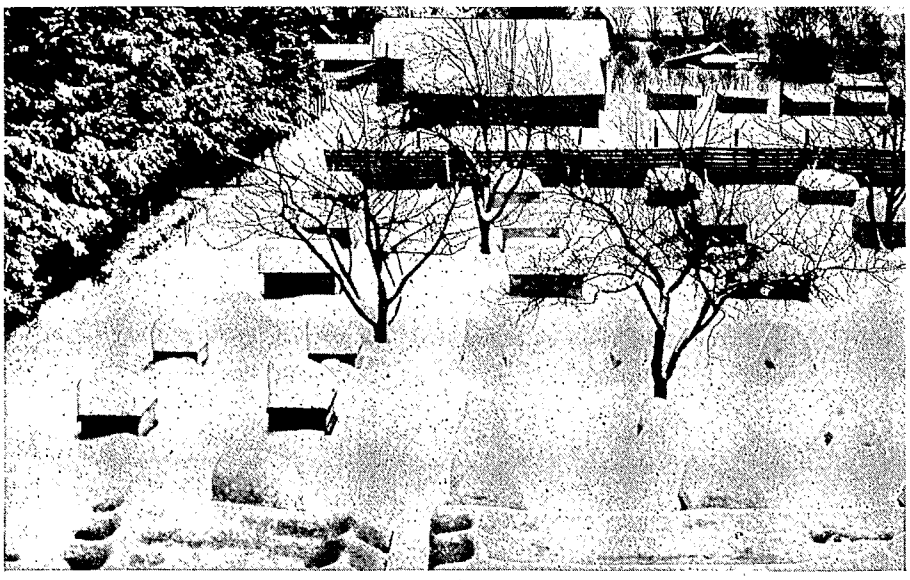
DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

# BEE DIVISION

## REPORT OF THE DOMINION APIARIST

C. B. GOODERHAM, B.S.A.

## FOR THE YEAR 1930



Outdoor wintered bees at Ottawa, January, 1931. The single colony cases in the front of the picture are well blanketed with snow. Most of these single cases are fitted with top entrances. See Fig. 4.

Published by authority of the Hon. Robert Weir, Minister of Agriculture,
Ottawa, 1931

# BEE DIVISION

## REPORT OF THE DOMINION APIARIST, C. B. GOODERHAM, B.S.A., FOR THE YEAR 1930

### GENERAL NOTES

Canada has again demonstrated her ability to produce honey, for in spite of unfavourable weather conditions which resulted in less than average production in some parts of the Dominion, one of the largest crops in her history was harvested during the year 1930. Of the nine provinces, Prince Edward Island, New Brunswick and Ontario were the only ones to report a crop lower than that of the previous year. Nova Scotia, Quebec, Manitoba, Saskatchewan, Alberta and British Columbia not only reported a crop larger than that of 1929 but one which was also the largest in the history of these provinces. The following table shows the estimated crops for all the provinces for the past six years.

THE ESTIMATED HONEY CROP FOR EACH PROVINCE FOR THE PAST SIX YEARS

| — | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 |
|---|---|---|---|---|---|---|
| Prince Edward Island | 2,500 | 2,500 | 4,000 | 9,500 | 14,050 | 10,000 |
| Nova Scotia | 27,500 | 27,500 | 50,000 | 52,000 | 55,000 | 63,731 |
| New Brunswick | 100,000 | 100,000 | 120,000 | 110,000 | 140,000 | 100,000 |
| Quebec | 4,190,364 | 3,833,593 | 4,348,223 | 4,024,856 | 5,000,000 | 5,500,000 |
| Ontario | 10,000,000 | 5,000,000 | 9,500,000 | 13,860,033 | 15,000,000 | 12,000,000 |
| Manitoba | 4,107,120 | 3,522,512 | 7,386,575 | 5,774,398 | 6,853,600 | 10,110,128 |
| Saskatchewan | 162,175 | 170,287 | 500,976 | 422,302 | 404,902 | 685,551 |
| Alberta | 115,000 | 215,000 | 300,000 | 336,000 | 521,790 | 1,578,900 |
| British Columbia | 638,319 | 898,257 | 986,719 | 985,709 | 989,393 | 1,121,325 |
| Total | 19,342,978 | 13,769,649 | 23,196,493 | 25,574,798 | 28,978,735 | 31,169,635 |

It will be noted in the above table that honey production has been steadily increasing in most of the provinces, but that the greatest proportional gains have been made in the western provinces.

Over the greater part of Canada the winter of 1929-1930 was not at all severe on bee life. In the eastern provinces the bees wintered fairly well. In some localities a few losses occurred because of colony weakness and starvation due to the lack of a fall honey flow the previous year and to the want of care in preparing the bees for the winter. Good wintering cannot be expected unless the colonies are of good strength and properly prepared to withstand the rigours of winter. In the prairie provinces bees wintered exceptionally well even though the winter appeared to be long and severe in some localities. Many beekeepers reported that they had never seen the bees winter so well before. In British Columbia although weather conditions were reported as being rather severe, few losses occurred.

The spring weather of 1931 was more variable in most regions and very trying on bees. In some parts of the eastern provinces the spring was exceptionally warm and dry while in others it was just the opposite—wet and cool. In the vicinity of Ottawa it was unwise to remove outdoor wintered bees from

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their cases until after fruit bloom was well advanced. In the prairie provinces the spring was for the most part dry and very windy while in British Columbia it was late, cool and showery. Under most of these conditions heavy spring feeding was necessary to avoid starvation and to build the colonies up for the heavy honey flow later in the season. In the Okanagan Valley of British Columbia heavy spring losses occurred which were attributed to poisoning through poisonous spray applied to fruit trees for the control of injurious insect pests. Unless something is done to prevent this danger one of the best honey producing areas of the province will have to be abandoned by the beekeepers during the spring and early summer months, and should this be done it is quite possible that the fruit growers themselves may suffer in reduced crops.

For the most part the summer was hot and dry, a condition usually thought to be very unsatisfactory for nectar secretion. In spite of the dry weather, however, an abundance of nectar was evidently available, for in most parts of Canada good average crops were obtained. Some localities did fall below normal production.

In Eastern Canada the fall of 1930 was quite satisfactory for the feeding and preparation of bees for the winter 1930-1931. In Western Canada, however, early cold weather interfered somewhat with this work.

Marketing conditions have remained fair and honey has been moving fairly steadily. Although the present prices of honey are somewhat lower than in previous years they still appear to be relatively higher than many other agricultural products. It is quite evident that lower prices are not going to be allowed to interfere with production for the prospects are that more package bees than ever will be imported this spring, especially in the Western Provinces. Lower prices on package bees are likely to act as an incentive to greater buying.

During the past year a visit was paid to all the Branch Farm apiaries throughout Canada and two weeks were spent in the Annapolis Valley, Nova Scotia, where some important pollinization work is being conducted. Addresses were given at the annual conventions of the Beekeepers' Associations of Quebec, Ontario, Manitoba and Saskatchewan, also at various other beekeepers' meetings. Assistance was also given at the apicultural short courses at Guelph, Winnipeg and Regina. During the year, 24,269 apiary reminders were sent out as well as other information pertaining to beekeeping.

The following pages of this report dealing with experimental work in connection with apiary management were prepared and written by Mr. A. H. W. Birch, B.S.A., who has charge of the experimental apiaries at Ottawa and by Mr. F. R. Armstrong, B.S.A., who is responsible for honey investigations and inspection.

## THE SEASON

One of the most important factors in the success or failure of the beekeeper is the weather. Therefore, since he can neither forecast nor control it, he should anticipate the worst condition and make preparations for it.

The following are the weather conditions at Ottawa for the beekeeper's year which commenced at the end of the main honey flow of 1929:—

The month of August though bright had a lesser amount of sunshine and lower temperatures than is usual for this time of year and what rainfall there was, was light. An unusual occurrence for August was a slight snow fall in the evening of the fourth. On most of the days there was little or no wind; what strong winds there were came toward the end of the month.

September was a wonderfully fine month with much sunshine, but despite its brightness and high temperatures during the day, the nights were quite cold. Little rain fell during this month, and though, as in August, most of the winds were light there were a few days in the middle of the month when it blew strong.

Since from the first of August, all colonies were headed by vigorous young queens, there was a large force of young bees in each to carry it safely through the winter. With this requisite for good wintering provided for, the colonies were next packed and fed their winter stores.

In the month of October the bright and dull days were about equal in number and but little rain fell. October 4 saw the first snow flurry with another on October 30. Cold weather in the first part of the month made feeding very difficult, especially was this so about October 9 when syrup had to be removed and warmed. The prevailing winds were westerly and mostly strong.

November, the month in which the bees should have their last good cleansing flight, was characterized by dullness. There were but few bright days in this month and the temperatures throughout were low; that is, too low for much bee flight. The last two days of the month were very cold, in fact, the coldest in many years, November 29 being 3 degrees below zero. The precipitation, most of which was rain, was heavy, though there were some snow falls. The prevailing winds ranged between west and southwest and were strong. At no time during this month did the bees have a really good cleansing flight.

The weather conditions of the month of December were in some respects unusual, particularly in regard to the amount of snowfall which according to Observatory records was the heaviest, with one exception, in 55 years. During the month, dull days predominated, snow fell on 13 days and rain on one. The temperatures for the most part ranged between freezing and zero, though on a few days it was below zero; the coldest day being December 12 when 14 below zero was registered.

The weather for the month of January was very changeable. There were spells of mild weather when temperatures were well above freezing, followed by others of sub-zero weather. The precipitation of both snow and rains, during the month, was heavy; this coupled with the mild spells made roads very bad. No predominating direction of the wind can be given as it seemed to blow equally from all quarters.

February brought odd though very pleasant weather. During the first half of the month, the temperatures were low but towards the end they were quite high. Between February 19 and 24 the maximum temperatures were well above freezing and on the first two days of this period the bees had splendid flights. The sunshine for the month was slightly above normal while the precipitation was the lowest in 40 years. The winds, too, were mostly light. The weather, therefore, during the past three months cannot be said to be all that could be desired for good outdoor wintering.

