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 1929

Bees in the orchard. Most fruit trees are self sterile or incompatible to their own pollen, therefore, cross pollination must be effected before fruit is borne. Honey bees are most effective agents for performing this task.

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BEE DIVISION

REPORT OF THE DOMINION APIARIST, C. B. GOODERHAM, B.S.A., FOR THE YEAR 1929

GENERAL NOTES

Canada, as a whole, has again experienced a very successful year in bee-keeping. It is true that the honey crop was rather patchy, some localities yielding below the average, while others were well above it, the latter, however, predominating. Furthermore, the major portion of the honey produced was of excellent quality, being light in colour, well flavoured and of good body.

The winter of 1928-29 was comparatively mild in Eastern Canada and parts of British Columbia and thus was fairly easy on bee life. The colonies came through in good condition and with a minimum of loss. In the Prairie Provinces, however, the winter was very severe with long periods of sub-zero weather which resulted in extremely heavy losses, especially where the bees were not given the very best of care and protection. In these provinces, however, winter losses are fairly easily and cheaply replaced by package bees, and in normal years these bees do exceedingly well, in some cases equalling the over-wintered colonies. In fact some beekeepers are making a practice of destroying their bees in the fall and restocking with package bees in the spring.

The spring and early summer were very disappointing. Because of unfavourable weather conditions during this period, the colonies were unable to build up as rapidly as could be desired, especially in the eastern provinces and British Columbia where a rapid increase in colony strength is very essential during the early part of the season in order that the colonies may be at maximum strength in time for the main honey flow. In the Prairie Provinces this is not so important because the main honey flow comes from three to four weeks later in the season, thus providing for a longer building up period prior to it. This longer building up period prior to the main honey flow from sweet clover is what makes package bees so successful in these provinces.

The weather conditions during the summer months caused many a beekeeper to become anxious over crop prospects. Long periods of dry weather when the major honey plants were in bloom threatened to cut short the nectar supply, especially was this true in the Prairie Provinces and in parts of British Columbia. With the exception of a few localities, however, these fears proved groundless for the total honey crop for 1929 is thought to be the largest on record, the only province so far reporting a crop below that of the previous year is Saskatchewan. Manitoba while not reaching a previous record exceeded her crop of 1928 while British Columbia, Alberta, Ontario, New Brunswick and Nova Scotia exceeded all previous records. Prince Edward Island, not a large producer also experienced good crops. No definite report has yet been received from Quebec, but good crops appear to have been general in this province also.

The fall of 1929-30 was an exceptionally good one for the preparation of bees for the present winter and there is no excuse for bees having been put away in an unsatisfactory condition.

The following pages of this report dealing with experimental projects were prepared by Mr. A. H. W. Birch, B.S.A., who has charge of the experimental apiaries at Ottawa and by Mr. W. G. le Maistre, B.S.A., who is responsible for investigations on honey and honey inspection.

THE SEASON

The greatest factor that enters into the business of beekeeping, and over which the beekeeper has no control, is the weather. From the last of July, when the beekeeper's year begins, until the crop is harvested, about twelve months later, the weather plays a most important part.

The month of August, 1928, was very hot with much sunshine, but despite this good weather, little honey was harvested by the bees. What rainfall there was, was light and came toward the first and last part of the month.

September was a normal month with about an equal number of bright and dull days. The temperatures throughout were moderate with but one exception which came near the end of the month when there was one degree of frost.

During these months the young bees, the backbone in the successfully wintering of a colony, were produced. And the last few days of September were ideal for making winter preparations, that is, for feeding and packing.

The greater part of October was dull to fair. The sunshine in this month was below the average; while the precipitation was far above the average of that for the past 36 years. The first snow of the season came on the 26th, when a light fall was experienced. This month was hard on unprotected colonies which were to be placed in the cellar, as the mercury was below freezing on many nights.

November, the month in which the bees have their last good cleansing flight was quite fine though during this month there was little sunshine. What little precipitation there was, was light. The bees had their last good cleansing flight on the day of the 14th and the morning of the 15th. Owing to the high temperature they were not placed in the cellar until the 20th, five days later.

