A good many accepted the opportunity to hear authorities discuss the problems of Iowa beekeeping management.

The State Association has been exceedingly active during the season of 1923. The co-operative effort inaugurated by the Association has proved attractive to a good many beekeepers and beneficial to those who took advantage of it. The Association now has a membership of 900 and has a very definite program outlined for the development of the beekeeping industry of the state. The Association activities are in very close harmony with the activities of the Extension Service with mutually beneficial results.

Number of apiaries examined on request	198
Number of colonies inspected	4,152
Number of diseased apiaries	160
Number of diseased colonies	567

BEEKEEPERS' CONVENTION

The twelfth annual meeting of the Iowa Beekeepers' Association was held, in connection with the annual meeting of the State Horticultural Society, at the Savery Hotel, Des Moines, December 5 and 6, 1923.

Officers for the year of 1924 were elected as follows: President, W. S. Walker, Iowa Falls; Vice President, E. M. Cole, Audubon; Secretary-Treasurer, F. B. Paddock, Ames; Directors, Stanley A. Ranney, Council Bluffs; F. W. Hall, Colo; N. Williamson, Bronson.

The Iowa Beekeepers' Association is affiliated with the Iowa State Horticultural Society.

State of Iowa
1924

REPORT OF THE
STATE APIARIST

FOR

The Year Ending December 31, 1924

Also Report of the Convention of the Iowa Beekeepers' Association in Des Moines, December 12-13, 1924

F. B. PADDOCK, State Apiarist
Ames, Iowa

Published by
THE STATE OF IOWA
Des Moines

LETTER OF TRANSMITTAL

HON. JOHN HAMMILL, *Governor*—

SIR: As required by law, I herewith transmit to you my fourth annual report as State Apiarist, for the year ending December 31, 1924.

F. B. PADDOCK, *State Apiarist.*

Ames, Iowa, February 10, 1925.

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REPORT OF STATE APIARIST

The season of 1924 has been the most favorable since 1920. This condition was not anticipated at the beginning of the year for the winter loss was unusually severe and the retarded spring did not permit the colonies to build up to normal strength for the beginning of the honey flow. The honey flow came at approximately normal dates and the combination of conditions resulted in an unusual amount of swarming. In spite of the fact that colonies were reduced through swarming, an unusual yield was obtained, due to the intense flow of nectar. The length of the honey flow was not abnormally long, but was probably longer than in previous seasons.

Over the state as a whole there has been an increase in the acreage of white sweet clover, which is undoubtedly a very favorable development for the beekeeper. The problem of nectar flow, of course, is fundamental with the beekeeper and a good many people are coming to realize the necessity of a careful study of the nectar secreting plants of their locality. There is a general comment that white clover is not yielding nectar as it did in former years. On the other hand, beekeeping is now quite profitable in a territory that was formerly thought to be of no value whatever. This change has been due to the increased acreage of sweet clover. In some sections of the western part of the state, there are quite extensive areas of white sweet clover and these conditions make honey production quite profitable.

The basswood is very rapidly disappearing from along the roads and streams and in this the beekeeper is losing a very fine source of honey. A plant which will undoubtedly revolutionize beekeeping is Hubam, the annual white sweet clover. This plant matures in one year and naturally the blooming period is rather late in the season. It blossoms when there are normally no plants yielding nectar in this state. Every beekeeper is quite enthusiastic about the possibilities of this plant since it yields nectar profusely over a long period of time and until hard frosts kill the growth of the plant. Wherever possible, beekeepers should encourage the planting of clover, both biennial sweet and the annual sweet. Both of these plants are fundamental with a broad agricultural program for the state. So that the interests of the beekeeper coincide exactly with the interest of the better farming.

The average yield of honey per colony in Iowa in 1924 was 79 pounds as compared with the average of the United States at 46 pounds. This indicates that the production in Iowa was very far above the average for the United States and in fact, Iowa in 1924 was one of the outstanding states of good yields. Each neighboring state was also well above the average for the United States. The production of 1924 is compared with 52 pounds per colony for 1923 and 62 pounds for the preceding nine year average. No figures are available at this time on the total production of honey for Iowa during 1924.

The character of the beekeeping of this state is changing in accordance with the demands of the time. There has been a general decrease in the amount of comb or section honey produced. This is indicated by the statistics showing that in 1924, 43% of the honey was comb and in the eight year average preceding, 51% was comb honey. In 1924 extracted honey comprised 52% of the total crop, showing an increase of 2% only over the eight year average. A new form of honey is appearing on the markets of the middle west and north, namely, bulk comb honey. During the season of 1924, it was reported that 5% of the total crop would be marketed in this form. Undoubtedly the demand of the market has some influence upon the form in which the honey is marketed. Unfortunately, the beekeepers are not in a position to say which form of honey is most profitable to produce. There probably is a greater demand for section honey than can be met by the 43% of our crop in that form. To partially meet this demand, the bulk honey is rapidly becoming very popular. In fact, this form of honey on the northern market has developed in the last three years and undoubtedly this form will continue to increase in popularity and be produced in correspondingly larger proportions. While the cost of production and market conditions seem to govern the type of honey produced, it must not be concluded that these are the sole factors. Changing types of honey flow will enter into the profitable production of section honey. With the increasing production of honey in this state, it is interesting to learn that about the same amount of honey is being sent to outside markets. The amount sold to out-of-state markets comprises 23% of the honey produced. The marketing situation is wholly unsatisfactory in several respects. Too much of our honey at the present time is sent outside of the state, some of which may reappear on the markets and undoubtedly more honey is sent into this state from other producing centers than that which the Iowa producers send out.

What is needed most is to consume Iowa honey within the state and after all of the local honey has been consumed, then depend on honey from outside sources.

The price obtained by the producer of this state is somewhat under the average price obtained for the United States. Comb honey, during 1924 sold at an average price of 22 cents, whereas the average price was 25 cents. This difference of three cents a pound means considerable in the aggregate, and it is to be regretted that the producers of this state are not obtaining the average price for their honey. Likewise, with extracted honey, the price in 1924 was 17 cents, whereas the average for the United States was 19 cents. With the amount of extracted honey produced in this state, this small difference means a very considerable loss to the producers. The fact that bulk comb honey is comparatively new on the market may account for the fact that the Iowa producer sold his produce in 1924, for 19 cents a pound, the same as extracted honey. Whereas it is only normal to expect that this product should bring more than extracted, and less than comb or section. The average price for the United States was 20 cents so that here again the Iowa producer has been marketing honey at a loss. Since 1915 there has been a very general tendency toward increased honey consumption in relation to the honey produced.

With the large crop produced this year in Iowa and a shortage in several important producing centers of the United States, there has been a very great demand on the part of buyers for the surplus Iowa honey. Never before in the history of the office has there been such an insistent demand of the buyers for the honey produced in Iowa. The large crop of 1924 and the tremendous demand does not mean that the marketing has been easy. Since the honey of this state is produced in the hands of so many beekeepers, there is seldom a great quantity of honey available in any one locality. So many small individual producers makes it very difficult to market a uniform product and consequently attract buyers advantageously. There has been some difficulty experienced in disposing of the crop this year on the part of beekeepers who normally operate 20 or 30 colonies of bees producing from 2,000 to 3,000 pounds surplus honey. With additional assistance, all of this honey has been moved satisfactorily.

The Beekeepers Bulletin has been issued quarterly and sent to the entire mailing list of more than 16,000 names in Iowa. The contents of this bulletin is primarily to give information, surmounted with items of more than special interest to those engaged in the production of honey. The service rendered by the publication of the bulletin is being more fully appreciated by more beekeepers each year. The fact that there are more than 16,000 people who receive this bulletin indicates that a good many people are engaged and interested in the development of honey production. This list means an average of more than 160 to each county in the state, although the distribution is not average in every county. It is known that there are a good many people interested in honey production who are not receiving this publication, but whenever a special request is made for beekeeping information, the name of the party is placed on the regular mailing list. A more widespread demand has been sent during the past year for information relative to honey production. More literature has been sent out than in several years.

The extension activities during the year 1924, were very satisfactory. While the work was not carried on in as many colonies as during previous years, it was the policy to attempt more thorough work in each colony. There were 76 demonstration apiaries in twenty-two counties located over the state. In addition to this, special demonstrations were conducted in eleven additional counties. This represents work of permanent nature in thirty-three counties of the state.

In conducting the above work, 54 meetings were held with a total attendance of 5,310 people. There was no material change in the method of operating the demonstration apiaries, as experience has shown that this work is fundamentally correct and needs only local applications for successful operation. As usual, five meetings were held throughout the year in connection with each established apiary. At these meetings the essential methods of operation were explained in detail. Wherever it was not possible to arrange the management operations in the yard, on account of the season, specific instructions were left with the owner of the yard and in every instance, most wonderful co-operation was given by the beekeeper.

Averaging all of the demonstration yards of the state, the yield of honey was 152 pounds as against 99 pounds for the check colonies that were operated by the owner in accordance with the methods which were formerly employed in the yard. From the fact that the state average yield per colony was given

at 79 pounds, it is evident that the check colonies were operated much better than is usual for the state. This means that the methods which have been given to the beekeepers as practiced in the demonstration apiaries, placed in practically every section of the state, showed an increase of 53 pounds of honey per colony. If this could be retailed at the normal market price of 20 cents a pound, it would mean that each colony of the demonstration apiaries showed an increase of $10.60 over the returns of the colonies operated by the co-operator beekeeper. The yield of all the demonstration colonies was more than the yield of all the check colonies by 17,632 pounds of honey. This increase over the normal yield, if sold at the market price, would mean an increased return of $3,526.40. It must be emphasized that this means the normal yield and the total returns obtained from the demonstration colonies which is shown above is still much above the state average. It hardly needs any argument in view of these figures to impress the average beekeeper that the methods which are advocated by the Extension Service are a financial success. If all of the colonies of the state could be increased as the colonies in the demonstration yards, the return in revenue would be an enormous sum. It would seem very evident that the extension activities in connection with the demonstration apiaries, has been able to return to the people of the state as much as has been expended.

While the above amount represented the increased money returns, it is the experience of those who have operated demonstration yards that the returns of the second year are greater than those of the first year. In one of the demonstration yards, composed of ten colonies, the yield of honey this year was 3,000 pounds. The best colony produced 500 pounds of surplus extracted honey. There has not been a locality in the state where it has not been possible to materially increase the returns by the methods employed in demonstration apiary work.

During the year of 1924, it was possible to inaugurate the foul brood inspection work on a basis of area clean-up plan. Two counties were selected for this purpose, namely, Warren and Woodbury. In Warren county it was possible to carry the work to completion where 329 apiaries were visited which were composed of 2,156 colonies. This careful inspection disclosed the fact there were nearly twice as many bees in the county as anyone knew existed. A lamentable fact shown by this inspection is that 25% of the colonies inspected were found to be diseased.

Here then, is truly a menace to the development of the beekeeping industry in this state. Warren county was selected because it represented the true, sideline phase of the industry. If these conditions exist in Warren county, there is every reason to believe that similar conditions may exist in similiar districts of the state where beekeeping is on a level.

Only about one-half of Woodbury county was covered in this intensive inspection work. One-hundred twenty apiaries, composed of 5,236 colonies were inspected. In Woodbury, only 6% of the colonies inspected were found to be diseased. This county is typical of the commercial phase of beekeeping. It is only natural that we would expect a better class of beekeeping, but even in this vicinity, or in the county just named, it is very evident that 6% of disease represents a very positive menace to the development of the work.

In addition to the intensive inspection work of these two counties, special calls were made over the entire state. This work covered 42 additional counties in the state. Where 180 apiaries were inspected, there were 4,239 colonies. In this general inspection over the state, it was found that 14% of the colonies were diseased. This is certainly a very high percentage of diseased bees. Some very definite and drastic campaign must be undertaken to place the production of honey on a profitable basis. A more detailed account of this inspection work will be found later in a report where the results are found.

The state association has again been very active in co-operating with this additional work conducted by the Extension Department and the inspection work. Wherever possible, the association has supplemented the activities of the two above agencies and co-ordinated all of the work. The Association membership is approximately 900 and the very definite program has been enlarged somewhat so as to render every possible service to its members and the beekeepers of the state. Of special value to the beekeeping development is the "Better Queen" campaign which was continud with increased vigor. The results of this effort are certainly very gratifying.

Apiaries inspected	629
Colonies inspected	11,631
Apiaries diseased	1,474
Colonies diseased	13%

BEEKEEPERS' CONVENTION

The thirteenth annual convention of the Iowa Beekeepers Association was held in conjunction with the annual meeting of the State Horticultural Society at the Chamberlain hotel, Des Moines, December 12-13, 1924.

OFFICERS FOR THE CURRENT SEASON

President—W. S. Walker, Iowa Falls
Vice-President—E. M. Cole, Audubon
Secretary-Treasurer—F. B. Paddock, Ames.
Director—N. Williamson, Bronson
Director—F. W. Hall, Colo
Director—Stanley Ranney, Council Bluffs

PAPERS READ BEFORE THE CONVENTION

ADAPTING SYSTEM TO LOCALITY

By Frank C. Pellett, Hamilton, Illinois

Locality is a badly overworked word in our beekeeping literature. It is too often used to explain away differences of opinion due to careless observation or improper manipulation. While differences in bee behavior are not usually to be credited to locality, a different system of manipulation is often necessary to make the most of the flows arising under different conditions.

The fundamentals of beekeeping are few and easily grasped by the intelligent mind. Room, stores and protection have been shown to constitute the essentials which must be recognized under any conditions. With a proper understanding of these, it then becomes important that he may apply his knowledge to bringing his colonies to the peak of brood-rearing in time for the principal harvest of the year. In this connection a brief consideration of the peculiar conditions to be met in different parts of the country and the effect upon the plans of the beekeeper may be of some interest.

In southwest Iowa, where the writer kept bees for several years, there was but one principal honey flow—from white clover. This flow lasted from ten days to six weeks. If the bees were not ready when the flow came there was little chance of securing a crop from a later flow. Usually there was sufficient fall flow to fill the hives, and put the bees into good condition for winter, but no surplus worth while was secured. In a location like that the beekeeper must bend every energy of the entire year to bring his bees to maximum strength at the beginning of

June and to prevent swarming till the brief flow is over. If the bees winter poorly there is little time for coddling the bees and building up weaklings to profitable strength. Good wintering becomes essential. It is also important that no time be lost in building up the colonies in spring. It was found that by wintering the colonies in two stories with the upper brood chamber well filled with honey that it was usually possible to turn the surplus of food into young bees and have the two stories well filled with brood and bees by the close of fruit bloom always providing that the bees wintered well. With careful attention it was possible to get from two to four times as much surplus as the average farmer with bees in the neighborhood was able to secure. There was seldom a season when it was possible to make increase ahead of the honey flow to any extent, without reducing the crop.

In contrast to this location there are places in the alfalfa districts of Colorado where the main flow comes in August, where it is the practice to make increase from the early flows and still have the bees in good condition for the principal flow. There some beekeepers practice wintering in two stories and as soon as the two stories are filled with brood in spring the upper story is removed and given a ripe queen cell. With the late flow it is possible to have two colonies instead of one for the gathering of the crop. In a situation of this kind, poor wintering is not nearly as disastrous providing of course that the bees come through alive, as it is where there is only one flow and that very early.

In the vicinity of Washington, D. C., tulip-tree, often spoken of as "poplar" is the principal source. Because it blooms so early that the bees are seldom ready for the flow, it is generally regarded as a poor location for beekeeping. Yet an average of something like 100 pounds of surplus honey per colony is gathered at the government apiary where careful wintering is practised.

In the lower Rio Grande Valley of Texas there are frequent flows from many sources. These flows are likely to come at almost any time after a rain. Heavy flows are infrequent and light flows coming so often it is difficult for the beekeeper to harvest much surplus, since the honey is largely consumed in the almost continuous brood rearing. The writer found the bees to be very strong in well kept apiaries in early March. There were reports, also, that bees sometimes swarmed as late as December and found sufficient support to carry them through. In a location like this, commercial honey production is less profitable than the production of bees and queens to supply the demand of northern beekeepers. In North Texas at Waxahachie, local beekeepers report that the bees are ready for business by April, yet the main flow does not come till June. They find it very difficult to keep down swarming during the intervening period. One man, T. W. Burleson, has solved his problem by selling his early bees in packages and still giving his colonies time to build up for the honey flow from cotton. Until the demand for bees developed he found great difficulty in overcoming the swarming problem.

In such locations beekeepers often are very indifferent about giving attention to wintering. They say that no matter how weak the bees are in spring, there is still time to build up for the flow and that strong colonies in early spring are of no particular advantage.

There are other factors beside the time of the honey flow that enter into the consideration of locality. The source and nature of the flows also determine to a great extent the system which is best suited to the conditions. Comb honey cannot be produced to advantage except under specially favorable conditions. A slow or intermittent flow will result in poorly finished sections and a short crop, where a good crop of extracted honey might be secured. In some sections of Colorado there is much gum-weed (Grindelia squarrosa) which granulates very quickly, sometimes even before the honey is sealed. Where this honey is mixed with the alfalfa, granulation is sure to follow within a short time and as a result the comb honey market gets a black eye. Granulated comb honey is a drag on the market and in such a situation extracted honey only should be produced. At least comb honey supers should be replaced with extracting supers during the flow from gum-weed. Enough of this gum-weed alfalfa mixture has gone to eastern markets to create a prejudice against Colorado comb honey in some places.

In several of the southern states, bitterweed (Helenium tenuifolium) is quite common. The honey is absolutely unpalatable and should never be placed on the market. Even a small quantity of this bitter honey is sufficient to spoil a whole tankful of good honey. There the beekeepers should remove all the good honey from the hive when the bees begin to work on bitterweed and give them empty supers of extracting combs. When the flow is over, if other flows are still to come, the bitter honey can be taken off and the other supers replaced. When the season is over the bitter honey can be given back to the bees for winter stores. No adverse reports have been found from the use of bitter honey for wintering the bees.

The available pasturage determines the number of colonies that can be successfully kept in one yard and this in turn influences the system of management. In North Georgia there is a large area where not more than twenty-five colonies are profitable in one apiary. There is a variety of sources of nectar available, but not enough of anything to support a large number of colonies. One beekeeper in that region keeps 800 colonies of bees in thirty yards. This requires a large amount of travel, but his returns are more nearly constant than in any other locality with which I am familiar. In contrast there are numerous locations in the sweet clover districts and some in the buckwheat regions where three hundred or more colonies do well in one location.

The presence or absence of a supply of pollen for brood rearing is also an important factor. In some places where there are heavy flows, pollen is scarce and the beekeepers find it necessary to take the bees elsewhere to build up. This requires long distance moving which is tiresome and expensive.

The dependability of the forage is also to be considered. There are many places where good crops can be gathered occasionally with frequent seasons of failure. This necessitates migratory beekeeping if the apiarist is to harvest a crop every year. There are numerous California beekeepers who make long moves from one to three or four times in a season, moving to such locations as promise an immediate harvest. This is practised to a lesser extent in some of the Central and Eastern States. The Dadants find it frequently to their advantage to move their apiaries to the lowlands along the Mississippi river when the crop is a failure on the uplands. This requires a move of something like thirty miles, which can easily be accomplished in a day with their big trucks.

The above examples could be multiplied indefinitely but are sufficient to show how necessary it is that the beekeeper be fully informed as to the conditions peculiar to his location and that he develop a system of beekeeping best adapted to those conditions.

BEE KEEPING AND THE FRUIT GROWER

S. W. Snyder, Center Point, Iowa

Do these apparently separate occupations antagonize each other, or should one engage in both at the same time? Any man who is mentally capable of making a paying business of beekeeping should also be capable of succeeding at fruit growing, and I would advise to engage in both to the extent of one's own strength or ability to get and manage competent helpers.

The beekeeper and fruit grower have much in common, and it has come to be well understood that fruit plantations yield much better crops when located in the vicinity of a large apiary than do those far removed from any bees. That the bees are sometimes accused of opening and destroying ripening fruit is a false accusation against them and no one has yet been able to prove that bees have ever opened sound fruit; that they will appropriate fruit juices when openly exposed no one will deny, but it has yet to be proven that bees can or ever have opened sound fruit.

Now and then a fruit grower will bob up and say, "I have seen them just dig into my plums and grapes and work away until there is nothing left but skins and seeds." To such I have this to say, "You have jumped at the conclusion that the bees had opened your fruit while in fact they did not." A due and close inspection would have revealed the fact that the fruit was first opened by one or more of the following agencies, a biting or gnawing insect, punctured by the sharp bill of a bird, or bursted open by a sudden change from dry to wet weather. I have known plums to be bursted so wide open by such a sudden change in weather as to let their seeds drop out and I have had hundreds and hundreds of pounds of grapes bursted in the same way. Who can blame the bees for appropriating the sweet juices thus exposed? CAUTION, get busy and dispose of such perishable crops before they become over ripe. Such crops should be gathered and used just before they become subject to injury by insects, birds or weather conditions.

Separately either beekeeping or fruit growing constitute a full grown man's job and fruit growing added to beekeeping brings to the beekeeper many new problems such as the study of varieties, growing, spraying and marketing. I observe that fruit growing in conjunction with honey

production brings to us many customers who might otherwise go elsewhere for their supply of fruit or honey. Now and then one or the other will fail to produce a crop and the income derived from the other is needed to tide one over what might otherwise result in disaster.

I believe a beekeeper in order to derive the greatest amount of benefit from his apiary should be an all around agriculturist and I believe a well kept apiary to be as necessary to the successful management or a large acreage as are the common list of domestic animals. The bees assist nature in fertilizing and rounding out the fruit seed and grain crops and the animals are necessary to eat up the resulting roughage.

CO-OPERATION

R. S. Herrick, Des Moines, Iowa

While necessity is the mother of invention, true co-operation is the result of a needed betterment in existing conditions. The word "co-operation" means the act of co-operating or of operating together to one end. It also means concurrent effort or labor. Possibly co-operation of one kind or another has been practiced by the human race for centuries. The word as used in the present day business means either the buying, selling of merchandise, produce, etc., or the loaning or borrowing of money.

The Iowa State Horticultural Society was organized on June 26, 1866, but it was not until December, 1912 that some of its members banded together and organized the Iowa Fruit Growers' Association. During its first year of operation, namely, 1913, it had but about 100 members. The object of the Association was the buying together of orchard spray material and harvesting equipment. In spite of the fact that it had no constitution and by-laws until November, 1922, it has gradually increased in memberships and also the amount of business transacted until at the present time it has anywhere from 500 to 1,000 members and does anywhere from $50,000 to $70,000 worth of business annually. We believe the reason for the existence of and the amount of business being done by the Iowa Fruit Growers' Association is co-operation on the part of its members. The cause and effect of this co-operation has been the more members, the more business transacted, and the more business transacted the better the price of the material sold to the members. For example, as near as we can figure, this association has saved many of its members around 25% on the cost of the spray material they have bought. While the association may not have saved the larger growers quite this much, at the same time, it has enabled them to receive prompt shipment and to see their neighbors increase the quality of their fruit and thus, to a certain extent, help to prevent the sale of inferior fruit. Fruit growers are commencing to realize the importance of quality instead of quantity production. The business end of the association has progressed hand in hand with the educational agencies of the state. This is another form of co-operation which should not be lost sight of. The problem of a better pack which means a better market in many localities of the state is yet to be solved but we believe with the co-operation of the association and educational agencies of the state that it will be solved. Thru co-operation it has been possible to get somewhere around one-half of the orchard trees in this state sprayed while in 1912 the percentage of sprayed trees was very small.

In the spring of 1922, the Iowa Vegetable Growers' Association installed a selling service of northern grown seed potatoes. That year six carloads of seed potatoes were sold thru the association. This, no doubt, increased the yield of potatoes as it is a known fact that northern grown seed will outyield southern Iowa seed. In 1923, the association sold nine carloads of northern grown seed potatoes and the same amount in 1924. This is a service which we believe can be increased in the future thru proper co-operation.

In 1922 the Society of the Iowa Florists installed a buying service for its members consisting of the co-operative purchasing of greenhouse spraying material and fumigants. During the same year, this society established an exchange list of plants and flowers which enabled its members to dispose of much of its surplus plants at a fair price and at no cost for advertising. This exchange list has become very popular and its length has increased considerably since it was first started. An exchange list is mimeographed monthly and sent not only to the members but to all those who might be interested in the buying of plants and flowers direct from the grower.

The Iowa Nurserymen's Association is at this time contemplating the co-operative buying of certain nursery supplies.

There really is no limit to what co-operation can accomplish. While it is true that many co-operative associations have failed, it is also true that a great many other businesses have also failed due to the lack of conservative business judgment. I suppose every co-operative association has what we might call luke warm or half hearted members. There are always people who like to, what we might say, shop around. They will join a co-operative association, secure its price list and then use it for a club or hammer on some company to secure better prices on the material which they desire. We are thankful that in the above named associations we do not have many members of this type. It must be borne in mind that it is impossible for any co-operative association to deal with every manufacturer of material used by its members. The management of any co-operative buying association should send out estimates for its wants to all of the companies handling the same and then be governed by about three requisites; namely, quality of goods, distributing facilities and price of goods. The average manufacturer unless he is able to secure the association's business, is not very enthusiastic about co-operative associations. Therefore, the members of these associations must remember that if they use the association price list to secure better prices for themselves that the credit for securing better prices, if the same is possible, should be given to their association. I personally know of a florist in this state who will not buy his greenhouse fumigants thru the Society of Iowa Florists because he is able, by using the Florist Price List, to secure a price from a competitive company equal to the association price and thus save his membership dues in the Society of Iowa Florists. This is what might be termed as pure selfishness because if there were no such thing as the Society of Iowa Florists, this florist would be paying the regular retail price on an 8 lb. can of nicofume which is $15.00 instead of the association price of $12.50. While this is a free country and all of that, at the same time, the management of co-operative associations often wishes that pure selfishness could be eliminated from its membership.