The month of March contained nothing of outstanding importance. The temperatures throughout were moderate; that is, they were normal but the number of hours of sunshine was below the average as was also the amount of precipitation. During the month, though there were a number of days on which some bees were flying there was not a really good flight until March 30.

April, a normal month, contained many days of bright sunshine on which the bees flew well despite the strong winds which were numerous. During this month the temperatures varied considerably and precipitation was light.

The month of May, another normal month, also contained many days of bright sunshine on which the bees flew well. But, as the weather was rather coolish, they were left undisturbed in their winter cases until toward the end of the month.

June brought warmer weather than is usual for that month. During the month both the temperatures and the rainfall were above normal as was also the number of hours of sunshine.

As a result of this good weather the colonies, which at the end of April were thought weak, were now found to be very strong.

July, the month in which the major part of the crop was harvested, was favourable to the gathering of nectar. Though at times the amount of humidity was excessive, the weather as a whole was good to the beekeeper, for from the first of the month to the twenty-eighth, when the flow ended, there was but one day on which the colonies on scales did not register gains.

Summarizing we find that the weather during the fall preparations for the winter was not of the best, for though August and September supplied an abundance of young bees, the backbone of good wintering, October hindered feeding operations and November provided no good cleansing flight. Neither

FIG. 1.—Apple trees in bloom but bees still in their cases because of wet cool weather.

were the winter months all that could be desired for good wintering, for though December supplied the best of protection—plenty of snow—the temperatures in January and February varied considerably which is disturbing to bees wintering outside. The spring months, however, were favourable to the building up of colonies, in that they contained many bright days with moderate temperatures on which the bees flew well.

The summer months were favourable to harvesting. With the close of the main flow which came toward the end of July, preparations were begun for next season's crop.

## THE YEAR'S ACTIVITIES IN THE APIARY

The activities in the apiary were, during the past year, much the same as those of previous years. While the crop from the main flow was still being harvested, the first preparation for next season's crop was begun, by the requeening of colonies. This consisted in giving to each colony that lacked a vigorous queen, a young mated one. Thus by feeding time, approximately two months later, all colonies contained a large number of young bees, so essential for good wintering.

During this period of building up of colonies, what uniting was necessary was done; that is, the bees of the mating-boxes which all through the summer had held a surplus supply of young mated queens, were united to the weaker colonies in the bee yard. The first requisite for good wintering, a goodly number of young bees being provided, the second and third requisites, ample stores and adequate protection, were next given attention. First of all, all colonies were weighed and the amount of extra stores required by each was figured. Then, the hives were placed in their winter cases and were given under and side packing, after which the colonies were fed, some sugar syrup, others natural stores. Following feeding which was finished by the middle of October, the top-packing was put in place and the windbreaks were set up.

The winter weather, as previously mentioned, was not all that could be desired for good wintering owing to the changeable temperatures which would suddenly drop below zero and as suddenly rise above freezing. A saving feature, however, was the mild weather on February 19 and 20 when the bees had splendid flights. Then, despite the fact that a few bees were flying on nearly all the days of March, it was not until the thirtieth of this month that they had another really good flight.

On April 12 the first pollen of the season was seen being brought in; this is three days later than that of last year.

The following table shows the dates of the first pollen being brought in during the past eight years:—

DATES OF THE BRINGING IN OF THE FIRST POLLEN

| 1923 | 1924 | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 |
|---|---|---|---|---|---|---|---|
| April 25 | April 26 | April 10 | May 1 | April 14 | April 30 | April 9 | April 12 |

The warm weather of April 12 and 13 on which the bees brought in pollen was followed by a cold spell of about 13 days, after which it gradually became warmer until on April 30 it was warm enough to make the first examination.

Owing to the nights being coolish the colonies were not removed from their winter cases until May 27, and thus as there were no colonies on scales, no losses or gains during the early flow can be given. Since this is the time when the eggs which are to provide the young fielders for the first of the flow should be laid, the least disturbance to the colonies the better. Also, to stimulate brood rearing at this time, the stores over and above what was required to carry the bees through the winter should be ample.

The approximate dates of the light honey flow were from May 14 to 30. Then followed a period of depression during which time the colonies on scales used more for brood rearing than they harvested. It will thus be seen that all colonies should be well provided with stores that there be no slacking of brood rearing.

On June 14, the main honey flow began, and on July 28, forty-five days later, it ended. From June 14 to July 17, the principle sources of nectar were White Dutch and alsike clovers, though between July 6 and 15 basswood contributed as well. Then on July 18, sweet clover began to yield and with White Dutch and alsike it continued on to the end of the flow.

Compared with that of last year, the main flow of this year was two days later in starting and two days shorter in duration, thus both finished on the same date, July 28.

The weather during the flow being favourable to gathering and the colonies strong, a large crop was harvested.

The highest average gain was made on July 17, when 8 pounds 10 ounces was harvested; this is 4 pounds 1 ounce less than the highest average gain in 1929, which was made on July 12.

The honey crop of the Ottawa apiary and that of the out-apiary at Britannia amounted this year to 14,936 pounds 8 ounces—nearly 7½ tons. This amount is greater than that produced last year by 1,161 pounds 8 ounces, from practically the same number of colonies. As last year, so this year quite a number of the colonies in the Ottawa yard were used in experiments that reduced their productivity; therefore, a fair average for the whole of this yard cannot be made.

There were, however, twenty-four colonies in the yard, all of which receiving the same treatment throughout the season, produced an average of 157 pounds 9 ounces.

It should here be noted that though the sources of nectar are plentiful, they are not all available in that at blooming time part of them are cut.

At the Britannia yard, eight colonies harvested a crop of 1,537 pounds 8 ounces, or an average of 192 pounds 3 ounces per colony. The average for this yard is below that of last year by 15 pounds 7 ounces.

Owing to various manipulations the number of the colonies in the Ottawa yard during the season was increased to about 118, but by feeding time this number had been reduced to 106, which is the same number as was present last fall. In the Britannia yard this winter there will be one more colony than last year. This makes the total for both yards 115 going into winter quarters.

## BEES AS POLLINATORS

During the past season further work was done to determine the value of honey-bees, other insects, and wind as cross-pollinators of black currants.

The varieties under experiment this season were the Beauty and the Kerry, the latter variety which was used last year being used again this year to secure further information regarding it.

On May 6, the first work in connection with this experiment began with the erection of the framework of the tents. No cotton covering, however, was put on until just before blooming time, May 9, to allow the bushes the benefit of the direct sunlight as long as possible.

Tagging of the clusters was done on May 13, at which time it was noticed that some of the bushes were in extremely poor condition. And though under the conditions the prospect of getting much from this season's experiment was small, the work was continued through the blooming period, which began on May 14 and ended May 28. During this time notes were taken daily of the progress of the bloom and of such other things that might have a bearing on the results.

Then on June 5, count was made of the set.

In the following table will be seen the percentage of set for the past four years:—

| Group | 1927 | 1928 | 1929 | 1930 |
|---|---|---|---|---|
| Check bushes outside the tents | 59·1 | 80·5 | 73·6 | 75·5 |
| Wire gauze tents, permitting the entrance of insects smaller than honey-bees | 37·6 | 32·7 | 28·0 | 12·4* |
| Bee tent containing bees but excluding other insects | 35·6 | 30·7 | 59·9 | 12·6* |
| Impervious tent permitting air circulation but excluding insects | 32·2 | 20·3 | 18·9 | 4·3* |

Before considering the above table, one should note that but half of the bushes in this season's experiment had enough clusters on them to permit of sixty clusters on each being tagged; the other half with one exception had barely two dozen each, the exception having but six. Thus it will be seen that the experiment was thrown badly out of balance, and since the results marked with an asterisk (*) are the results of the unbalanced groups, they cannot be taken into account.

Comparing the average set of the check bushes of this season with those of the past two seasons, we find that it checks them very closely.

FIG. 2.—Three swarms in one. Ottawa, June 30, 1931.

Further, it is seen that though the bushes in the impervious tent were excluded from the visits of all insects, they produced a low average set. From this it may be said that black currants are self--fertile to an extent.

Again, as the highest sets were produced by the check bushes to which all pollinating agencies had free access and the lowest by the bushes in the impervious tent from which all insects were excluded, it is seen that the best results are obtained by the presence of insects, of which the most dependable kind for such work are the honey-bees.

## QUEEN BREEDING

One of the most useful things that a beekeeper can have in the apiary during the active season is a supply of young mated queens on which he can draw to replace what queens are missing, have failed or are likely to fail. To have such a supply constantly on hand some beekeepers prefer to purchase their queens from a commercial queen-breeder, while others would rather rear what they require themselves.

Since we at Ottawa prefer to rear our own, our practice has been for a number of years past to begin queen-rearing about the middle of June in order to have young mated queens for the first week in July. Prior to this time what queens are required are drawn from the double colonies of "The Two Queen System" which will be described later.

This year the first batch of cells was grafted on June 17 and the last batch on July 22. During this period grafting was done, as far as possible, at weekly intervals; though when grafting day found all mating-boxes full, and a batch of cells ripe or ready to hatch, it was deferred a week to prevent having too many cells on hand.

The method of starting cells used this year was the same as that of last, the "Queenless Broodless" colony method which as its name implies consists in making a colony queenless and broodless.

The first step in rearing queens by this method is, if nothing is coming in, to feed the colony to be used to start the cells for three days before grafting takes place.

Then on grafting day, about 10 o'clock in the morning, the queen is found and set aside while practically all the bees are shaken from the combs into a new hive which has previously been equipped with 2 combs of honey and pollen, and 8 drawn combs and placed on the old stand. The hive is then closed and left undisturbed until about 4 o'clock in the afternoon when grafting is done. The queen and brood are next placed back into the old hive which is located nearby.

That the young larvae which are to become our young queens may be well nourished, the breeding colony also, if no nectar is coming in, should be fed several days prior to grafting time.

The grafting methods used were the same as employed for the past few years, namely, priming a wax lined cell cup with a drop of royal jelly diluted with an equal amount of water and then transferring a two-day-old larvae into it. For best results, the placing of the empty wax lined cell cups into the hive when preparing it in the morning is recommended, since it gives the bees time to work them over.