In December, though the snow came early, the weather was mild throughout the month, it being particularly so between the 10th and 20th and again between the 24th and 29th. What little snow fell was nearly all gone by Christmas which might practically be called a green one. The winds were mostly westerly and light.

January was a very fine month, there being neither very cold spells, nor heavy snowstorms. While the snowfall for the month was below normal, the rainfall was the heaviest for any January in the past thirty-eight years. The amount of sunshine too was above normal.

February also was very fine, there being about the same number of days of bright sunshine as in the preceding month. During this month, the bees were flying on six occasions, quite a good flight occuring on the 16th. Thus the weather of the winter months was favourable to good wintering.

Despite the fact that March was a month of little sunshine, bees were flying on sixteen days, on seven of which they had good flights. The first really good flight was on the 15th of the month. In this month, too, the snowfall was light but there was much rain. Records show that this March compared with others preceding it, was the wettest in 39 years.

April which was ushered in by a heavy rain and sleet storm may be termed a backward month, having about an equal number of bright and dull days. The precipitation, principally of rain, was fairly heavy; while the winds which were mainly from the west or east, were quite strong towards the latter part of the month. On the 9th of the month pollen was being brought in by the outside wintered colonies but owing to a dip in temperature the bees in the cellar were not removed until the 22nd.

May was another backward month. The first part of the month was dull, rainy and cool, the middle a mixture of all sorts of weather and the last part bright. Though most of the month was coolish, the mercury during the last four days was exceptionally high. Thus it will be seen that the two preceding months were not particularly favourable to the building up of colonies.

The first half of June, also, was not at all favourable to bee flight, as it consisted of dull days with heavy winds. About the 11th of the month, however, the weather improved and with the change for the better the main honey flow started.

July, the busiest month of the year for the bees, was all that could be desired from a beekeeper's point of view. The hours of sunshine were above the average, in fact there were very few days other than bright ones and the temperatures throughout the month were high. On the other hand, the precipitation was light as were the winds, there being but six days on which the winds blew strongly.

With the close of the honey flow, preparations for harvesting next year's crop began by seeing that each colony was headed by a vigorous queen.

Summarizing: The fall months were good for preparing the colonies for winter, that is, for building them up, packing and feeding. The winter months also were favourable, in that they were not hard on bee life. But the spring and early summer months, the time when the colonies should be becoming populous in preparation for the flow, were very poor for building up. The summer months were ideal.

THE SEASON'S WORK IN THE OTTAWA APIARY AND IN THE OUT-APIARY AT BRITANNIA

While the main honey flow of 1928 was still in progress the first preparation for the following year's crop was begun by seeing that each colony was headed by a vigorous queen. This preparation, which was started in the middle of July and continued into early August, consisted in gradually removing queens that were to be replaced and introducing young laying queens in their places. Thus before the flow had ended, the eggs that were to supply the young bees for good wintering were being laid in great quantities and by the last of September, feeding time, all colonies were very populous.

Packing and feeding operations were then proceeded with and finally finished by the middle of October. Owing to the comparatively mild winter, the bees in both the Ottawa and Britannia yards wintered very well. (For details of this work see the section on wintering).

In the month of February, bees were flying on a number of occasions, but not until March 15, on which day the highest temperature of the month, 51° F. was registered, were they seen having their first really good cleansing flight. Following this date though many good flights were noted, it was not until April 9, twenty-five days later, that the first pollen was observed being brought in by the bees of outside wintered colonies.

The following list shows that the first pollen of the season was observed being brought in earlier this year than on any of the six preceding years:—

DATES OF BRINGING IN FIRST POLLEN

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

A period of depression was next experienced, temperatures fell and dullness prevailed, which prevented the removal of the cellar wintered bees until April 22. Between April 29 and May 4, when red maples and willows were in bloom, continuous rain, snow and strong winds prevented the bees taking advantage of

these spring sources of nectar. And up to the middle of May, owing to the unsettled state of the weather, the bees secured but little from the hard maples and early dandelions.

The effect of this weather is shown by the colonies on scales which between April 24 and May 24 showed losses with but few exceptions. Under such conditions it is plain that the natural sources cannot be depended on for building up a colony in the spring and that sufficient stores must be given in the fall not only to carry the colony through the winter but also through the early spring until such a time as the weather becomes settled and the bees can fly continuously to gather sufficient for their needs.

