. It is better to move at night or on cool cloudy days since all of the worker bees will be at home. All entrances to the colony must be closed to prevent their escape, even at night. They should be provided ventilation during movement by screening the entrance and using screen wire, nailed down, in place of the cover. On arrival at their new home, they should be allowed to settle down for an hour or so, quietly open the entrance and do not disturb for a day or two. Bees must be removed from their old home, about 2 miles, or they will return to it and be lost to the buyer. Seasonal management of bees, after their purchase, is discussed farther on in this circular.

Package bees may also be bought, but their care is more difficult and requires experience in their installation and in their establishment. Packages usually are purchased from beekeepers in the southern states and are used to increase holdings or to replace winter losses farther north. These packages consist of one, two, three or more pounds of bees and may or may not be accompanied by a queen, according to the desire of the buyer.

Location of Apiary.—An apiary is a place where bees are kept. If one has but a few bees, they are usually kept at the home. In commercial honey production, where large numbers of colonies are operated, it is necessary to have numerous apiaries. In Colorado, an apiary consists of from a few to 100 colonies. Apiaries, located away from home, are called outapiaries. A territory is capable of supporting a limited number of colonies, hence the necessity for outapiaries.

There are some important factors in locating apiaries, whether they be at home or not. The first essential of a good apiary location is its proximity to an abundance of honey plants. The success of beekeeping, depends on good honey crops. It is not a practical venture to plant honey-producing crops especially for bees. Commercial or even amateur beekeeping depends for its success on honey plants grown for other purposes. In return for this service to the beekeeper, the grower of seed crops and fruit especially, depends on honey bees for the pollination of his flowers so that seed or fruit may be produced.
There are other important factors in locating apiaries. They do not require shade in this climate, in fact, they are better out in the sunlight, with plenty of space between hives. Bees are best located on a southern slope, with good drainage and no danger from flooding by irrigation ditches or cloudbursts. Apiaries are better located out of sight from highways, to prevent pilfering. They should be fenced, if there is danger from stock interference, as some animals, particularly horses, are readily killed by bees. Outapiaries must be accessible by truck in order that honey and supplies may be conveniently hauled to and from the location. Irrigation laterals are frequently serious obstructions.

Beekeeping Regions in Colorado.—The beekeeping regions of Colorado are naturally limited to those sections of the state where irrigation is extensively practiced. The largest single area is that from Denver north to Fort Collins and east to Greeley. From this latter city, a comparatively narrow strip borders the Platte River to the Nebraska line. In the southeast, a fine strip of territory borders the Arkansas River from Canon City to the Kansas border. In the south central portion of the state, the San Luis Valley is excellent territory for a limited number of colonies, even at its elevation of 7200 to 7600 feet. On the Western Slope, the irrigated valleys of the Colorado,
Gunnison and Uncompahgre Rivers afford some of the best beekeeping territory of the state. In the southwest, Montezuma and LaPlata are important honey-producing counties. Aside from these main sections of the state there are other limited localities where opportunity is afforded.

**Honey-Producing Plants.**—The main honey-producing plants of Colorado are alfalfa and sweet clover, both of which produce a quality of honey unexcelled anywhere. The early cutting of alfalfa has materially reduced its possibilities as a honey-producing plant. The producing season of these plants extends from early June to late August or September, depending on the latitude and altitude. Alfalfa has been known to produce as much as 20 pounds of honey per colony, per day, for a few days.

There are other plants of importance to beekeepers. Dandelion bloom comes at a season when its nectar and pollen are very important in the building up of strong colonies of bees. This is true also of fruit-tree bloom. Many dryland or desert plants, as they are termed, perform the same function. Elm and maple furnish bees with pollen early in the spring. There is also a host of wild and garden plants which contribute their little to the whole honey crop. Some of these have the reputation of being undesirables, in that they produce a strong-flavored, less-desirable type of honey.

There is excellent literature on honey plants by Pellett (A) and Pammel (B).

**The Bee Family or Colony.**—The bee family or colony normally consists of three types of individuals, the queen, the worker and the drone.

The queen is the virtual mother of the colony. Normally there is but one per colony. At swarming time there may be more or if the queen be growing old and failing in her duties, the bees will make provision for a new queen. The duty of the queen is to lay all of the eggs from which all of the bees in the colony come. The queen may live 4 to 5 years or more.

The worker bee's name describes its duty. It gathers the nectar and pollen from the flowers and stores it in the hive. It brings in water when needed. It does the house cleaning and attends to the wants of the young. It defends the hive against all intruders, including the owner and operator. Yet in spite of its industry, the worker seldom lives to enjoy the fruit of its toil. During the busy season, the worker lives but 6 weeks, while in the less active season, they will live from fall till spring. A colony may contain 50,000 workers or more at the height of the
producing season. Considering the rapid death rate of the workers in the producing season, the birth rate must be equally high. It is known that a queen may lay as many as 1500 to 2000 eggs per day to replenish this death rate.