While it is true that we all have our individual likes and dislikes, we should be willing to modify our desires to the extent of co-operating along the lines which will be of the most value to those who are engaged in the same business which we are.

FALL FEEDING

L. E. Dills, Ames, Iowa

To the general public the feeding of bees might be looked upon as one method of producing artificial honey. However, to the experienced beekeeper it is often the means of getting his colonies strong for the main honey flow or the carrying of the lighter ones through the winter in such a condition that they can build up rapidly the following spring for the honey flow. The method of feeding often determines whether the beekeeping practices are being carried on at a profit or loss; or in other words, the way the feeding problem is handled is very likely to determine success or failure at beekeeping.

Langstroth and Dadant in their book, "The Honey Bee," say regarding feeding, "Few things in practical beekeeping are more important than the feeding of bees yet none have been more grossly mismanaged or neglected. The prudent beekeeper will no more neglect his destitute colonies than he will fail to provide for his own table. A beekeeper whose colonies are allowed to perish is on a level with a farmer whose cattle are allowed to starve in their stalls; while those who withhold from them the needed aid in seasons when they cannot gather a supply, resemble the merchant who burns up his ships if they have made an unfavorable voyage."

In reviewing the literature on this subject one is amazed at the vast amount which has been published. Every bee book, practically every bulletin on apiculture, or copy of a bee magazine has some article on feeding. But if the literature is examined more closely we are further amazed at the very small amount of scientific data available on this important problem. With the exception of a few minor experiments at several colleges, feeding experiments are almost nil. Practically all the articles that have been published are simply a remodeling or "rehashing," as it has very appropriately been called, of previously published work. Our knowledge in the past has been largely gained by ideas of practical men, who oftentimes being pressed with other work, have not given the subject due thought or careful trial before their views were published. Too often in such cases conclusions are drawn somewhat as follows: Last year I fed my bees honey in the fall, this year I fed them sugar syrup, this year they have come through the winter better than they did last year; therefore, sugar syrup is superior to honey as a bee feed. Usually no thought or attention is given to variations in time of feeding, type of winter, strength of colonies, method of feeding and a hundred and one things which might be responsible for failure or success rather than the honey or sugar used for feed. To prove that sugar is superior to honey would necessitate a trial by colonies handled under like conditions at the same time. Then is it not possible that if the experiments were altered so that if they were fed at a later season, or different amounts on proportions that the results would be negative to what they were before?

How do we know that sugar is a superior feed to honey in the dead of winter? What is the effect of sugar syrup and honey if fed late? How late will the bees take feed? Will they take a thick sugar syrup faster than they will a thin? Will they winter better if sugar is given to them in a thin syrup forcing them to invert it more thoroly by taking it more slowly? What percent of feed is consumed in inverting sugar syrup and removing the excess moisture?

In order to answer some of these questions and throw more light on feeding as a whole, a series of experiments were begun at Iowa State College this fall (1924).

For this work twelve colonies were selected from the college apiary. Eight of these were in modified Dadant hives, the other four were jumbo hives. These had all been requeened the previous summer with young Italian queens but no previous record of each individual hive had been kept and no brood counts were made. However, at the beginning of the experiment all had a small patch of brood in the center of the broodnest. Next, the colonies were divided into four groups with three hives in each group, two dadants and one jumbo. Each group was equalized as much as possible in strength. That is, if one group had a strong colony, it was also given a weak one, this way each group was given an equal chance and also individual colonies would give a check on the difference between the utilizing of feed by a strong colony and a weak one.

Unfortunately the experiment was not begun early as facilities were not then at hand for conducting the work. However, practically all the work was done during October when most of the feeding is usually done and as the weather was warm, no trouble with feeding was anticipated. Next after dividing the colonies according to strength and arranging them in groups, they were leveled for feeding and weighed on a very accurate platform scale. Then feeding was begun in earnest.

The feed given was as follows:

Group I—Honey.

Group II—Honey one part and water one part.

Group III—Sugar forty parts and water sixty parts.

Group IV—Sugar sixty parts and water forty parts.

The common feeder which is the ten pound pail with ten holes punched in the top with a four-penny nail was used. This was inverted over the hole in the inner cover and as fast as the bees had carried down the feed, the pail was refilled and given to them again. An attempt was made to give each colony an excess of twenty pounds of stores over and above what they already contained. It is hoped that an accurate comparison can be made on the effect of the various feeds since twenty pounds of stores is over and above what they will need for the actual period of cellar wintering and this feed will be used first because the last stored food is always stored just above the cluster and as the bees gradually move up they will eat the last stored first. The plan is to count and weigh the dead bees each week, thus getting a very accurate check on the comparative value of each feed. For example, if honey causes the accumulation of feces more than sugar, the dead bees collected from the hives that have been fed honey will weigh more than those fed sugar. No direct comparison between good honey and sugar has ever been published and it is highly desirable to have the true relation between the two. It has been reported to me that elementary experiments have been conducted at Washington on the comparative weights of dead bees fed various feeds but the results have never been published. Only a good grade of clover honey mixed with a very small amount of buckwheat was used in this experiment. The sugar was the best grade white granulated sugar. If the bees die more rapidly from the hives that have been fed the thinner feed we would be inclined to believe that they have used up more of their energy in evaporating the excess of water from the feed and possibly some conclusions can be drawn on the proportion of water that should be used. Also, if the heavier syrup has been fed faster than they could invert it, the sugar is likely to granulate in the combs and the bees die as it is impossible for them to get water to liquify it as they do in the spring.

Some interesting results have already been obtained and it is hoped the ones just mentioned and many more will be decided upon before the winter is over.

At first the feeding was done with the entrances wide open. No tendency toward robbing was experienced but when the entrance blocks were used the bees carried down the syrup slightly faster. Several days later the weather turned slightly colder and since it was desirable to hasten feeding the inner covers were removed and the pails set directly over the frames to see what effect that would have on the rapidity with which syrup would be carried down. It was observed that the feed was carried down considerably faster after removing the inner covers, however, it is impossible to say how much faster on each group as the inners covers were all removed at once and therefore we had no check. An interesting comparison was shown by the rate at which the various feeds were taken down and the average daily gain. Taking the daily gain of the group fed thick sugar syrup which gained the fastest, as 100 percent, we have the following table:

Group I—Honey, 78%.

Group II—Thin honey, 27%.

Group III—Thin syrup, 22%.

Group IV—Thick syrup, 100%.

This would lead us to believe that colonies under similar conditions to these, while carrying down one hundred pounds of thick sugar syrup, could only carry down seventy-eight pounds of honey or twenty-two pounds of a thin sugar syrup. Provided the bees winter successfully, this is contrary to common opinion as the general belief is that honey can be fed later than sugar syrup. However, it is interesting to note that the results agree with common opinion in that more concentrated feeds are better for late fall feeding since a larger amount can be added in a shorter time and with less work on the part of the bees.

When any feed is given, only a certain percent of it is actually stored; some is always used in other duties around the hive, such as carrying it down, evaporating it to the proper consistency, and rearing brood.

The following table shows how much was stored and what percent was lost:

	Percent of feed stored.	Percent store expressed as honey & sugar.	Percent lost.
Honey	74	74	26
Honey and water	26	52	48
Thin sugar	24	48	52
Thick sugar	62	71	29

This gives a good comparison of the amount needed for evaporating, storing and inverting. About three-fourths of the thicker feeds were finally stored in the combs as food. Approximately twenty-five percent must have been used in evaporating water. The table also shows a greater loss in the sugar than in the honey; this is very likely the amount of energy required for inverting the cane sugar to invert sugar. The first column of the above table shows the pounds stored in every hundred pounds of feed. We see in the thin syrup twenty-four pounds of feed is stored out of every forty of sugar fed as such. Or, expressed in percent, we have sixty percent using sugar as a basis, or out of every one hundred pounds of sugar fed as a thin syrup, we have sixty-two pounds of feed stored out of every sixty pounds of sugar, or one hundred-three pounds out of every one hundred pounds of sugar fed. This is at first appearance an inconsistency in that it seems as though more was stored than was fed, but when we consider that honey or stored sugar syrup is twenty percent water, we can readily account for this excess and see some is lost during the storing process. This experiment would lead us to believe that advice to consider the weight of feed given by weight of sugar and not syrup is right for thick syrup, but not for thin.

Ordinarily when we think of giving bees a ten pound pail of honey, we think of giving them ten pounds of stores; in this case it would be only giving them seven and one-half pounds. Or in the group that were fed thin honey we ordinarily think when we give them ten pounds of honey and water fifty percent each that we are giving them five pounds of feed. But according to this trial we would only be giving them two and one-half pounds of stores. So the consistency of the feed should be considered in estimating the amount that will ultimately be turned into stores. In this trial I believe

there was a big loss in brood rearing; very likely that accounts for most of the twenty-six percent of the loss in feeding honey. However, the feed was given in this case after I believe is the best time for feeding. No doubt there would be a bigger loss earlier as brood rearing would probably be stimulated even more. No brood counts were made but all the hives had brood and most of the time the pollen carriers were busy bringing in pollen. Another fall it is hoped that brood counts can be made on all colonies and the relation between the amount of brood stimulation and the various feeds used can be found.

The winter weighing and counting of bees as is now being carried out will be of great interest to ascertain the loss, or rather drain on the energies of the bees in inverting the sugar and in evaporating the feed. Probably here is our biggest loss in feeding, since our bees are worn out prematurely and thus are not able to properly attend a prolific queen the following spring. Recently Professor Jager of Minnesota University made the statement that in feeding bees sugar syrup, only seventy percent is actually turned into stores. Referring to our tables I find that our results show that seventy-one percent of the sugar was actually turned into stores when a thick syrup was fed. We have besides this the big loss in vitality and wear on the bees in inverting it, and if feed is given too late to invert it will be granulated in the comb, thus killing the colony as they cannot get water to liquify it as they do in the spring.

To overcome losses resulting from the use of cane sugar, Professor Jager has been working with methods for its inversion before feeding. Such a process perfected would be a big saving on bees as well as feed. With the assistance of the chemistry department of the university he has succeeded in using an enzyme, invertase, to change the cane sugar into invert sugar. Most beekeepers are already familiar with the use of tartaric acid to invert part of the sugar before feeding. The usual method is to add one tablespoonful of tartaric acid to twenty pounds of sugar. In older texts and magazines we find references to the addition of vinegar to the syrup so that the acetic acid would invert the sugar.

It is hoped that it will be possible to carry on laboratory experiments at Ames with the use of invertase and the different acids this winter. The inverted feed will then be given a practical trial on the college apiary this spring and next fall.

These rather preliminary experiments just mentioned and the ones to follow should be confirmed by re-tests at this college and other institutions. Much can also be added to our knowledge by careful observations of the practical beekeeper. By these means it is hoped that we can actually get some new facts about this much neglected subject of feeding bees of which we find so much written but very little actually known.

STORES AS A CROP INSURANCE

G. H. Cale, Hamilton, Illinois

Feeding has at times been a much abused practice and a subject of considerable discussion in the bee magazines. In the spring it is common to have colonies run short of stores and since usually there is a possibility of minor nectar flows occurring to make good the deficiency, feeding is often neglected. Nature is ever a fickle dame, however, and colonies should be watched to insure that sufficient food is constantly present to prevent starvation. As long as there is capped honey in the hive, additional food is, for a time unnecessary.

However, since the object of all well directed work in the apiary previous to the honeyflow is to have a strong gathering force when the flow begins, there comes a time in spring when feeding is done not only to prevent starvation but also to insure the continuance of brood rearing. When the queen breaks her winter's rest and starts to lay, the daily quota of eggs gradually increases until a high level is reached when the number of eggs in a day may average three or four thousand. Under favorable conditions there is no other period in the year when the amount of brood present at one time is as great as at this peek in the first part of the season. Strong colonies may then increase their population from a force of 15,000 to 20,000 bees to one of 80,000 or more, an increase of 12 to 13 pounds of bees.

Unfortunately, conditions are not always favorable to this increase and one of the frequent drawbacks is the lack of the stimulation which comes from the presence of an abundance of food for the development of the brood. Where there is a limited food supply the number of mouths must of necessity be restricted and unless nectar is to be found in plenty outside the hive the daily additions to the brood inside will be reduced sometime before the reserve food is exhausted. Strong colonies with large amounts of brood often do not retrench quickly enough and when stores are scant, such colonies must be watched carefully, since they frequently die of starvation in a very short time.

This behavior places an emphasis on feeding which has not been given often enough. A few figures on the food requirements of brood are available which are interesting and of much practical value. In looking over the results of the experiments in beekeeping conducted by R. L. Taylor at the Michigan Agricultural Experiment Station, Demuth obtained figures from which he was able to express the total food requirements of the honeybee from the hatching of the egg to the emergence of the adult. It requires approximately 5 pounds of honey to a pound of bees; or one frame of honey to one frame of brood. The probable accuracy of these figures will be readily supported by those who have observed the swift disappearance of stores when brood rearing is at its height. To increase in numbers from three or four pounds of bees in early spring to the sixteen or eighteen pounds which we like to have before the honeyflow, takes a minimum, therefore of 60 to 70 pounds of honey not figuring the food consumed by bees which emerge and are removed by death.

There is also another factor which enters the feeding question at this time. The mere production of bees is not so important as the need for **bees of the right age at the right time.** Figure 1.

Since the honeybee is not capable of materially renewing its energy, the life of the worker is not measured by time but by the amount of work done. For the maximum efficiency of the honey gathering force, therefore, the workers must not have consumed much energy in field labors before the honeyflow begins. Bees may easily be too old for the production of the largest crop. On the other hand, it is equally true that a working force with a majority still too young to engage actively in field work will not do justice to the honeyflow until the bees age a bit. It then frequently happens that the best of the flow is over. There is evidently a definite period previous to the honeyflow, during which the raising of bees is the most favorable thing a colony can do.

For practical discussion, the factors which may be considered as determining this period, as above indicated, are the length of life of the worker and the age at which bees first go to the field. Since the usually accepted average for the life of the worker is six weeks, bees emerging previous to the sixth week before the honeyflow are of no use during the flow. Hence brood rearing, from the beekeeper's standpoint, assumes first importance in the colony activity, for a month and a half before the honeyflow. Yet of the workers produced then, only those that are just becoming field bees when the flow starts will be of maximum value. When brood rearing is at its best, it is not unusual to see 75,000 cells of brood at one time and we would like to exert some magic which would insure all this brood present as eggs about 35 days before the flow. Should the harvest last over six weeks, of course, it is important to continue with a renewed force of workers until it ends.

There are regions and seasons when, under a natural stimulus, this peak of favorable population is long past before the flow begins and the beekeeper's problem is then complicated by the need of delaying the peak in some way or of continuing the heavy brood rearing. No two seasons are alike in this and the beekeeper must be alert enough to be able to shift his program to meet the needs of the occasion.

It is generally unsafe to depend entirely on the nectar resources at this time of year to supply the rich abundance of stores so essential to the development of numerous honey gatherers. Each three days, for weeks at a time, a fertile queen may easily fill two frames with eggs which hatch into thousands of hungry larvae. The enormous growth which these tiny creatures make in the six days of their larval life is indicative of their food requirements and there are periods when over 6 pounds of honey a day are needed to keep up the development. Figure 2. When sufficient nectar is obtained, to furnish this amount of food daily, it comes pretty near being a honeyflow for which the bees should have already been developed.

The result of this discussion is to bring us back again to the need of providing the colony with at least a part of its spring food requirements in some other way. The feeder is usually resorted to and frequently of necessity. There are years when the early consumption of stores is excessive, due to unusual climatic conditions; or the honeyflows the year before may have failed to supply enough for reserve stores; or other obstructions due to unavoidable circumstances may leave the feeder as the only way out. It can scarcely be disputed, however, that from all points of view, the ideal way to provide stores is to leave an abundance of sealed honey with each colony in the fall; enough to last the winter through and under normal conditions, to provide for brood rearing in the spring. There seems to be only two excusable situations for using the feeder, (a) to prevent actual starvation or an undesirable shortage due to unavoidable conditions, (b) to stimulate brood rearing between honeyflows or in queen rearing.

In either case, syrup, or candy made of granulated sugar or honey free from disease, are the only foods which can be universally recommended. In feeding to make good a deficiency, the syrup is usually made of one or two parts of sugar to one of water but for stimulative purposes a much thinner syrup is more effective. A common formula is, two parts water to one of sugar but it is frequently made even thinner than this. Unless feeding for winter stores, no attention need be paid to securing the inversion of the sugar to prevent granulation since the bees readily take care of this part of the process. The heaviest feeding is best done during the six weeks period when brood rearing is of most value and it must be remembered that at this time large amounts of food are necessary.

Stimulative feeding is a matter which can be overdone especially in the early season when the weather is still cool. The practice of stimulation at this time is often inadvisable and, in the hands of the inexperienced, it is easy to overcome the good judgment of the bees and induce them to rear more brood than they can care for properly. Later stimulation may be valueless since usually when it would do the most good there is sufficient nectar available to serve the same purpose. It should be again emphasized here that, in the spring, neither stimulative feed nor nectar alone take the place of an abundant reserve of stores. When there is a dearth of nectar, however, or it is necessary to keep up brood rearing out of season, as in queen rearing, stimulative feeding is an acceptable practice.

Candy feed is most useful in cool weather to prevent starvation from lack of stores. The ordinary good candy or queen cage candy, in amounts sufficient to give five or six pounds to each colony, is satisfactory. The receipt for this candy is well known and calls for honey or invert syrup mixed to a stiff dough with confectionery sugar which contains no starch. If honey is used in making the candy it must be free from disease. When mixing, it is a good scheme to heat the syrup or honey, since the resulting candy will then remain stiff at ordinary temperatures. Paper pie plates serve well as inexpensive containers. Plate 3. Two of these filled with candy and inverted over each cluster of bees will last a long time unless brood rearing becomes too great. It is also important to keep the cluster covered with some protecting material to prevent the escape of heat and, where packing of any kind is used, this may be replaced about the plates. Loose packing may be kept from sifting down between the frames by covering the top of the hive with a burlap or cloth before replacing the packing. Plate 4. Receipts are also available for making fondants which are useful for feeding in this manner and which do not require the use of honey.

When using syrup it is most practical to make, at one time, amounts sufficient to care for all the colonies that may need help. The sugar and water may be mixed and heated slowly in a large container until the sugar is entirely melted. To carry the feed to outapiaries, five gallon cans are convenient. We use five gallon oil cans for this purpose, since it is easy to pour the feed from them and they are stout enough to stand considerable handling. Figure 5. Of all the feeders used, we find the inverted or atmospheric feeder to be by far the most useful. Two of these holding five pounds each are inverted at the top edge of the hive with the oil cloths, which we use, turned back just enough to let the bees get to the feed. Figure 6. In settled warm weather this is not of importance. Shallow pans of feed placed on the frames and covered with grass to serve as floats will do very well but they are not satisfactory unless the weather is warm since the bees may not take the feed readily. Outside feeders are not satisfactory since they not only create considerable disturbance but usually colonies already well supplied with stores, being the stronger, get most of the feed and the object of the work is thus partly defeated.

It is better to be beforehand than behindhand when colonies are in danger of becoming short of stores and in a country where the roads to outapiaries quickly become impassable to machines after rains or thaws, it is important to watch the chances for visits to the yards. Each yard should be supplied with sufficient cans of feed and with feeders enough to care for later emergencies.

THE COLOR OF FLOWERS AND RELATION TO BEE PLANTS

By L. H. Pammel, Ames, Iowa

In a work (*) which I published some years ago I made the following comment on the color of flowers:

"Sprengel in a general way noted the characters of anemophilous plants. The flowers are usually dull in color but there are some apparent exceptions as in Plantago. This plan is, however, intermediate between anemophilous and entomophilous flowers.

"John H. Lovell in that delightfully written book, 'The Flower and the Bee, Plant Life and Pollination,' states in regard to Sprengel's observation: 'The salver-formed flower of the forget-me-not is sky-blue with a yellow eye.' While studying the flower of Myosotis I was struck by the yellow ring which surrounds the opening of the corolla tube, and which is beautifully conspicuous against the sky-blue of the limb. Might not, I thought, this circumstance also have some reference to insects? Might not nature have especially colored this ring, to the end that it might show insects the way to the nectar-reservoir? On further observation

*Flower Ecology 25.

he found that the entrances to many other flowers were marked with spots, lines and dots differently colored from the rest of the corolla. These marks he called 'nectar guides.' 'If the particular color of one part of a flower,' he rightly inferred, 'serves to enable an insect, which has settled on the flower, easily to find the right way to the nectar, then the general color of the corolla is serviceable in rendering the flowers provided with it conspicuous even from afar to the eyes of insects that hover in the air in search of food.'

"The stigmas are small and generally inconspicuous. They are colored red in the hazel and other trees but these colors are due to certain chemical changes and the constitution of nutritive fluids and the action of light and heat. There is no reason to believe that they were developed for insect pollination. Some plants like the soft maple *(Acer saccharinum)* were formerly anemophilous. The soil, climate, altitude effect the production of color. John H. Lovell[1] has contributed a number of interesting papers on the colors of northern flowers which should be consulted in this connection. The red color may serve various purposes.

"Dr. MacDougal[2] has likewise given a good popular account of colors. He says, 'The function subserved by many of the coloring substances besides chlorophyll are by no means secondary in distribution or importance to the individual plant to the exterior adaptation described above,' that is the physiological uses of color in plants.

'F. Grace Smith[3] has also given an interesting discussion of red color in plants.

"Dr. MacDougal speaking of color substances says that 'it can not be presumed apriori that the colors exhibited by the flowers or any other organ of the plant are devices to attract and guide insect visitors is becoming more and more apparent. * * that great care is necessary in the interpretation of areas of color in plants is emphasized by the fact that accumulating observations tend to show that a color sense is wholly lacking except among the higher insects, and that if the colors of flowers were fashioned to attract insect visitors must have been received at a very recent date, that is, since the acquisition of the color sense by insects.'

"Dr. Coulter[4] makes a statement that experiments made indicate that the presence of the red color slightly increased the temperature by absorbing more heat and that the red color may be a slight protection to living substance and thus lessen the danger from exposure to cold. If this explanation is correct it shows why the pistils of anemophilous plants and the cones of conifers in the spring should be red, but it is more than likely that there are other reasons that must be taken into consideration in accounting for these colors.

"Probably Marion I. Newbiggen[5] is correct, that it is as yet impossible to give a definite physiological explanation as to origin of pigment."

[1]Am. Nat. 33:493. 35:197. 36:203.
[2]Pop. Sci. Mo. 49:71.
[3]Bot. Gazette 32:332.
[4]Plant Relation 242.
[5]Biological Lectures. Wood's Holl.

Lovell in the work quoted states that as the results of the interdependence of bees and flowers there has been devoloped a "great company of bright-colored blossoms, which are especially adapted to their visits, and are, in consequence, called bee flowers." The nectar is deep seated and the flowers are often irregular. Lovell points out that butterfly flowers are commonly red colored. He points out that many alpine flowers are red colored. Orchis, Lilium, Ericaceae, our Primula, Silene of the Rocky Mountains are reddish in color. One of our native Monarda, the M. didyma and the cardinal flower are red. Lovell says:

"There would seem to be no apriori reason why red butterflies may not be strongly influenced by red flowers. The ornamental coloring of their wings is largely the result of sexual selection; and, since the different sexes readily recognize each other, it is not improbable that in seeking nectar they are specially attracted by flowers of the same color as themselves. This view is strengthened by the fact that blue butterflies may show a preference for blue flowers, e. g., blue species of Lycoena, have been seen to favor the blue blossoms of Phyteuma.

"Red waves of light, as is well known, excite attention and are seen where other hues are passed by unnoticed; they are the longest waves of the solar spectrum and, like long oceanic waves, possess a great amount of energy."

In my "Ecology," I state:

"Mr. John H. Lovell in American Naturalist says: 'In the apetalous families of eastern North America, there are 175 green, 89 white, 51 yellow, 45 red and 24 purple flowers. The 1217 polypetalous plants have 140 green, 410 white, 333 yellow, 84 red, 193 purple and 57 blue flowers. The northern Choripetalae, then, contains 315 green, 499 white, 384 yellow, 129 red, 217 purple and 57 blue flowers. Of the 92 families belonging to the Choripetalae, 47 contain green, 52 white, 45 yellow, 28 red, 49 purple and blue flowers. The much greater abundance of species and families with green, white and yellow coloration, as well as the less specialized structure of the flowers, points to these colors as more primitive or more easily developed than red, bright purple or blue. In certain genera, however, small dull red and purplish flowers are evidently derived directly from the primitive green.'

"Mr. Robertson well shows that: 'Concealment of nectar, however, accomplishes one important result that cannot be accomplished by a change in time of blooming, and that is the simultaneous exclusion of flies and short-tongued Hymenoptera. The effect of concealment of nectar can only be ascertained by comparison with a form having free honey, and blooming at the same time with Erynigium and Cicuta.'

" 'The first condition which seems to be a departure from the original is an aggregation of flowers in a more or less close cluster. In this case the lower lip loses its distinctive function both as a vexillary organ and as a landing place. Both offices are immediately assumed by the inflorescence itself. As long as the flowers remain separate, they attract the insects which are pleased by the special floral form and are adapted to it. But when the flowers become clustered they attract less specialized insects to what appears an undifferentiated color mass. In a similar way, separated flowers are only readily visited by insects to which the lower lip forms a convenient resting place. But when the flowers form a compact inflorescence, a landing place is formed by the flower cluster. Even when the floral structure remains the same, I always expect to find less specialized insects on the crowded flower.'