The gains from dandelion and fruit bloom by the colonies on scales began on May 25 and ended on May 30. During this time an average daily gain of 1 pound 5 ounces was made, the greatest daily average coming on May 29 when 2 pounds 5 ounces was harvested.

Between the early flow and main flow, that is, between May 31 and June 11, the colonies on scales lost daily about 7 ounces, although during that time a little was harvested by the bees. This shows the need for seeing that all colonies have sufficient stores so that no slacking in brood rearing may take place at this time.

On June 12, thirteen days earlier than last year, the main honey flow started and lasted until July 28, a period of forty-seven days.

During this time, as the weather was favourable, and the colonies fairly strong, a good crop was harvested.

The following table shows the length of flows from the different sources, the number of days on which gains and losses were made, and the average gains and losses.

Length of flows and dearths	Sources	Gains on	Average daily gains		Losses on	Average daily losses	
			lb.	oz.		lb.	oz.
May 25 to May 30	Dandelion and fruit bloom	6 days	1	5	.. ..	..	..
May 29 to June 11	Practically nothing coming in	1 day	0	3	11 days	0	7
June 12 to June 26	Alsike	11 days	2	5	4 days	0	10
June 27 to July 28	Alsike, Dutch and sweet clover	24 days	6	12	8 days	1	0

Considering the main honey flow as a whole there were thirty-five days on which the average daily gain was 5 pounds 6 ounces, and twelve days on which the average daily loss was 14 ounces.

The highest gains were made on July 12 when the average of the colonies on scales was 12 pounds 11 ounces.

The honey crop harvested by the Ottawa apiary and the out-apiary at Britannia was 13,775 pounds. This amount is 8,757 pounds 8 ounces greater than was produced last year by these yards containing about the same number of colonies.

Owing to some of the colonies in the Ottawa yard being used for experiments which reduced their productivity, a fair average for this yard cannot be given.

In this yard, however, from a group of twenty-four colonies which have been run for a number of years on a commercial basis, an average of 120 pounds was secured.

It must be remembered, however, that while the main sources which are from White Dutch, alsike and sweet clover are abundant, only part of them are available, owing to the fact that they are cut about the time they come into bloom.

At the Britannia apiary, from a group of eight colonies, a crop of 1,661 pounds, or an average of 207 pounds, 10 ounces of honey was harvested. Com-

pared with last year's crop which was but 669 pounds, 8 ounces, or an average of 87 pounds, 7 ounces, it will be seen that this yard made a substantial gain.

During the season, the number of colonies in the Ottawa yard as the result of different manipulations increased to approximately 117. This number, however, was gradually reduced until there were but 106 in the fall.

BEES AS POLLINATORS

The fact that bees are very necessary for cross-pollination is being realized more and more by fruit growers many of whom to ensure a good crop are now renting colonies of bees or maintaining their own.

With this in mind, the Bee Division in conjunction with the Horticultural Division, continued the work of the past season to determine the value of honey-bees as cross-pollinators of black currants, and also to find out what part smaller insects and wind play.

The same block of bushes used last season were again used this season, but the layout of the work was different. Of the two varieties of black currants used, the Magnus and the Kerry, there were six bushes of each planted in rows running north and south and approximately 6 feet apart. The Magnus bushes which formed the eastern row were spaced 5 feet apart in the row, while the Kerry bushes in the next row to the west were similarly located.

The difference in the layout of the work this year was as follows:—

Check bushes that were free to the visit of all insects last year were this year enclosed by the "Bee Tent" and what were enclosed by the "Bee Tent" last year became the check bushes of this year. Similarly the two bushes in the tent which were impervious to the visits of all insects but in which pollen had a chance of drifting from one bush to the other, were tented separately, while the separately tented bushes were enclosed in one tent. The wire gauze tent which