The drone bee is the male of the colony. His sole function is to mate with the queen, who mates but once in her life. This function accomplished, the drone dies instantly, a martyr to his passion.

The number of drones per colony varies, the beekeeper keeping them to a minimum. They do no work and must be fed by the workers. They are normally killed off in the fall, by the workers, to avoid their hungry mouths during the winter. In the spring another batch is hatched.

The three types of individuals in the colony come from the eggs laid by one queen. The drone comes from an unfertilized egg. The queen and the worker come from identical fertilized eggs. After hatching, the young larvae may be fed on different foods, one developing into a queen and another into a worker. It depends on the need of the colony, whether a larva will be developed into a worker or a queen. The final result depends on the different foods supplied to the larvae by the workers. If the colony needs a queen, the young larva is fed a stronger, more concentrated food and develops into a queen. If a queen is not needed, the young larva is fed ordinary food and develops into an ordinary worker.

Queen bees may be purchased from queen breeders on the market. They ordinarily bring 75¢ to $1.00. Books on Queen-rearing, by Smith (C), Pellett (D) and Doolittle (E) are available.
During the development of the young, the individual goes thru three stages, the egg, the larva or grub, the pupa and the adult. It requires 16, 21 and 24 days respectively for the development of the queen, worker and drone, from the time the egg is laid until the adult bee emerges.

**Races of Bees.**—Honey bees are not native to the North American continent. Those found commonly in this country had their ancestry in Europe. We frequently speak of wild bees, meaning those found in hollow trees, houses and caves. These bees, or their forbears, have escaped from the apiary of some beekeeper.

There are three races of bees in this country which are more or less common. The Italian is probably the most common, while the Caucasian, from the Caucasus Mountains and the Carniolan from Carniola are coming into more prominence. Superiority is claimed for each and each has its merit.

**Equipment.**—The personal equipment necessary to operate bees properly, consists of a bee veil, a smoker and a hive tool. It is unwise to expose the head and face to bee stings. A smoker is essential to keep bees under control and a hive tool is used for prying apart hive bodies, frames, and for scraping and cleaning.

In keeping bees under control with smoke it is unwise to use too much. If it is proper season to work with bees, two or three light puffs, at the entrance and over the frames, is plenty. The smoke should be dense and cool. Cedar bark, oily waste and planer shavings make good smoker fuel. Smoke the bees lightly, give them a little time and they will soon disappear below the top-bars of the frames.

It is not possible to describe herein, the
necessary equipment for beekeeping operations, such as hives, frames, covers, extractors, and etc., but one should bear in mind the advisability of using only standard equipment from the beginning. All beekeeping equipment must eventually be sold, either for profit or due to the death of the owner or for some such reason. In such event, equipment which is not standard is not worth as much as the nails which hold it together.

Organized Beekeeping.—The beekeeping industry is comparatively well organized, not only in the state but nationally as well. In Colorado, the Colorado Honey Producers Association is a business group, organized to sell honey and to buy supplies for its members. The American Honey Institute and the American Honey Producers League are organized for the purpose of promoting the interests of beekeepers and in publicising honey to the public. Allied industries are also members of the Institute and contribute to its welfare.

The beekeeping industry is also concerned with the organization of county, state and national government. The national government maintains a group of scientific workers for research work in beekeeping. Headquarters for this group are in Washington, while field laboratories are established in California, Louisiana and Wyoming. The states maintain inspection services in conjunction with the counties and also teach beekeeping in the agricultural colleges and carry on investigational work.

Beekeeping Pests.—Bees are subject to pests and diseases, much as other animals are. Their diseases are not transmissible to other animals or to man but are a common and serious matter to the honey producer. It is on account of these diseases that inspection services are maintained by the states and counties. Further information is given on this subject in a later part of this circular.

Beekeeping Seasons.—As a matter of convenience, the year will be divided into the four equal seasons for further discussion of seasonal operations. These seasons are considered as made up of March to May inclusive and etc. Since this circular is for the information of beginners, further discussion continues with spring.