"The relation between conspicuousness and pollination of flowers is noticeable in some flowers, as in *Lysimachia vulgaris* of which two forms occur, one in which the parts of the flower are larger and colored more intensely; in this case self-pollination rarely occurs; but a form which grows in shaded places has smaller and less conspicuous flowers and these are seldom visited by insects. An equally instructive case is afforded by the small heart's ease (*Viola tricolor*). The species has two varieties. The large flowered variety with conspicuous flowers, variety *vulgaris*, which has given rise to our pansy, is frequently visited by bumble-bees and other insects. In fact there is no occasion for self-pollination since insects carry pollen from one flower to another. The variety *arvensis*, on the other hand, is smaller and is a weed in gardens and fields. It is seldom visited by insects. Yet in both cases, the spur of the lower petal contains the honey. *Rhinanthus crista-galli* variety *major* is abundantly visited by insects while the variety *minor* has not many visitors. It follows from this that colors are important in pollination."

Colors of flowers may be changed. White flowers of the lowlands when grown in alpine regions, become red. Our Monarda mollis of the prairie states is lavender in color but the same, or a closely related species in the foothills of the Rockies near Denver at altitudes of 7,000 feet, are much darker in color. These color changes are quite marked in many species of plants.

The doctrine that colors of flowers are important first made by Mueller, remained unchallenged until Felix Plateau made the assertion that Mueller was wrong and that it was the sense of smell that attracted insects. The statements of Plateau were widely lused in textbooks. Since then, however, some elaborate experiments made in Germany have vindicated H. Mueller. Lovell records his own observation as follows on the subject:

"If the flowers of the common pear (*Pyrus communis*) be deprived of their petals, honey-bees will at once cease to visit them for nectar, as is shown by the following observations. A cluster of seven blossoms near the end of a branch was watched for fifteen minutes and received eight visits from honey-bees. The petals were now all removed and it was observed for a second quarter of an hour. Though a number of bees flew nearby, it received not a single visit, due in part to association, for the bees came from other blossoms on the same tree, which had proved the first source of attraction.

"Two other clusters of flowers, growing side by side, but nearer the bole of the tree, consisting each of 8 flowers, were observed for fifteen minutes, and 16 visits of honey-bees were noted. The petals of one of these clusters were now removed. During fifteen minutes the adjacent cluster, which still retained its petals, received 11 visits, while not one was made to the cluster without petals. In one instance a bee hovered over it but did not alight. These results were very conclusive, and showed that the bees were guided almost entirely by the presence of the petals."

"In another experiment blue and red slips of paper 3 inches long by 1 inch wide were used instead of flowers. After the bee had made a few visits to the blue paper, on which there was a small quantity of honey, the red slip of paper with a little honey on it was placed 6 inches to the right of it. The bee returned to the blue paper which still remained in its original position. The blue and red papers were now transposed 9 times and in each instance the bee returned to the blue paper, from which it gathered its load of honey. In another experiment a honey-bee distinguished with equal ease between blue and yellow slips of paper. Beekeepers have long recognized the ability of bees to distinguish between different colors, and at times paint their hives red, white and blue in order to prevent young queens from entering the wrong hive after mating."

He cites a number of other experiments made by him, all of which go to show that colors are important. Details of many of these facts will be found in his paper in a number of articles appearing the American Naturalist on "Can Bees Distinguish Colors?"[1], "Is Conspicuousness an Advantage to Flowers?"[2] Dr. L. A. Kenoyer, who made a study of timberline flowers of the Rocky Mountain states that the clovers were the most recipient of the visits of bees. The flowers of these species were nearly all purple.

Forel[3] who carried on extensive investigation of the color and odor sense in distinguishing flowers calls attention to the wrong conclusion of Plateau at least in part. These are admirably summarized in a fine paper by Clements and Long[4] as follows:

"Conclusions as to Plateau's views. The admiration felt for Plateau's frank admission that he had been wrong in assigning an exaggerated importance to the sense of smell in attraction is more or less eclipsed by the fact that this was never again referred to in his later papers, in which he returned finally to his original view that the attractive role of color is null or nearly so. In spite of Plateau's originality, industry, and patience, the bias in favor of odor and against color pervaded all his researches, blinding him to many faults of execution and leading him to unwarranted conclusions. How dominant this prejudice was is shown by the fact that within six pages after his apology for exaggerating the role of smell in attraction, he states that his studies refute the view of Mueller that color plays an important part in this process. This also led him frequently to overlook facts and results that were not in accord with his views, and to make gratuitous assumptions as to the work of other investigators. A second great fault of his experiments was the failure to insist upon the regular use of controls, with the consequence that the results were often open to any interpretation desired. With this went the failure to realize that time, place and conditions work great differences in response, and that this was usually the explanation of the discrepancies between his results and those of his critics, rather than carelessness or lack of thought on their part. Finally, as Forel in particular insisted, he paid practically no attention at first to the importance of habit and memory, and gave them too little consideration throughout. In spite of all this, he deserves great credit as the pioneer in experimental pollination, as an indefatigable investigator, and a good-natured and courteous opponent."

I am quoting from this paper as follows:

"The view that bees do not discriminate between colors has been advanced by Bonnier, Bulman, Plateau, Forel, MacLeod and others. Bulman stated that 'it matters not one iota to a bee whether the flower is blue, red, pink, yellow, white or green; so long as there is honey, that is sufficient,' a statement approved by both Plateau and Forel. They have failed to reckon with intelligence and habit, however, as well as with the fact that odor and form doubtless enable the bee to recognize that the difference in color is immaterial to him. Darwin appreciated the significance of this when he said, 'bumble and hive bees are good botanists, for they know that varieties may differ widely in the color of their flowers and yet belong to the same species.' (1876:416), and Lovell in particular had confirmed the view of Lubbock and Mueller that bees easily distinguish colors and go to some in preference to others. Mueller (1883:275) pointed out that it is necessary to keep in mind certain char-

[1]Am. Naturalist 44: 673-1910.
[2]Am. Naturalist 43: 338.
[3]The Sensation of Insects.
[4]Experimental Pollination—an Outline of the Ecology of Flowers and Insects—Carnegie Institution Publication 336.

acteristics of the honey-bee in connection with its color preferences, if one is to avoid hasty conclusions. Chief among these are their shyness and lack of cleverness in unaccustomed surroundings. However, their shyness and desire for freedom are overruled by the all-powerful impulse for honey. The shyness and lack of skill of bees in unaccustomed places are in marked contrast to their prompt decisions and shrewdness at flowers. On flowers to which they are not especially adapted, various individuals often behave very differently, and they also show great individual differences in their color preferences.

"Bonnier decided that bees exhibited no choice between red, yellow, green and white, but his results were regarded as inconclusive by Lubbock, since his squares were largely covered by the bees, and since he omitted blue and used no uncolored checks. Lubbock made most extensive experiments, which disclosed a decided choice for blue, with white and yellow usually next. To avoid artificial colors, Mueler employed detached petals, but obtained similar results. While there were marked individual differences, there were but few cases in which one or more individuals reversed the preference (p. 139). The least attractive of all colors was glaring yellow; white and yellowish-white were visited about as readily as many shades of purple, but less readily than blue or violet. Violet excelled all other flower colors except blue, a pure deep shade of the latter having the advantage indicated by the ratios 81:37 and 50:35. Among the brilliant flower colors, bright yellow was the most attractive. The green of leaves was less than half as attractive as rose, but slightly more so than scarlet or orange. Forel found that *Bombus* exhibited a distinct preference for blue over red, though he appears to have forgotten the inability of the bee to find honey on red or to have felt that this had no relation to the behavior of bees at flowers. Plateau showed that insects made no choice between the differently colored flowers of the same species or variety, but entirely overlooked habit as an explanation of this. He did prove, however, that in his experiments at least the so-called admiration of syrphids for bright colors, mottling, etc., was little different from their behavior before colorless or inanimate objects."

I have checked the following purple, blue and red bee flowers of our flora:

Buckwheat Family. Smartweed *(Polygonum pennsylvanicum,)* Lady's Thumb *(Polygonum Persicaria).*

Caper Family. Stinking Clover, Rocky Mountain Bee plant *(Cleome serrulata).*

Rose Family. Pear *(Pyrus communis,)* apple *(Pyrus malus).*

Pulse Family. Redbud or Judas Tree *(Cercis canadensis)*, Red clover *(Trifolium pratense)*, Alsike Clover *(Trifolium hybridum)*, Alfalfa *(Medicago sativa)*, False Indigo *(Amorpha fruticosa)*, Lead Plant, *(Amorpha canescens).*

Flax Family. Soft Maple *(Acer saccharinum).*

Mallow Family. Hollyhock *(Althaea rosea).*

Evening Primrose Family. Willow Herb *(Epilobium angustifolium,)* Guara *(Gaura coccinea)*, Gaura *(Gaura biennis).*

Milkweed Family. Butterfly-weed *(Asclepias tuberosa)*, Swamp milkweed *(Asclepias incarnata)*, Common Milkweed *(Asclepias syriaca)*, Smooth Milkweed *(Asclepias Sullivantii).*

Borage Family. Borage *(Borage officinalis).*

Vervian Family. Vervian *(Verbena stricta).*

Mint Family. Germander, Wood Sage *(Teucrium canadense)*, Heal-all, Carpenter-weed *(Prunella vulgaris)*, Hedge Nettle *(Stachys-sp.)*, Motherwort *(Leonurus cardiaca)*, Horse Mint *(Monarda punctata)*, Penneyroyal *(Hedeoma pulegioides).*

Honeysuckle Family. Tartarian Honeysuckle *(Lonicera tatarica).*

Composite Family. Ironweed *(Veronia fasciculata)*, Joe-Pye Weed *(Eupatorium purpureum)*, Aster *(Aster sp.)*, Purple Cone-flower, *(Brauneria purpurea)*, Bachelor's Button *(Centaurea Cyanus)*, Chicory *(Cichorium Intybus).*

The following yellow or greenish yellow flowers occur:

Willow Family. Willow *(Salix sp.).*

Mustard Family. Rape *(Brassica napus)*, Black Mustard *(Brassica nigra)*, Charlock *(Brassica arvensis).*

Pulse Family. Wild Senna *(Cassia marylandica)*, Partridge Pea *(Cassia Chamaecrista)*, Yellow Hop Clover *(Trifolium procumbens)*, Yellow Sweet Clover *(Melilotus officinalis)*, Indian Sweet Clover *(Melilotus indica)*, Black Medick *(Medicago lupulina).*

Maple Family. Hard Maple *(Acer nigrum).*

Rose Famiy. Five Finger *(Potentilla monspeliensis).*

Buckthorn Family. Common Buckthorn *(Rhamnus cathartica)*, Rhamnus *(Rhamnus Frangula).*

Grape Family. Wild Grape *(Vitis vulpina)*, Cultivated Grape *(Vitis Labrusca).*

Linden Family. Linden or Basswood *(Tilia americana).*

Parsley Family. Wild Parsnip *(Pastinaca sativa).*

Milkweed Family. Whorled Milkweed *(Asclepias verticillata).*

Figwort Family. Figwort or Simpson Honey Plant *(Scropularia marylandica).*

Gourd Family. Squash *(Cucurbita sp.)*, Pumpkin *(Cucurbita Pepo)*, Muskmelon *(Cucumis melo)*, Watermelon *(Citrullus vulgaris).*

Composite Family. Canadian Goldenrod *(Solidago canadensis)*. Smooth Goldenrod *(Solidago serotina)*, Large Goldenrod *(Solidago rigida)*, Cup Plant *(Silphium perfoliatum)*, *Compass* Plant, Rosin Weed *(Silphium laciniatum)*, Sunflower *(Helianthus sp.)*, Tickseed *(Coreopsis palmata)*, Spanish Needle *(Bidens aristosa)*, Sneezweed *(Helenium autumnale)*, Dandelion *(Taraxacum officinale).*

The white or greenish white flowers are as follows:

Mignonette Family. Mignonette *(Reseda odorata).*

Saxifrage Family. Missouri Gooseberry *(Ribes gracile)*, Garden gooseberry *(Ribes Grossularia)*, Red currant *(Ribes vulgare).*

Rose Family. Juneberry *(Amelanchier canadensis)*, Hawthorn *(Crataegue sp.)*, Strawberry *(Fragaria sp.)*, Red Raspberry *(Rubus idaeus)*, Black Raspberry *(Rubus occidentalis)*, Blackberry *(Rubus sp.)*, Plum *(Prunus sp.)*, Garden Cherry *(Prunus cerasus)*, Choke cherry *(Prunus virginiana)*, Wild Black Cherry *(Prunus serotina)*, Bird Cherry *(Prunus pennsylvanica).*

Pulse Family. White Clover *(Trifolium repens)*, white sweet clover *(Melilotus ala.).*

Mallow Family. Mallow *(Malva sp.).*

Cornel Family. Dogwood *(Cornus sp.).*

Dogbane Family Indian Hemp *(Apocynum cannabinum)*, Indian Hemp *(Apocynum androsamaefolium)*.

Mint Family. Catnip *(Nepeta Cataria)*, Mountain Mint *(Pycnanthenum virginianum)*.

Figwort Family. Culver's Root *(Veronica virginica)*.

Madder Family. Bedstraw *(Galium sp.)*

Honeysuckle Family. Coral Berry, Buckbrush *(Symphoricarpos orbiculatus)*, Snowberry *(Symphoricarpos occidentalis)*, Elder *(Sambucus canadensis)*, Red-berried elder *(Sambucus racemosa)*, Black haw *(Viburnum Lentago)*.

Composite Family. Boneset *(Eupatorium perfoliatum)*, Daisy Fleabane, Whitewood *(Erigeron annuus)*.

It will be seen that some of the best of our honey plants, like the white sweet clover, white clover, raspberry, plums, cherries, have white or whitish flowers. Comparatively few of the good honey plants have yellow flowers. However, the dandelion, basswood and yellow sweet clover are notable exceptions. Of those having reddish, purple lavender and blue flowers, mention may be made of Germander, alsike clover, False indigo, hoary vervain, hollyhock, honeysuckle, gaura borage, some asters. The frequency of visits of bees of some of the different flowers has been brought out in a striking way in the following plants: White sweet clover, yellow sweet clover, hollyhock, heart's ease.

THE UTILIZATION OF POLLEN BY THE HONEYBEE

Ralph L. Parker, Ames, Iowa

The animal body in order to grow and maintain itself needs certain foods. If these foods are not present in the right amount there is a deficiency of growth, for the growing animal and the adult cannot perform as much or do as much work as the well nourished one. The constituents of such a balanced ration are proteins, carbohydrates, fats, minerals and water. (1) Proteins are complex compounds which have nitrogen as their principal element. Protetin is the building up material for the tissues of the body. Worn out tissues are broken down and the waste products are passed out of the body. These have to be replaced, which is done by the injected protein-containing food. This process of wearing out the tissue and then replacing it or repairing that part of an organ which has done its duty, as a general rule is going on all the while as long as the animal lives. The adult worker bee is an exception which will be taken up in another part of this paper. The nitrogen-containing food is never stored in the body to any great extent. The excess to the needs of the organism is excreted. Many insects store very small quantities of protein but not enough to carry on the work of replacement which is normally carried on in other animals. (2) Carbohydrates are also complex compounds which are made up of carbon, hydrogen and oxygen. These are the energy and heat giving foods such as sugars, starch, etc., which upon combustion or use in the body produce carbon dioxide and water. Without them little muscular activity could be performed. Unlike the proteins these are stored in the body to be ready for immediate use when called for. This storage is usually in the form of animal starch (glycogen) or muscle sugars. In the bee this storage is in the muscles of the body. As far as we know today it does not have a liver to store the glycogen as the human does so that the muscles of its body act as storage organs particularly those of the stomach (ventriculus). By this means of storage no considerable amount is possible to be present at any one time as in the higher animals. An adult bee without food of a carbohydrate nature dies quickly, in a very few hours. (3) Fat, another food is also energy and heat producing and might be spoken of as a condensed carbohydrate for it has less oxygen in proportion to hydrogen. In many animals this is stored in considerable quantity as a reserve food supply. The bee larva or worm stores fat in enormous quantities for use later in its development.

(4) Mineral matter, salts or ash is used by all animals, being necessary for growth, giving density to protoplasm and tissue, support for the body and also stimulating cell metabolism. (5) Water, the last, a solvent for many of the proteins, carbohydrates and salts. It also gives fluidity to the make-up of the body (protoplasm) in order that metabolism and anabolism may be carried on. Bee larvae take an enormous quantity of water during their larval life.

As has been pointed out there are five essential foods an animal needs in order to maintain the life processes. For example, a calf, a chicken or a pig without enough protein or mineral matter is a stunted animal when it reaches maturity. Without sufficient carbohydrate it does not exercise and thus does not eat as much, producing an under nourished animal. What happens to the young bees when a shortage of the essential food occurs? Runts are the product if allowed to develop completely. The usual procedure is that the bees pull the larvae out of the cells before complete development and throw them outside the hive. This happens if there is a lack of protein, carbohydrate, fat, and mineral food present for the nurse bees to elaborate into brood food, or if there is insufficient water at hand to properly care for the young brood.

The sources of the various essential food substances are pollen, honey, and of course, water. The only source of supply for protein is the pollen collected by the worker bees from the flowers during the active season. It is fed to the larvae in various forms, modified very much for the three days of larval life. After that time the larvae are fed cracked pollen grains, honey and water. Information gained from investigations so far points out that the adult worker cannot utilize any appreciable amount of protein or fat that may be taken into the body for maintenance or repair of tissues. Both of these foods come to the bee by means of pollen. The carbohydrate in many pollens is not available to the bee so that the source of this food is in honey, honey-dew or sugar fed to the bees. The larvae being fed honey or its equivalent along with pollen. Fat is derived from pollen and carbohydrate. The carbohydrate being combined with more carbohydrate and oxygen split off. The larva stores great quantities of fat for future use in completing its life history. Mineral matter such as phosphorous, sulphur, calcium, iron, sodium, potassium, magnesium, etc., is brought to the bee in water, honey and pollen.

Now comes the question how does the bee use pollen? But first let us see how the bee gathers pollen. The hairs on the body are mostly of that kind which are known as branched or plumose thus making it possible to have pollen grains collected on them. From these hairs the grains are by the legs and worked back to the pollen combs on the inside of the third pair of legs. The pollen combs are rubbed together and the pollen is combed out of them by the pecten comb which forces it through the auricle or wax pinchers (the latter is a misnomer) into the corbiculae or pollen baskets. When arriving at the hive it finds a suitable cell and proceeds to stick its hind legs into the cell while holding onto the cell above with its fore legs. With the tibial spines on the middle legs the pellets of pollen are pushed from the pollen baskets, thus they drop into the cell.

Nurse bees may nibble from an incoming ladened worker's pellets or go to a pollen cell to get pollen for elaboration into brood food. It is assumed that they predigest pollen in some way before feeding it to the larvae, but this point has not been proven as yet. The early larval food is a rich protein mixture which is secreted by the nurse bees and is glandular in origin. After the first three days of larval life the composition of the food is changed. From now on the mid-intestine is found to contain pollen grains showing that the larvae are able to digest pollen grains. Before the grains can be acted upon by the digestive ferments their shells are cracked by the bees with the aid of the mandibles. Those grains which have not been cracked pass through the digestive tract intact. The shell of the pollen grain is made up of complex carbohydrates known as cellulose and this would indicate that there is no cytase present in the bees digestive tract, cytase being the enzyme or ferment which is capable of breaking up the cellulose. Proteolytic enzymes are present which act upon the protein in the pollen, breaking up the complex proteins to simpler ones. Starch that may be in some pollens is not acted upon for there is no enzyme present capable of producing the necessary change. Some pollens contain oils or fats, these being acted upon by the enzyme lipase making it possible for the larvae to assimilate these, lipase being the fat splitting enzyme. In the growing larvae the requirement of food is enormous so that great quantities of pollen, honey and water are needed during the active season when brood-rearing is greatest. Protein and fat are derived from the pollen of flowers. The proteins go to make up the new tissue of the growing organism and the fat to the fat body which comprises about two-thirds of all larval tissue. The fat body, containing large amounts of fat and to some extent granules of protein and glycogen, is used later in some way as an aid to metamorphosis at the time of pupation.

Pollen as used by the adult bee in the maintenance of its own body is meager. The bee lives on the average only about six weeks in the active season. During this time it is successively nurse, wax-builder, house bee, guard, etc., before it becomes a field bee. It becomes a field bee only the latter two weeks of its life having spent most of its time within the hive. In the adult organism a maintenance ration is considerably less than that for a growing organism. The various activities of the house bee are not as strenuous as those of the field bee and thus the aging is not so rapid here as later in life. The nurse bee's chief function is the manufacture of larval food and the care of the larvae. Thus their activity is mostly that of glandular secretion. As with the nurse bee the wax-builder's function is mostly glandular. When it becomes a field bee the work is infinitely more arduous, wearing out tissues much faster, while flying in search of provender. The life of the bee is likened to the charge in a storage battery. When the charge is all used then there is no more response. So it is with the bee, the fresh organism starting out in life does light work which gradually becomes heavier and all the while it is gradually wearing out, until suddenly weakening to the extent that it is unable to fly or walk. If the bee was able to assimilate protein and fat in the adult stage then its life would be prolonged.

As has been pointed out pollen is an important source of supply of certain kinds of food for the bees, namely protein and fat. It is also noted that the assimilation of these foods is in the larval stage while carbohydrates, which are limited to the various sugars, are used in the larval and adult stages.

VENTILATION BY THE BEE-COLONY

John G. Jessup, Council Bluffs, Iowa

Ventilation by the bee colony has been referred to by many writers. Thomas Nutt, an English author, writing in 1832, was one of the first to remark that ventilation was essential to supply pure air and cool the hive. T. B. Minor, in 1833, writes: "Plenty of fresh air is essential to the colony, and this is provided by fanning bees." He goes on to emphasize the importance of a large entrance, and marvels at the division of labor. So we find that the importance of ample ventilation was early understood by the students of beekeeping.

We find a very elaborate hive containing a thermometer and two ventilators for the control of temperature described by Neighbour in 1866, and his recommendation was that the ventilators be closed each night. However, this hive was too complicated to be practical. The conclusions of Wighton, writing in 1842, although incorrect, are very interesting. He recommends allowing bees to cluster outside the hive, in order to allow the hive to cool. He states: "Bees do not cool their hives by fanning with their wings at the entrance. This is considered an act of pleasure, for they often perform it elsewhere. The reason why they never fan with their wings except where it is hot is because they are never pleased when cold."

Very nearly all authors on beekeeping have observed the fanning of the bees at the entrance and have given considerable space to the discussions of the subject. Indeed, colony ventilation and the unique manner in which the bees overcome this problem, which is, of course, one of extreme importance, to them, has always struck me as being one of the most interesting accomplishments of the colony. But what I desire to point out is that in all literature there is no discussion as to the exact amount of air required by a colony in hot weather.

In order to obtain some information on this subject, experiments were conducted at Iowa State College, on July 6th and 7th, 1923. For this experiment one of the strongest colonies in the yard was selected and weighed. This weighing showed that the colony had fourteen pounds, twelve ounces of bees. Since a pound contains about five thousand bees it may be assumed that the colony population was approximately 73,750 bees. It was interesting to find that of the total weight of bees in the colony, only ten pounds and one and a half ounces were in the hive at 2:15 p. m. when the bees were shaken from the combs, while an additional four pounds and ten and a half ounces of bees returned with loads from the field. That is, there were 50,496 bees within the hive attending to the home duties while 23,281 bees were in the field gathering food for the colony. Expressed in percentage we have 31½ per cent of the colony in the field with 68½ per cent remaining in the hive to look after the brood and the storing and ripening of honey. On July 6th the colony made a net gain of 8 lbs. 8½ ounces, and on the 7th, 4 lbs. 7 oz. A great deal of evaporation of nectar must have been taking place and large quantities of fresh air were necessary to carry off the water vapor. And as the weather was hot, ventilation was essential to cool the hive.

For this experiment a modified Dadant hive with 3 extracting supers was used. All cracks of the hive were sealed air tight and the hive equipped with a special entrance having two circular openings in the front of the hive near the bottom board. These entrances were each made of such a size that the opening they provided was equal to that of the regular ⅞" entrance. This type of entrance was necessary to make possible the use of a circular anemometer for recording the rate of ventilation.

The bees did not choose either opening to serve as a continuous intake or outlet, but alternated the direction of the current, first in on one side and out on the other, and then a complete reverse, the air traveling in the opposite direction. At times each opening served both as an intake and outlet, the air passing in and out of both.

Part of the time the direction of the air current would remain the same for ten to twelve hours. At other times the direction of ventilation would be changed every half hour, and again, every two or three hours. There was no apparent cause for these changes, and they cannot be explained without a thorough understanding of why certain bees fan, what determines the direction in which they fan, how the directions of air currents are determined, and other such problems of bee behavior.

A summary of the results of these observations are recorded in the following table:

July 6, a. m.	Temp. F.	Rate of Ventilation Ft. per Min.	Cubic Ft. Circulating Per Hour
10:00	77	260	783
12:00	84	238	616
2:00 p. m.	89	289	748
4:00	92	268	693
6:00	91	312	807
8:00	85	189	489
10:00	81	225	582
12:00	78	245	608
July 7, a. m.			
2:00	74	246	638
4:00	71	267	691
6:00	70	256	662
8:00	79	277	717

This data shows there is considerable variation in the rate of ventilation. For example on July 6th at 6 p. m. the rate was 312 ft. per minute while at 8:00 p. m. it was only 189 ft. per minute. The cause of this variation is difficult to explain and will not be attempted here. In general, however, the ventilation was carried on with regularity, a stream of air constantly being forced through the hive by the fanning bees.

It was surprising to find that this colony forced through the hive every hour a volume of air that was more than that contained in a room 8 ft. square and with a 9 ft. ceiling. Such a room contains 576 cubic ft. of air, and the colony forced through the hive as much as 807 cubic ft. per hour.