Grafting finished, the cells are first placed into the Queenless Broodless colony to be started; this takes 18 to 20 hours. They are next transferred to the finishing colony where they are completed nine days later, or in ten days' time from grafting.

The last-mentioned colony, the finishing colony, is prepared a few days before it is required for use by raising capped brood to a top super; then just before transferring the cells from the starting colony to it, what cells are started there should be killed.

Queens during the season were mated from double and single mating boxes and from top supers of which there were 14, 6 and 9 respectively; that is, there was accommodation for 43 queens. Though a special board was used to separate the top super from the rest of the hive by the last method, good results may be obtained by using a quilt or honey board in place of this board and raising the cover of the hive slightly so that the queen may fly forth from above.

During the season, there were 170 cells grafted and 142 or 83 per cent finished; of these, 88 went into mating-boxes, 11 into top supers, 1 to a queenless

colony and 42 into nursery cages. The percentage of queens mated was this year greater than that of last, there being in all 71 per cent. Of the above queens reared practically all were used in the Ottawa and Britannia yards. Owing to shortness of help this work had to be discontinued before the end of the season.

## TWO QUEEN SYSTEM

After bringing his bees through the winter without the loss of a single colony, it is most discouraging to the beekeeper to find, at the first examination in the spring, that several colonies are queenless.

This means that these colonies which might be producers must be united to other colonies, since it is practically impossible to procure queens so early in the season; unless, however, the beekeeper has had the foresight to prepare for such an emergency by wintering over some spare queens. Such a supply of spare queens should be large enough to replace not only what losses are found at the first examination but also those which are likely to occur between that time and the first week in July when there should be newly mated queens on hand.

The system used at Ottawa to meet these requirements is the "Two Queen System". What equipment is needed for this work can be very easily made, since it consists in merely dividing a hive down the middle by a thin wooden division board, care of course being taken to see that it is bee tight.

The hive being made, the stocking of it is also easily done. At requeening time all that is necessary is to set the old queen removed from the colony being requeened aside with a couple of frames of brood and later to place her into one of the compartments of the divided hive.

Another method, done just before feeding time, is to place a weak colony of less than five frames into one of the above-mentioned compartments instead of uniting it to a normal colony as is usually done.

In the latter part of July, when requeening the colonies in the Ottawa yard, 16 spare queens removed from normal colonies being requeened were placed in 8 such double hives. Then, as they were to winter outside, they were packed and fed as other colonies were. At the first examination on April 30, though two of the queens were found dead, there were still fourteen to replace winter and late spring losses.

## CAUCASIAN VS. ITALIAN BEES

To determine how Caucasian bees compare with Italians as regards honey-gathering, hardiness and swarming, work was started at the Britannia yard on July 31, 1929, by the introduction of Caucasian queens to a number of colonies. All were accepted, and at the last thorough examination on August 9 were well established. The Italian colonies used were already located there.

As the colonies of both the groups under test were housed in double walled hives, they were not disturbed to any extent by the preparations made for the winter. On September 25, each colony received its winter stores which consisted of a deep super of honey weighing approximately 50 pounds; then, on October 18, the final or top packing was put into place and the bees allowed to remain undisturbed until the spring. As a further protection from the cold winds, a wind-break similar to that used by the railway companies was set up on the north and west sides of the yard.

Both groups came through the winter without any loss, and at the first examination, on May 1, it was found that the average strength of the Caucasian colonies was slightly greater than that of the Italians in both bees and brood, the former having an average of 8½ frames of bees and 6½ frames of brood to the latter's 7¼ of bees and 6 of brood.

During the month of May, the colonies were allowed to build up undisturbed; but throughout June and July, they were examined at as nearly 9-day intervals as possible to determine how they were progressing and to give what room was necessary for storage.

As it was found that one colony in each of the groups was weaker than the others, it was strengthened by giving it brood from others of its own group.

How the colonies in each of the groups built up between June 4 and July 26 is shown in the following table.

TABLE SHOWING THE NUMBER OF FRAMES OF BEES AND BROOD DURING THE ACTIVE SEASON

| — | Italian Group | | | | | | | | Caucasian Group | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | |
| | Bees | Brood | Bees | Brood | Bees | Brood | Bees | Brood | Bees | Brood | Bees | Brood | Bees | Brood | Bees | Brood |
| June 4 | 17 | 16 | 17 | 16 | 16 | 14 | 9 | 7 | 10 | 9 | 14 | 13 | 12 | 10 | 16 | 14 |
| " 13 | 17 | 16 | 16 | 16 | 16 | 14 | 11 | 10 | 10 | 8 | 16 | 16 | 13 | 13 | 16 | 15 |
| " 21 | 20 | 16 | 17 | 16 | 17 | 15 | 14 | 11 | 14 | 11 | 16 | 15 | 14 | 13 | 18 | 14 |
| July 2 | 23 | 13 | 22 | 16 | 21 | 14 | 19½ | 14 | 19 | 10 | 22 | 15 | 22 | 13 | 24 | 18 |
| " 9 | 30 | 9 | 23⅓ | 9 | 26½ | 11 | 22 | 10 | 22 | 9 | 25 | 15 | 24½ | 16 | 30 | 13 |
| " 18 | 37 | 3 | 30⅓ | 6 | 32 | 9 | 24⅓ | 11½ | 24½ | 7 | 22 | 3 | 24½ | 5 | 29 | 9 |
| " 26 | 38 | 8 | 32 | 8 | 36 | 9 | 27 | 8 | 27 | 8 | 24 | 5 | 24½ | x | 33 | 4 |

Averaging the above, we have for comparison the following:—

| — | Bees | | Brood | |
|---|---|---|---|---|
| | Italian | Caucasian | Italian | Caucasian |
| | frames | frames | frames | frames |
| June 4 | 14¾ | 13 | 13¼ | 11½ |
| " 13 | 15 | 13¾ | 14 | 12¾ |
| " 21 | 17 | 15½ | 14½ | 13½ |
| July 2 | 21½ | 21¾ | 14¼ | 13 |
| " 9 | 25½ | 25¼ | 9¾ | 14½ |
| " 18 | 31 | 25 | 7¾ | 4½ |
| " 20 | 33¼ | 27¼ | 8¼ | 5½ |

From the above it will be seen that between the first examination on May 1 and June 4, the Italian group secured the lead in the number of frames covered by both bees and brood and held it throughout the season with two exceptions; the first of which occurred on July 2 when the Caucasians had a fraction of a comb of bees more and on July 9 when they surpassed the Italians by 4¾ combs of brood.

The flow which began on June 14, ended on July 28, 44 days later, and during that time the crops produced were:—

| Italian group | | | Caucasian group | | |
|---|---|---|---|---|---|
| Colony number | Crop | | Colony number | Crop | |
| | lb. | oz. | | lb. | oz. |
| 1 | 278 | 0 | 5 | 155 | 8 |
| 2 | 173 | 0 | 6 | 194 | 8 |
| 3 | 274 | 0 | 7 | 122 | 0 |
| 4 | 200 | 0 | 8 | 140 | 8 |
| Total | 925 | 0 | | 612 | 8 |
| Average | 231 | 4 | | 153 | 2 |

Though the Italian group by producing the larger crop would seem to be the better, it must be remembered that this is but the result of the first year of a five-year test and that, therefore, judgment must be reserved.

In so far as swarming is concerned, there were no preparations of any account made by the colonies of either group.

## WEAK COLONIES STRENGTHENED BY PACKAGE BEES

Further work was done during the past summer to determine whether it pays to assist weak colonies by the addition of package bees. As this experiment has been run for a number of years, the following procedure must necessarily be much the same as that employed in previous years.

In preparation for this work the nuclei to be used the following spring as weak colonies, were made up at the latter part of July. These nuclei, of which there was a greater number made than actually would be required, each consisted of a queen with two frames of brood. They were housed in double hives, that is, in hives which were divided down the middle by division boards and held 2 nuclei, one in each compartment. By fall they had built up fairly well and at the last examination on September 27 averaged 3·8 frames each. As the winter was not of the best for carrying bees over, it was found in the spring when they were examined on April 26 that they were reduced to an average of 2·5 frames.

On April 28 the packages, which had been ordered early in the year from a reliable southern dealer, arrived and all of them, of which there were 9 two-pound packages and 3 three-pound, were found to be in very good condition.

To secure further information regarding the shipping of dry queens, that is, of queens which had no food or attendant bees with them in their cages but which relied on the bees of the packages to feed them, all queens were ordered to be sent dry. Of the twelve received alive in seemingly good condition 9 carried on to nearly the end of the main flow and 7 were still present at the last examination on August 28—the three lost being through introduction.

Immediately upon their arrival the packages were released from the Customs, brought to the apiary and placed in the cellar where the bees were fed a thin syrup which was painted upon the wire screening of the cages. There they remained until the following day, April 29, to quiet down, after which 5 of the two-pound packages were united to weak colonies. As a check on these colonies there were 5 other weak ones which received no assistance.

The procedure in uniting a package to a weak colony was, first, to transfer the combs covered by the weak colony to one side of a ten-frame hive, leaving sufficient room for the shipping cage alongside. The feeder and queen cage were next removed from the shipping cage, and if the imported queen was to be used, the cork of the queen cage was removed and candy substituted, after which it was placed between two combs and the queen left for the bees to liberate. This done, the shipping cage was then inverted and placed alongside the combs in the hive, care being taken to raise it slightly that the bees might pass out and unite with those of the weak colony on the combs.

Both the weak assisted colonies and those used as checks which were not assisted, were in packed or protected hives where they remained until May 27. Furthermore, since the bees were now at some distance from their former location there was no chance of either group being favoured by drifting or returning.

As but five of the nine two-pound packages received were used for the weak colony experiment, the remaining 4 were run in competition with the 3 three-pound ones to determine what advantage, if any, the latter had over the former.

The method employed having been outlined, the results which are set forth in the following table are next to be considered.