Spring

Purchase of Colonies.—Spring is usually the best time for the beginner to purchase one or two colonies of bees, when the fruit or dandelions begin to bloom. If the colonies have come thru the winter to that time, their chances of survival are very good, since, from that time on they should be almost self-supporting.
Early Spring Observations.—In order to consider here, the complete seasonal management, this discussion is continued from the first of March. Occasional winter observations should continue until the dandelion flow. There is not much work necessary during the late winter and early spring, which will be of value. If the colony was left with adequate food the previous fall, it should not be disturbed unnecessarily in early spring. It is advisable to see if the bees are still alive. This observation should be made monthly or preferably twice a month. On a cloudy day or in the evening, when bees are not flying, a light tap on the side of the hive will make the bees buzz in response, if they are alive. To see bees flying to and from the hive on a warm, sunny day does not mean that the colony is alive. Other bees may be robbing a dead colony and present the appearance of life when in reality the colony is dead. If there is no response, the dead colony should be placed where no bees can get to it. If in doubt as to the cause of death, inquire of the local inspector or ask a commercial beekeeper to examine it.

Causes of Winter Death Loss.—The main causes of winter death are queenlessness, starvation, extreme cold, smothering and disease. If death results from the first cause, the combs will have a large amount of pollen in the former brood nest. If true starvation causes death, there will be an absence of honey and usually very few bees. If extreme cold be responsible, the bees will cluster close in a compact mass and there may or may not be plenty of honey. Extreme cold makes it impossible for the bees to move to honey and they are actually starved to death, with plenty of food in the hive. Smothering may usually be detected by the presence of dead bees in all parts of the hive. Disease will be discussed later.

When a colony is found dead, the bees should be removed from the combs to prevent their decomposition and moulding of the combs. Mouldy combs are not acceptable to bees.

Spring House Cleaning.—In the early warm weather, after winter has broken, the bottom boards should be removed from the hive and all of the dead bees, obstructions and debris scraped from it. Also tilt the hive backward and remove any obstructions that may be between the combs. It only takes a moment or two to do this chore and it improves ventilation and sanitation.

First Spring Flow.—There are a number of things which should be done during this season. The first spring flow can be detected by the presence of bees on the early flowers and by the
presence of fresh nectar in the combs. The first nectar usually comes from dandelions, fruit bloom, willows or wild flowers. With this first flow, it is possible to work with the bees without their robbing or stinging too vigorously.

House Cleaning Continued.—With the first flow, the frames should be scraped free of burr combs and propolis, the inside of the hive body scraped, as well as the bottoms and covers. This cleaning will simplify manipulations thru the summer. During the cleaning operations, the general condition of the colony may be estimated. Possibly it is too weak or too strong; perhaps it needs a new queen; perhaps it needs more space for brood rearing or honey storage. But, before proceeding to rectify any of these situations, be sure that the colony is healthy. If it is not healthy, it is wasting time and money to make any changes.

Uniting Weak Colonies.—Weak colonies are seldom worth “petting” along. Neither is it good practice to unite two weak colonies. Unite a weak to a strong colony, set it on top of a strong colony with two thicknesses of newspaper between, cutting the paper with a hive tool in one or two places. Root (F) and Phillips (G) discuss uniting in thoro fashion.

Colonies Too Strong.—It frequently happens that some colonies come to the main honey flow with too many bees, so that they swarm or present trouble in swarm control. This condition can be avoided earlier in the season. It appears that there are usually enough bees in an apiary, if properly distributed among the hives, to give good results. But they usually need distribution. Some colonies are too strong, others are under strength. In equalizing the colony strength, it is a good practice to shake a frame or two of bees
from the strong, in front of the weak. This may need doing more than once, with 2 or 3-week intervals. Be sure that the queen is not on the shaken frames.

Requeening in Spring.—At this season, it is too early to raise queens for replacements. They may be purchased from more favorable climates, at reasonable rates and may be located from the advertisements in the bee press (V, W, X, Y, Z). Instructions for their introduction accompany purchased queens. Colony weakness and lack of uniformity of brood are indications that a queen needs to be replaced.

Cramped Quarters.—A rapidly growing colony, coupled with incoming nectar and pollen, soon fills all available space in the hive. Colonies which have wintered in single-story hives, should have another story added at this season. The need for more space should always be anticipated and supplied. A crowd-

Fig. 5.—Frame of foundation and a drawn-out extracted comb.

ed colony means trouble in the future. Adequate room for brood rearing and for honey storage spells contented bees, good crops and contented beekeepers.

Summary of Spring Manipulations.—The spring manipulations mentioned above are designed to bring the bees along to the main honey flow so that they will reach their greatest numbers per colony, about a week or 10 days after the main flow starts. Uniformly strong colonies, healthy colonies, colonies with good queens, house-cleaned colonies and colonies with ample space are the results of good spring management.
Use of Foundation.—Foundation is a thin sheet of beeswax with the imprint of honey-comb cells on both surfaces. It is securely hanged in the center of the frame and extends from end to end and from top to bottom of the frame. Its use is to accomplish two things. The cells built on it are of the proper size in which to raise worker bees. There is no profit in raising drones and there will be plenty of these even under the best of circumstances. Also, foundation guides the bees in building straight combs. It is required by law that bees be kept in hives with straight combs, in frames that can be readily removed. The purpose of this requirement is to permit the ready examination of combs for bee diseases.