The records on the rate of ventilation show that ventilation is carried on somewhat more rapidly during the day than at night. This fact, coupled with the higher temperature and lower relative humidity of the air, would show beyond any doubt that more evaporation of nectar takes place during the day than at night. Some authorities in the past have been of the opinion that greater evaporation took place at night due to the return of the field bees. And because the fanning of the bees appears to be much greater in the quiet of evening, while in reality it is less than during the heat of the day.

The results of this experiment should emphasize the need of providing ample ventilation for our bees in hot weather. It is little wonder that bees with contracted entrances are forced to quit work in the hive and cluster on the outside, due to its being impossible for them to obtain the needed supply of air.

QUEEN REARING

Peter C. Tangen, Ossian, Iowa.

For seventeen years we have been trying to develop a prolific strain of bees which will also be good workers that will bring in a big crop of honey. This effort is made because we feel that a big crop of honey depends on the queen. Up to this time many different strains of Italian queens have been tried, some reared by several of the best queen breeders in the country. All beekeepers who have visited the queen rearing apiary have been well satisfied with the queens they have purchased.

The Doolittle method is used to rear the best queens. We feel that in rearing our queens the most important thing is to have all queen cells supplied with an abundance of royal jelly, even more than is used by the queens in their growth. Queens which are not supplied with an abundance of royal jelly seem to be smaller and will not make what could otherwise be called a first class queen. A good large queen is what every one should want at the head of each one of their colonies. When there is no honey coming in, the colonies and nuclei that are taking care of the queen cells and young queens will be developed. Nursery cages were used at first, but it soon became evident that better queens could be raised without them, and therefore the unprotected cell is given to the nucleus. This seems to be the natural way and the queen will be better taken care of by the nurse bees. Of course these extra efforts mean work, but the results mean better queens and that is what we believe all beekeepers want. We have concluded that where queen rearing is started too early, the quality is inferior to the queens reared later when the weather is more favorable.

As to the future of queen rearing, the best reply is that just at home here this year, four times as many queens were sold as last year. This is a proof that the Italians are gaining in popularity every year, and that it will be only a matter of a few years until we will all have better queens, more honey and less stings.

We always like to have a plentiful supply of drones available at all time so all queens will be mated from the home yard. This tends to prevent them from flying a long distance and being mated to a black drone. Good drones are just as important as good queens. It is with bees as stock, a farmer having all purebred cattle of any kind would not want a scrub at the head of his herd. So for the best stock we must have high quality.

Too much importance should not be placed on color, only to the extent that if the bees are yellow, it is almost certain they have no black blood in them. The black bees are inferior in many respects, and it has been experienced that yellow bees are superior providing they are of pure Italian stock, bred for yellow by selection and not by introducing some Cyprian stock which gives bees a vicious disposition.

No one who keeps bees likes a cross strain and certainly we do not believe in being stung any more than any other beekeeper. All the cross bees have been discarded as soon as they appear. Apparently no cross blood remains in our stock for we do not use veil or gloves and it is an added pleasure to work with the bees without them. Of course we must work slowly as the bees are more apt to sting when we work fast, therefore the slower we work the less we will get stung.

Of later years the largest and best layers have been selected for mother queens, because it is a known fact that the most prolific queens are the ones to breed from to get a good crop of honey. In all stock the quality can be greatly improved by selection and restriction in the specimens that are to reproduce their kind, and bees are no exception to the rule. By breeding queens from only the best mothers the beekeeper will be able in a short time to secure a strain of bees in his apiary that will be very gentle and also good honey gatherers.

The main reason we became interested in queen raising was that black bees are very cross and hard to work with, and therefore we decided to improve the apiary by introducing pure Italian queens purchased from some of the leading queen breeders of the south. It seems that we have at last succeeded in producing a prolific strain of bees that will also be good workers and will bring in a big crop of honey.

QUEEN REARING

Orin Stanley, Lamoni, Iowa

Altho, interested in queen rearing from a very early age, I did not expect to be producing them commercially when I first began to raise queens. The start was made to supply our own yards and to get some of the neighboring beekeepers Italianized. However, there was soon quite a demand for queens and what queens were sold, gave good satisfaction, so it was decided to go into the queen rearing business commercially.

In queen work as in stock breeding close attention must be given to the breeding stock selected. A good breeding queen should be the mother of a colony that are good honey gatherers, are gentle, and have good color. She should be a prolific layer and the brood should not be scattered.

When settled warm weather comes in the spring, the first thing is to find a colony that is superseding their queen and have some queen cells nearly ready to seal. From these cells one can get a supply of royal jelly to use when grafting a large amount of cells. If one cannot find such cells started, some young brood can be raised above an excluder and if the bees are fed they will start several cells on these combs.

For cell building colonies it is best to use strong two or three story colonies and the day before grafting, an excluder is put under the upper hive to make sure that the queen is below. It is well to leave eight or nine frames of brood in the hive above the excluder. The next day after getting the cell building colonies in shape, is the time to graft. The wax cups that are bought from a supply house are used for cells. These cups are placed in wooden cell cups and about twelve or fifteen of them are placed on each cell bar with wax. Only two bars are used to a frame making about thirty cells given to each colony.

After the cells are ready, go to one of the colonies that has queen cells started and get some of the cells for the royal jelly which they contain. The cells are taken to the grafting house, which should be quite warm. The larvae in these cells are then thrown away and the warm royal jelly is then lifted out of the cell with a flat ended jelly spoon and a very small amount of jelly is placed in the bottom of each of the wax cell cups on the cell bars. The cells are then ready for grafting or transferring the larvae from the worker cells to the prepared queen cells. Then go to the hive containing the queen that has been selected as a breeding queen and get a frame containing brood from 12 to 24 hours old. Larvae of that age are very small. They should not be exposed to direct sunlight and one also needs to be very careful that they do not get chilled.

Cells are grafted twice a week and it is the aim to get a few more cells each time than will be needed so that the next time of grafting some can be used to furnish royal jelly for the following batch of cells. The royal jelly from cells that are almost ready to cap is preferred, as there is generally a big lot of it in each cell at that stage and it is about right to use. Since the fresh royal jelly has been used, and the grafting has been done in the grafting house when the temperature was too high to be comfortable, a larger per cent of the cells have been accepted than ever before.

When the grafting is finished the date is marked on the top of the frame of cell bars so that it will be easy to tell when the queens will hatch. Then they are taken to the cell building colonies and put in with the brood above the excluder. It is well to keep a record of the hives where the cells are put so that one will not have to hunt all over the yard in looking for the cells when they are ready to be placed in the nuclei. When the frame is placed in the hive the bees are sprinkled with syrup so the bees will accept and feed the cells better. Unless there is a fair flow of honey the cell building colonies must be fed or the bees will not feed the larvae and draw out long beautiful cells as they must do if we have the best queens. Cell building colonies are kept strong in order to keep up the temperature in the hive for heat is as necessary as food in rearing the best quality queens. To keep the colonies strong in cool weather during the spring it is sometimes necessary to take brood from other swarms to build up. The frames of brood above the excluder are looked over in five or six days to make sure there are no queen cells on them. Fine batches of queen cells have been destroyed by a young queen hatching on one of the frames in the same hive with the cells.

The nucleus hives are made by dividing standard 10-frame or jumbo hives in two parts with an entrance at each end. The inner cover is ripped so that it is possible to examine the nucleus on one side without disturbing the one on the other side of the hive. The number of the nuclei and the queen register cards are all tacked on the south end of the hives so by looking at one end one can tell what is in each side of the hive. A brick on top of the hive helps to keep the cover on in case of a wind and it can be placed in several different positions to indicate whether the queen is missing, hatched, laying, or if there is a cell in the nucleus.

Nine days after grafting, a load of nucleus hives is taken to any outyard where they are filled. In forming nuclei it is best to go to a strong colony, find the queen and set that frame on the outside of the hive so that she will not get in the nuclei. Then take one frame of brood and one frame of honey for each nucleus and set the frames in the empty nucleus hives putting in two empty combs in each to fill them. Two or three nuclei can often be formed from one colony. If there are not enough bees on the two combs to make a strong nucleus, shake another frame in and then close the hive for a short time. After taking out the frames for the nuclei, set the queen back in the hive and fill in with empty comb or frames of foundation. It is quite an advantage to get nuclei at an outyard as the bees do not leave them and go back to the old colony like they will if they are formed in the home yard. The nuclei are generally brought home in the afternoon and opened up just before dark. Nuclei must be kept in the shade while they are shut in or they will get too hot and die.

The next day after being brought home the nuclei are ready to accept queen cells. The cells are taken from the frames of cell bars in the cell building colonies and carried very carefully. They are easily put in the nuclei by simply lifting out the frame of brood and pressing the base of the cell in the comb close to the brood where it will be kept warm by the cluster of bees till the cell hatches the next day. When the cells are put in, the cards on the front are marked "Cell" and dated the next day as that is when the cells will hatch. Three or four days later the nuclei are inspected and this time they are marked either hatched or missing. If marked missing another cell will be given in three or four days. As grafting is done twice a week and it is never over four days till ripe queen cells are available.

If care is taken there will not be many cells destroyed in the nuclei, probably 10% would cover the loss of cells in the nuclei. After all nuclei have been supplied with cells any extra are discarded, as caged cells do not produce the best queens. There is some loss of queens at mating time. It has been observed where the mating hives are close together there is more loss than where the hives are scattered. If scattered more, this loss may be almost entirely eliminated.

When the young queens are about ten days old they should be laying and in about two more days they are ready to ship. It is best to wait till they are laying well before shipping. If several eggs are found in one cell where the queen has plenty of room it is a sure sign that the queen is a drone layer. If queens have reared properly in the cell there will be a very small per cent of drone layers unless it happens to come a spell of bad weather with cold rain for several days. Then the number of drone laying queens increases. One advantage of using the large nucleus hives holding four standard frames is that one can see what a young queen is really doing. The baby mating hives have been tried and they are no good or at least not for this locality. They are so small that a good queen is crowded and is liable to lay several eggs in one cell in which case one does not know if it is a good queen or a drone laying queen. Another advantage of the large mating hives is that they can go through a dearth of honey better than the small ones without being fed. This is very important here as we very often have a dearth of honey when queen rearing should be at its height.

In filling orders for queens, an order is made to ship orders the day after they are received. Next to good queens promptness in getting queens delivered is the important thing in commercial rearing. This can only be done by having a large number of mating nuclei. Of course, this makes an added expense, but it helps greatly in filling rush orders. It is safe to say that fully one-half of the orders are marked "Rush." A good many beekeepers do not requeen till the old queen is dead or has quit laying and it seems that such a colony is very hard to requeen. When the old queen has been failing there is liable to be a virgin in the hive which is very apt to be overlooked in which case the new queen is sure to be killed. It is best to requeen at least every two years whether the old queen seems to be failing at the time or not.

For shipping queens the long distance, Benton cages are used, and for getting the queen into the cage a device is used which was by my friend Mr. Lyman Andrag. With this it is not necessary to touch the queen and the fact that no queen has been lost in shipment this year, 1924, shows that they go through in good shape.

REQUEENING

Paul Laird, St. Charles, Iowa.

Any average beekeeper with little experience can requeen a colony of bees, if requeening means pulling the head off one queen and putting another in her place, regardless of whether she is accepted or not. If the attempt is made to introduce a queen when conditions are not right for successful introduction, one may sacrifice not only chances for a surplus honey crop, but may also endanger the very life of the colony itself.

A definition of requeening may be given as the successful replacement of one queen for another of a different strain, whether by queen cell, virgin, or mated queen. In a broad sense, therefore, the subject of requeening covers not only queen introduction but queen rearing as well; and the result of observations which have been made during the past few years has so closely correlated the two subjects that it would be difficult indeed, to discuss either one without making some reference to the other.

My first experience in requeening came in July, 1920. Up to this time my bees in common with those of my neighbors were black or hybrid and had a very unsociable disposition, especially when disturbed in any way. It seemed advisable to try a better race of bees so two untested Italian queens were ordered from a queen breeder in Michigan.

The queens came by return mail and were immediately introduced to three-frame nuclei. Both of these queens were accepted. When the young bees began to emerge, they looked so nice that one select tested queen was ordered from a queen breeder in Ohio which cost $3.00. It seemed that such a queen ought to produce at least 50% more honey than one costing only half as much. This queen was introduced to a full colony and was readily accepted.

When the bees were packed for the winter, half of them, including

the three recently requeened, were given a second hive body with about thirty pounds of extra honey. The other half were left in single story hives, but were also well packed for winter.

The spring of 1921 opened unusually early and the bees began working on the soft maples on March 1. Two days later the pussy willows began to yield nectar, and by the last of the month many of the apples were in full bloom. Four freezes in quick succession ruined the fruit crop and left the bees in single story hives in danger of starvation. On May 14 it was necessary to feed sugar syrup and continue to feed heavily until the first of June when a light flow of honey from white and alsike clover made further feeding unnecessary. By the time the main honey flow did begin, about June 10, the bees in single story hives were in no condition for storing nectar. Before they could build up to sufficient strength the honey flow was nearly over, so the best such colonies could do, was to store enough honey for their own use.

The double story hives with an abundance of stores for spring brood rearing reached their prime in early June and stored an average of 130 pounds surplus. First and third places went to the Michigan queens while the beautiful select tested queen was next to the bottom in surplus honey production. But what those bees lacked in honey production, they made up in propolizing ability. A super with nice new sections could not be left on a week until it would be thoroughly gummed over.

It seemed that a queen which had cost $3.00 ought to be given another chance to make good so she was allowed to live through the winter. The next year, she did even better—so far as the production of propolis was concerned—but when it came to figuring out the total production of surplus honey the amount of this queen's credit was a very low figure indeed.

In the past four years, queens have been secured from about twenty-five breeders in fourteen states. Year by year different strains have been tested out under the same conditions and only the very best retained. Then these in turn have been pitted against others of world renown and the poorer ones rejected. At present there are eleven strains represented in my apiary. Most of these are from queen breeders who have a reputation for sending out high producing stock, and not one of them advertises his queens at bargain prices.

Many people think only of the honey which the bees will produce, and while this is the primary purpose of beekeeping there are other things which have a strong bearing in the matter. Almost any kind of bees will produce a fair crop of honey when nectar is abundant; but when the flowers are scarce and the bees have to work long and late for what little they can gather, then it is that the high producing strains will forge far ahead of their less resourceful sisters. Often such colonies will produce a nice surplus, while the ordinary strains will be harvesting barely enough nectar for their every day needs.

Last year an untested Italian queen was bought from an Indiana beekeeper, a man who does not attempt to produce queens commercially. This queen was a very ordinary looking individual. She was introduced to a fairly strong colony on August 6 and about four weeks later the colony was strengthened by the addition of two frames of brood. All other colonies received exactly the same treatment and this colony went into winter quarters apparently no stronger than the others.

Spring came and at least a dozen others built up to equal or greater strength. But when the honey flow finally did open, this one colony seemed to be more industrious than any of the others. No matter whether the flow of nectar was heavy or light, those bees would be out working, while the other bees would often be loafing, starting queen cells, or trying to swarm. In September when the last of the surplus was taken away, this colony had 230 pounds of honey to its credit, while the best of the others which had received exactly the same treatment, had made barely half as much. Moreover two daughters of this queen which had been reared in July showed a very strong tendency to equal the mother's record for their workers were far superior in industry to the ordinary stock.

Too often we find such as the man who flooded the country with advertisements of bright yellow Italian queens inferior to none, sent by return mail at the bargain price of sixty cents. In one respect, this man's advertisement was correct. His queens were inferior to none when it came to swarming. Just about the time they would get a handful of bees in the hive, they would decide to swarm and if you tried to prevent swarming, those bees would simply quit work and sulk. One colony swarmed five times, and even an after-swarm sent off a swarm in less than two months after it had been hived on full sheets of foundation. This is but one of a number of instances where an otherwise promising strain was rejected because of excessive swarming.

But swarming and propolizing are not the only faults with which one has to contend in the selection of an ideal strain of bees. We often speak of black bees as having an evil disposition, but I assure you that I have had more than one colony of Italians which far surpassed in crossness any black bees I ever saw. Most strains of goldens because they carry some Cyprian blood, are much more irritable than the darker trains of Italians, and for the same reason are more inclined to swarm.

About the first of June this year, two frames of queen cells were started, as it seemed that the weather would soon moderate so that it would be safe to start queen rearing nuclei. But instead of getting warmer, it kept growing colder. A week later when the queen cells were approaching maturity, and it was clear that some disposition must be made of them soon, it was necessary to study the proposition from all angles in the hope that something might be done to relieve the situation. The queen cells almost ready to hatch and the weather so cold that even a strong three-frame nucleus if placed by itself would be unable to give the newly hatched queen the warmth and care which was absolutely essential to her welfare. To make matters worse some of the queens were already sold and customers were awaiting their delivery. After revolving several schemes, the problem seemed solved in this way. Instead of placing nuclei in hives by themselves they were placed in hive-bodies above populous colonies with only a piece of screen wire between. By this means each nucleus received plenty of warmth from the strong colony below, and the queen on emerging was certain to be well cared for by the bees of the nucleus. In thirty-six hours after the nuclei were formed the covers were placed slightly ajar so that the bees could fly freely. The plan worked all right except that the bees were more inclined to rob than is the case with isolated nuclei.

Three colonies were Demareed, and in each case a ripe queen cell was given to the bees in the upper story a day later. Colony No. 23 received four frames of brood and two of honey, while colony No. 18 got only four frames all containing brood and honey. In every case the colony was three stories high and the lower story where the old queen was confined was full of empty comb while the second story contained both empty comb and honey.

All three of the queen cells hatched. Colony No. 23 raised a splendid queen which is now at the head of one of the strongest colonies although she was left in the parent hive for nearly a month. Colony No. 22 allowed its queen to live for seven days and then she disappeared. No. 18 had a nice laying queen, but the frames were spaced too far apart and two days later the queen was missing.

One colony which was starting queen cells was Demareed during the early days of July. No particular attention was given to the colony for a few days, but in some manner one of the supers got moved about so that a crack was left in the upper story and the queen could fly out and mate. On July 11 the old queen in the hive below was taken away, and at the same time all the brood was removed and replaced with brood from a superior queen. A few days later the hive was examined and no queen cells were found in the lower story. Some frames containing eggs were placed in the hive. Four days later there were still no queen cells. For the third time a frame with eggs was given and two days later the bees were building plenty of cells. The upper story was examined and a nice plump laying queen was found which had been laying not more than three days. Four other colonies treated in the same manner gave the same results.

A sixth colony was separated by two excluders, one just above the lower story and the other just below the top story where the young queen was. The bees in the lower story raised a queen just as though the other queen did not exist. From this it may be assumed that the presence of the virgin queen in the upper story was the cause of the bees not starting cells below. Anyone who has witnessed the tremendous energy with which a newly hatched queen will seek out and destroy all possible rivals, and her frantic desperation when she is prevented from accomplishing her cruel purpose, will readily agree that there is more than a mere possibility that the presence of a virgin queen on one side of a queen excluder may well deter the bees from starting queen cells on the other. But if she be prevented from leaving the upper story by the use of an additional queen excluder she cannot get close enough to the lower story to make her influence felt. Likewise as soon as she has begun to lay she is busy on the combs in the upper story far from the brood nest below. Possibly the bees are disappointed to find that their queen is not laying in the lower story and conclude that she is defective.

Acting on this line of reasoning it was assumed that two virgin queens would not occupy the same hive at the same time even though separated by a queen excluder, and it was very satisfactory to see this demonstrated in the only colony where it was tried. There is a possibility that the surmise is incorrect, and that something else was responsible for the refusal of the bees to build queen cells.

Through the months of July and August the nuclei were united until on September 10, there were only five. On that date the last queens were sold, and the pieces of screen wire which had been separating the nuclei from the hive below were removed. The bees at once started queen cells, and when they were cut out, two of the five nuclei developed laying workers. Not one of them made any attempt to fight, although the honey flow was failing rapidly.

Another colony which had an old queen was observed to be failing in early spring. On examination the queen was found to be a partial drone layer and queen cells were started. About May 25 of this year the first cell hatched. For some reason the bees permitted the old queen to live and for the next ten days both queens would often be found on the same comb. On June 6, it seemed from the appearance of the young queen that she was ready to lay, so the hive was closed and not opened until June 25. The young queen was missing, and had not been laying for at least a week; but the old queen was still laying about half drone and half worker eggs. In the hive were a number of queen cells and all of them were excellent in appearance. On June 28, several of the cells had hatched and July 11 when the hive was again examined there was an abundance of eggs.

Five days later both sealed and unsealed brood was found and on July 24 a young laying queen was observed. All this time there was an unusual amount of drone brood, and most of it was in worker cells. At last it was determined to find out what was the matter with that colony, for fear there there was something wrong with the queen. On August 9, just six weeks to a day after the queen cells had hatched the hive was opened and thorough examination of every brood frame in the colony was made. The first frame which was taken out had drone brood in worker cells, and right in the center was the old clipped queen. The old queen was killed on the spot, but before the examination was finished, it seemed this action was hasty. The next thing that seemed peculiar was the presence of two larvae in the same cell. On looking closer, a number of other cells were found in the same condition; and in many cases the larvae in the same cell were of different ages, showing that both eggs had not been deposited by the queen at the same time. Several frames were filled with eggs, there being from one to three eggs in every cell, while the bees did not have five pounds of honey in the hive.

When the last frame was taken out, the mystery was partially explained, for there on the comb were two fine young laying queens, not two inches apart. Thus there had been three laying queens in the hive

for almost five weeks, and the colony was very weak and on the verge of starvation. Both queens were still in the hive six days later, but two days after that one of the queens was missing. However, there was still ample proof of the fact that all three queens had lived together, for some cells contained two larvae of different ages, many others had more than one egg in them and some of the drone brood of the old queen showed on the same frame nicely capped.

If the loss of the newly introduced queen was the only bad result when the queen was not accepted, a person could afford to lose half of his queens in order to get the other half of his colonies to accept queens of better stock. But unfortunately as soon as the old queen is removed, the bees will start queen cells to replace her, and if the queen is not accepted, there is danger of their swarming as soon as the first queen cell hatches. For this reason many people hesitate to attempt to requeen their colonies even though they know the advantages of so doing. Conditions must be just right or the chance of success will be materially lessened. The queen must be introduced so that she will not get out of her cage until the bees become accustomed to her; but at the same time the longer she remains in the cage the nearer the queen cells are to maturity, which makes the bees less likely to accept the new queen. There is a golden mean, and it varies according to the condition of each hive.

Just as in a football game between two elevens equally matched in strength and ability, the final result depends largely upon judgment and this can only be attained by an analysis of the conditions under which success is more often attained.

As a rule success or failure in queen introduction depends upon four things:

First, the condition of the queen to be introduced.

Second, the amount and duration of the honey flow at the time of introduction.

Third, the proportion of old and young bees within the hive.

Fourth, the length of time between the removal of the old queen and the release of the new one.

Unquestionably the first two are the most important, for there are times during a heavy honey flow when a vigorous queen can be successfully introduced to any colony regardless of its condition. Unfortunately there are too many seasons when conditions are not just right, and introduction is attempted with more or less disastrous results.

Some may think it strange that the condition of the queen should be considered, because nearly all the queens which are introduced each year are only a few days old, and should be in their prime; but I am convinced that more queens are lost because they themselves are defective than from any other cause.

Consider the conditions. In the first place most of our queens are shipped from other states, and because the people in the south are able to produce them at a lower price, by far the larger part come from Dixie. Again, for the reason that they can sell their queens cheaper and so meet competition, most of our queen breeders ship their queens in small cages which hold about a dozen nurse bees, and scarcely give the queen room to turn around. Finally, despite the fact that it has been proved time and again that the best queen cannot be produced by short cut method, a few of our queen breeders still use cell protectors and baby nuclei. So quite often the queens that are offered for sale at a bargain are cheap in more ways than one.

Generally one can get quality queens at a fair price; and if it were possible to take the queen out of one hive and introduce her to another colony immediately, the first of the four points would not need to be considered. But what does your queen from a distance endure? Probably she is laying and is heavy with eggs. The queen breeder gets an order for a queen from an Iowa Beekeeper. He goes to the hive, selects a laying queen, puts her in a tiny cage, crowds in about a dozen bees to keep her warm, puts a two cent stamp and card of instructions on the cage, and turns her over to the tender mercies of the United States mail.

Taken from the hive where the temperature is nearly 96°, her cage is thrown into a mailsack and she is tossed and bumped around for days. The Iowa Beekeeper receives his queen, carefully follows the directions given for introduction, and when he looks into the hive six days later only to find no queen, he blames everything but the right cause.

In June, 1922, five queens were shipped into St. Charles, Iowa, from Alabama. Two were killed, one was successfully introduced by the cage method, and two were given to sealed emerging brood. Not one of these queens made even a creditable showing, but their daughters did splendidly.

In August of the same year, two queens were received from Florida. One was introduced by the cage method, but was not accepted. The other was introduced to frames of sealed emerging brood, and three weeks later was superseded. In May, 1921, a queen was shipped from Mississippi, and was introduced to sealed brood only. In less than ten days she was superseded. Had the cage method been used, neither of these queens would have been accepted, for the bees seem to know by instinct when the queen is defective.

The next thing which must be considered is the amount and duration of the honey flow. This would be just as important as the first point, but for the fact that it has been taught for so long a time that we must feed and feed liberally if there is no nectar coming in when the queen is introduced. Consequently, it should be placed second in importance because it is doubtful if the losses caused by the failure to provide sugar syrup as a substitute for nectar are very severe at any time.