RESULTS OF THE DIFFERENT GROUPS

| Assisted | | | | | | | Unassisted | | | | | | | Straight two pound packages | | | | | Straight three pound packages | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of colony | Number of combs covered by bees on April 26 | Weight of bees added | Number of combs covered by bees on June 13 | Number of combs covered by brood on June 13 | Crop | | Number of colony | Number of combs covered by bees on April 26 | Weight of bees added | Number of combs covered by bees on June 13 | Number of combs covered by brood on June 13 | Crop | | Number of colony | Number of combs covered by bees on June 13 | Number of combs covered by brood on June 13 | Crop | | Number of colony | Number of combs covered by bees on June 13 | Number of combs covered by brood on June 13 | Crop | |
| | | lb. | | | lb. | oz. | | | lb. | | | lb. | oz. | | | | lb. | oz. | | | | lb. | oz. |
| 231 | 3 | 2 | 15 | 11 | 102 | 8 | 202 | 2 | 0 | 3 | 3 | 38 | 0 | 300 | 6 | 6 | 89 | 0 | 308 | 8 | 8 | 112 | 0 |
| 248 | 3 | 2 | 8 | 8 | 145 | 0 | 220 | 3 | 0 | 3 | 3 | 32 | 0 | 304 | 6 | 6 | 76 | 8 | 313 | 6 | 6 | 125 | 0 |
| 294 | 1 | 2 | 14 | 5 | 128 | 0 | 224 | 1 | 0 | 2 | 2 | ..... | | 307 | 6 | 6 | 101 | 8 | 316 | 7 | 6 | 82 | 8 |
| 301 | 4 | 2 | 14 | 11 | 162 | 0 | 236 | 4 | 0 | 5 | 5 | 94 | 0 | 326 | 6 | 6 | 75 | 8 | .... | .... | .... | ..... | |
| 302 | 2 | 2 | 12 | 9 | 222 | 0 | 277 | 3 | 0 | 7 | 6 | 108 | 8 | .... | .... | .... | ..... | | .... | .... | .... | ..... | |
| Total Group. | 13 | 10 | 63 | 44 | 759 | 8 | .... | 13 | 0 | 20 | 19 | 272 | 8 | .... | 24 | 24 | 342 | 8 | .... | 21 | 20 | 319 | 8 |
| Average of Group. | 2·6 | 2·0 | 12·6 | 8·8 | 151 | 14 | .... | 2·6 | 0 | 4·0 | 3·8 | 54 | 8 | .... | 6·0 | 6·0 | 85 | 10 | .... | 7·0 | 6·6 | 106 | 8 |

The first thing to be noticed in the above table is that though the weak colonies selected for this experiment were not all of the same strength, it being impossible to secure such, the strength of the individuals in the assisted group matched those of the unassisted group exactly and, therefore, the total number of combs covered by both groups was the same—13,

Then on April 29, owing to the addition of the two-pound packages, the average colony strength of the assisted group was increased by 77 per cent.

From this date on the colonies of both groups gradually built up until on June 13, one day before the main flow began, as seen in the table, the assisted group had increased in strength proportionally more than had the unassisted; the ratio of the assisted to the unassisted group which on April 26 was 4·6 to 2·6 was on June 13, 12·6 to 4·0.

Further, it will be seen that the unassisted group was the only one in the table which did not build up well. This failure to build up may, to an extent, be attributed to the fact that the location of the weak colonies of both groups were changed on April 29; but while the losses occasioned by returning bees of the assisted group were partially compensated by the addition of the two-pound packages, those of the unassisted group made the weak colonies still weaker. Had these colonies been a bit stronger they might have stood their loss and still have had sufficient strength to support their queens better and thus to have improved their showing, though at no time could one expect such weak colonies to provide the backing necessary to cause a good queen to do anything like her best.

The crops harvested by the two groups, it will be seen, were exactly proportional to their strength at the beginning of the flow; that is, the assisted group that was approximately three times as strong as the unassisted produced about three times the crop that it did.

Having seen that the assisted group outstripped the unassisted one, we have but to find the value of the average crop of each to determine whether the addition of the packages paid. The average crop of 151 pounds 14 ounces of the assisted group if sold at 15 cents per pound would bring $22.78 while that of the unassisted, 54 pounds 8 ounces, $8.18. The difference $14.60 when the cost of the package and the expressage is deducted leaves a profit of

approximately $10.60. In considering the above results, one must bear in mind that the crop harvested this year was one of the best ever harvested in this district, also that though the unassisted group did very badly this year, it in other years surpassed the crops of straight packages.

Turning next to the comparison of the two and three pound packages, we find that the latter produced a 20 pound 14 ounce greater crop than did the former, and that this excess figured at 15 cents per pound yielded $3.13 from which when $1 the extra cost of the larger package, was deducted, a profit of $2.13 was left. Further work on this experiment will be done next year.

## COMPARISON OF DIFFERENT SIZED HIVES

Since some beekeepers claim that there are no hives like the large hives, while others are equally emphatic in their commendation of the smaller ones, the standard hives, comparisons of normal colonies in different sized hives within these limits have been made at Ottawa during the past six years to determine, if possible, what effect the size of the hive has on the building up of the colony in the spring, on its swarming tendencies, on its crop and on its wintering.

The kinds of hives used in this experiment, of which there were but three, were the 11 frame Modified Dadant, the 10 frame Jumbo and the 10 frame Langstroth, eight of each.

All colonies were run on a commercial basis; that is, they received no manipulations other than those required at the nine day examinations at which time the colony condition was noted and what room was necessary for storage purposes was given.

As in other years, this experiment began toward the close of the main flow of the preceding year with the requeening of half of each group with the current season's queens. Thus there were in each group four colonies headed by 1928 queens, and another four by those of 1929. Between the main flow and feeding time, as there is no fall flow in this district, each colony in the yard retained a super of honey that there should be no chance of starvation or curtailment in brood rearing.

Fall preparations were next begun with the reduction of the hives of all groups to one story after which on September 27 they were weighed; then on September 30 they were placed into their winter cases with under and side packing. On October 4 feeding began with the giving of sugar syrup, of which each colony received at least 20 pounds; while to those which were low in stores extra syrup was given.

Following the top packing which was put in place on October 28 and the setting up of the temporary windbreaks which protected the yard on all sides, but the east on which there was a natural windbreak, the bees were left undisturbed until the spring.

On April 25, when the bees were still inactive, the colonies of the Dadant Group were moved to a location thought to be more favoured.

At the first examination on April 30, five days later, though it was found that all colonies came through the winter alive, it was seen that some of them were far from strong, noticeably in the Langstroth group.

This will be seen in the following table which shows the strength of the different groups at the first examination on the above date.

RESULTS FROM THE DIFFERENT HIVES

| Dadant | | | Jumbo | | | Langstroth | | | |
|---|---|---|---|---|---|---|---|---|---|
| Colony number | Frames of bees | Frames of brood | Colony number | Frames of bees | Frames of brood | Colony number | Frames of bees | Frames of brood | Condition |
| 2 | 6 | 5 | 101 | 4 | 3 | 233 | 2 | 0 | Queenless |
| 3 | 6 | 4 | 105 | 4 | 3 | 243 | 4 | 3 | |
| 4 | 5 | 4 | 108 | 5 | 4 | 244 | 6 | 4 | |
| 5 | 4 | 4 | 109 | 5 | 4 | 250 | 6 | 5 | |
| 7 | 5 | 3 | 114 | 4 | 3 | 253 | 3 | 3 | Failing queen |
| 8 | 6 | 5 | 116 | 5 | 4 | 260 | 6 | 5 | |
| 9 | 4 | 4 | 120 | 6 | 5 | 282 | 3 | 3 | Failing queen |
| 11 | 5 | 3 | 121 | 5 | 4 | 298 | 7 | 6 | |
| | 41 | 32 | | 38 | 30 | | 37 | 29 | |

FIG. 3.—Hives fitted with glass panels to allow sunlight to penetrate the brood chamber.

Attention is drawn to the fact, which is shown in the following table of 6 years work, that the group covering the greatest number of combs at the first examination in the spring, with one exception produced the greatest crop, and also that the lowest produced the lowest. It will be seen, therefore, that good wintering pays.

Turning back to the fall examination which was made on September 27, 1929, we find that the Dadant, Jumbo and Langstroth groups covered on an average 9·7, 8·8 and 9·0 combs per colony respectively. Though by an examination of the individual strength of the colonies in the above table it will be seen that some colonies needed assistance badly, the only help that was given was at the expense of others of the same group.

During the building up period, when it was found that the brood chamber of a Langstroth hive was becoming crowded, the queen was given a second chamber above; but in the case of the larger hives, the Dadant and the Jumbo, which are supposed to be large enough for the most prolific of queens, no extra space was given.

From the notes taken at the periodic examinations during the season the average strength in bees and brood of the different groups has been found and is set forth in the following table.

COMPARISON OF THE STRENGTH OF GROUPS

| | Average number of frames covered by bees | | | Average number of frames of brood | | |
|---|---|---|---|---|---|---|
| | Langstroth | Jumbo | Dadant | Langstroth | Jumbo | Dadant |
| June 2 | 8·5 | 8·5 | 9·2 | 7·6 | 7·7 | 8·3 |
| June 12 | 10·4 | 9·7 | 10·2 | 8·0 | 7·5 | 8·8 |
| June 23 | 12·5 | 10·5 | 11·2 | 10·2 | 7·6 | 8·6 |
| July 3 | 16·5 | 16·1 | 14·3 | 11·6 | 8·0 | 8·7 |
| July 12 | 23·0 | 21·5 | 17·8 | 10·5 | 8·1 | 8·7 |

Though the above table shows the Langstroth group to be leading in the number of frames of both bees and brood from June 23 on, it would seem that the larger frames in this case were more heavily covered by bees and contained larger patches of brood, since the colonies of the Dadant and Jumbo groups produced the larger crops.

During the season, the colonies in no one type of hive showed any less inclination to swarm than did those in the other types, as in each group there was one colony that cast a swarm.