Summer

Main Honey Flow.—All manipulations and preparations till this time have been made with the idea of having strong colonies, ready for the main honey flow. It is an exciting time. All preparations have been made, supers for honey are ready, bees are in good condition; all that is necessary is plenty of flowers and normal moisture to keep them growing. When the bees begin to work on alfalfa or sweet clover, it is time to give them more space in which to store honey.

Supering.—In adding supers (storage room) to colonies, for the main honey flow, the method varies with the production of comb or extracted honey. In either case it is advisable to add one super of extracting combs during the first part of the flow, since it requires a good strong flow to produce first-class comb honey.

Supering for Comb Honey.—Previous mention has been made of the necessity for adequate space for the rearing of brood in the spring time, before the main honey flow. It has also been mentioned that colonies should be as equal as possible in strength, at the beginning of the main flow. It is to be remembered also that bees, with plenty of room for storage and brood rearing, are slow to enter either comb-honey supers or supers of foundation. Being slow in this new venture, we can force or entice them into their new quarters. Comb-honey supers should not be added for 2 or 3 days after the beginning of the main flow, but the bees should be put in readiness, just prior to that time. Assuming that all colonies are in two stories at the beginning of the flow, as much as possible of the brood should be in the lower story. Then, when it is time to add comb supers, it is a simple matter to remove the upper story and replace it with one or two comb supers. Do not remove the queen
with the upper story. The upper story may be given to a colony that is not suited to comb-honey production, or may be set up as an increase beside the parent colony. Later, the bees that emerge from this surplus brood may be shaken in front of the parent hive.

In adding the first super, it may be that the colony is just so strong as to force the bees to enter the new super. Usually the bees are "baited" into the first new sections. Two or three sections of the previous year, partially filled or drawn out, are placed in the super with the new sections to "bait" the bees into the first new super of sections. Subsequent supers are added in the order indicated in Fig. 6.

Toward the end of the season, supers should be added with caution. The flow may stop at any time and it is not desirable to have a lot of partially filled sections on hand, since they cannot be used over again. That is the purpose of adding the last super on top, to force the bees to finish the sections already started.

Excellent information is available on comb-honey production by Demuth (1). For those planning to specialize in comb-honey production, a thorough study of this author's work should be made.

Supering for Extracted Honey.—Assuming that the colony is in a two-story hive, the next super may be added directly on top. Subsequent supers should be added at the same point, that is, by raising the filled supers and inserting the empty just above the original two-story hive. For the beginner and amateur, this is probably the simplest and most effective method. Another way is to crowd the bees, queen and brood into one story, place a queen excluder on top of it, add an empty super

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Fig. 6.—The order in which comb-honey supers should be added. Courtesy, Bureau of Entomology, U. S. D. A.
and place the top part of the original two-story hive above that. Add each subsequent empty super next to the excluder. Fresh supers may be added when the previously added one is one-half to two-thirds full. Toward the end of the season's blooming period, be more conservative in adding supers, so that the combs may be filled out. In producing extracted honey, better results are had by using 9 combs in a 10-frame super and 7 combs in an 8-frame super. The combs are "fatter" and more easily uncapped. Combs may be extracted when about three-quarters of the honey-filled cells are capped over. These combs may be returned to the bees for refilling.

In using the second method, above mentioned, there is frequently more brood than may be accommodated in the lower story. It may be safely left in the upper, but at 9 days this brood should be examined and all queen cells removed. Otherwise the colony may be ruined by swarming.

Swarming.—Swarming is the natural method of colony increase among bees. Beekeepers prefer to control the increase in their number of colonies. Hence, swarming is discouraged and prevented as much as possible. No beekeeper has time to watch for swarms but he must make some increase occasionally.

Factors contributing to the desire to swarm are, crowding of either the brood nest or honey storage space, unbalanced ratio between young and old bees, old queens, lack of proper ventilation, superceedure, starvation, disease and absence of brood. If these factors were all corrected, swarming would be reduced to a minimum. But, with all our knowledge and care, swarms will occur even in extracted-honey production.