If there is a very heavy honey flow which lasts continuously from morning till night, it is better to use one of the direct methods of introduction, for the bees will be so busy as scarcely to notice the change of queens; but if the cage method be used the bees will often start queen cells and swarm with the newly introduced queen.

Suppose that a colony of bees reaches its prime and swarms on July 4th. The swarm is hived on the old stand with the old hive close beside it. In a week's time the old hive is removed to another stand to prevent after-swarming. What is the best time to requeen the old hive? If all queen cells are removed on July 11, and the colony is given a queen in the proper manner the bees will have no other alternative than to accept her. But one cannot be sure of getting a queen on a few days' notice. What then is the next time when conditions within the hive will be favorable to success?

From the time the first queen cell hatches until the young queen begins to lay, a span of ten or twelve days, it is useless to attempt to introduce a queen unless the young queen is first removed; and a virgin queen in a populous hive is about as easy to find as the proverbial needle in a haystack. Let us assume that our queen hatches on July 12th and begins to lay on July 22nd. If we attempt to requeen on July 25th, we find no brood, but plenty of eggs and young bees. The greatest danger of introducing a queen at this time would be that when the queen got out of her cage most of the cells from which brood had recently emerged might be filled with honey, leaving no room for the queen to lay. Under such conditions the queen becomes restless and is likely to be killed.

If we wait a week later and requeen on August 1st, our chances of success will be lessened still more, for no bees will be emerging by the time the queen is released and every bee in the hive will be at least one week old. A week later on August 8th, conditions will be still worse, for every bee in that hive will be at least two weeks old, and no bees will be hatching until after the queen is released. From this time on however, the chances of success based on conditions within the hive will grow brighter and brighter, as each day will see more and more young bees issuing from their cells and replacing the older workers that have worn themselves out in the field. Probably the most satisfactory time to requeen would be about August 20th, or nearly seven weeks after the prime swarm emerged. At this time a very large percentage of the bees in the colony are extremely young, and there is an abundance of empty cells for the queen to lay in.

If a colony does not swarm, one should aim to requeen when the young bees in the hive are in the majority, and a light honey flow is on. Just when the young bees will be most numerous depends on the rapidity with which the old bees die off during the honey flow, and on the number of eggs which the queen will lay after the peak of brood rearing is passed. The swarm itself should not be requeened until four or five weeks after it issued, thus giving time for an abundance of young bees to hatch.

Queen breeders when they ship their queens always include a card of instructions, but those instructions vary greatly in several particulars. A few will send instructions for introducing with their own particular cages, and these should be followed closely; but by far the greater number send out instructions which are printed by some manufacturer of queen cages who seem to fear that the queen may get out of her cage too soon. Here is an extract from one of them: "For best results the colony should not have been queenless for more than two cr three days," and goes on to say, "Place the cage between two frames, and at the end of three days remove the tin from the end and allow the bees to release the queen by eating out the candy."

A colony queenless for two or three days will, of course, start queen cells; and if anyone thinks that he can get the bees to tear those cells down by giving them an alien queen in a cage, he is badly fooled to say the least. Two days before and three days after the queen is placed in the hive—five days in all—elapse from the time the old queen was removed until the bees are given a chance to eat out the candy. Probably some of the cells are within three days of hatching when the queen finally gets out of her cage. The bees decide against her, and then the beekeeper complains about his bad luck.

This is an extreme case, but here is one that is quite common. The old queen is removed and the new queen is introduced immediately. The bees miss their queen and start cells to replace her. There is a piece of pasteboard over the candy end of the cage, and the bees at once begin to gnaw it away. At the end of twenty-four hours they have disposed of the pasteboard and at once begin to attack the candy. Perhaps they do not work as energetically as they should, or perhaps the candy is harder than usual. At any rate, four days more elapse before the queen gets out of her cage.

Meanwhile the queen cells are sealed over, and the bees look forward to the day when they will have a queen of their own stock. Possibly there is a light honey flow on, and the queen may have been accepted at one time by the majority. But when day after day elapses and the queen is still confined to her cage, while the queen cells approach nearer and nearer to the time of maturity, the majority in favor of the queen sinks lower and lower, until it finally reaches the vanishing point. Then a distinct sentiment unfavorable to the queen begins to grow, and when she gets out of her cage she is not accepted.

On the other hand there is a chance that the queen will be killed if she gets out of her cage before the bees become accustomed to her, but it is better to risk having her come out too early than too late. Unless the candy is almost eaten through, I prefer to remove the pasteboard or tin immediately, and not infrequently will dig out some of the candy so as to give the bees a good starting point. In introducing to weak colonies or to colonies which are hopelessly queenless, it is an excellent plan to run a match stick through the candy, leaving a hole too small for the bees to pass through.

During the past year about fifty colonies have been requeened and to the best knowledge, but one queen has been lost. This one was lost because the bees would not eat out the candy and release her, although they were hopelessly queenless. She was left in the cage for eight days, finally the candy was dug out, but the queen was not accepted.

It is a good plan to place the cage with the candy end up between two frames containing a large proportion of sealed emerging brood. In this position the cage should rest on or near the bottom board with emerging brood directly above. When the queen gets out of the cage, she finds herself right in the center of the brood nest with plenty of

empty cells in which to deposit her eggs, and is much more likely to be accepted.

If you want to be successful in queen introduction, study your colonies, and requeen when conditions within the hive are most favorable to success; buy your queens from some reputable breeder near you, even if you do have to pay a little higher price; and introduce them in whatever manner best suits the conditions at that time. If you fail, go over your work step by step and try to find out wherein your were in error. Consider whether the queen could have been injured from any cause; whether the honey flow was sufficient, or if not, did you feed the bees properly? Was there a possibility that there were too many old bees or not enough brood in the hive? And lastly, could an error have been made in the method of introduction? Then try again.

HOW TO MARKET HONEY

E. W. Atkins, Watertown, Wisconsin

A honey market becomes easily glutted and prices drop precipitately with a good crop, primarily because honey selling as a whole is on an amateur basis.

The problem of marketing honey today as many who have studied the subject see it, is primarily to get honey in a position so that it is more available to the average housewife at prices that the public can be made to believe are comparable with other articles of diet now readily available at moderate prices. It is claimed that the surest and safest way to build up a market for honey is to have it handled thru the legitimate channels of trade by men and organizations whose worth and standing is known and, therefore, whose products are accepted by the community because of tacit endorsement.

First, to create a better market for honey we must increase the sales of honey. I am not a native of Wisconsin, but I must admit that Wisconsin has gone farther as a state than most states in the Union in putting honey on the map with the endorsement of the regular channels of trade. According to Dr. S. B. Fracker of Madison, the primary thing in putting honey on the map is to supply and enforce standards by which honey can be graded and which will accurately describe it.

Every person who is seriously interested in the future of honey sales ought to read that statement several times.

Ezra Warner, president of Sprague, Warner & Company, Chicago, one of the greatest organizations of wholesale grocers in the world, in speaking to the writer about the marketing of honey said: "The primary thing in the sale of any food product is the absolute protection of the customer by the maintenance of quality."

In other words, the first requirement that you Wisconsin beekeepers have set up in marketing your honey is thoroughly endorsed by one of the biggest merchandisers of food products in the world. This is particularly interesting because in Wisconsin we market more than 5,000,000 pounds of honey in a year. Mr. Edward Nordman, state commissioner of markets, says of the plan now being successfully operated in Wisconsin, "Instead of honey being shipped out of Wisconsin by the carload as formerly, it is now shipped out only in small quantities. The beekeeper takes more care, labels his honey properly, and has increased his trade."

The second standard set up by your association for successful honey marketing is, "An attractive container and a label or trademark upon which the public can rely for quality goods."

This follows as the night follows the day in any successful merchandising campaign. None of us walk into the grocery store nowadays and ask for a cake of soap, but usually ask for some specific kind of soap which we have come to know by its label or trademark, such as "Palmolive," "Pears" or "American Family."

Dr. Fracker continues: "The first step toward establishing a standard of quality has already been taken in a grading system and the state grades are printed on the labels. Beekeepers that use the grades can, therefore guarantee the quality of honey sold under this label, for the grading of honeys under these labels is absolutely enforced by the State Department of Markets.

Naturally the third part of the Wisconsin program stipulated "Advertising and publicity which will remind prospective purchasers of the delightful flavor of honey every day."

In 1924 the firm with which I am connected attempted to find out the status of honey marketing in this country by offering cash prizes for the best ideas put forth by anyone on honey marketing. The campaign brought out quite effectively that there is in this country at the present time no big, constructive program for the sale of honey and that the nearest one to it is the Wisconsin association. This lacks perhaps only the dignity of a statewide advertising campaign to put the plan on a plane in Wisconsin with Aunt Jemimah's pancake flour, Log Cabin syrups, or any of the other well-known and widely advertised food products.

Mr. E. A. Meineke of Chicago very aptly says, "We cannot get very far if we sell a man a jar of honey and he does not use it, for so long as he has that first jar of honey he will not be in the market for more." Perhaps it is fair to say as does John Auckland of Iowa, that "Honey production has not been conducted on a commercial scale long enough to become established as a staple food." Note particularly the use of the word commercial in Mr. Auckland's statement.

The peddling of honey would not be such a drawback to the business if it furnished honey regularly and supplied a dependable product. The trouble is that it spoils the larger sale of honey through the regular channels, for when the peddler's supply is gone, people wait in vain for his return and too frequently do not buy any more in the meantime.

Undoubtedly, as Mr. Auckland claims, "Honey packages usually make a sad appearance in comparison with those of most of the packaged foods." Also, unfortunately, the extracting rooms and packing rooms of too many beekeepers would be sad places to take a prospective customer for an observation of the extraction of honey, as compared to the immaculately clean cow barn of such wonderful plants as the Carnation

Milk Company. No one willingly eats dirty food and while a customer may be inveigled into purchasing a package of food that he afterwards finds out is dirty, it will prejudice him, and most of his friends and relatives, from that time henceforth, against the purchase of the same kind of a product, no matter how cleanly it may be the next time nor how well endorsed it comes.

"Any beekeeper can raise the status of beekeeping in the eyes of the public by improving the appearance of his honey house," according to Miss Anna Klinner of Illinois.

Mr. A. G. Murry of Virginia says, "The proper management of an advertising campaign, should include first, an adequate supply of clean, well-graded honey."

It is not necessary to dispose of inferior grades of honey to those who intend to use it as a raw food. The use of the dark and inferior grades of honey in the baking and candy industries where it has to be thoroughly sterilized by heat is commonly known.

The use of inferior grades of honey as an anti-freeze mixture in the radiators of automobiles affords an outlet for that kind of honey that undoubtedly at present exceeds production. It is reported that a beekeeper in Iowa recently purchased a carload for that purpose. Perhaps the principal reason why such honey finds its way to the regular markets is because too many beekeepers have not honestly learned the grading of honey and convinced themselves that inferior grades are worth less money. To too many, honey is honey.

On the other hand, the use of good honey for other than food always seems a shame. Honey may make good cosmetics, cough syrups, and corn salves, but it is primarily a good, wholesome food, and the future of honey sales does not lie in attempting to substitute it for something for which it is not really a substitute.

One of the most widely heralded and so-called authorities on foods has for some years maintained in a New York newspaper that blended honey was an unfair product, should be prohibited by law, and that the innocent purchaser was "skinned" when he purchased blended honey. There is no reason to doubt that this man was sincere, but there is every reason to doubt his good common sense. Anyone acquainted with honey knows that some localities always produce light colored honey, and others darker honey. Anyone knows that if a dark honey is sold to your grocer this year and a white honey the next year, that the housewife, upon buying the second time, will question the purity of the product that does not look like the product she bought before and was satisfied with. This is easily overcome in the bottling of honey by blending the various colors and grades. Blended honey on all the shelves of every grocery store will be approximately the same body, color and flavor, year after year. The food value of the blended package is just as great as the unblended package, and is worth in every way just as much as the straight product. As a matter of fact, the average commercial bottler's plant is so clean that the blended product is frequently far superior to most of the unblended products sold by many producers of honey.

In times of a dearth of honey in the region producing light colored honey, or in the region producing dark colored honey, it is an easy matter to provide a supply if it can be shipped in and by being blended have the same appearance on the grocer's shelves in that territory as it had the year before. Since this can be done and does not in any way affect the purity of food value of honey, and since it is one of the most commonly accepted principles of merchandising that a continuous identical supply of each foodstuff is necessary for its continued sales, this apparently offers an entirely legitimate and successful method of operation.

Perhaps there is more discussion today among beekeepers about the prices at which honey should sell than any other question. In most localities honey does not bring what it is worth, primarily because the average beekeeper peddler first hasn't the backbone to charge what it is worth; second, the average beeekeeper, peddler or not, unfortunately thinks that when things are sold direct to the consumer that it is perfectly proper to cut the life out of the prices charged by the regular channels of trade.

It is perfectly reasonable then, to expect that the fifth premise adopted by the Wisconsin Association, according to Dr. Fracker, should have been "A fair price, not too high in comparison with sugars and preserves, but one which means *some profit to the retailer and wholesaler as well as to the producer.*"

Any beekeeper who takes the time to realize that, if he recognizes that his endorsement of a food product among strangers has no standing as compared to the label on a package of some nationally known grocery house of first credit rating.

Therefore, it is not unexpected this fifth premise adopted by the Wisconsin Association urging sales through the legitimate channels of trade, should have the endorsement of that dean of wholesale grocers, Mr. Ezra Warner of Chicago.

He says the second feature paramount for the marketing of honey successfully is "Selling through channels of distribution for more protection to the consumer."

This is a point that should be very carefully thought over by every beekeeper today. Ninety-nine percent of the food products entering the American home come from the local grocer. Why then, should the bee keeping fraternity, as an unknown quantity, attempt to set itself up as a substitute for the channels that supply 99% of the food products to the American home?

There are about 233,000 retail grocers in the United States who handle more than 12½ billion dollars worth of food products per year. Most of these food products are bought from a wholesale grocery house of good standing, like Sprague, Warner & Company, for instance. The grocer knows that he must have an endorsement better than his own to sell food products in his own locality. Therefore, he purchases from the wholesale house whose labels are nationally advertised and backed up by an absolute protection to the customer of maintenance of quality. Therefore, a grocer finds it easy to sell such trade-marked products and also impossible to sell such hit or miss products as the average jar or pail of

honey, crudely put up, perhaps even dirty, not to say unendorsed by anyone of standing.

The grocer is entitled to a legitimate profit and in the case of honey is probably entitled to more profit than he makes on nationally advertised brands of food. This is because the market for these has been created for him, while he must stop in his rush and hurry to devote more expense and time in attempting to sell honey than nationally advertised products in his store. It is a well known fact, proven by dozens of careful investigations, that women buy more food products than men where these products are offered through the legitimate channels of trade.

There seems to be a light ahead and American beekeepers can safely assume that as a general rule they are on the right track, for the following reasons:

1. There has never been a time when more effort and publicity was being given to educating producers and buyers of honey as to what honest grades are.

2. Certainly at no time in the history of honey marketing have more rapid strides been taken towards the use of more attractive containers and labels and cleanliness of the product.

3. While the national, or even regional, merchandising of honey has not appeared, and may not for many years, most of the efforts used by beekeepers and called advertising and publicity are doing much to remind purchasers of the use of honey. Perhaps nothing more deplorable occurs in this case than the widespread advertising that American foulbrood secures, for while we beekeepers know it has nothing to do with the cleanliness or food value of honey, it certainly is not appetizing to the buying public.

4. Perhaps the least progress is being made right now to afford a *continuous supply of honey* to the channels through which it is being sold. The writer realizes the danger of prophecy, but is willing to hazard a guess that nothing is deterring the national use of honey more in these present times than the lack of an adequate, similar and constant supply of honey in the markets where it occasionally appears.

5. The prices at which honey sells are in most cases perfectly fair and legitimate where it is sold through the regular channels of trade, such as grocery stores. Unfair prices are found on dining cars and in restaurants, as in most such cases these are unreasonably high. Unfortunately, as we previously said, most beekeepers are peddlers, and as most peddlers sell their product for less than a good product is worth through the legitimate channels of trade, we believe that in most cases where honey is sold direct to the consumer, it is sold at too low a price. However, it would be unreasonable not to admit here at this time that a great deal of progress is also being made in this line.

Through his friendship for the writer, Mr. Carroll Dean Murphy, an advertising man, has recently had a great deal of contact with the beekeeping industry. He says that present attempts to market a widely-produced product like honey over the production of which the marketers have no control, is folly. The co-operators are frequently quoted by some people in talking to beekeepers, who are always careful to omit that these co-operative associations in some cases control absolutely more than 90% of the total production of their product in the United States. They are therefore, in a position to obtain a fair price for their products. The bottler or large seller of honey who is knifed in the back by the beekeeper is, unfortunately, not in such a position of control, and his frequent disgust at the sales tactics of many American beekeepers is not unexpected.

On the other hand, Mr. Murphy believes that it is perhaps not impossible, but undesirable, to attempt the great task of trying to market honey nationally at one full swoop. This entails national advertising, which requires thousands of dollars, and necessitates the enforcement of grading, which is now next to impossible in the case of honey, for there is no way to force the producer to ship his honey to the bottler or any reliable source where the proper grading and blending could take place. Without this no sensible individual or association can attempt to advertise nationally a product over which they have no control as to its cleanliness, purity, and grading, not to mention the container and its appearance.

Again, this advertising authority suggests the co-operation of two or more successful producers' associations in reasonable proximity to each other to pool their crop, sell it through one manager under one label, and through the legitimate channels of trade. He believes that honey so marketed could be sold at a price to include the cost of any reasonable advertising campaign, provided the pooling of this association was marketed in a restricted area at first, such as from one large nearby city. Inasmuch as this has been used in the marketing of other food products whose whole situation is similar to the marketing situation of honey, and inasmuch as these other attempts have usually been most successful, it is reasonable to assume that this advice is sound.

Mr. Murphy further suggests that after one group of producers has succeeded in their locality, they try a second locality, maintaining their distribution and advertising in the first locality, or that they co-operate with a second association of producers in another region, to dispose of their excess crop. He believes the country could be divided into about fifteen or twenty such regions, and in the course of a reasonable time, say twenty years, that the national advertising of honey could then be attempted and paid for out of the product as it was sold, that the product would have a guarantee it required, and its distribution through the legitimate channels of trade. This would avoid glutted markets in one locality and scanted or neglected markets in another. At least, this opinion sounds more reasonable than any other that has so far been presented to the writer.

Therefore, in closing, while I realize that only one plan of national marketing has been suggested in this paper, and that it is untried, I hope that the facts that have been presented here will at least make you realize the enormous possibilities of honey production in this country, running into the millions of pounds. The sadly neglected market awaits the sensible attentions of those individuals, whether producers of honey or not, who will at least be conservative and not attempt to market their

product in a way that immediately stamps every legitimate channel of trade as an enemy of honey.

SELLING THE CROP AT HOME

W. S. Pangburn, Center Junction, Iowa

In years past much has been written and said about the marketing of honey, and if one should judge from what has recently been printed in the bee journals, the problem is far from being solved. Indeed in my opinion it is one of the problems that will always confront the commercial honey producer.

The selling game dates back to the time when folks first produced a surplus over and above what they required for their own use. That surplus might be anything from a chicken to a load of corn, hay, hogs, cattle, or it might be honey. Marketing always has been a problem in relation to many of the products produced by individuals, and is still one today, and while it may not always be as large a problem as it is at the present time, the time will never come when the honey producer can say that he will not have to worry about disposing of his or her crop.

I have given the selling end of the bee business as much thought and attention as the most of you, and to sum it all up, I find it mighty hard to outline a satisfactory program that would apply to all, for various reasons. Frankly, we do not always follow the same course in disposing of our crop ourselves; hence, why should I attempt to tell you just how to dispose of your crop under some hard and fast rule when I do not practice the thing in question myself. Another thing, I do not know your ability as a honey salesman, and this alone would have quite a bearing as to how you should dispose of your crop.

I do not know the quality of honey you produce. Of course, we all produce quality honey. But do we? You know it makes all the difference in the world as to where you sell your quality honey, and the kind that does not have the quality. You must not try to unload both kinds on the same market; you will regret it if you do. Neither do I know whether you produce 500 lbs. or 50,000 lbs. per year, or whether you are in close proximity to a large city, or like myself have to be content with the small towns. Neither do I know your manner of packing; that is, whether you use new pails neatly labeled and filled with quality honey. All these things have no little to do as to how and where you should sell your honey.

I may not be able to tell you how you are going to dispose of all your honey at home, because I am aware that in many instances this is not possible as in our own case, but will offer some stray shots that may help you to dispose of some of it at least. We believe that the beekeepers of every county in this state should see that every county in the state of Iowa is supplied with the necessary honey for its needs. Oh! you say beekeepers are doing that now. Beg pardon, but it is not being done in many instances and because it is not being done there is considerable honey being shipped into the state that never should be shipped in.

We aim as much as possible to have some one in every town in the county handling our honey. It may be a merchant or someone else, and we might add that the latter usually sells more honey than the merchants because they push the sales much better than the merchant who has so many different lines to sell. However, if it is a merchant who is to sell our honey, we make inquiry as to which merchant has the best trade and handles the best line of goods. This is of more importance than you might think if you are selling quality honey.

Get them to display your honey. The merchant who piles your honey under the counter, or sets it with the glucose syrups never sells much honey. Honey is not as yet a staple article, much as we would like to see it, and must be displayed in order to bring it to the minds of the would-be customer. You will have to push this display business yourself, as the average merchant for some reason unknown to me will display everything else in his store excepting honey. Only a short time ago I was in a town where one merchant had been handling our honey for years. He had one-half of his store front filled with the different sizes of containers of a certain brand of sorghum. It was a gorgeous display. He had even gone to the trouble of going into the country and getting an armful of cane stalks to decorate the window. While looking at that window I just thought, old fellow, if you would give honey one-half the display you have given that sorghum you would sell more honey. I was too much riled up to mention it to him that day, but he has it coming. How many merchants do you know, who in advertising special sale days, include honey in the list?

If you are a fairly good salesman, and have the time, the house to house canvass is usually better than letting the merchants sell it, and you will as a rule sell more honey. This is practically an unexpored field with most beekeepers, but if followed by those who can conveniently do so would sell tons of honey, but do not sell to your merchants and then peddle your honey in his territory and sell it for less than he is getting. If you do, you will sell him just once, remember that.

Sell quality honey, as it is the only honey that will build up a trade, and that put up in new containers bearing a neat clean label. Keep your customers supplied even if you are forced to buy of some other beekeeper. It is mighty poor policy to get your customers to eating honey, and then by not keeping them supplied let them go back to eating the cheap syrups because "he is sold out." I have known beekeepers who seemed to take special pride in being able to say that "I am sold out and could have sold more." To me that sounds foolish, because it is not so much overproduction of honey that confronts us as underconsumption, and unequal distribution, and the beekeeper who allows his customers to go hungry for honey and makes no effort to supply them, is helping to bring these undesirable conditions about.

Our old friends, Dr. Bonney and C. P. Dadant, have always been very enthusiastic over educating the public to eat granulated honey, and I have tried in years past to do quite a little along that line myself, but I have come to the conclusion that the time when the people of this country will prefer granulated honey to the liquid is a long way off, an^d^

I have quit talking along that line only in the way of explanation. I am thoroly convinced that we have lost many of our mail order customers in the past by selling them honey that was not tested, and granulated shortly after they received it, and for some time we have heated all our honey before sending it out. The merchants do not want it in the granulated form, and with them it is mighty slow sale in that form. Who can say that granulated honey compares favorably with a fine clear liquid honey in looks? To my mind there is no comparison, and the merchants who buy our honey appreciate the fact that our honey does not granulate on their shelves, at least for some time. Heat your honey so it will show up at its best, unless you have a trade that prefers it in the granulated form.

If you have a poor grade of honey do not offer it for sale to your merchant. It will be a poor business getter, and will do more harm than good; better sell it to the bakeries, feed it to the bees or use it in your radiator. No explanation to a customer for poor honey will ever prove satisfactory as it takes quality honey to create a demand and hold your customers, two things worth catering to.

There is a great deal of talk about national advertising of honey, and your attention is continually being directed to other lines of products that have enjoyed a large sale thru this manner of advertising. In my opinion, for the most part we have an entirely different proposition to handle. First, because we are not yet ready for an extensive campaign of advertising for the very good reason that we have no established headquarters to take care of the demand for honey that this sort of advertising is expected to create.

All firms advertising in a big way have the advantage over us in several ways. First, they have a plant that can turn out the required products to care for whatever business that comes their way. Second, these plants are owned either by one man or a company of men who are on the job, and every dollar spent for advertising that brings results benefits these few individuals directly, and no one else. We as beekeepers are scattered all over the United States like a lot of sheep, every fellow for himself, and as the old adage goes, and the devil for us all, and what ever money is spent in national advertising will help you and me indirectly and that is all we can expect.

Another thing, these firms who follow this sort of advertising follow up those big campaigns with skilled salesmen which adds another enormous expense, something that would be impossible in the selling of honey, if for no other reason than the cost of production is too near the selling price to admit anything of that kind. I need not tell you that it costs money to produce honey. You who have been beekeepers for any length of time, and have put in most of your time with the bees know full well that it is no royal road to wealth. We use no cheap fillers to give bulk to our product and sell it at an enormous profit. It is the pure quill, quality food, and you have a labor expense that is the biggest item to consider, and there is no way of getting away from it, with other overhead expense added, notwithstanding some claim that bees work for nothing, steal the honey, and board themselves. We have no way of knowing from one season to the next what our output will be, because we have mighty little to say about it only in the way of knowing how to get our bees in shape for the honey flow, and then trust to the good Lord to do the rest.