Coming now to the ultimate test, the crop, we find that the Dadant group this year produced the largest crop with the Jumbo group second. The amounts harvested were: by the Dadant group 1,357 pounds 4 ounces, by the Jumbo 1,291 pounds and by the Langstroth 1,134 pounds 8 ounces or averages of 169 pounds 8 ounces, 161 pounds 6 ounces, and 141 pounds 13 ounces respectively.

In the following table the results of the past 6 years' work are set forth for comparison.

COMPARISON OF HIVES

1925

| Group | Number of colonies | How wintered | Combs covered at first examination | Number of colonies swarmed | Average crop per colony | | Combs covered at last examination |
|---|---|---|---|---|---|---|---|
| | | | | | lb. | oz. | |
| Langstroth | 8 | Outside | 8·0 | 0 | 138 | 0* | 9·0 |
| Jumbo | 8 | " | 6·9 | 0 | 130 | 4 | 9·2 |
| Dadant | 8 | " | 6·6 | 1 | 106 | 11 | 9·7 |
| **1926** | | | | | | | |
| Langstroth | 8 | Outside | 7·2 | 0 | 49 | 3* | 9·4 |
| Jumbo | 8 | " | 5·4 | 0 | 39 | 4 | 9·2 |
| Dadant | 8 | " | 6·2 | 0 | 42 | 8 | 9·9 |
| **1927** | | | | | | | |
| Langstroth | 8 | Outside | 6·8 | 0 | 99 | 5 | 8·6 |
| Jumbo | 8 | " | 6·5 | 0 | 127 | 6* | 8·2 |
| Dadant | 8 | " | 6·0 | 1 | 71 | 15 | 8·5 |
| **1928** | | | | | | | |
| Langstroth | 8 | Outside | 7·7 | 0 | 60 | 9* | 8·6 |
| Jumbo | 8 | " | 7·7 | 0 | 54 | 14 | 8·5 |
| Dadant | 8 | " | 7·0 | 0 | 35 | 12 | 9·2 |
| **1929** | | | | | | | |
| Langstroth | 8 | Outside | 6·8 | 0 | 116 | 3 | 9·0 |
| Jumbo | 8 | " | 6·8 | 1 | 145 | 4* | 8·8 |
| Dadant | 8 | " | 5·5 | 0 | 99 | 12 | 9·7 |
| **1930** | | | | | | | |
| Langstroth | 8 | Outside | 4·6 | 1 | 141 | 13 | 9·1 |
| Jumbo | 8 | " | 4·7 | 1 | 161 | 6 | 8·7 |
| Dadant | 8 | " | 5·1 | 1 | 169 | 8* | 10·0 |

*Highest crop.

## STRENGTH OF COLONY

To secure further information regarding the strength of the field force of a colony work was continued during the past season. Also work was started to determine the hive force and total force of a colony.

The procedure employed this year to determine the field force was similar to that of other years; namely, on the day preceding the test, the colony selected was prepared by placing the queen with two frames of brood and eight empty combs into a super which was put on the top of the hive but which was separated from it by a queen excluder and a bee-escape. The whole was then placed on a platform scale.

Before the bees were flying next morning, the hive was drawn backward several feet and turned so that it faced at right angles to the direction it formerly did. The super containing the queen was next removed and placed on the old stand and sufficient supers were added to give it the appearance of the old hive.

This operation was done carefully without disturbance to the bees that they, not realizing the change, might fly directly to the field and return to the old location. During the day it was hoped that all the field force would leave and return to the old location.

The first thing next morning the hive was again weighed to determine what it had lost in weight by the exodus of the fielders.

The first test was made on June 26, at which time White Dutch and Alsike clover were the sources of nectar. The loss in weight at this test was 4 pounds 2 ounces which if 5,000 bees were allowed to the pound as commonly supposed would mean there were 20,625 fielders present. As no other tests in past years have been made so early there is nothing to check this figure by. The second and third tests were made on July 10 and 22 at which times 5 pounds 7 ounces, and 5 pounds 6 ounces were the losses in weight. Figuring as before we have field forces of 27,187 and 26,875 bees respectively. It will be seen by referring to the following table that these figures are below those of the like dates of last year. This may be explained by the colony, once quite strong, falling below normal, evidence of which is seen in the fact that it produced but 93 pounds of honey or about 60 pounds below the average crop for yard.

On June 28 and July 12, the days following the first two of the above weighings, weights were taken of these colonies as a whole, then immediately after all the bees were shaken from the combs and the weights of the hives were taken. At these weighings it was found that the loss in weight due to the bees shaken was 11 pounds 2 ounces and 11 pounds 4 ounces which figuring as above equal 55,625 and 56,250 bees respectively. From these total forces the field forces were next deducted leaving 35,000 and 29,063 for the hives forces respectively. Combining the above results we have:—

| | | | |
|---|---|---|---|
| June 26–28 | Total force = 55,625 | July 10–12 | Total force = 56,250 |
| | Field force = 20,625 | | Field force = 27,187 |
| | Hive force = 35,000 | | Hive force = 29,063 |

The figures as computed for the past six years are shown in the following table for comparison.

STRENGTH OF FIELD FORCE

| 1925 | | 1926 | | 1927 | | 1928 | | 1929 | | 1930 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date | Bees | Date | Bees | Date | Bees | Date | Bees | Date | Bees | Date | Bees |
| July 9..... | 31,250 | July 20..... | 33,125 | July 15... | 22,187 | Julyo10... | 33,437 | July 10... | 29,062 | June 26... | 20,625 |
| " 27..... | 31,250 | " 27..... | 35,312 | " 26... | 34,062 | " 19... | 34,062 | " 17... | 36,562 | July 12... | 27,187 |
| ..... | ..... | ..... | ..... | Aug. 6... | 39,062 | " 25... | 39,687 | " 23... | 35,937 | " 22... | 26,875 |

## TOP ENTRANCE HIVES

"Top Entrance" hives were again tested during the past season to determine whether they have any advantage over those with bottom entrances.

On June 6, this test began with the giving of the "Top Entrance" boards. Four colonies, the same number as used last year, were again used this year.

The procedure was to examine the colonies every nine days and besides making the usual notes to take special note of where the brood was located. When making these examinations, in order to prevent returning field bees from being confused, it was necessary to provide some sort of support to set the brood

chamber on at its original height while the rest of the hive was being examined. As in other years, brood was found scattered throughout the hive, thus giving extra work sorting the combs when the crop was removed.

In the following table the crops of the past four years for both top and bottom entrance hives are shown:—

AVERAGE CROP OF BOTH TOP AND BOTTOM ENTRANCE HIVES

| Hives | 1927 | | 1928 | | 1929 | | 1930 | |
|---|---|---|---|---|---|---|---|---|
| | lb. | oz. | lb. | oz. | lb. | oz. | lb. | oz. |
| Top entrances | 88 | 12 | 25 | 0 | 80 | 10 | 113 | 0 |
| Bottom entrances | 99 | 11 | 50 | 6 | 120 | 0 | 157 | 9 |

FIG. 4.—Single colony wintering cases fitted with top entrances.

Summarizing, we do not find from our work with the "Top Entrance" hives that they have any advantage over those with lower entrances. On the other hand, however, we did find, when it was necessary to examine them, that they were most unhandy to handle, as they required a special support for the brood chamber; that the brood was often scattered throughout the hive necessitating extra work at extracting time to sort the combs; that when the entrances were lowered at this time due to the removal of supers of honey, robbers located them quicker than did the bees of the colony; that in the East the wax moth may become established in the empty extracting supers; and that at no time in our four years' test did the average crop of the "Top Entrance" hives come up to that of the rest of the yard.

The above table shows that so far the "Top Entrance" hives have produced less than those have with the "Bottom Entrances."

## MIDDLE ENTRANCE HIVES

On June 6, another season's work was begun to determine whether there is any advantage in having the entrance of the hive located just above the brood chamber instead of at the bottom or top of the hive. Four different kinds of middle entrances were used of which there were two of each kind under test. In all four methods, the brood chamber was separated from the supers by a queen excluder. The entrances, however, varied. When a one story brood chamber was used all the entrances were located immediately below the excluder but when the second story was added, three changed position to above this second story while the fourth, a permanent entrance was now between the two stories.

During the season these colonies were subjected to the usual nine day examinations at which time notes were made of their condition.

While swarming occurred in two colonies of two different groups, the remaining six colonies acted normally and altogether they produced 983 pounds 8 ounces which is an average of 122 pounds 15 ounces per colony. This is 34 pounds 10 ounces below the average for colonies with a lower entrance.

## WINTER CASES WITH UPPER ENTRANCES

During the winter of 1929-30, twelve colonies were wintered in quadruple cases with top entrances.

These colonies were prepared for winter in a like manner to others in the yard; that is, on September 27 they were weighed and three days later on September 30 they were placed in their winter quarters with top entrance boards and under and side packing in place; after which on October 4 they were fed and on October 28 received their final packing.

As in other years, they seemed to be wintering very well in that there were fewer dead bees about their entrances than about colonies with lower entrances. At this point it might also be noted that the same applies to single colonies that were wintered with top entrances. On looking over the yard on April 12, however, it was found that two of the twelve colonies were dead. The cause of death in one case was due to starvation, while that of the other may be attributed to trouble before the winter began since drone brood was present.

At the first examination in the spring the average strength of these colonies was equal to that of those with lower entrances.

This project is being continued during the winter of 1930-1931.

## BROOD COUNT

To secure further information regarding the daily emergence of young bees, counts were made each day, over periods of 14 to 16 days, to determine the number of young bees that had actually emerged during the preceding 24 hours.

Besides the taking of these counts further work was necessary in the improvement of the incubators to prevent the heavy mortality which was experienced last year. Also tests were made to determine whether under normal conditions this mortality is present. And to provide sufficient humidity, check hygrometers were installed.

As it was thought that the use of black bees would be a check on the home-made incubators, a colony of blacks were prepared, and on June 12 an endeavour was made to take a count but owing to the black bees refusing to fly, though several methods were employed, the attempt to first separate the bulk of the blacks from the newly emerged Italian bees failed and this method had to be abandoned.

As the incubation of brood above a normal colony had last year to be abandoned early owing to coolish weather setting in, it was decided this year in place of this method and the use of one incubator to use two incubators.