Swarming in comb-honey production is a serious matter. There is necessity to crowd
the bees, in order to force them to finish the sections in good order. Some colonies will go thru the season without a thought of swarming. Others are amenable to simple control measures. Others will swarm in spite of all precautions. Frequently the simple cutting out of all queen cells will put an end to the desire to swarm. In other cases this procedure must be practiced every 9 days during the major part of the flow. In other cases it is necessary to make an artificial swarm. This may be done by removing the brood nest to one side, replacing it with a super of foundation and shaking the bees in front of the hive, allowing them to run in onto the foundation and establish a new brood nest. It is preferable to place one frame of brood in the middle of the new brood chamber, otherwise the bees may abscond. This severe treatment usually ends swarming in the colony treated. After 8 days, the newly hatched bees in the old brood chamber may be shaken in front of the new and repeated at similar intervals until all of the bees have hatched. This procedure leaves the original colony with the appropriate number of bees. If increase be desired the original brood nest may be moved to one side, after shaking the bees from the combs, and thereby allow a queen to be mated on a new stand. If increase be not desirable, a new queen may still be raised and the whole brood nest united back to the original stand in the early fall. The desirable feature of this latter plan is that it places a new queen on the old original stand. It is preferable to kill the old queen before uniting if the new one shows promise. Objection is raised by some that the swarming strain is being maintained. For a detailed study of the swarming problem, the reader is referred to Demuth's bulletin (2) on the subject.

Increase.—Increase in bees means an increase in the number of colonies. As stated previously, swarming is the natural method of increase. Swarming is not controlled and is therefore bad practice. In most parts of Colorado, increase is made at the expense of a honey flow. If a colony be divided in May, both parts may make enough for winter stores but no honey for the owner. On the other hand, some bees or brood or both may be taken from several strong colonies, thereby making one new colony from several old ones and still having the same number of strong old colonies left. This new part may be given a purchased queen or a frame of brood with a queen cell from a colony about to swarm. If a laying queen is available, much time may be saved in starting the new colony, due to the time elapsing between a queen cell and a laying queen.

Removal of Surplus Honey.—"Surplus" honey is that part
of the crop over and above that needed by the bees for winter use. It is that part to which the owner is entitled for his intelligent handling of the bees.

There are easy and difficult ways of removing it from the colonies. The easiest time to remove any kind of honey is to remove it before the honey flow is over. Supers may be removed from the hive and stood on end, either on the ground or on top of the next hive. Bees in these supers will usually leave within a half hour. Very little smoke is needed, the less the better. A bee brush and a little smoke will soon finish the job. If much smoke be used, the bees will puncture the cell cappings and spoil the appearance of the honey, which is very injurious in appearance to comb or chunk honey. Another method of removing bees from supers of honey is to cover the super while still on the colony with a piece of outing flannel sprinkled with a half-and-half mixture of refined carbolic acid and water. In about 5 minutes, in warm weather, the bees should have gone down and the honey can be removed. Supers of honey should not be allowed to stand around the apiary longer than necessary in an exposed condition, particularly if bees are inclined to rob. Later in the season, it is more difficult to remove honey due to the cooler weather and the diminishing honey flow. Comb and chunk honey should be off the hives before this. Surplus honey remaining on the hives after the flow is over had better be re-
moved with bee escapes. These little tools are placed in the inner cover hole and allow the bees to escape downward, but do not permit their return. Honey supers from which the bees are to be removed by this method are placed above the escape and left for a day. By that time all bees should have gone down into the lower part of the hive. If not, the escape is probably clogged or there is brood above it.

**Extracting Honey.**

A honey extractor is a centrifugal machine used for throwing the honey from the combs. The combs are first uncapped on both sides, with a hot knife and then placed in the machine. The machine should be revolved slowly at first, throwing out part of the honey on one side, then reversing the combs, repeat the process. To clean the last of the honey from the combs, much greater speed is used, not sufficient however, to break the delicate wax. The honey should be thoroly strained thru screen wire, cheese cloth and 86-mesh bolting cloth.

![Extracting honey](image-url)
It may be necessary to warm the honey to strain it, but do not heat beyond 130 degrees F. for straining purposes. It may then be stored in appropriate containers. Heating honey should be done in a water-jacketed tank or boiler.

Wax from the cappings should drain for a day or two and be melted up in water. After solidification, it has a ready sale.

Comb honey sections should be scraped free of propolis and burr combs, graded and stored in dust-proof containers.

Requirements for grading and packing honey are outlined in a U. S. Department of Agriculture Circular (3).

Autumn

Preparation for Winter.—As soon as possible after the removal of the last honey, the bees should be checked over and prepared for winter. There are three or four fundamentals to observe in this preparation.

Queens.—Each colony should be observed to see if the queen is still functioning properly. A few queens are usually lost during the late summer, either incident to supercedure or loss in swarming. If the colony is still strong in bees and the season not too late, new queens may be introduced. Usually it is better to unite the queenless colony to another colony.
Winter Food.—The amount of winter food (honey) necessary to a colony, in Colorado, varies from 40 to 80 pounds. Where the short producing season prevails, at least 80 pounds will be necessary. Where dandelions and fruit bloom or other early flowers are prevalent, 50 pounds are usually adequate. Colonies wintered in cellars or caves may use less. Some producers prefer to leave about 30 pounds on each colony and reserve in the honey house the other 20 pounds to be given to the bees in early March. This is a good practice, where stealing of winter stores is common.