Perhaps you may think from what I have said about national advertising that I am opposed to it. However, I am not, and am in favor of any kind of advertising that will bring results, but I am not in favor of spending as large a sum for advertising until we pave the way for that sort of thing. When we have a co-operative honey exchange in each state that can gather this honey together, grade it, and by the proper blending of the honeys put up a standard grade and flavor under a special brand, we will then be ready to talk about national advertising. How far do you think wide-spread advertising would get Heinz and others if they sent out vinegar, pickles and catsup of different colors and flavors? Not very far. The secret of their success is uniform color and flavor, something that would be impossible with honey produced by different beekeepers in different localities. Even a few miles makes a very great difference in the flavor of white clover honey. Scarcely any two localities produce just exactly the same flavor of honey as those who have been in a position to sample different honeys will tell you. How, then, can we expect to create a demand that will stand under these conditions? Honey is eaten by many people who, as we happen to know, are very skeptical, and will continue to be so until they can buy a standard flavor and color under a certain brand. We who have been producing honey for years know full well that there is as many different colors and flavors of honey as there are blossoms from which it is made, but it is mighty hard to convince the public that orders honey thru national advertising that this is true, and he concludes that he is stung because the last honey they bought was of a different color and flavor than the first, with the result that he does not buy any more honey.

Right here is where the beekeeper comes in on a proposition of this kind. We have not as yet an organization whereby this honey can be gathered, and graded. Every beekeeper should market all the honey at home they possibly can. There is one very important reason why you should do this, and that is the honey eaters of your locality are used to the flavor of your honey, having eaten honey from the same locality for years and are acquainted with the flavors much better than those living some distance from you. No honey that you might ship in would likely suit your home customers quite like the honey that is produced there. Then why not see that they get what they want. Many beekeepers seem to think there is greener pastures in some other state and try and ship all their honey out of their own locality, and neglect their home trade. National advertising will never help such beekeepers because they do not take advantage of the opportunity that lies at their door.

Remember that should we get to the point where national advertising is a reality, it will not relieve you and me of the responsibility of disposing of your own crop, at least not to any great extent, and we being on the ground and understanding our own locality and its needs, are in a better position than any one else to care for that business, and in so doing will advertise our own honey, and reap whatever benefits that come from our efforts.

BUILDING A MARKET

Stanley A. Ranney, Council Bluffs, Iowa

It is just as big a job to market a crop of honey in a wholesale and retail way and at prices that mean a profit, as it is to produce it. Of course, it is not hard to dispose of honey at $1.25 to $1.50 for a ten pound pail at retail, as some beekeepers do. But to put the honey up in an attractive form and sell it at either wholesale or retail, at prices that will pay for the work is no easy job.

To sell well, honey must be put up in an attractive form. It must be clear and free from scum or foam, especially that put up in glass. Each package must have a neat and well arranged label. Al honey put up in glass jars should be heated to about 150 degrees and then poured through a double thickness of cheesecloth into a tank from which it is run into the jars.

Honey can be sold at both wholesale and retail by the producers but a price should be established on all size packages at which they are to be sold for at retail. When selling to the grocery stores, allow them a discount from the retail price for handling it. Guarantee the honey in every way and agree to replace any of it which should prove unsatisfactory for any reason at any time. This replacing agreement helps a great deal in getting dealers to sell honey for some of them are reluctant to handle it because they say it may turn to sugar before they get it sold. Of course, we tell them that all honey will crystallize in time and that is the best proof of its purity, but the public is still not convinced and the dealer makes a good excuse out of it.

Another thing that will help to build a market for honey is to have a brand or name for it. People become accustomed to any product that has a name and they will remember it and ask for it by that name. "Honeydale" is the name I use and there is no question but that it has helped in building a trade for my honey. If the State Association would select a brand for its members to use, it would help the sale of honey.

In order to hold a grocery store trade it is necessary to call on them about once a month, as very few will look you up when they get out of honey. They seem to be in the habit of having the different salesmen call on them at certain times, and it is the same with honey, if you do not call on them ever so often they will generally order from the first salesman along that has honey to sell. My wholesale prices on honey are always very close to those that the wholesale grocery houses sell it for. Always protect the wholesale trade by selling honey at retail for the same price as the stores would expect to get for it.

Another way of selling honey is by making a display of it on the street on busy days, especially Saturday afternoons and evenings. A rack is made so that it will fold up and which fits over the front end of a Ford. On top of this rack some boards are placed, so as to form a table on which the honey can be displayed. Everybody who passes along the street can see it and this helps to advertise the honey. If they do not buy when they see it first, they will go away thinking about honey and will probably buy some the next time they see it. In warm weather observation hive with live bees can be used. Such a display will always attract considerable attention.

It may pay to have some agent who will sell honey on a commission and build up a regular trade by calling at residences and taking orders. The honey may be delivered then or later at a definite time Such an agent talks honey to everybody he meets and if they do not buy the first time he calls on them, they will generally buy some sooner or later.

In conclusion, it might be said that there are three things which are important to successfully build a market for honey. They are: first, put it up in a clean and attractive shape; second, always guarantee the quality of the product, and third, hold the retail and a wholesale prices high enough, so that if you should run out of honey, you can afford to buy it and sell it at a profit enough to pay you for your trouble of getting it ready for market.

INCREASED EFFICIENCY OF PRODUCTION

F. B. Paddock, Ames, Iowa

The problem expressed in the title should not be new to beekeepers, for we find Alexander saying, "Do not spend any time worrying over the frequency of poor seasons, but spend your time in preparing your bees to make the most they can of any kind of season that comes, then you will be almost surprised to see how few poor seasons there are. We have not had a really poor season in twenty-five years, while some of my neighbors complain of a poor season nearly every summer." The excuse then for this discussion is found in the need of bringing to the attention of the beekeeper, the necessity of practices which will increase their production. Again we find Alexander saying, "Far too many beekeepers think that the value of their apiaries consists in the number of colonies they keep."

No doubt there are many who feel that this is no time to consider the production of more pounds of honey in the United States. We hear on almost every hand the plea that increased production will reduce prices. In that connection, it is interesting to note that in a recent speech, Dr. E. D. Ball, Director of Scientific Research of the United States Department of Agriculture, says, "Food production of the nation has not been keeping pace with the population for nearly two decades, and if the same ratio continues for an equal length of time, the nation will not be on a self-sustaining basis. Increase in production may be brought about by bringing up the methods of the poorer producers to those of the better ones. Increases in the possibility of production of food can be brought about only by developing better plants and animals, better soils, and better methods, and by the removal of pests and diseases."

Figures are always interesting, for it is possible to prove almost anything by statistics. The crop report for 1922 contains some very interesting data for the beekeeper of Illinois. We find that while Illinois produces only 5% of the surplus honey crop of the United States, it does tie with New York, Iowa, and Texas for second place among the States. It is very interesting to note that for the period of 1913-20, the average yield per colony in Illinois was sixty-one pounds. In the year of 1921, only fifty pounds were produced by each colony, and in 1922 the production per colony was eighty pounds. The most careful statistics compiled in the last year or two, indicated that seventy pounds of honey must be produced in order to secure reasonable returns on the investment. We seen then that there is a problem confronting the production of honey in Illinois. These statistics further show that there has been a slight decrease in the production of comb honey since 1914, with a relatively less increase in the extracted, but a relatively large increase in the production of bulk comb honey. Conditions should be very favorable for honey production in Illinois as the figures indicate a large home consumption since only 16% of the honey produced is shipped outside of the state.

In casting about for factors which might be considered in any campaign for increased efficiency of production, we might mention disease control, winter loss, swarm control, and better stock. While it might not be wise to say that the brood diseases are widely spread in Illinois, yet there is little doubt but that loss by disease over the state is very considerable. 'It is exceedingly difficult to put this loss in a statement containing dollars and cents, but one can readily conceive of a large total as the result of the presence of disease. As in every state, the beekeepers of Illinois need more assistance in an effort to eradicate contagious diseases among bees. There will be few who will question the accuracy of this statement that thousands of dollars are lost every year through the ravages of disease.

In the matter of winter loss, it is possible to make a more definite statement. Statistics show that during the five-year period of 1914-19, the winter loss in Illinois was reported to be 11%. In the year 1920-21 this loss was reported 5% and in 1921-22 it was reported 12%. Here then is a loss which can be reduced by more improved management and must be reduced before honey can be produced efficiently. There is no business today which can succeed with even the annual loss suffered by the beekeeper in wintering, which means one colony out of every ten. In the possible improvement of management looking toward the reduction of this tremendous winter loss, we have three possible factors. These are the introduction of new queens, the provision of ample stores, and plenty of protection.

There may be localities where conditions make it advisable not to fall requeen, but it is necessary to determine that this practice should not be followed rather than not to attempt it. In general over the United States, so much good has resulted from introducing new queens in colonies in the fall that it has become the rule rather than the exception. The exact time to requeen must depend upon local conditions. As has been advised by Dr. Phillips, the new queen must be in operation in the hive at least six weeks before the cessation of the fall honey flow. If the honey flow is available so as to permit this, then the practice is excellent. There are probably some local conditions where the fall flow is not dependable and under these conditions the new queen should be introduced during the last week of the summer flow. Experiments have been conducted which show very conclusively that a colony headed by a new queen goes into the winter much better prepared, than the colony with the old queen, or even with the spring introduced queen.

In the matter of stores, the information which has been given to us, is nine pounds of honey for every pound of bees in the colony, and an additional fifteen pounds as an insurance policy against disaster. In the normal colony this means that sixty pounds of honey must be provided at the beginning of the winter period. In experiments which have been conducted by Park at the Iowa Station, the actual consumption has been found to average fifty-two pounds. It is very evident then that the sixty pounds given as a theoretical estimate is hardly sufficient.

That so many beekeepers should fail to appreciate the need of protection is beyond comprehension. Probably every other form of live stock is given reasonable consideration during the cold period of the year. That the winter loss is not larger than it is, is a matter of marvel. Either cellar wintering or outdoor protection in the form of packing cases, will give excellent results, depending upon the locality. It would not be wise to advocate one method to the exclusion of the other.

The success of the beekeeper is no longer measured by the number of swarms which his colony has. It is taking a long time for this idea to disappear. Yet there are many beekeepers who experience a thrill when a swarm issues from one of their colonies. That honey production could be cut in half by the swarming problem has been determined. Why is it not best then to practice every means which will reduce swarming? Here again we find a factor which cannot be reduced to figures, and it is to be regretted that this condition exists, for the intangible result is very difficult for the average beekeeper to appreciate. One must study local conditions and govern their operations accordingly. For the Standard Langstroth hive, the demaree method has been given as a panacea for the swarm control problem. Mr. Park in his investigations at the Iowa Station has found that there is danger in the over-use of this method. In his conclusion he says "conditions necessary to insure a maximum crop when using the demaree method of swarm control are: 1st. The honey flow lasting at least four weeks. 2nd. Colony strong enough at the beginning of the flow to absorb the shock of the treatment." Methods which may prove satisfactory in one loclaity, will not necessarily be satisfactory in another locality. The large hive has been listed by some as a means to reduce swarming. This method may prove satisfactory in many localities.

Perhaps the most important factor in increasing the efficiency of production is the securing of better queens. The low production which is prevalent in every yard, as is evident by the uneven returns per colony, indicates that the queen which the beekeeper is now getting comes from an indifferent producing stock. In experiments conducted by the writer,

it was found that the loss caused by every queen which produced less than the average per yard, was $18.00 each for a single season. Even if we were forced to pay more for our queens and were assured of a better standard, it would certainly be a paying investment. We have learned in other lines of production through the Babcock test that there are boarder cows in most every herd, and through the trap nest, we have found that most every flock contains boarder hens. In spite of this, the beekeeper is content with indifferent production by queens in the yard. The following deductions were made as the result of these experiments. 1st, there is too much loss in queen introduction. 2nd, there is too much replacement necessary. 3rd, there is too low a proportion of good replacement. 4th, the cost of good replacement is very high. In the matter of stock improvement, it must be necessary to consider the record of performance of the parent before we can expect any performance of the offspring. It is not necessary to depend upon the purchase of queens for stock improvement. Many of our most successful beekeepers have learned to rear their own queens. These, of course, are reared from the highest producing colony and after a series of such selection, it is possible to secure quite a satisfactory result in the matter of production from home reared queens.

The matter of stock improvement may not necessarily depend upon a single selection of a race of bees. In Switzerland we know that very successful efforts are being made to improve their stock by selection and by mating through the establishment of mating stations high in the Alps mountains. In Great Britain the same bee may not necessarily give the best results, so we find that the beekeepers there have stations on one of the Shetland Islands where they can breed a strain of bees best fitted for conditions in Great Britain. Why should the beekeepers of the United States expect to secure maximum results from a strain of bees developed under a series of conditions absolutely foreign to the conditions under which they are expected to work? In this connection it is interesting to note that the Colorado beekeepers, in co-operation with their experiment station, contemplate the establishment of a queen mating station in isolated spots in the mountains. The purpose of this work is to evolve a strain of bees best suited for their climatic conditions.

Is it not possible then to readily understand why honey production today is so expensive with the present inefficient methods employed? The solution of this problem rests in the hands of the beekeeper. The responsibility cannot be shifted to some unknown party. The problem is not one of price of honey, but of the pounds which can be produced at the present investment.

SOME NOTES ON THE BEHAVIOR OF HONEY-SOLUTION AS AN ANTI-FREEZE FOR AUTOMOBILE RADIATORS.

Russell H. Kelty, East Lansing, Michigan

There is no longer any question as to the effectiveness of a proper mixture of honey and water in resisting the low temperatures of winter.

Repeated experiments have shown that a honey-water solution containing sixty percent honey, by weight, will withstand the winter temperatures of the northern states, whereas a fifty-fifty mixture is preferable for states in the latitude of Ohio.

Occasionally the temperature in either district may drop low enough to congeal the solution but no damage will be done to the radiator, on account of the fact that honey-solution commences to congeal at the bottom instead of at the top as in the case of ice, with the result that there is no tendency for expansion, horizontally.

Granting that a proper mixture of honey and water is efficient in resisting low temperatures, there are other phases of its behavior which will influence its general acceptance as an anti-freeze.

In the beginning it should be emphasized that to give satisfaction the honey-mixture should be made properly. A method that has given success is as follows: Take the proper amounts of honey and water, for instance, to make three gallons of the sixty-forty solution, twenty-one pounds of honey and five quarts of water are required; for the fifty-fifty solution, six quarts of water and fifteen pounds of honey are required; heat the water, stir in the honey and when near the boiling point, stir in one quart of denatured alcohol and allow to boil not more than from three to five minutes. After removing the scum and straining, the solution is then ready for use.

If made according to directions, the fifty-fifty solution should test, at room temperature, 1225-1250 and the sixty-forty solution should test 1275 to 1300, with an ordinary battery testing hydrometer.

A solution which is boiled too long will register more than 1300 and will be too thick to circulate properly. It is not absolutely necessary to use alcohol in making the solution but a solution from which the gum in the honey has been precipitated by the addition of alcohol will resist a temperature of ten to fifteen degrees lower than the same solution made without alcohol.

The fact that honey-solution seeps through apparently water-tight connections suggests the use of absolutely tight hose connections and engine head gaskets. It is possible that some ingredient could be added to the solution to check seepage, but to date nothing that is really satisfactory has been found. However, little trouble will be experienced from this source if proper care is taken to see that the radiator does not leak, and that all joints are tight before the solution is used.

It has been found that honey-solution has a tendency to foam when boiling. Therefore, if too thick a solution is used in a thermo-siphon cooling system, circulation may be retarded sufficiently to cause boiling of the solution in the engine head with the formation of foam which passes out through the over-flow pipe. In extreme cases the foaming may continue until the solution has nearly all boiled away before the motorist is aware of it. In such cases the addition of water alone to replace the lost solution might result in so thin a solution that freezing would damage the radiator. Also should the overflow pipe become plugged, the boiling and foaming may produce sufficient pressure to burst the hose connections. There is little probability that such a thing would happen in a cooling system having a water pump. In fact, we have never heard of this sort of trouble where a water pump was used, unless there was some obstruction, such as dirt and sediment, in the radiator previously.

Whenever the radiator is observed to steam, either on account of the solution being too thick to circulate well because of water lost from boiling or because the solution has congealed on account of low temperature, the engine should be immediately stopped and more water added if the solution has been boiling, or if part of the solution is congealed, a blanket should be thrown over the radiator for a few minutes to allow the congealed portion to liquify so that circulation will commence again.

There are thousands of satisfied users of honey-solution. Its permanency and ever-safe features are especially attractive to those who drive every day, such as mail carriers, taxi drivers and delivery men.

SOME CHANGES IN EUROPEAN FOULBROOD CONTROL

E. F. Phillips, Ithaca, New York

European foulbrood is not a disease which causes the damage in the state of Iowa that it does in certain other parts of the country, yet from time to time it causes sufficient loss to Iowa beekeepers to justify some discussion of it in the Annual Report. This disease has since its first differentiation been a puzzle to American beekeepers, and it is only recently that we have been able to unravel some of its mysteries.

The disease is an infectious one, being caused by a specific micro-organism, known as *Bacillus pluton*. This organism does not form spores and is, therefore, less resistant to heat and other disinfectants than is the cause of American foulbrood. The organism which causes European foulbrood is capable of causing the disease and of bringing about the death of the larva which it attacks, but it does not cause decay of the tissues of the dead larva. The decay is caused by other organisms which enter either before or after death has occurred and since there are several such such organisms often found in the dead larvae, this accounts for the great variety of colors and characteristics of the decayed material which we usually call the symptoms of the disease. This great variability has been the cause of much discussion among beekeepers as to the description of the diseased material and they have at time waxed warm as to whether there is an odor with this disease and as to what the typical color of the dead larvae is. In some cases there is a pronounced odor, in others almost none; in some cases the predominant color is yellow, in others brown, grey or black. The very existence of such variations in odor, color, consistency of the dead larvae and the like is the best symptom which we have for this disease, since in no other known brood disease of bees do such wide variations occur.

The most important recent advance on our knowledge of this disease is the fact that it does not occur everywhere, and where it does occur, it does not cause the same damage everywhere within its range. The significance of these facts will be brought out later. For example, in those parts of the white clover region where the soil, temperature and other conditions are such as to provide optimum conditions for nectar secretion from this species and its allied form, alsike clover, the disease is rare, and in the very best of the clover region it does not occur. Before going further, it should be stated that exceptions to this statement have been found, and these will be mentioned later. Opposed to the clover region, we have a condition in the buckwheat region which is quite dissimilar: everywhere that buckwheat is the major honey source, this disease occurs almost every year and has caused great damage. In the great alfalfa territory of the irrigated regions of the west, this disease is almost absent, and in the few cases where it has been introduced, it has caused little damage and has in most cases disappeared entirely. To give another opposite condition, in the vast area of the states of Washington and Oregon where willowherb or fireweed is a chief source, this disease is present year after year and causes much damage. The southern states are as a rule entirely free of this disease, and this is not because the disease has never been taken there. As an exception to this general statement, in the Yazoo Delta of Mississippi the disease is unusually prevalent and causes much damage.

To bring out still further the variation in the distribution of this disease, which at first glance seems so devoid of any law, this disease has been introduced into good clover regions on several occasions and has disappeared without any treatment or control of any kind. In other regions, such as southern California, for example, after its introduction it spread like wildfire and has caused great losses to beekeepers. In the clover region it sometimes gains entrance for a short time, as was the case in the apiary of the late beloved Doctor Miller in 1909, but under these circumstances it is much easier to control than it is every year in the buckwheat region. Mention was made earlier of an exception to the general statement regarding the clover region, and this should be explained. The disease was differentiated for the first time in the United States when it broke out in the Mohawk Valley of eastern New York, much of which is a good clover region. Here it caused much damage and raged for several years. This occurred at that period of American beekeeping when beekeepers believed it essential that small and shallow hives be used in order to crowd the "surplus" honey into the comb-honey supers. The honey which enters supers under such conditions is not all surplus in the true sense, for after the supers are removed the colony is usually left with such scant stores in the brood-nest as to make proper development of the colony the following spring entirely impossible. This practice became general and resulted in a reduction in the size of the colonies to such a degree as to be almost unbelievable today, when large, strong colonies are so much stressed everywhere. This weakening of colonies through what we now consider bad beekeeping management was doubtless the cause of the vast spread of European foulbrood.

The facts previously stated seem to be virtually without explanation, yet when we examine them carefully we see that there is a fundamental difference between the conditions where the disease is bad and those where it is either absent or mild. Briefly stated, this difference is that in locations where the honey-flow comes within eight or ten weeks of the beginning of normal brood-rearing in the spring, and where this honey-flow is heavy and dependable year after year, this disease causes no damage, except that if for some reason beyond the control of the beekeeper the honey-flow fails, the disease may enter for that season, only to disappear when the honey-flow again returns to normal. In the alfalfa region, nectar secretion from this plant and from sweet clover begins relatively just a little later than in the white clover region, and here if the disease enters it may stay for a time, may cause some loss, but ultimately disappears or is easily controlled. In the buckwheat and willowherb regions, the chief honey-flow comes relatively much later, and under these conditions the disease has opportunity to play havoc with the colonies before a heavy honey-flow comes to stop it. We, therefore, see that in the few examples cited, there is a fundamental difference in the nature of localities where the disease exists and where it does not. Many other examples of the same king might be given if space permitted.

To digress slightly from this discussion of the nature of different localities, beekeeping may be defined as the providing of those things which bees need at such times as Nature fails to provide these. This definition does not include the work of the beekeeper in providing supers and caring for the honey-crop but pertains solely to the actual care of the bees. In every known beekeeping locality there are shorter or longer periods of the active season when nectar does not come to the hive freely enough to provide the bees with all the food that they need, and during these intervals it is the duty of the beekeeper to see that they have food in abundance. During winter and part of the brood-rearing season, bees need protection against inclement weather conditions, when Nature fails to provide that degree of warmth best suited to the needs of the bees. It thus happens that for a considerable part of the active season, the beekeeper must look to the comfort and welfare of his charges.

European foulbrood is a disease which attacks colonies at a specific time of year, namely late spring, and early summer. If Nature fails to provide an abundance of food at this period, the colonies fail to develop rapidly, and it is only these lagging colonies which are subject to the attack of the disease. Colonies which develop freely at this season and which are on the up grade are able to pass through this period without contracting the disease, even though exposed to it. It is not entirely correct to say that the disease attacks only weak colonies, for colonies may be rather weak in numbers and still escape provided they are building up rapidly. It is thus made clear why certain regions are subject to this disease. Where Nature is regularly providing suitable conditions for colony development at the critical season for this disease, European foulbrood has no chance, but where the honey-flow comes late the disease is endemic.

All of this is interesting, but what is the bearing on the control of the disease by the beekeeper? Where Nature fails to give the right condition at the right time, the beekeeper may step in and supply the things which the bees need and thus ward off the disease just as surely as when a heavy honey-flow does the work. We have thus within recent years come to stress the prevention of this disease rather than treatment after it occurs. By providing proper stores and protection for winter so that the colonies are not badly weakened during this trying period, by providing abundant stores during the period of heavy brood-rearing in spring and by requeening so as to provide adequate egg-laying, the disease becomes a minor nuisance, not a scourge. Under the test of beekeeping practices, the disease is entirely eliminated, even in regions where it is at its worst. This is a most hopeful situation and every effort should be made to prevent the disease.

When the disease actually enters an apiary, what should the beekeeper do? It is then too late for preventive measures. Various periods of queenlessness have been advocated, but we now know that the caging or removal of the queen need be prolonged only long enough to give the bees a good start in the removal of the dead larvae. These need not all be removed before egg-laying is again permitted, provided the colonies are strengthened and provided prolific queens are in all the colonies. The most important step is to provide an adequate food supply. The honey in a colony diseased with European foulbrood may be retained without danger and the combs in which brood has died of this disease are readily cleaned by the bees so as to make them safe for further use, so the shaking treatment is never called for. It is in fact, the worst possible way of handling a colony with this disease and should never be advocated.

Much attention has been paid to the use of Italian queens in the control of European foulbrood, and quite properly. The common black bees often found in the United States are extremely prone to contract this disease, and the Carniolans are apparently little better. Italians are not "resistant" to this disease in a strict interpretation of this word as used in medicine, but they do have the ability to clean house and to remove the dead larvae better than do bees of any other races. They should, therefore, be used exclusively where this disease often occurs. It has been found, however, that under careless beekeeping management and also under inoculation, any colony of Italian bees may be overcome with this disease unless the conditions for colony development are right. To place complete reliance on Italians is, therefore, not the correct attitude for this disease, even though their use is of the highest advantage.

This situation regarding European foulbrood has changed the attitude of apiary inspectors decidedly. It also presents to them a serious problem. In brief, European foulbrood is controlled best by those means which we can include under the one designation "Good Beekeeping." As the inspector goes about his work, it is extremely difficult for him to insure that each beekeeper visited shall become a good beekeeper, and this makes his work with European foulbrood trying. He may recommend dequeening for a period, but if this is all that is done the disease will doubtless recur. He may recommend the use of Italian bees but this alone will not insure freedom from the disease. He usually cannot stay long enough to make a good beekeeper of the man in whose apiary

the disease is found but has time merely to relieve the situation somewhat. In regions where the disease is never at its worst, some of these single measures may be enough; this is not true, however, in the buckwheat or the willowherb regions. To destroy colonies with European foulbrood is, of course, unpardonable, for it is not a disease which necessarily causes loss to neighboring beekeepers. Since each beekeeper has it in his own power to keep his apiary free of this disease, regardless of conditions in nearby apiaries, the eradication and control of this disease is not so urgent a problem, and as a result the wise apiary inspectors are doing what they can to make better beekeepers of those who are troubled by the disease and are not attempting to enforce eradication regulations with strictness. This makes it imperative, of course, that the inspectors be able to diagnose the two diseases without error, for to advocate the wrong treatment is a fatal step. It is obviously equally important that the beekeeper be able to diagnose these two diseases himself, for he does not always have an inspector at hand to do his thinking for him.