As a guide in regulating the temperature and humidity of the incubators, the end wall of a hive containing a normal colony was drilled to permit a chemical thermometer being inserted, while the other end wall was cut out and replaced by wire gauze screening outside of which a box with a glass face held a hygrometer.

The incubators were equipped much the same as last year excepting for larger pans of water which were used and one of them being similarly equipped to the check colony, above described, with a hygrometer. Apart from these changes the temperature of each incubator was controlled by a thermostadt which was set to give 96° F. in the upper chamber, containing the capped brood. This upper chamber had a bottom of wire gauze screening to imprison the young emerged bees and to permit of the free circulation of heat.

During the season there were nine counts made extending over the period which began on June 12 and ended on September 9.

Commencing with June 12, the first count lasted 14 days or until June 26 during which time 10,839 young bees emerged and 2,389 were removed from the cells dead.

The eggs for this count were laid between May 22 and June 5, and amounted to 13,228 or an average of 1,102 laid daily.

Following a short period required to clean and tune up the incubators, two more batches were started on July 3. These batches, which we will call Nos. 2 and 3, lasted for 14 days or until July 17. In batch No. 2 there were 14,691 emerged, while 2,675 were dead, and in No. 3 17,000 emerged, and 1,478 died. The 17,366 eggs in No. 2 and 18,478 in No. 3 were laid between June 13 and 26, and averaged 1,447 and 1,540 respectively.

Immediately these counts were finished at noon on July 17 the incubators were prepared for batches Nos. 4 and 5 which were started the following day, July 18, at noon. These batches also were incubated for a period of 14 days which ended on August 1. Batch No. 4 contained a total of 17,230 of which 16,765 emerged and 465 died; while batch No. 5 of 19,400 had 15,046 alive and 4,354 dead. Thus the queen of No. 4 batch laid on an average 1,436 eggs a day from June 28 to July 11, and that of No. 5 an average of 1,617 during the same period.

About this time it was noticed that immediately the brood was placed into the incubators the temperatures jumped up very rapidly, owing to the addition of the extra heat of the brood and it was thought that this excess heat was responsible for the death at the start of the very young pupae. Steps, therefore, to remedy this were taken when the next batches Nos. 6 and 7 were started on August 5. These batches ran for 16 days and had a lower death rate.

It is interesting to note that the two queens responsible for the eggs laid in these batches were sisters, that they were hatched the same day and that they laid practically the same number of eggs, in the same time—No. 6 laying 16,114 and No. 7, 16,182. Of these amounts No. 6 had 15,687 emerge and but 427 dead while No. 7 had 15,746 alive and 436 dead. The daily averages were 1,342 and 1,348 respectively.

The last batches, Nos. 8 and 9, ran for 15 days; that is, from August 26 to September 9, and they are interesting in that practically all the young bees emerged from both incubators.

In batch No. 8 there were 15,464 of which but 27 died, while No. 9 which had 8,299 lost 82.

Tabulating the above results we have for comparison.

| Date | Incubator No. 1 | | | | | Incubator No. 2 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Batch number | Live count | Dead count | Total count | Average | Batch number | Live count | Dead count | Total count | Average |
| June 12 to 26..... | 1 | 10,839 | 2,389 | 13,228 | 1,102 | ..... | Black bees failed | | | |
| July 4 to 17..... | 2 | 14,691 | 2,675 | 17,366 | 1,447 | 3 | 17,000 | 1,478 | 18,478 | 1,540 |
| July 19 to Aug. 1. | 4 | 16,765 | 465 | 17,230 | 1,436 | 5 | 15,046 | 4,354 | 19,400 | 1,617 |
| Aug. 6 to 21..... | 6 | 15,687 | 427 | 16,114 | 1,342 | 7 | 15,746 | 436 | 16,182 | 1,348 |
| Aug. 26 to Sept. 9 | 8 | 15,437 | 27 | 15,464 | 1,288 | 9 | 8,217 | 82 | 8,299 | 691 |

As it is of interest to note the daily emergence of young bees of a normal colony, over a definite period, the counts of batches Nos. 6 and 7 which emerged from August 6 to 21 is shown in the following chart.

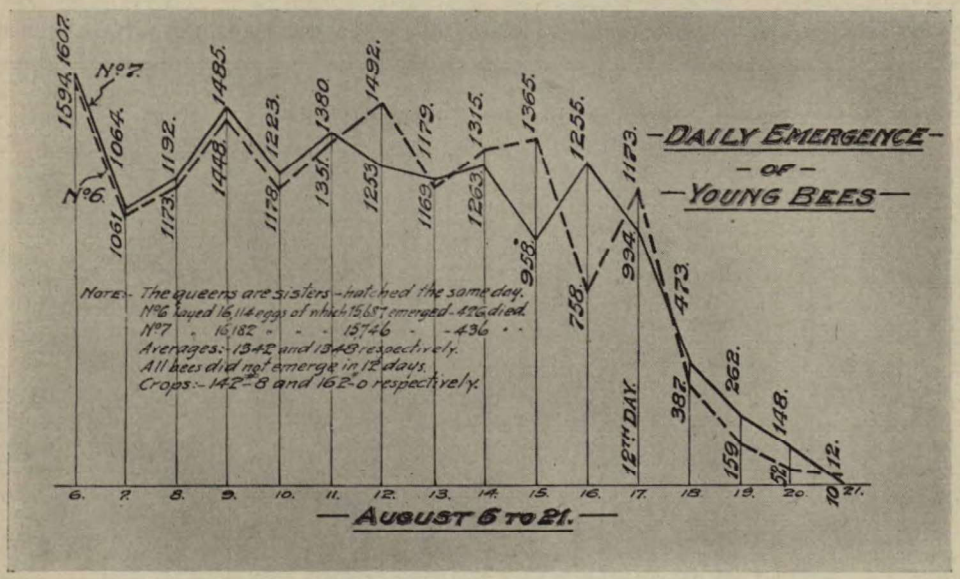


FIG. 5.—Chart showing daily emergence of young bees for August 6 to 21, 1930.

In last year's report, the question was noted as to whether all capped brood emerges under normal conditions or whether there is a high percentage of it that dies. With this in mind, it was decided to leave the brood in the care of the young bees until all had emerged but to prevent their carrying out any dead that there might be. On June 25, therefore, a full set of brood was raised above an excluder in a normal colony. By July 4 it was all capped, so it was placed in a super with a wire screen bottom above a strong colony. On July 16, twelve days later, when examined it was found to have all emerged without any dead, showing that it all does emerge under normal conditions. This test was repeated with another batch with like results.

From this year's work it will be seen that practically a complete emergence can be secured but that further work to reduce the emergence time to 12 days will be necessary when the experiment is continued next season.

## DAILY WEIGHTS OF AN OUTSIDE WINTERED COLONY

To determine the amount of stores consumed daily by a normal colony wintered out-of-doors, a mediumly strong colony in a Kootenay case was placed on a platform scale over which a cotton tent was erected to prevent it becoming blocked by snow.

This colony at feeding time, on October 3, received a shallow super containing 35 pounds of natural stores plus 2 ten-pound pails of honey syrup, after which the tent was put in place.

Daily weighings were begun on October 17 and continued until May 31 but owing to a certain amount of nectar being brought in during the latter month, only that period from October 17 to April 30 is considered in the following table.

STORES CONSUMED BY A NORMAL COLONY WINTERED OUTSIDE FROM OCTOBER 18, 1929 TO APRIL 30, 1930

| Day of the month | October | November | December | January | February | March | April |
|---|---|---|---|---|---|---|---|
| | oz. | oz. | oz. | oz. | oz. | oz. | oz. |
| 1 | ..... | 0 | 0 | 3 | 1 | 4 | 2 |
| 2 | ..... | 4 (rain) | 2 | 0 | 1 | 0 | 2 |
| 3 | ..... | 2 | 1 | 1 | 2 | 3 | 6 |
| 4 | ..... | 1 | 2 | 2 | 2 | 4 | (bees flying first time) 20 |
| 5 | ..... | 0 | 2 | 3 | 0 | 3 | 0 |
| 6 | ..... | 4 | 1 | 0 | 3 | 0 | 8 |
| 7 | ..... | 2 | 1 | 0 | 2 | 4 | 2 |
| 8 | ..... | 3 | 4 | 0 | 2 | 0 | 6 |
| 9 | ..... | 1 | 2 | 4 | 0 | 4 | 4 |
| 10 | ..... | 0 | 2 | 1 | 0 | 4 | 3 |
| 11 | ..... | 2 | 3 | 3 | 5 | 2 | 2 |
| 12 | ..... | 1 | 1 | 2 | 2 | 0 | 10 |
| 13 | ..... | 1 | 2 | 0 | 0 | 3 | 9 |
| 14 | ..... | 0 | 0 | 2 | 2 | 5 | 3 |
| 15 | ..... | 1 | 0 | 0 | 4 | 4 | 7 |
| 16 | ..... | 3 | 3 | 4 | 4 | 3 | 7 |
| 17 | ..... | 2 | 1 | 3 | 2 | 3 | 0 |
| 18 | 3 | 3 | 1 | 0 | 2 | 0 | 0 |
| 19 | 4 | 2 | 3 | 3 | 0 | 2 | 7 |
| 20 | 2 | 0 | 0 | 2 | 2 | 4 | 8 |
| 21 | 5 | 4 | 3 | 0 | 2 | 4 | 7 |
| 22 | 1 | 2 | 3 | 1 | 2 | 4 | 2 |
| 23 | 1 | 3 | 2 | 2 | 2 | 6 | 6 |
| 24 | 4 | 0 | 2 | 2 | 0 | 2 | 3 |
| 25 | 0 | 4 | 0 | 2 | 4 | 2 | 3 |
| 26 | 3 | 3 | 1 | 2 | 4 | 0 | (tent removed) 12 |
| 27 | 3 | 0 | 0 | 2 | 2 | 4 | 14 |
| 28 | 4 | 0 | 1 | 2 | 4 | 0 | 8 |
| 29 | 4 | 4 | 1 | 0 | ..... | 2 | 12 |
| 30 | 1 | 5 | 2 | 4 | ..... | 5 | 4 |
| 31 | 0 | ..... | 1 | 2 | ..... | 1 | ..... |
| | lb. oz. | lb. oz. | lb. oz. | lb. oz. | lb. oz. | lb. oz. | lb. oz. |
| Totals | 2 3 | 3 5 | 2 15 | 3 4 | 3 8 | 5 2 | 11 1 |
| Averages | 0 2·5 | 0 1·8 | 0 1·5 | 0 1·7 | 0 2·0 | 0 2·6 | 0 5·9 |

In the above table it will be seen that the monthly losses decreased from October to December, the month of least consumption, after which they gradually increased each month until the maximum monthly consumption was reached in April. This is what might be expected for by this time brood rearing was well under way in this colony; it seems to have begun according to the figures sometime in March.