Colony Strength.—There is no object in trying to winter a colony that is below normal strength. If a colony has produced a good crop of honey, has a good queen and plenty of honey, its chances of wintering well are good.

Winter Protection.—Apparently bees should not be exposed to unnecessary wind and cold in winter. Some natural shelter is advisable, such as a southern slope or windbreak of trees. In colder or more elevated sections, protection is advisable around the hive. Two or three thicknesses of building paper wrapped closely about each or several colonies seems to give needed protection.

Outdoor wintering is ably discussed by Phillips and Demuth (4). In some sections bees are carried into cellars or caves built for the purpose. Before attempting to winter bees in cellars, it is advisable to discuss the matter with a beekeeper who has had experience in such matters, and to study carefully the advice of Phillips and Demuth (5).

When this work of the autumn has been completed, it is advisable to leave the bees alone during the winter months except for a monthly or semi-monthly visit to see.
that they are all alive as previously suggested. If they become covered with hard, or drifted snow, it should be cleared away from the entrance.

**Preparation of Honey for Market.**—Reference has been previously made to this subject as to standards for U. S. grades. In placing honey on the market, only the highest grades and the finest quality should be sold. Selling of low-grade honey is wasted effort, since it prevents further sales. A beekeeper who has established a trade, should never run out of honey even if it is necessary to buy from other beekeepers. It is bad practice to oversell a customer. The honey will probably go out of condition on his hands, with consequent loss and dissatisfaction. It is the beekeeper’s business to insure that honey sold by him will be in good condition until it is consumed.

Extracted honey should be packed in containers suitable to the market on which it is to be sold. If sold to the retail trade, it may be packed in 2.5, 5, 8 and 16-ounce glass honey jars or in pint and quart Mason jars or in 2.5, 5 and 10-pound honey pails. If sold to packers or exporters, the 60-pound, square can is standard.

Extracted honey is preferred liquid by the American public. Most extracted honeys will granulate or crystallize shortly after removal from the combs. It is the natural thing to happen. To restore honey to its liquid form, it must be heated. Overheating causes darkening of color and injures the flavor, both of which are objectionable. Usually honey heated to 170 degrees F. for one-half hour or to 180 degrees F. for one-quarter hour will remain liquid long enough. For the beginner 160 degrees F. for 2 hours will be safer. The honey should be raised to the temperature desired as rapidly as possible and after being held for the appropriate time it must be cooled rapidly, not just allowed to cool at room temperature. It should be cooled to below 100 degrees F. Honey, treated after this fashion, will remain liquid for 6 to 12 months as a rule and the color will not be materially injured.

**Selling Honey.**—Beginners should not sell honey below the price established by commercial producers who supply the local market. The beginner cannot produce honey as cheaply as the commercial producer and is therefore only destroying the market by price cutting. Honey will sell on quality better than on price. Emphasis should be placed on the heavy body, the clarity, the delicious flavor and aroma and its hundreds of uses. Regarding the uses of honey, Hunt and Atwater (6) have prepared excellent information on the matter.
Apiary Pests and Diseases

Diseases of Honey Bees.—As previously mentioned, honey bees are subject to diseases and attacks by pests, just as are other animals. These diseases are characteristic of honey bees alone and are not transmitted to man or other animals or plants. Some of these diseases are of great importance to Colorado beekeepers, while others are of less consequence. The most important are discussed herein. Excellent literature on most of the bee diseases is available from the investigations of Burnside (7), Hambleton (8), Phillips (9 & 10), Sturtevant (11) and White (12, 13 & 14.) The work of these authors, mentioned herewith, refers only to the recognition and control of common diseases, their efforts having a much wider field than as indicated.

Sacbrood.—This is probably the most common disease of honey bee larvae. Normally it does not kill whole colonies and just as normally, it infests every colony in the apiary. It is a seasonal disease, common in the spring and disappearing in the summer. It may kill only a few larvae or it may kill many in each colony. Some years it is more destructive than others. Some beekeepers admit that this disease kills more individual larvae than our most deadly and feared disease.

This disease is caused by a filterable virus, that is, it cannot be detected under the microscope. Its method of transmission from colony to colony is unknown. Little if anything is done in a curative way. Strong colonies have a better chance to overcome the disease as well as colonies headed by young queens. Requeening is advocated in unusually severe cases.