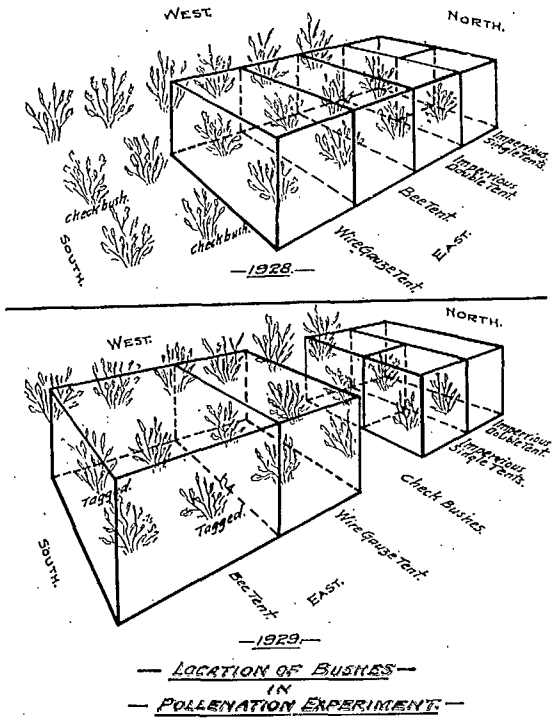

FIG. 1.—Sketch of tents showing layout of bushes used in experiment for 1928 and 1929.

permitted the visit of insects smaller than honey-bees, housed the same bushes in both 1928 and 1929.

For comparison's sake, the preceding sketch shows the layout of the work for the past two years. It will be noticed that the same bushes used as checks last year were this year tagged and enclosed by the "Bee Tent." This tent, as formerly, was constructed of cotton, excluded all insects, and contained a mediumly strong colony of bees.

The "Wire Gauze Tent" adjoining it to the north was constructed on three sides of wire gauze of such a mesh that honey-bees could not pass through but smaller insects could get in and work the bloom. It should be noticed also that the wind passed more freely through this tent than it did through any of the other tents. Next came the check bushes. These bushes were under normal conditions; that is, they were free to all the agencies which might cause cross-pollination, such as the visits of insects and the unhampered sweep of the wind.

The tents, to the north, known as the Impervious Tents were constructed entirely of cotton, which prevented the entrance of all insects, but through which the wind could pass to an extent. Those covering the single bushes cut off not only the visits of insects but also the entrance of foreign pollen, thus determining to what extent black currants were self-fertile. The most northerly tent, on the other hand, though it prevented insect visits, it permitted pollen to be blown from one bush to the other.

As a further means of determining to what extent wind played in the pollination of this fruit, vaselined slides were placed between the two bushes in the last mentioned tent to catch pollen which might be carried by the wind. And as a check on these enclosed slides, a similar number were placed between the check bushes.

Comparing the yields of the two varieties of black currants used, the Magnus and the Kerry, we find that the records for the past ten years show the Magnus average as slightly higher than that of the Kerry but the difference is so small as to be considered negligible. It must be borne in mind, however, that this year, 1929, is Kerry's heavy bearing year, while last year, 1928, Magnus bore the heavier. It must also be noted that this alternating holds good over the past six years.

On May 2, two days earlier than last year, this experiment was begun with the erection of the framework of the tents. The cotton covering, however, was not put on at this time, as it was thought it would be better to allow the bushes to benefit by the direct sunlight as long as possible. Owing to the backwardness of the season nothing further was done until just before the bushes came into bloom when on May 14 the cotton covering was put on.

Three days later, on May 17, tagging operations were done; that is, all the bushes with the exception of two spare ones in the "Bee Tent" were tagged. This operation was similar to that of previous years; it consisted in counting the number of blossoms in a cluster and attaching a tag to it, on which was marked the number of the cluster and the number of blossoms in it. Sixty clusters on each of the 10 bushes used were tagged.

The following day, May 18, a mediumly strong colony of bees was placed in the "Bee Tent" where it remained until all bloom had fallen. In regard to the work of the bees, it must be noted that those in the "Bee Tent" were working the bloom more heavily this season than ever before noticed. As it was suggested that thrips might play a part in cross-pollination, a careful search was made for them on two occasions but none could be found. On June 10, some days after all bloom had fallen, the colony of bees was removed from the "Bee Tent", after which all the tents were demolished.