The total amount of stores consumed over this period was 31 pounds 10 ounces besides which there was about two and a half pounds consumed between feeding time, October 3, and when the weighings began on October 17. From this it will be seen that a colony with 40 pounds of stores has none too much to winter on.

Incidentally, it might be mentioned that this colony harvested 94 sections and 60 pounds 8 ounces of extracted honey the following season.

Further weights are being taken during the winter of 1930-31.

## COMB VERSUS FOUNDATION

During the past two seasons, work has been carried on to determine whether there is a wastage of wax by a colony on drawn combs.

The procedure in this experiment was: when storage supers were given at the beginning of the main honey flow to see that one group received supers containing 4 sheets of foundation and 5 drawn combs in each; while another received similar supers of 9 drawn combs. Overwintered colonies were used in both years.

In 1929, it was found that the group of colonies given foundation produced an average of 125 pounds of honey and 4 combs drawn, while those with all drawn combs got an average of but 120 pounds.

Next year, 1930, however, in the group with foundation each colony harvested 148 pounds 2 ounces of honey and drew 7 combs; while in the drawn comb group 157 pounds 9 ounces was secured per colony.

Owing to the variation in strength of overwintered colonies, package bees will likely be used when this work is continued next year.

## EFFECT OF SUNLIGHT ON A COLONY

To determine what effect sunlight has on a colony work was begun on June 7 by placing 5 normal colonies into hives fitted with glass ends. Of this number one had single glass ends, two double glass similar to double windows with an air space between the glasses, and two with special single glass through which the violet rays of the sun could pass. These hives were placed facing east, thus receiving the morning and afternoon sun.

At first the bees were very active running on the glass, but this gradually subsided as the season advanced, though not entirely.

No tendency to build up faster was noticed in these colonies than in others during the season; neither did the bees appear any gentler than other bees in the yard. From two hives swarms issued, one from the hive with single glass ends and the other from that with double glass, both being the ordinary window glass.

The crop from the five sunlight hives was 503 pounds or an average of 100 pounds 9 ounces which is 57 pounds 9 ounces below that of the group run on a commercial basis. The following shows the colonies in the violet ray hives to have harvested the greatest crops.

| | |
|---|---|
| Colony No. 401—ordinary single glass=103 – 8. | Swarmed 3 times. |
| Colony No. 402—ordinary double glass= 58 – 8. | |
| Colony No. 403—ordinary double glass= 72 – 0. | Swarmed 3 times. |
| Colony No. 404—violet ray single glass=125 – 0. | |
| Colony No. 405—violet ray single glass=144 – 0. | |
| 503 – 0. | |

## DISEASE

Before reporting on the number of cases of bee diseases examined by this Division during the past year, it should be noted that these diseases are confined to bees only.

All honeys, therefore, are perfectly safe for human consumption.

A greater number of samples of brood for examination was received in the year 1930 than in any one of the preceding 9 years. Ninety-six samples were received during the season of which there were thirty-nine infected by American Foulbrood, thirty-nine by European Foulbrood, and eighteen cases of no disease present.

There is no charge to the beekeeper for making these examinations and he will do well should he find any abnormal looking brood in his yard to send a sample of it to the Bee Division, Central Experimental Farm, Ottawa, for examination.

Never send such a sample in a tin box unless there be many nail holes in it to provide ventilation; otherwise it will arrive in too filthy a condition to examine. As all packages addressed to this Division go through the mail without charge, it is only necessary to address the package plainly and to mark it "O.H.M.S." in the upper right hand corner where stamps are usually placed, not forgetting to state the name and address of the sender.

The number of samples received each year for the past ten years is to be found in the following table.

SAMPLES OF DISEASE EXAMINED

| Disease | 1921 | 1922 | 1923 | 1924 | 1925 | 1926 | 1927 | 1928 | 1929 | 1930 |
|---|---|---|---|---|---|---|---|---|---|---|
| American foulbrood | | 8 | 25 | 24 | 8 | 22 | 48 | 27 | 16 | 39 |
| European foulbrood | | 7 | 16 | 6 | 9 | 28 | 27 | 21 | 17 | 39 |
| Sacbrood | | 10 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| No disease | | 1 | 9 | 5 | 2 | 11 | 17 | 12 | 7 | 18 |
| | 20 | 26 | 50 | 38 | 19 | 61 | 92 | 60 | 40 | 96 |

## WINTERING

The number of colonies wintered at Ottawa and at Britannia during the winter of 1929-30 was one hundred and fourteen.

Preparations for the winter began toward the end of the main honey flow when it was seen that all colonies were headed by vigorous young queens. Those that were not vigorous were replaced. This is very essential in order that there be a strong force of young bees in each hive before the cold weather sets in. The fall preparations proper began on September 27 when all colonies were weighed prior to their being fed and packed away in their winter cases.

This year all the colonies at Ottawa were wintered out-of-doors, as there was no room in the bee cellar, the room being taken up by another experiment. In this yard there were one hundred and six colonies in various kinds of cases.

In the Britannia yard, the colonies were wintered as in other years, in double walled hives.

OUTSIDE WINTERED COLONIES

Though the above mentioned weights should tell one how much food each colony requires, they are not altogether to be relied on, since the presence of combs partly filled with pollen might lead one to think that the colony had more stores than were really present. To prevent the chance of any colony being short of stores as the result of this, our practice is to feed all colonies at least 4 pails of syrup and to give those which are light as much more as will make up for what they lack.

Then, on September 30, three days after weighing, the colonies were placed into their winter quarters with under and side packing and on October 4 they were fed.

More colonies were wintered this year in single cases or double walled hives than in previous years owing primarily to lack of cellar accommodation. Beside the singles there were also a number of both four and two colony cases used. Of these cases there were: fourteen quadruples or four colony cases housing 55 colonies, six two colony containing 12 colonies, 31 singles and 8 doubles holding double hives in each of which there were 2 queens—altogether 106 colonies.

The singles consisted of: Kootenay cases, Ottawa double walled hives, some with 3 inches of packing and others with 4, Chrysler cases, and hives lined with insulating board.

Though last year practically all the colonies were fed sugar, this year half of them were given natural stores, that is 57 received sugar syrup and 57 got natural stores; of the latter 41 had shallow supers and 16 deep ones.

The final or top packing was put in place on October 28 and the windbreak set up. These windbreaks were of similar construction to those used by the railroads, commonly called snow fences. They protected the apiary on all except the east side, where there is a natural hedge.

Though in the early part of the winter the heavy snowfall was advantageous to good wintering, the temperatures in the latter part were not conducive to such, as they were very changeable.

During the winter in the Ottawa yard 2 whole colonies and 2 halves of doubles died; while in the Britannia yard all came through the winter without loss.

At the first examination at the end of April, the colonies appeared very weak; that is, they covered on an average 5 frames but by the second examination, a month later, they had built up remarkably and seemed very strong.

COLONIES WINTERED IN 1930-31

Again all colonies are wintered out-of-doors and the number this year is one more than that of last, namely 115. Beside these colonies three nuclei as taken from the mating-boxes were placed in a spare quadruple case.

The protection given this year is much like that of last; that is, there are 15 quadruple cases housing 55 colonies and 3 nuclei, 6 double cases holding 12, 33 singles and 6 others with 2 queens in each.

Five of the 33 colonies wintered singly are in hives insulated by commercial insulating board in place of shavings.

Of these, three were constructed this year: one of half inch material lined with half inch insulating board, while the other two were old hives, in one case covered by one thickness of the same insulating material and in the other with two thicknesses. The last mentioned hives are shown in the accompanying photograph.


FIG. 6.—Hives 301 and 302 are ordinary 10-frame Langstroth hives covered by insulating board. No other protection is given these two colonies for the winter.

## HONEY INSPECTION

During the past year a total amount of 442,866 pounds of honey was inspected for the export market by this Division.

Of this amount 190,800 pounds were actually graded at car loading points, and the remainder of 252,066 pounds was inspected in Toronto and Montreal warehouses.

It was found necessary to regrade 47,400 pounds or 18·8 per cent of the honey inspected in warehouses, while 25,380 pounds, or 5·73 per cent of the total honey inspected, was rejected as unfit for any but a manufacturers market on account of its dirty, or otherwise unsatisfactory condition.

## EXPERIMENT ON THE STORAGE OF HONEY

This experiment was begun in 1929 in an effort to determine what are the best conditions of temperature and humidity for the storage of honey; and at the same time, to discover if there is any relationship between the physical, chemical and biological properties of the honey, and its keeping qualities.

A twenty-three-pound sample of honey put up in 46 one-half-pound jars, was obtained from each of eighteen Branch Farms, representative of the various producing areas of the Dominion. Each of these samples was drawn from one tank, and where possible was from one floral source.

On arrival of the samples at the Bee Division one jar of each was sent to the Divisions of Bacteriology and Chemistry for microbiological and chemical analyses. The remaining 45 jars of each sample were placed in storage, as shown in the following table, after a record had been made of the physical characteristics of each sample.

| Storage temperatures | 40°F. | 50°F. | 60°F. | 70°F. | Uncontrolled (outside) |
|---|---|---|---|---|---|
| Closed | 8 | 8 | 8 | 8 | 8 |
| Open | 1 | 1 | 1 | 1 | 1 |

Daily records are kept of temperatures and humidities in the various storages, and each month the honey is examined and any physical changes that may have occurred, are recorded.