Sacbrood should be readily recognized by all beekeepers. The larvae, dead of this disease, may be found in capped or uncapped cells. If the head of the larva, dead of this disease, has not been torn by the adult bees in the process of removal from the cell, the head will be definitely turned up from the bottom of the cell. It will be well advanced toward the cell opening and is usually black in color. If a match or toothpick be used to remove the remains from the cell, the dead larva will usually come out in the form of a little sac. That is why it is called sacbrood. The adult bees remove the dead larvae, piece by piece.

American Foulbrood.—Of all the larval diseases, this is the most feared by beekeepers. It is a killer of colonies. It is a persistent disease. Once attacked, a colony does not recover.

This disease is caused by Bacillus larvae, an organism visible under the microscope. The honey of the colony affected becomes contaminated with the organisms. When the infected
colony dies, its honey is stolen by bees from healthy colonies, who in turn become diseased. This is the natural method of spread. Beekeepers sometimes spread the disease unwittingly by the use of infested combs on healthy colonies.

Larvae, dead of this disease, are sometimes confused with larvae dead of sacbrood. Larvae, dead of American foulbrood, are usually found in capped cells. If dead for considerable time, the cells may be uncapped by the bees, who make an effort to remove those which are dead. The dead larvae adhere to the cell walls so closely that it is impossible for the bees to remove them from the walls. The cappings of the cells containing dead larvae will be sunken and brownish in appearance, or they may have punctured, ragged-edged openings. The head of the dead larva, unlike those dead of sacbrood, will be flattened on a lower side of the cell wall. Depending on the length of time dead, the larva will be whitish, light brown, coffee colored or almost black. As the colors become darker, the larva dries down and flattens out until it becomes a hard, dry scale lying on the lower sides of the cell walls. If, before the dead larva dries, a toothpick be inserted into the dead mass, the contents of the cell will adhere in a gluey string as the toothpick is withdrawn. The odor of the colony, in the advanced stages of the disease, is distinctly gluey and slightly putrifactive.

Fig. 13.—Section of a brood comb from a colony dead of American foulbrood.
It is by the complete destruction of all infected material that this disease may best be controlled. The colony should be killed by placing a tablespoonful or more of calcium cyanide dust, on the bottom board, back 2 or 3 inches from the entrance. The job can best be done during honey flow and at night or on a cool cloudy day when bees are not flying. Stop the entrance with dirt after introduction of the cyanide. Do not inhale the fumes of this poison, as they are deadly. Previous to killing the colony, a burning pit should have been dug in the ground. The hole should be deep enough and large enough so that when the material has been burned completely, the residue may be covered with at least a foot of dirt. The hole is to catch the honey as it drips from the burning combs. If this honey be allowed to run on top of the ground, it will be picked up by other bees, carried to healthy colonies and contaminate them. Combs filled with honey are difficult to burn, so a quart of gasoline or kerosene, sprinkled over the material to be burned, will make a good fire. When the colony has been killed, carry it carefully to the edge of the pit and dump all of the frames and bees into the pit. The hive bodies, supers, covers and bottom boards may be saved. Scrape them thoroly into the pit and char them thoroly on the inside with a blow torch. Do not leave any infected material such as frames, honey or scrapings above the ground. When thoroly scraped and scorched or boiled in strong lye water, the hives, bottoms and covers may be used again with safety.

European Foulbrood.—This disease occurs but little in Colorado. There are three small areas, in which one or two colonies occasionally appear. Formerly this disease caused wholesale destruction of colonies in the United States. With the discovery that Italian bees, in strong colonies, can successfully combat the disease, it has held but little terror over Colorado beekeepers. Italian bees are better housekeepers than the formerly widespread black bee. It is for this reason that the Italian bee is held in such favor in this country.

European foulbrood is caused by Bacillus pluton, an organism visible under the microscope. It is more prevalent in spring than in summer. Colonies slightly affected by the disease may recover.

Larvae, dead of this disease, are always found in cells that have not been capped. Death occurs before capping takes place. The position of the larva in the cell is a good diagnostic factor. The larvae die while still in the active stage and apparently, due to the pain caused by the disease and death, they are not found in the normal position but may be in most any position in the
cell, on the sides, top or out at the front. There is a sour odor to the badly infected colony. The toothpick test for American foulbrood does not work.

The control for this disease has been suggested. Italian bees, in strong colonies, seem to be able to combat the disease successfully.

**Nosema Disease.**—This is a disease of the adult honey bees. It is caused by an intestinal, protozoan parasite and frequently kills the adult bees. It is widely distributed in Colorado and while the actual colony loss is not great, so far as is known, it has been known to reduce the strength of colonies considerably.

It can best be diagnosed by sending samples of the dead bees to the office of the State Entomologist, Fort Collins, Colo.