It is a comfort to know that for at least one of the serious diseases of the brood of bees, we have preventive measures which reduce the damage to a point which is negligible in most localities. This is a great advance, and it is much to be regretted that the nature of American foulbrood makes hope for preventive measures for that disease extremely small.

APIARY INSPECTION IN WISCONSIN

S. B. Fracker, Madison, Wisconsin

When the Wisconsin apiary inspection service was reorganized five or six years ago the beekeepers of the state were facing an unusually discouraging state of affairs. American foul-brood was known in about half the area of the state and was doing so much damage that beekeepers in some districts were gradually being driven out of business. In many of these areas the beekeepers were unfamiliar with foulbrood and were ascribing their losses to winter-killing, poor supplies and several other conditions. Of course the more influential and better educated beekeepers knew what the trouble was, many of them realizing that they were facing a desperate situation.

At the same time European foulbrood had a very strong hold in three different sections, two of which included some of the best beekeeping territory in the state. One area covered about three northeastern counties where large apiaries run by active and interested German beekeepers were known and had formerly been prosperous. The other district included several counties in the northwestern section and there European foulbrood was so virulent that even the best informed honey producers were having serious trouble with it. Since that time this disease has been brought under control by better beekeeping practice.

Apiary inspection had been carried on by the usual methods for the previous twenty years and while a great deal of good had been done, there had been no delaying the onward sweep of disease. Laws prohibiting the moving of infected equipment were on the statute books but as only small areas were inspected the laws were of no effect. A most curious feature of this period and a tendency which still continues more or less is the usual sudden desire on the part of the beekeepers with an American foulbrood infected yard to get away from his infected neighborhood and see whether he can clean up in a clean district. This never has, and never will work out satisfactorily, the only result being that the beekeeper, when he moved into the clean territory, instead of being able to free his own yard from disease, retains the infection and distributes it to all his neighbors.

What we believe to be the most important feature of bee disease control followed in Wisconsin is therefore the limitation on the moving of bees and used equipment from one location to another. Since Wisconsin is almost the only state which has such a provision it is perhaps worth while to give the statute on this subject in full. It reads:

"No person shall sell, barter, offer for sale or barter, move, transport, deliver, ship, or offer for shipment any apiary, bees, comb, or used beekeeping appliances without a permit from the inspector of apiaries; or in lieu thereof, if shipped or transported from without the state, a certificate duly issued by an official state inspector showing that said apiary, bees, comb or appliances have been inspected and found not infected with any communicable disease of bees. Such permit, or a copy of such certificate, shall be affixed to the outside of every package, box, crate, or bundle containing bees, comb, or used beekeeping appliances. The inspector may refuse such permit whenever such refusal is necessary, in his judgment, to prevent the dissemination of any communicable disease of bees or until after he finds by inspection that the said apiary, bees, comb, or appliances are not infected with any such disease."

Penalties are also provided for the violation of this section, for the use of invalid or altered permits and deputy inspectors are authorized to seize any shipment found at any time or place without such permit or certificate affixed.

Careful attention is given to the administration of this feature. Application blanks are distributed through county inspectors, county agents, and upon request. Permits may also be issued as a result of an informal application by letter, provided the necessary information is given.

As the inspection service is now examining all the colonies in approximately one-fourth of the apiaries in the state and has a good many records from practically every county, ti does not take long to determine the possibility of the distribution of disease when an application is received. In area clean-up districts, which will be described later, the issuance of the permit depends upon the inspection record of the applicant. In other counties the permit is issued if the neighborhood is free from disease and if the trip is only to be a short distance. Permit is also issued without special inspection for very short trips in infected districts in which no clean-up work is being done. Other cases are referred to county inspectors who are appointed by civil service examination but who work only upon request of the Madison office and usually have only from two to half a dozen inspections per year. The system of county clean-up campaigns and county inspectors makes it possible to enforce these provisions very rigidly. Not all the violations discovered are

prosecuted, there often being insufficient evidence or entire lack of willful intent or absence of damage. During the last two or three years about half a dozen prosecutions have been made each year, most of them in cases where diseased bees were actually transported and where the owner had every reason to be familiar with the law on the subject.

As a result of these regulations no cases of the introduction of A. F. B. into new localities since 1919 when the law went into effect have been discovered. Several new localities have been found with A. F. B. but in all cases the disease had been introduced before the law went into effect. In one case A. F. B. was introduced into a Wisconsin apiary by the robbing out of infected equipment on the other side of the Mississippi River but this was cleaned up and the Wisconsin apiary moved out of range of the infected yard in Iowa.

Associated with the limitation on the movement of bees is the second important feature of our plan, that of the clean-up of particular areas. An interesting feature is the fact that Wisconsin and Michigan are following two separate policies in connection with area clean-up campaigns. The Michigan inspectors have begun at Lake Superior and have now inspected all of the apiaries in the northern peninsula and several northern counties of the southern peninsula. Vigorous and drastic measures are being taken to eliminate foulbrood entirely from this section, a matter which is a comparatively easy task in a district as thinly settled as this where beekeepers are scarce and at great distances. In one or two counties, in fact, beekeepers appear to be entirely wanting. This plan in Michigan has been followed by the establishment of a quarantine line prohibiting the introduction of bees on comb from outside that area whether inspected or not. The only means of adding to the number of colonies in Upper Michigan are by natural increase and the introduction of combless packages, the importation of both nuclei and entire colonies being prohibited. In Wisconsin this policy was not practicable owing to the widespread interest and vigorous demand for assistance from the heavily infected areas of the east central section of the state. Such funds as were available had to be put into the regions where American foulbrood was most common and most virulent, or the necessary support on the part of the beekeepers could not have been secured and retained. Areas are taken up county by county, the area clean-up district in general now occupying the entire eastern third of the state and a single isolated county in the west central section.

Counties are chosen for clean-up work on the basis of the thoroughness of the organization of the county beekeepers' association and the extent of the demand for inspection. Before a county is entered the county beekeepers' association makes a formal request by submitting resolutions passed at the annual meeting. It has never been possible for the state department to follow out these requests as fast as they have been received. In fact, during the last two years, in addition to the request from the beekeepers, all the new counties undertaken have been chosen as a result of an appropriation by the county board of supervisors. The beekeepers have gone to the county board stating that the department of agriculture had so many demands on its funds that this particular county probably could not receive assistance for some years and requesting that the county board pay part of the expense. In these cases the state department has more than doubled the appropriation made by the county and has shown a preference for such counties rather than others in which less interest is shown. Delays in reaching counties which have filed request have really resulted in less difficulty than was expected.

In the area clean-up district every apiary of whatever size is searched out and visited. If it is possible to secure an experienced beekeeper in the county to do this work with an assistant he is always chosen. Usually no one is able to get away from his own work for sufficiently long periods to carry on the campaign and outside full-time inspectors must be employed. The apicultural classes of the college of agriculture have been the most extensive sources of trained men for this purpose.

Within the district every yard is searched out and inspected. None of the methods of compulsory registration of beekeepers, listing by the crop reporters or assessors have proven sufficiently inclusive. The best work is being done in places where the inspectors not only ask every beekeeper to name all the neighbors who keep bees but also to make a careful search for apiaries along every highway.

When American foulbrood is found, instructions are given for either treatment or destruction and the first year the owner is left to follow out the plans as best he can with such assistance from the inspector as the owner requests. The second season, if disease is carried over more pressure is given but if infection is still present the third year the inspector destroys the colonies found diseased and cleans up the premises in general. As a result of these methods, disease is reduced at the rate of about fifty percent a year in practically all the areas in which we have been working. When the amount of infection gets below two percent of the number of colonies, more difficulty is experienced in cleaning up the last traces of disease.

The question is often asked as to whether treatment is as satisfactory as destruction in bee disease control. It is a general experience that the destruction of infected colonies is somewhat less likely to result in reinfection the following year. Our records, however, give no support to the idea that treatment does not result in cleaning up bee yards. Figures from the state which have already been published, have shown that in one year 27 apiaries in four counties cleaned up by following the treatment method. In Fond du Lac County in 1922, 46 beekeepers treated their infected colonies and 29 of them showed no disease the following summer. This is the highest percentage which has ever been secured as a result of treatment. In the same area the same year 39 owners of infected yards destroyed their diseased colonies and only ten of them showed disease this summer, an improvement of about 75 percent.

Our experience in Wisconsin shows that the method of treatment almost without exception, eliminates American foulbrood from the treated colony, but that it is more often retained in the yard than when the plan of destruction is followed. This is not so much on account of the difference between treatment and destruction as because of the fact

that treatment indicates a particularly economical tendency on the part of the beekeeper, and destruction shows a desire to do whatever is necessary or even a little more in order to eliminate disease. This state of mind is of the utmost importance, for when beekeepers undertake the problem of disease control from the point of view of saving everything possible unless it is known positively to be infected, that attitude is fatal to success. One can reduce foulbrood losses by following that policy but cannot eliminate disease entirely.

Fortunately, the immovable frame hive problem is not a serious one in Wisconsin except in a few localities. The department has the authority to order anyone having hives with immovable frames or not permitting of ready examination to transfer the colonies to modern equipment and in fact has authority to destroy the bees if this is not done. The latter measure is practically never followed, however, except at the request of the owner, although sometimes it takes two years before the older and more backward beekeepers can be induced to make the necessary transfer. Within the last month a number of log gums belonging to an aged German beekeeper in Milwaukee county have been burned up, the owner having neglected to make this transfer in spite of persistent pressure for the past three years.

An important feature of this work and one which cannot be emphasized too much is the fact that American foulbrood is connected entirely with large apiaries rather than small ones. It is moved from place to place by commercial beekeepers who make a large part of their living from honey production, and is retained in the large yards much longer than in the small ones. In any particular locality the first apiary to show disease will usually be one of the largest in the area and the last yard to clean it up will be the biggest of all. Of those beekeepers who fail to eliminate American foulbrood in three seasons, only one-tenth own less than ten colonies of bees and most of the yards are from 30 to 100 in size. The reason for this is that in large yards the honey house is full of infection, the floor, table, tools and extractor are daubed with infected honey, many suspected colonies contain foulbrood bacilli and after the bees are shaken infected material is stored for a day or two before destruction. Bees have been found gaining access to infected honey in supposedly bee-tight honey houses not only through missing window panes, a crack in the siding or open doors but through such places as the stovepipe, the keyhole, or a crack in the cement floor. The storage of infected material in the honey house for even a few days is one of the largest factors in maintaining disease in commercial apiaries. It is carefully impressed on the minds of all the inspectors working for the department that the clean-up of infected colonies themselves is one of the smallest parts of their work, the most important feature being the destruction or disinfection of infected equipment.

In general, four different types of apiary inspection campaigns are being carried on in the United States at present. The most common form may be known as inspection on demand, the inspector going here and there and examining apiaries when he suspects or some of the beekeepers suspect the presence of disease.

Another group of states, the most notable of which is Florida, have been considering American foulbrood as an emergency and adopting a policy based on the assumption that it has been recently introduced into their area. On this assumption, every infected colony is being destroyed immediately upon discovery and where the percentage of infection is very low this is by far the most satisfactory plan.

In Iowa, a purely educational method is being followed. Under this plan all possible publicity and extension work is done, meetings held and demonstrations, but the actual cleaning up of disease is left to volunteer action on the part of beekeepers.

The fourth plan, the one discussed in this paper, is the area clean-up system, various modifications of which have been followed out in a number of states. Michigan has been mentioned, Indiana and Pennsylvania have secured excellent results by this method, Minnesota and Wyoming are following it also, and Ohio has begun such a plan in two counties during the past summer. Judging from the results in Wisconsin it offers great hope of permanent control in heavily infected states.

MEANS OF SPREADING FOULBROOD

J. H. Monast, Ames, Iowa

American foulbrood is a fatal and contagious disease of bees, dreaded most by beekeepers. The germs of the disease are carried from one cell to another, colony to colony, and then to the neighboring apiaries, soon infecting whole areas unless some means of prevention of spread is adopted. In order to prevent the spreading of American foulbrood, it is necessary to consider the many means by which this serious disease is brought into an apiary.

Not so many years ago, many writers claimed that foulbrood originated from chilled or dead brood. Dr. Howard of Texas, a man of authority in the beekeeping world, proved beyond a doubt that chilled or common dead brood does not produce foulbrood. There were also writers who believed that foulbrood germs floated in the air and spread disease in that manner. The modern conception of the spreading of foulbrood is that the adult bee must come in contact with the germs before it can be transmitted from one source to another.

Generally American foulbrood does not appear to be serious during a honey flow, but at the close of the honey season, or at time of scarcity, it is quite serious and as the bees at such time will rob anywhere they can find stores it is the duty of every beekeeper to keep infected equipment and diseased colonies well protected from robbers. Hive entrances of weak colonies should be contracted and diseased colonies should be isolated to prevent spreading of disease by drifting of young bees.

It has been rather the fashion in the past to blame the box hive beekeeper as the chief offender in the spread of disease. While working last summer as inspector it did not appear that such was true. While the box hive often harbors disease, it is seldom spread until the colony dies and is robbed out. An apiary of box hives is often found healthy or with only one or two cases, while the neighboring apiaries in modern hives

are badly infected. Of course the reason is not in any merit of the box hive, but in the fact that the bees are left undisturbed while the enthusiastic amateur is constantly exchanging combs of honey or brood, uniting weak colonies, dividing strong ones for increase, extracting honey and feeding it back to other colonies, and last but not least buying bees and queens from unknown beekeepers in their locality.

While disease is certainly carried from abroad by robbing, it seems most certain that a large percentage of the new cases come from colonies in the same apiaries. Some of the more modern beekeepers advocate that every super and every frame should be numbered to correspond with the hive on which it belongs and should be used there and nowhere else. If this suggestion was followed exactly no doubt the disease could be controlled, but the plan seems impractical since it involves a little more care than the average beekeeper puts into the work.

The interchange of extracting combs and super and the practice of carrying around the apiary of a small uncovered box for burr comb and bits of wax taken here and there are also good means of carrying disease around the yard. The box is especially dangerous when there is dearth of honey as the robbers are out scouting for every drop of honey they can find and the burr comb box usually has honey in it.

One invariably finds new cases of American foulbrood in the strongest colonies first whereas in European foulbrood it is often the weakest colonies that get it first. The reason why the strongest colonies get American foulbrood infection first is that they have a larger and more vigorous working force and have plenty of bees to do scouting work, so they are likely to find colonies infected by the disease before weaker colonies can find them.

Since the bees are not able to remove the scale from the cells of American foulbrood infected colonies, the result is that honey is stored in the cells over the scale. This is especially true during the honey flow. When bees are gathering honey quite a lot of it is placed around in the brood chamber and the honey is likely to be placed in cells containing American foulbrood. Most of the honey will be carried up into the supers after the bees have ripened it. The spores of American foulbrood float out in the honey and when the honey is taken up to the super the disease germs may reach any part of the colony, so that in replacing the supers after extracting the disease is quite often spread.

There are some beekeepers who when they find a cell of foulbrood in a colony cut out that cell. Such practice is useless since the cause is not removed for the spores are likely to be in honey in any part of the hive.

The careless and shiftless beekeeper probably contributes more to the spread of disease than all other causes put together. As a rule he has theories of his own about disease, he prefers to believe that whenever a colony dies that starvation and not disease was the cause. Such a type was met last summer who had 100% American foulbrood in his yard and the method of treating was smoke. A smudge was made, the combs were slowly passed through the smoke and the cure was complete. Within a radius of five miles from this man's place, practically every small backlot beekeeper was keeping diseased bees and upon investigating further it was found that Mr. "Smoke Expert" was taking care of the bees on shares or had something to do with the bees since spring. There is no doubt that there are many more of these careless, ignorant and indifferent people at the bottom of our rapidly spreading foulbrood infection.

Many beekeepers unwittingly aid the spread of disease by putting swarms into hives or upon combs that have come from diseased colonies. In localities where American foulbrood is present swarms should always be hived on sheets of foundation. This will allow the bees to consume the honey in their honey stomach in drawing out the combs and thus eliminate the possibility of bringing disease to the new colony.

Discarded receptacles that have contained honey from a diseased colony, may also be a source of infection if not thoroughly cleaned. Thousands and thousands of small honey jars, cans, pails and other honey smeared containers are thrown in the refuse pile each year only to be cleaned up by the bees from some nearby apiary and if the honey in these containers came from diseased colonies one can readily see the amount of disease that can be spread from an apiary of medium size. This menace is very difficult to eliminate entirely.

Queen cages and nuclei containers have often transmitted disease especially when the queen candy was made of honey. If the attendant bees are killed and the queen is transferred to a clean cage before introducing, the beekeeper will be safe from foulbrood. In the case of the nucleus the bees should be transferred to full sheets of foundation to eliminate the disease.

One of the worst crimes of beekeepers is to loan each other equipment or to sell honey in combs for feed with the understanding that the combs are to be returned. A case was brought to attention last summer where a beekeeper bought two hundred combs of honey for feed, with the understanding that the empty combs were to be returned. The beekeeper who sold the honey had never had foulbrood in his yard while the inspection of the buyer's yards showed approximately 10% infection. I need go no further; another beekeeper will have his foulbrood troubles next year if the combs were returned.

The central extracting plant seems to have many points in favor of spreading disease. The truck used for hauling the super back and forth should be bee tight, otherwise there will be robbing when there is no flow on and if foulbrood is present it will spread rapidly.

Some beekeepers are of the opinion that disease is oftentimes spread through the bees' water supply. Theoretically this may be true, but in practice the amount of foulbrood transmitted through this means is negligible.

Last but not least is the man who is always complaining about the other fellow's bees being in such bad condition. This kind of beekeeper does more to harbor and spread disease than the beekeeper who does not know foulbrood when he sees it. In the first place he knows all there is to know about foulbrood as he can tell the common and scientific names of each state of development that the disease goes through

and yet he never gets rid of the disease in his own apiaries. When an inspector comes to him and asks him why he doesn't clean up his answer is invariably the same "eliminate my neighbor's bees and I'll get rid of foulbrood." If we all took that attitude the beekeeping industry would disappear from this country in less than fifty years.

CLEANING UP FOULBROOD

Newton Boggs, Ames, Iowa

At a beekeepers' meeting it is always easy to start a discussion on the foulbrood question, especially on the ways that it can be carried and on the infection that always comes from the "neighbor's bees."

In the fall of 1917, which had been a very good season, an apiary some distance from my own was purchased. The bees were said to be free from foulbrood. However, in the following season the disease developed in about 50 percent of the colonies.

The following season everything which showed any cells of foulbrood was shaken on full sheets of foundation, and the others, which were apparently free from foulbrood, were left alone. But the start was too late to clean up, as the "bacillus larvae" had gotten into some of the other colonies. It could not be detected as it was probably stored in some of the honey in the top or ends of the brood frames, which would be used the following season or perhaps two or three seasons later.

In later seasons a few cases of the disease have been picking up which in all probability have been lurking in some of the honey in the edges of the brood chamber. It seems certain now that if American foulbrood is found in nearly thirty percent of the colonies it would be much better to treat the entire apiary (now that we have Hotzleman's solution). However, with just a small apiary it might be best also to treat everything.

The best way for the small beekeeper to treat colonies is to have a hospital yard a few rods away from the apiary, so that when a colony is found with the disease it can be moved immediately. This should be done in the evening when the bees have quit flying. After they are in their new location a couple of days there is not much danger that they will go back to the clean colonies in the apiary, and then it is time to treat them. While on the subject of hospital yards, it would be well to say a few words in regard to hospital colonies that have been noticed in inspection work. There is a great tendency to place the diseased brood combs over a strong diseased colony; to be shaken twenty-one days later. This generally results in the colony being upset by stock breaking into the apiary or the cover being blown off and thus a case of robbing is started in this colony which was to be saved.

Another source of infection is in diseased combs which are put away to be treated later. Usually they are carried into the honey house and allowed to drip on the floor. When other honey is brought in, it is sometimes set on the floor in the same place as the diseased combs (which are to be extracted when the beekeeper has time) and then the clean hive is put back on a colony in the apiary. Also the beekeeper brings a few bees into the honey house with him which might carry out some of this diseased honey or a few robbers might get in when the door is open and get the diseased honey. The best thing to do with diseased combs is to melt them up at once or treat them in the alcohol formation solution.

During a visit with an extensive beekeeper in Colorado in 1922 we were talking over Dr. Frackers' article on "bee tight honey houses" which had appeared at that time in Gleanings. He said that he really had a bee tight place in which he kept his foulbrood combs. He showed a room lined with tin in the corner of his honey house, but he had forgotten that he usually had a stove in there during the winter and when it was taken out it had left a hole in the roof where the stove pipe had been.

Some of the beekeepers whom I have visited and who have had a great deal of experience with foulbrood make it a practice when finding a diseased colony to sulphur the bees. This is done in the evening when the bees have quit flying and the diseased combs and hive are immediately taken care of. Others go as far as to burn everything on the spot.

Some beekeepers feel that they get their foulbrood from their neighbor's bees. An inspector is sometimes told that if the neighbor's bees were cleaned up, it will be easy to keep clean of the disease. However, there are some extensive beekeepers who never worry about the disease of their neighbors or the bee trees in the neighborhood. When they find a good location, they put an apiary there and keep a close watch, and when a colony is found infected, it is moved away and treated. These beemen say that they have only a few cases of disease showing up in their apiary and after three years in a locality that disease is seldom found in their apiary. These men contend that most of the foulbrood is scattered by the beekeeper himself.

In summing up, the following points should be kept in mind:

1. Do not buy bees or used bee equipment without a health certificate from an apiary inspector.

2. Do away with the hospital colonies and melt up or treat combs immediately, and remove all diseased honey from the apiary and honey house.

3. Do not treat colonies in the apiary as young bees are very much inclined to drift.

4. Clean your own apiary first and keep it clean and do not be careless with used equipment.

INTERNATIONAL NOTES ON THE BEE MOTHS

F. B. Paddock, Ames, Iowa

In 1913, the writer published data on the life history of the larger bee moth and in 1916 this work was republished with some additional observations. Since that time there has been no further data collected on the life history of this pest by the writer and but very little has been done by other investigators.

In undertaking the work again on a much broader basis, the endeavor began with questionnaires sent over Iowa and then over the United States. From this point it seemed desirable to extend the questionnaires to include every nation in the world. The work has progressed far enough and the results are so interesting that it seems worth while at this time to mention some of the outstanding features.

In the first place the distribution of the pest is exceedingly interesting. We would expect to find it in the southern European countries but it was a matter of some interest to have it reported from Sweden, northern Russia and the province of Ontario in Canada. Within the geographical range of the pest, the distribution is quite general in the various regions. There are one or two possible examples. For instance: in Austria and Hungary the pest is not found in the greater altitudes of the mountainous areas. This same condition has been observed in the distribution of the pests in the United States. In Colorado, Wyoming and Montana the pests seem unable to persist at altitudes above 4,000 feet.

With many insect pests it is interesting to attempt to get in touch with the early records and with the bee moth we find that in Italy it was recorded at the time of Aristotle about 300 B. C. From that time on, it was frequently referred to by Italian writers of agriculture. In Hungary one correspondent tells that it was reported with remotest antiquity and in Austria it is recorded as known for centuries. We would assume that this pest followed in the footsteps of the western spread of the beekeeping industry. Therefore, it is of interest to note that in Germany it is recorded about the year of 1500 as the first date for this pest, whereas in Sweden the first record is about the year of 1700. In England a writer in 1870 referred to the bee moth as a pest of bees. Whenever this insect has been recorded, its distribution has been steady and rapid within a given geographical unit. It seems to have spread very rapidly in early ages due in part to the rather unscientific methods of handling bees then as compared to methods of recent times.

Today beekeepers are not especially handicapped by the presence of this pest and its continued ravages seems to be due entirely to the indifferent keeper. The replies from practically every country accord in the opinion that weak colonies poorly kept serve as the source of supply for the bee moth. Therefore, while it may not be particularly serious it is apparently always present and this means that the beekeepers must wage a constant fight against the pest.

In European countries where skeps are the rule, this pest is not necessarily correlated with the immovable frame hive. For in those countries a more careful type of beekeeping is conducted where bees are kept in skeps. The correlation is with the indifferent beekeeping and not with the type of hive is the opinion of most of the European correspondents. There is considerable difference of opinion as to the correlation of the presence of this insect with the black race of bees. In Europe the prevailing opinion is that the color of the bee plays no part whatsoever in the prevalence of the bee moth. Throughout Great Britain and North America, the feeling is that there is very positive correlation between the continued presence of this pest and the black bee. Perhaps this difference of opinion can be accounted for by the fact that in the latter group of countries, the Italian race of bees has come to be more common among the practical beekeepers and in this way the correlation is apparently with the race of bees and really not with the type of beekeeping. In every country this pest is quite serious on stored combs and the most stringent artificial measures must be taken to save the stored brood or extracted combs.

Perhaps the greatest difference in replies was in regard to the life history of this pest. This may be due to the fact that the life history has been little studied in the various countries or it may be due to a peculiar life history which allows for a considerable overlapping of broods. In regard to how this pest survived the winter, the correspondents almost invariably included all four stages of the pest. This would seem to indicate a need for a more careful study of the habits of this pest in order to more accurately lay out the campaign for control measures.

At the present time the remedies used against this pest are more or less standardized. In every case, strong colonies are recommended and recognized as excellent and when this work is carefully done, the rest of the measures must be directed towards stored combs. For this purpose fumigation is more frequently used than any other method. Through the southern European countries, fumigation with sulphur is commonly employed. In northern Europe, there is a tendency to use hydrocyanic acid gas. In Great Britain, naphthaline has proved to be satisfactory fumigant. In no foreign country has any reference been made to the use of carbon bi-sulphide which is so commonly employed throughout North America. In every case the fumigation is recognized as being least efficient against the egg stage of this pest and therefore a series of treatments is necessary to complete the control campaign. Probably this is the reason that the North American beekeeper has practiced the use of carbon bi-sulphide which is effective against the egg stage of this insect.