It was originally planned to remove, for further chemical and biological analyses, one jar of each sample from each of the five storages, at the end of the first six months, and thereafter, one at the end of each twelve months, until the end of the fifth year. Any samples remaining in storage at that time were to be left until fermented.

Owing to circumstances over which we had no control the first jars were not removed until the twelfth month in storage, and then a microbiological examination only, was made. No report on this examination is yet available.

Certain physical changes of some interest are already apparent in the various samples. A comparison made December 11, 1930, brought out the following points:—

(1) Samples stored at 40°F. and 50°F. were in all cases lightest in colour and with one exception were equal in colour to each other.

(2) Samples stored at variable temperatures were next lightest in colour in all cases.

(3) Samples held at 60°F. and 70°F. were in all cases the darkest.

(4) Samples held at 40°F., 50°F. and variable temperatures were flocculent in 2 cases out of eighteen.

(5) Samples held at 60°F. were flocculent in 9 cases out of eighteen.

(6) Samples held at 70°F. were flocculent in 3 cases out of eighteen.

(7) Samples held at 60°F. were of apparently coarser granulation in 7 cases out of eighteen.

(8) Samples held at 70°F. were of apparently coarser granulation in 4 cases out of eighteen.

(9) Samples held at variable temperatures were of apparently coarser granulation in 1 out of eighteen cases.

From these observations it would seem that the higher storage temperature tends towards darkness, flocculence and a coarser granulation in honey. To date spoilage has occurred in only two of the five storages, namely, 70°F. and fluctuating temperatures. In each of these two storages, jars of the same three samples were found to be fermented.

At the conclusion of this experiment the results of the various analyses will be tabulated and examined in an effort to determine the relationship, if any, between the physical, biological and chemical properties of the various honeys, and their keeping qualities at various temperatures.

## EXPERIMENT ON THE FERMENTATION OF HONEY

This experiment was begun in 1929 with the object in view of obtaining data on the keeping qualities of Canadian honeys, and if possible, to arrive at some definite conclusions as to the main causes of spoilage in Canadian honeys.

PLAN OF WORK.—(1) To obtain, in duplicate, a representative number of samples from the varying sources of each province.

(2) To make physical, chemical and microbiological analyses of each sample on arrival, and a further microbiological analysis of each sample when it is found to be spoiled.

(3) To store these samples at room temperatures until spoiled, and to observe and record, at regular intervals, the physical changes that might take place.

(4) To correlate all observations made, and if possible to prescribe ways and means of preventing the spoilage of honey in storage.

To obtain a representative number of duplicate samples from the varying sources of each province, a circular letter asking for same was prepared, and was sent out to all Provincial Apiarists and large producers of honey. This letter stipulated that samples must be from the same extraction and drawn from one tank.

Certain information as to the source and treatment of each sample was obtained by means of a questionnaire.

Two hundred and eleven samples were finally collected at the Bee Division, Central Experimental Farm, Otawa. These represented to a greater or less extent, all the provinces of the Dominion and embraced a great variety of sources. The distribution and sources of these samples appear in tables A. and B.

When the duplicate samples arrived one container of each was placed in storage at the Bee Division. The duplicate of each sample was sent to the Division of Bacteriology where it was divided into two portions.

One of these portions was retained by the Division of Bacteriology for microbiological analysis, and the other was sent to the Division of Chemistry for chemical analysis.

The chemical analyses were carried out under the direction of Dr. F. T. Shutt, Dominion Chemist. The results of these analyses are appearing in the reports of the Division of Chemistry for the years 1929-30 and 1930-31.

The results of the microbiological analyses as carried out under the direction of Dr. A. G. Lochhead will appear in the report of the Division of Bacteriology for 1930.

Prior to placing samples in storage at the Bee Division, a physical analysis was made of each. This took into consideration the treatment of the honey, its consistency, the type of granulation, and the colour determined by the Pfund Honey Grader.

These samples were stored at room temperature in order to obtain as closely as possible, the conditions under which honey is stored on grocery shelves. The temperature ranged from 45°F. to 85°F. The average temperature was 67·3°F.

When possible, all samples were examined once a month, care being taken to prevent any contamination of the honey when the containers were opened. Any physical changes which had taken place in a sample were recorded at each examination, until fermentation was definitely established.

Table C. shows the rate of spoilage of samples in relation to province of origin.

Table D. shows the fermented samples in relation to sources and provinces of origin.

To date, only forty-two samples have been found to be fermented and these have been forwarded to the Division of Bacteriology for further analyses. As yet no report on these samples is available, nor can any attempt at correlating the factors entering into the spoilage of honey be made at this time.

TABLE A—DISTRIBUTION OF SAMPLES

| Province | Number of samples | Condition of samples when received | | | Colour | | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Liquid | Solid | Semi-liquid | Water-white | White | Golden | Light amber | Dark amber | Dark | |
| Prince Edward Island | 3 | 1 | 2 | ..... | .... | 3 | ..... | ..... | ..... | ..... | |
| Nova Scotia | 6 | 1 | 4 | ..... | ..... | 4 | 1 | ..... | ..... | 1 | 1 undetermined condition. |
| New Brunswick | 2 | 1 | 1 | ..... | ..... | ..... | 2 | ..... | ..... | ..... | |
| Quebec | 50 | 19 | 27 | 1 | 24 | 10 | 8 | ..... | 8 | ..... | 3 undetermined condition. |
| Ontario | 59 | 7 | 46 | 5 | 22 | 29 | 5 | ..... | 2 | 1 | 1 undetermined condition. |
| Manitoba | 38 | 2 | 36 | ..... | 25 | 12 | 1 | ..... | ..... | ..... | |
| Saskatchewan | 26 | 4 | 22 | ..... | 10 | 12 | 3 | ..... | 1 | ..... | |
| Alberta | 5 | 1 | 4 | ..... | 2 | 1 | ..... | 2 | ..... | ..... | |
| British Columbia | 22 | 10 | 11 | 1 | 4 | 10 | 5 | 2 | 1 | ..... | |
| Totals | 211 | 46 | 153 | 7 | 87 | 81 | 25 | 4 | 12 | 2 | 5 undetermined. |

TABLE B—FLORAL SOURCE OF SAMPLES

| Chief sources of samples | Prince Edward Island | Nova Scotia | New Brunswick | Quebec | Ontario | Manitoba | Saskatchewan | Alberta | British Columbia | Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| All clovers+ | 2 | 3 | 1 | 31 | 42 | 35 | 21 | 3 | 16 | 154 |
| Clovers and basswood | ..... | ..... | ..... | 3 | 9 | ..... | ..... | ..... | ..... | 12 |
| Clovers and buckwheat | ..... | 1 | ..... | 4 | 2 | ..... | ..... | ..... | ..... | 7 |
| High percentage of buckwheat | ..... | ..... | ..... | 6 | 2 | ..... | ..... | ..... | ..... | 8 |
| Fireweed | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 2 | 3 | 5 |
| Mixed | ..... | 2 | ..... | 3 | ..... | 2 | 3 | ..... | 2 | 12 |
| No source given | 1 | ..... | 1 | 3 | 4 | 1 | 2 | ..... | ..... | 12 |
| Clematis vulgaris* | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | 1 | 1 |

* This plant was given as the probable source of the sample but on analysis it was found that the sample is in all probability Honey-dew.

TABLE C—SPOILAGE OF SAMPLES

| Province | Number of samples | Number of samples unfermented | Number of samples fermented after months in storage | | | | | | | | | | | | Per cent Spoilage |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Totals | |
| | | | | | | | | | | | | | | | | % |
| Prince Edward Island | 3 | 3 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 0 | |
| Nova Scotia | 6 | 3 | .... | 1 | 1 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | 3 | 50 |
| New Brunswick | 2 | 2 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 0 | |
| Quebec | 50 | 36 | 5 | 1 | 1 | 1 | .... | .... | .... | 2 | .... | 4 | .... | .... | 14 | 28 |
| Ontario | 59 | 43 | .... | .... | 2 | 2 | .... | 2 | .... | 1 | .... | 7 | 2 | .... | 16 | 27·1 |
| Manitoba | 38 | 33 | .... | .... | 1 | .... | .... | .... | .... | .... | .... | 4 | .... | .... | 5 | 13·1 |
| Saskatchewan | 26 | 23 | .... | 1 | .... | 1 | .... | .... | .... | .... | .... | 1 | .... | .... | 3 | 11·5 |
| Alberta | 5 | 5 | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | .... | 0 | |
| British Columbia | 22 | 21 | .... | .... | .... | .... | .... | .... | .... | .... | .... | 1 | .... | .... | 1 | 4·5 |
| Totals | 211 | 169 | 5 | 3 | 5 | 4 | .... | 3 | .... | 3 | .... | 17 | 2 | .... | 42 | 19·9 |

TABLE D—LOCATION AND SOURCE IN RELATION TO FERMENTATION

| Main sources of samples | Fermented samples | | | | | | | | | Totals |
|---|---|---|---|---|---|---|---|---|---|---|
| | Prince Edward Island | Nova Scotia | New Brunswick | Quebec | Ontario | Manitoba | Saskatchewan | Alberta | British Columbia | |
| All clovers | ..... | 1 | ..... | 7 | 11 | 4 | 2 | ..... | 1 | 26 |
| Clovers and basswood | ..... | ..... | ..... | 1 | 3 | ..... | ..... | ..... | ..... | 4 |
| Clovers and buckwheat | ..... | 1 | ..... | 1 | ..... | ..... | ..... | ..... | ..... | 2 |
| High percentage of buckwheat | ..... | ..... | ..... | 3 | 1 | ..... | ..... | ..... | ..... | 4 |
| Fireweed | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | |
| Mixed | ..... | 1 | ..... | 1 | ..... | ..... | 1 | ..... | ..... | 3 |
| No source given | ..... | ..... | ..... | 1 | 1 | 1 | ..... | ..... | ..... | 3 |
| Clematis vulgaris | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

OTTAWA: Printed by F. A. ACLAND, Printer to the King's Most Excellent Majesty, 1931.