Evidence of the disease may be noted if bees are dying in considerable numbers in front of the hive or if they are crawling and dying away from the hive. The examples of this disease, as observed by the author, have always been evidenced by piles of dead and dying bees immediately in front of the hive. In the observed cases, 1 or 2 quarts of dead bees have been present.

No treatment has been suggested. Since the disease is said to be spread thru stagnant water near the apiary, a good precaution would be to move the affected apiary from the vicinity, and to provide a suitable supply of fresh water for the bees.

**Wax Moths.**—There are several species of moths, the larvae of which destroy honey combs. Four of these moths are found in Colorado and have done considerable damage. The most common damage is to stored combs. The damage is done in summer or to combs which are stored in warm rooms in winter. Strong colonies of bees will protect the combs on the hive during the summer and combs should not be stored at warm temperatures over winter. Observation of these rules will protect against most wax-moth damage in Colorado.

**Mice.**—Mice are very destructive to beekeeping equipment, particularly to combs. The entrances to live colonies should be too narrow to permit their entry in winter. Stored combs and supers should be stacked in winter and if stored in summer, so as to prevent their admission.

**Skunks.**—In some sections of the state, skunks are quite a serious pest. They prowl at night, molest the entrances to the hives and eat the bees that come out in defense of the hive. It is open season, by fair means or foul, among beekeepers, on these odoriferous nuisances.
Fig. 14.—Evidence of destructive damage to combs by wax-moth larvae. Also shows larvae, pupae and cocoons of greater wax moth.
Ants.—Occasionally ants become a pest to bees, even to the extent of destroying strong colonies. Two or three tablespoonfuls of calcium cyanide dust or granules, dug into the nest, will soon dispose of an ant hill. Extreme care should be observed in using this poison. The gas from the powder must not be inhaled as it is deadly poison. If the hill be near a hive, move it to one side, before poisoning.

Beekeeping Laws

Apiary Inspection.—Many states have laws governing the keeping of bees. Colorado is no exception. The greatest concern of the law is to control or eradicate bee diseases. Most of the irrigated counties of Colorado have county apiary inspectors. It is their duty to find and, in many cases, destroy diseased colonies to prevent the spread of bee diseases. However, the owners can do more to prevent the spread of bee diseases than the inspectors, if they have a mind to do so. The main function of the inspector is to protect the innocent from the careless or ignorant. Copies of the Apiary Inspection Act may be had from the Office of the State Entomologist.

The Law of the Honey Bee.—This book is a compilation of legal cases involving honey bees. Its author, Colin Campbell (H), was formerly General Counsel for the American Honey Producers League.

Questions Answered.—The information contained in this circular does not cover the whole field of beekeeping. As the interested beginner progresses, questions will come up for solution. The Office of the State Entomologist will be glad to assist with these new problems as they arise.

References

Bulletins.—The following circulars and bulletins have been referred to in the text and may be secured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at the prices indicated. Make remittance by postal money order.

(1) Farmers' Bulletin 1039, Commercial comb-honey production, 5c.
(2) Farmers' Bulletin 1198, Swarm control, 5c.
(3) Circular 24, U. S. Grades, color standards, and packing requirements for honey, 5c.
(4) Farmers' Bulletin 1012, Preparation of bees for outdoor wintering, 5c.
(5) Farmers' Bulletin 1014, Wintering bees in cellars. 5c
(6) Farmers' Bulletin 653, Honey and its uses in the home. 5c
(7) Tech. Bulletin 149, Fungous diseases of the honey bee. 5c.
(8) Farmers' Bulletin 1713, Treatment of American foulbrood. 5c
(9) Farmers' Bulletin 975, Control of European foulbrood. 5c
(10) Department Circ. 287, Occurrence of diseases of adult bees. 5c
(11) Department Bul. 804, Behavior of bees in colonies affected by European foulbrood. 5c
(12) Department Bul. 431, Sacbrood. 10c
(13) Department Bul. 810, European foulbrood. 10c
(14) Department Bul. 780, Nosema disease. 10c

Books.—Reference has been made in this circular, to the following books. They may be purchased thru the Colorado Honey Producers' Association or from any leading bee supply house.

(A) American Honey Plants. Frank C. Pellett.
(B) Honey Plants of Iowa. L. H. Pammel.
(C) Queen Rearing Simplified. J. Smith.
(D) Practical Queen Rearing. Frank C. Pellett.
(E) Scientific Queen Rearing. G. M. Doolittle.
(G) Beekeeping. E. F. Phillips.

Magazines.—The following are up-to-date monthly magazines on beekeeping. Sample copies are available on request.

(W) Beekeepers Item. Box 838, San Antonio, Texas.
(X) Bees and Honey. Alhambra, California.
(Y) Gleanings in Bee Culture. Medina, Ohio.