It is intensely interesting to learn that the lesser bee moth is nearly always present with the greater. In every case, there seems to be confusion by the rank and file of beekeepers concerning the correct identification of these two pests. Through southern Europe the lesser bee moth is a more serious pest than the greater. It is more inclined to be found in the hive along with the bees and it seems the destruction wrought by this pest is not as rapid as by the greater species so for that reason a colony of bees can survive for a much longer period of time before giving up the fight. In Europe the smaller species is not as much a pest of stored combs as is the case in North America.

Parasites and predaceous enemies were seldom mentioned by correspondents. In Italy a hymenopterous parasite is present but apparently not in sufficient numbers to be of economic importance. In France two species of parasites are recorded and again the parasites do not apparently exert a big influence in keeping this pest in check.

The study made so far includes South America, Asia and Australia but the information is not complete enough at this date to draw any deductions.

In making the above brief notes, certain features are rather outstanding. First, it soon became evident there was a very keen desire on the part of beekeepers and entomologists to co-operate to the greatest extent in this international effort. It is to be hoped this feeble effort can be made to develop into a much larger sphere of international co-operative activity.

Another point which must come to the observer is that this pest has been with beekeeping since the earliest recorded times and although fought constantly, it is still present and doing a very considerable amount of damage in every country.

Again the life history of this pest is very little understood and entomologists recognize the fact that the life history of an insect pest must be carefully worked out before planning the control measures. The difference between the two species may be partly responsible for the difference in life history and the resultant combative measures.

THE MINIMUM FLYING WEIGHT OF THE HONEYBEE

By Wallace Park

The first published account of weights of honeybees of which we have record is that quoted by Wildman[1] from the unknown author of the "Natural History of Bees." It is assumed that the book referred to is the "Histoire Naturelle des Abeilles," published in Paris, 1744, or the English translation of the same work which was published in London the same year. This author weighed bees killed in a robbing episode and found that 168 were required to weigh half an ounce, which would be 84.4 mg. per bee. To satisfy himself on this point, Wildman weighed bees which he took from a hive on a very cold day. They were allowed to fly to a window where they soon became chilled and inactive. He found that of these, only 154 were required to weigh half an ounce, which is equivalent to 92 mg. per bee. During the last century, Cotton[2], Collin[3], Gelieu[4], Koons[5] and[6], Gillette[7], Lazenby[8], Macdonald[9] and some others have published data on the weight of bees.

A dependable method for finding the numerical strength of a colony has long been sought by the practical apiarist as well as the scientific worker. Bees are now sold extensively by the pound at prices that are about ten times that of honey. The purchaser should be able to check up on the number of bees he gets per pound in order to know whether he is getting full value in bees. Both of these problems require for their solution the use of a factor which may be designated as the *minimum flying weight*. The particular need for such a factor in connection with the studies at hand was for determining the nectar-carrying capacity of the honeybee. With this factor established, the load carried could be found by deducting it from the gross weight of the loaded bee.

Several previous investigators have attempted to determine the carrying capacity of the bee by deducting the average weight of outgoing bees from that of incoming bees. Whether or not the *average* weight of outgoing bees may safely be used as a basis for this determination may be decided from Table 1, which contains a fairly complete list of weights previously published for outgoing bees, together with records secured during the present investigation. A variation of from 71 to 123 mg. is shown for individual bees and from 75 to 104 mg. for averages. These are wide variations especially as all but a few of these figures are for the Italian race. Figures from Koons[3] and[4] are for Italian and Italian-Black hybrids; this from Gillette[7] and those secured by the writer are for Italians. In the other cases, the rate used is not stated. Not only is there variation in weights obtained from different colonies, but also in records taken from a single colony on different days and even for different times on the same day, as is shown by the data from colony 62.

TABLE 1—WEIGHTS OF OUTGOING BEES

Investigator	Number bees used	Aver. wt. in mg.	Hour		Date	Colony number	Remarks
*Unknown	168	84.4			1744		Bees killed in robbing episode
Gelieu		83.0					Probably outgoing bees
Koons	1	80.0			1893		Lightest of 10 bees
"	1	109.5			"		Heaviest of 10 bees
"	10	93.9			"		
"	1	82.5			1895		Lightest of 10 bees
"	1	122.2			"		Heaviest of 10 bees
"	10	94.5			"		
Gillette	29	75.2		6-15	1894		
"	20	75.2		10-5	1896		Robbers
"	20	90.7		6-28	1897		
"	5	86.9		6-28	"		Stomach entirely empty
"	1	83.3		6-28	"		Selected small
Lazenby	1	71.0		5-17	1899		Lightest of 16 bees
"	1	92.0		5-17	"		Heaviest of 16 bees
"	1	79.0		5-17	"		
Macdonald		82.5			1912		
Park	25	84.0	8:30	7-28	1919	57	
"	25	84.2	8:00	8-29	"	48	
"	10	82.9	3:00	12-30	"	1	
"	25	89.2	8:00	8-4	"	62	No gain—no loss
"	25	83.3	2:30	8-4	"	62	No gain—no loss
"	25	95.0	10:00	8-28	"	62	Good gain (6 lb.)
"	25	100.8	1:00	8-28	"	62	Good gain (6 lb.)
"	25	104.0	4:00	8-28	"	62	Good gain (6 lb.)
"	25	88.8	7:30	9-5	"	62	Fair gain (4.5 lb.)
"	25	94.5	4:30	9-5	"	62	Fair gain (4.5 lb.)
"	25	84.4	8:00	9-11	"	62	Slight loss
"	25	82.5	12:30	9-11	"	62	Slight loss
"	25	81.2	4:30	9-11	"	62	Slight loss
"	25	89.0	2:30	4-5	1920	26	
"	25	86.2	3:00	4-7	"	46	Temperature 47F.
"	25	84.7	3:00	4-7	"	46	Temperature 47F.
"	25	86.9	3:00	4-7	"	46	Temperature 47F.
"	25	87.3	2:00	4-8	"	46	Temperature 52F.
"	25	86.1	2:10	4-8	"	46	Temperature 52F.
"	25	84.6	2:20	4-8	"	46	Temperature 52F.
"	25	85.5	2:30	4-8	"	46	Temperature 52F.
"	75	90.5	2:00	4-20	"	59	Robbers
"	50	81.5	9:00	4-28	"	59	
"	50	89.4	1:30	5-7	"	59	
"	25	100.4	2:00	5-14	"	62	Small gain (1 lb.)

Average 82.2 mg.
*Quoted by Wildman (1).

In the present investigations, the weighings were made as follows: As a rule, 25 bees were caught as they left the hive and were placed in a cyanide bottle long enough to render them inactive, but not long enough to kill them outright. They were then placed in a small glass weighing jar having a tight fitting, ground glass cover to reduce the chances for loss of weight by evaporation. The weighing was done as soon as possible on chemical balances which are considered accurate to the tenth of a milligram. This is less than one-millionth of a pound.

The series of ten weights from colony 62 was obtained at different hours on four different days, as may be seen from the table. Honey-flow conditions represented on these days ranged all the way from a dearth on September 11, to a heavy honey-flow on August 28. The lightest average weight found for any lot was 81.2 mg. and the heaviest, 104 mg., while the others can be arranged in a series running from the one extreme to the other with no two of them the same. It will be noticed that there is an extreme variation of 52 mg. in the weight of outgoing bees from different colonies and possibly different races. Even in the weighings from a single colony, a variation of 23 mg. is shown together with irregular variations from day to day, indicating that other factors are probably involved. It therefore seems necessary to approach the problem from other angles in an attempt to eliminate the other factors.

LOW OUTGOING WEIGHTS

In studying this table, we are confronted by the fact that there is a minimum below which outgoing weights seldom fall. This minimum must approach the actual minimum flying weight. It is to be expected, then, that the average of a few of the lowest weights taken from a series such as that from colony 62, would represent an approximation to the normal minimum flying weight for that colony.

The three lowest of these weights were obtained at times when the bees were scarcely able to secure nectar enough for their daily needs. There were, however, abundant stores in the hive. We have found that under such conditions, outgoing bees weigh much less than when nectar is abundant in the fields. This is shown very clearly by the records from colony 62 as given in Table 1. As will be noticed, August 28 and September 5 were in a period of honey-flow. Colonies on scales registered strong gains for both days, and outgoing bees showed high weights. On the other hand, August 4 was in a period during which the bees neither gained nor lost, while September 11 was the first day in a period of loss. Moderate to low weights were recorded for outgoing bees on both these days. If, from this series of ten weighings from colony 62, we take the average of the three lowest, 81.2, 82.5 and 83.3 mg., we obtained 82.3 mg.

Other low weights secured were 82.9 and 81.5 mg. from colonies 1 and 59 respectively, and the average of all five low weights is 82.3 mg.

Comparing minimum weights given by other workers, for outgoing bees, with this average of 82.3 mg., we find that the unknown author of the "Histoire Naturelle des Abeilles," quoted by Wildman[1], found 84.4 mg. as the average weight of 168 bees that lost their lives in a robbing episode; and, altho not outgoing bees in the strictest sense of the term, they were undoubtedly bees that were practically devoid of any load, and may properly be classed with outgoing bees. The minimum weight found by Gelieu[4] was 83 mg., but we are not informed of the number of bees used in this determination. The lightest weights recorded by Koons[3] and[4] are 80 and 82.5 mg. respectively. Each of these figures represents the weight of a single bee.

Gillette[7] gives 75.2 mg. as the lightest average weight for outgoing bees found by him. This average is so much lower than that obtained by any other worker from weights based upon a similar number of bees, that there is reason to suspect that some unusual and recognized factor was responsible for this exceptionally low weight. This is, obviously, an error in Gillette's figures as there is a difference of only 2.7 mg. in the weights of loaded and unloaded pollen-bearers recorded under date of June 15. It may be that this same error affected the weight of the outgoing bees quoted above. Lazenby[4] weighed sixteen outgoing bees individually. Of the sixteen, eleven weighed less than 82 mg. and the average of all sixteen was 79 mg. Figures given by Mcdonald[9] indicate that he found 82.5 mg. as the average minimum weight for bees.

Summarizing the low weights given by previous workers, we find that Gillette's 75.2 mg. may well be eliminated on account of reasons already given. Those figures known to be based upon the weight of a single bee can, in all fairness, be used in the determination of an average, only when accorded their proper values by means of a weighted average.

The low averages obtained by other workers may be tabulated as follows:

Unknown	Average of 168 bees	84.4 mg.
Gelieu	Average of bees	83.0 "
Lazenby	Average of 16 bees	79.0 "
Macdonald	Average of bees	82.5 "
	Average	82.2 mg.

This average together with that found during the present investigation, gives a grand average of 82.2 mg. for the minimum flying weight as determined from low outgoing weights.

THE WEIGHT OF UNLOADED POLLEN-CARRIERS

It is stated by both Gillette[7] and Lazenby[4], that incoming pollen-bearers carry very little honey or nectar in the honey stomach and that bees do not gather both pollen and nectar on the same trip. As shown by Casteel[10], outgoing pollen-bearers carry a small quantity of nectar of honey which they mix with the pollen as it is gathered. Our investigations show that this honey or nectar is almost entirely gone when the bee returns with a large load of pollen.

It was found, however, that when working on certain flowers, some bees do gather more or less of both nectar and pollen at one trip, but in general only a small proportion of the pollen-bearers will be found to return with much nectar. Such bees usually carry a noticeable quantity of nectar and only a medium or small load of pollen, so that it is not difficult for a trained eye to recognize them and thus avoid weighing them along with those that carry pollen only. When bees are carrying

pollen from corn or other sources which produce no nectar, such precaution is not necessary.

In order to determine the amount of honey carried by returning pollen-bearers, fifty bees carrying loads of pollen were caught. The honey-stomachs were removed from these and were found to average 1.8 mg. The weight of the average empty honey-stomach was found to be 1.5 mg. or less. This leaves approximately one-half milligram as the weight of the possible load carried in the honey-stomach of these selected pollen-carriers. Examination of honey-stomachs from other lots of heavily lo ded pollen-carriers has shown that the case given above is not exceptional. It was found practical, therefore, to use heavily loaded pollen-carriers for the purpose of getting at the normal minimum flying weight of the bee. The only thing necessary to prepare such bees for weighing was to stupify them in a cyanide bottle as usual and carefully remove the pellets of pollen from their legs.

Average weights of unloaded pollen-carriers appear in Table II. Six weighings were made from colony 62. Only bees carrying the same kind of pollen were weighed together. The intention was to weight 25 bees in each lot, but that was found to be impractical in two cases due to the lack of bees carrying the desired kind of pollen at those particular times. The average for all six weighings is 81.7 mg. One lot of unloaded pollen-bearers from colony 57 averaged 83.4 mg., while two groups taken from colony 59 on different days, averaged 85.5 and 83.2 mg., respectively.

TABLE II—WEIGHTS OF UNLOADED POLLEN-CARRIERS

Average weight in mg.			Hour	Date	Source	Number bees used	Colony number
Loaded pollen-carriers	Unloaded pollen-carriers	Pollen load					
....	83.5	....	....	6-15, 1894	Gillette (1897)	29	....
....	82.5	....	....	6-28, 1897	" "	10	....
96.6	83.4	13.2	8:30	7-28, 1919	Corn	25	57
97.2	81.9	15.3	8:00	8- 4, 1919	"	25	62
89.4	78.7	10.7	2:30	8- 4, 1919	"	7	62
98.2	80.0	18.2	8:00	8- 4, 1919	Red Clover	25	62
102.0	82.0	20.0	2:30	8- 4, 1919	" "	25	62
95.9	83.4	12.5	2:30	8- 4, 1919	Heartsease	25	62
98.5	85.5	13.0	2:00	4-20, 1920	Elm	25	59
102.0	84.0	18.0	1:00	9-11, 1919	Red Clover	20	62
112.2	83.2	29.0	1:30	5- 7, 1920	Hard Maple	50	59
111.9	*89.6	22.3	9:30	5-20, 1920	Apple	25	64
106.4	81.3	25.1	9:40	5-20, 1920	"	25	22
108.4	84.8	23.6	9:50	5-20, 1920	"	25	12
117.3	90.2	27.1	10:00	5-20, 1920	"	25	6
113.5	86.2	27.3	10:00	5-20, 1920	"	25	20
Average	83.9						

Gillette[7] gives average weights from two groups of 29 and 10 unloaded pollen-carriers as 83.5 and 82.5 mg., respectively, but evidently attached no importance to them for they are not mentioned in his discussion.

*These bees carried an average of 4 mg. of nectar.

Summarizing these results, we find the averages from five colonies as follows:

Colony	62	(127 bees)	81.7 mg.	81.7 mg.	(127 bees)
	57	(25 bees)	83.4		
	59	(75 bees)	84.3	83.4 mg.	(139 bees)
Gillette		(29 bees)	83.5		
Gillette		(10 bees)	82.5		
Grand Average				82.5 mg.	(266 bees)

THE WEIGHT OF THE BEE MINUS THE CONTENTS OF ITS HONEY-SAC

Another method by which the actual weight of an unloaded bee was obtained was by collecting bees and removing their honey-sacs. The weight of a bee after removal, plus the average weight of an empty honey-sac was considered as the minimum weight of the bee. This called for the determination of the average weight of empty honey-sacs.

The Weight of the Emp'y Honey-Sac was determined as follows: When weighing honey-sacs removed from incoming pollen-bearers, it was found that many of them contained no honey or nectar that could be discovered. The three lots in which the least contents were found, averaged 1.8, 1.7 and 1.5 mgs. and were determined from groups of 50, 25, and 25 respectively. These lots were all from normal colonies that had abundant stores. Nectar was plentiful in the field on the day the two lightest averages were obtained, and some carried small amounts of nectar, so the averages obtained may be considered normal. We can expect the figure, 1.5 mg. to be high enough, since some honey-sacs contained an appreciable amount of nectar or honey. Then the weight of the empty honey-sac must be something less than 1.5 mg. and for practical purposes, this figure is sufficient.

TABLE III—WEIGHTS OF BEES MINUS CONTENTS OF HONEY-STOMACHS

Average weight in mg.			Hour	Date	Number weighed	Colony number
Gross wt of bee	Honey-stomach contents	Net wt. of bee				
137.0	55.5	*81.5	....	6-28, 1907	5	....
126.2	41.1	85.1	2:30	8- 4, 1919	20	62
119.5	32.0	87.5	8:00	9-11, 1919	20	62
89.2	9.4	79.8	8:00	8- 4, 1919	25	62
83.3	5.7	77.6	2:30	8- 4, 1919	25	62
83.2	0.3	82.9	1:30	5- 7, 1920	50	39
89.4	5.7	83.7	1:30	5- 7, 1920	50	59
89.6	3.9	85.7	9:30	5-20, 1920	25	64
81.3	0.2	81.1	9:40	5-20, 1920	25	22
84.8	1.3	83.5	9:50	5-20, 1920	25	12
90.2	1.8	88.4	10:00	5-20, 1920	25	6
86.2	0.8	86.2	10:10	5-20, 1920	25	20
Average...................		83.6				

THE MINIMUM FLYING WEIGHT

Three averages of minimum flying weights have now been determined, each by a different method. These averages are as follows:

Low outgoing weights	82.2 mg.
Unloaded pollen-bearers	82.5 "
Bee minus content of honey-sac	83.6 "
Grand Average	82.8 mg.

As it is impossible for a bee to weigh less than a bee does weigh, and the weight as determined from low averages of outgoing bees is based upon a large number of weighings obtained under many different conditions and by different workers, it is to be expected that 82.2 mg. is, at least, high enough. The average obtained from unloaded pollen-bearers is slightly higher, but this can be accounted for by the fact that at least a part of these bees carried appreciable amounts of honey or nectar, and by the fact that all particles of pollen were not removed from the bees.

Provided the technique is sufficiently good, the most nearly accurate results might be expected from the third method, that of deducting the weight of the content of the honey-sac from the gross weight of the bee. The averages secured by this method, however, are higher than those secured by either of the other two methods. There is, undoubtedly, another factor involved. This factor seems to have been practically eliminated in the case of the other two methods. By choosing only the lower weights, in which this factor probably was not present, we would get an average of 82 mg. instead of 83.6 mg. This would reduce the grand average by .6 mg., giving a grand average of 82.2 mg.

The grand average of 266 unloaded pollen-bearers should fairly represent the minimum weight of a bee. Apparently, in selecting the pollen-carriers, the other factors that add to the weights in Tables I and III, have been eliminated. The fact that this average and the one obtained by selecting only the low weights of outgoing bees, approach each other so closely, indicates that a fairly stable minimum has been found. If 82 mg. is accepted as the better average for bees with their honey-sac content removed, we will have a remarkable agreement in the three figures from different methods, and the grand average of 82.2 mg. which they will give must even then be above rather than below the absolute minimum flying weight, but close enough to be serviceable for all practical purposes.

CONCLUSION

The minimum flying weight of the Italian bee is approximately 82 mg.

LITERATURE CITED

1. Wildman, Thomas, A Treatise on the Management of Bees, p. 77, London, 1768.
2. Cotton, William Charles, By Bee Book, p. 327, London, 1842.
3. Collin, L'Abbe, Le Guide due Proprietaire D'Abeilles, p. 82, Paris, 1865.

*Computed from Gillette's[7] table by subtracting the average weight of loaded honey-stomachs from the weight of incoming bees taken at the same time, and then adding 1.5 mg. as the average weight of an empty honey-stomach.

4. Langstroth, L. L. and Dadant, C. P.: The Honeybee, p. 250, Hamilton, Ill., 1922.

5. Koons, B. F., The Number of Bees in a Pound, Gleanings in Bee Culture, 21: 633-634, 1893.

6. Koons, B. F., The Weight of Bees, Loaded and Empty, Gleanings in Bee Culture, 23: 699-700, 1895.

7. Gillette, C. P., The Weight of Bees and the Loads They Carry, Proc. Soc. Prom. Agr. Sci 14: 60-63, 1897.

8. Lazenby, W. R., The Pollination of Fruit by Honeybees, Proc. Soc. Prom. Agr. Sci 16: 68-73, 1899.

9. MacDonald, D. M., The Weight of Bees, British Bee Journal, 40: 292, 1912.

10. Casteel, D. B., The Behavior of the Honeybees in Pollen Collecting, U. S. D. A. Bur. of Ent. Bul. 121, p. 29, 1912.

EDUCATION IN FOULBROOD CONTROL

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The eradication and control of bee diseases in Iowa is a serious problem to every beekeeper in the state. Apiary inspection records show that 95% of the counties have foulbrood in them and that approximately 18% of the colonies are diseased in these counties, also that about 15% of the colonies are housed in immovable frame hives. There are over 16,000 beekeepers owning approximately 190,000 colonies of bees. This does not represent all the bees or all the beekeepers. From the above information it can readily be seen that the problem of controlling disease in Iowa will have to be a state-wide campaign; one in which the beekeepers will have to co-operate and assist in locating beekeepers, cleaning up diseased colonies and preventing the spread of disease.

Our first problem in Iowa then is to secure co-operation. To secure co-operation, it is first necessary to show the type of small beekeeper (we will largely have to deal with) that our methods are sound and practical. Second, if we secure the co-operation of beekeepers, it is necessary to have a local organization to work through. To have an organization that will function and "stick," it is necessary to have a definite program outlined for the local organization. The program outlined should be one that will interest the beekeepers in their work and make better beekeepers of them Our second problem is to locate the beekeepers. This can easily be done when we have a good local organization with co-operators located in each township in the area to be cleaned up. The duties of the co-operator being to get the beekeepers out to the demonstrations, get names and location of all beekeepers in his township and to assist the inspector when he is in his territory.

The third problem is to get all beekeepers owning bees in immovable frame hives to transfer them into good modern hives. This can be done by having result demonstrations showing the method of transferring and the profit gained by keeping bees in good equipment. Also have co-operators and beekeepers in neighborhood who will assist beginners in transferring. The fourth problem is to keep area free of disease or to prevent the disease from spreading. This can be done by educating the beekeepers (by demonstrations) the symptoms of foulbrood, and emphasizing the danger of bringing the disease into the apiary through bees purchased on combs, or buying second-hand equipment. Also inform the beekeepers to notify state inspectors when bees are brought into their neighborhood on combs.

In sizing up the disease situation in Iowa, it can be realized that the only effective and logical means of actually cleaning up the foulbrood is to get the beekeepers to demand the clean-up. Each should be actually willing to do his duty in a campaign to eradicate the disease in his apiary as well as in his neighborhood. Therefore, before the foulbrood work should be started in a county 75% of the beekeepers should be required to sign a petition asking for the work, also agreeing to assist in its eradication.

The method advocated to pave the way to an effective foulbrood campaign is an educational program in the form of result demonstrations. The object of the demonstration being to correct the problems confronting the inspectors, namely lack of co-operation from beekeepers, locating beekeepers, box hives, poor beekeepers and lack of interest on part of the beekeepers. The most effective educational projects are the result demonstration or demonstration apiaries. The demonstration apiary is a project conducted by the extension bee specialist through the county farm bureau. Before the project is conducted in a county, a number of beekeepers request the work through the county farm bureau. A definite program is outlined and beekeepers who are anxious to succeed in bees are selected as co-operators. Five seasonal meetings are then conducted at each demonstration apiary. The first meeting held in January or February is to establish the demonstration and organize a county beekeepers association. The members of the county association select four beekeepers located in different townships in the county to act as co-operators. The requirement of the co-operator being that he will turn over to the extension specialist, 10 colonies of bees, five of which are to be handled according to specialist's instructions and the other five to be used as check colonies or colonies handled according to co-operator's own judgment. Second, that he will assist the specialist and will use his influence in interesting the neighbors in the project and getting them out to the meetings. Third, that the bees shall be hived in good equipment wintered according to specialist's desire, and be requeened with pure stock. Equipment used at demonstration apiary is secured from bee supply houses for a liberal discount. Free literature foundation and other material is given by the bee supply houses for demonstration, all of which is given to co-operators after their demonstration.

The second, third and fourth meetings are held at the demonstration apiary and seasonal subjects are demonstrated and discussed. At the end of the season the yield of honey from demonstration colonies are compared with those from the check colonies and the importance of good equipment, pure stock, swarm control, proper protection, and disease free colonies was shown to be the cause of increase in production.

Where the beekeepers are shown that it is possible to clean up disease, make good yields of honey and not get stung at every move, they are then ready to co-operate and help boost beekeeping in their county and state.

Educational programs are conducted at beekeepers' picnics. In counties where the farm bureau feels that there is not sufficient interest to warrant the demonstration apiaries, a beekeepers' picnic is held. The extension specialist attends this meeting and discusses the problem most needed to the beekeepers of that vicinity. In most cases it being foulbrood. Therefore, in the forenoon a talk is given on foulbrood and the problems of different beekeepers discussed. In the afternoon a practical demonstration of disease treatment and care is conducted by the specialist.

The third project is inspection tours. In this project the beekeepers meet at a certain place and visit each apiary to be inspected. As the colonies are being inspected, the specialist also gives the plans that should be used in cleaning up the disease in that particular case.

In all of the above projects, the expense of the specialist is paid partly by the Extension Service and part by the county farm bureau. The meetings are advertised by the county agent through the local papers, at township meetings, through his directors and by sending mimeographed letters to all beekeepers in his county.

Education as a means of foulbrood can be summed up as follows: First, it is necessary to secure an effective organization; second, it will open an easy way to locate the beekeepers; third, it is the best means of getting beekeepers to transfer bees from box hives; fourth, it is the only way to effectively prevent the spread and reappearance of disease in a neighborhood.