The following calendar shows the weather conditions during the blooming period, the development of the bloom in the "Wire Gauze Tent" and the "Bee Tent", and the work of both honey-bees and other insects.

WEATHER CONDITIONS AND THE DEVELOPMENT OF BLOOM

Date	Weather	Wire gauze tent with insects smaller than honey-bees	Bee tent with honey-bees
May 18.....	.....	.....	Bees placed into tent.
" 18.....	Fair, N. wind—light F. 63°.....	3 per cent bloom open. No insects present.	2 per cent bloom open. A few bees working.
" 19.....	.....	.....	.....
" 20.....	Bright, S. wind—light. F. 50°....	7 per cent bloom open. No insects present.	7 per cent bloom open. A few bees working.
" 21.....	Fair to dull—NW. wind—light. F. 59°.	15 per cent bloom open. No insects present.	15 per cent bloom open. Bees working.
" 22.....	Bright, N. wind—F. strong. F. 54°.	27 per cent bloom open. No insects present.	30 per cent bloom open. Very few bees working.
" 23.....	Fair, S. wind—v. strong. F. 66°..	35 per cent bloom open. No insects present.	47 per cent bloom open. Bees working.
" 24.....	.....	.....	.....
" 25.....	Bright, SW. wind-light F. 60°.....	47 per cent bloom open. Two or 3 insects present.	62 per cent bloom open. Bees working well.
" 26.....	.....	.....	.....
" 27.....	Bright to fair to dull. SW. wind—strong. F. 76°.	75 per cent bloom open. A few insects present.	92 per cent bloom open. Bees working splendidly.
" 28.....	Bright. No wind. F. 87°.....	90 per cent bloom open. No insects present.	99 per cent bloom open. Bees working.
" 29.....	Bright. SW. wind—light. F. 85°.	95 per cent bloom open. No insects present.	100 per cent bloom open. A few bees working.
" 30.....	Bright. SW. wind—light. F. 90°.	100 per cent bloom open. No insects present.	100 per cent bloom open. A few bees working.
" 31.....	Bright. SW. wind—F. strong. F. 82°.	100 per cent bloom open. No insects present.	100 per cent bloom open. A very few bees working.
June 1.....	Dull, NW. wind—strong F. 50°....	100 per cent bloom open. No insects present.	100 per cent bloom open. No bees working.
" 2.....	.....	.....	.....
" 3.....	.....	.....	.....

From May 18, when the bees were placed into their tent, until June 2, daily visits were made to the tents and check bushes to determine how the experiment was progressing. On these visits notes were made of the development of the bloom, of the work of both the honey-bees and other insects, and of any other factors that might have a bearing on the results; part of which are tabulated in the above calendar.

On June 14, when the fruit had developed sufficiently, a count of the set was made. In making the count, the procedure in the case of a missing cluster, was to cancel the bud count for that tag number.

The figures of the experiment are set forth in the following table:—

RESULTS OF POLLINATION EXPERIMENT FOR 1929

Group	Bush	Clusters tagged	Blossoms counted	Tags found	Fruits set	Percentage of fruit set	Percentage of fruit set for group
Bee tent.....	NE. bush.....	60	299	47	213	71·2	59·9
(4 bushes).	SW. "	60	392	58	201	51·2	
Wire gauze tent.....	East bush.....	60	371	55	127	34·2	28·0
(2 bushes).	West "	60	163	23	23	14·1	
Checks.....	East bush.....	60	274	52	220	80·2	73·6
(2 bushes in open).	West "	60	318	49	216	67·9	
Impervious tents.....	East bush.....	60	171	25	29	16·9	9·7
(1 bush in each).	West "	60	354	48	22	6·2	
Impervious tent.....	East bush.....	60	386	49	103	26·6	18·9
(2 bushes).	West "	60	275	39	22	8·0	

NOTE.—East row of bushes were Magnus. West row of bushes were Kerry.

The following table shows the percentages of set for the years 1927, 1928 and 1929:—

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

Comparing the percentages of set in the above table, we find that they are with one exception consistent over the past three years; that is, the group that had the highest set in 1927 had the highest set in 1928 and 1929 and so on down the scale. The exception referred to is the interchange in position of the second and third groups in 1929; where it will be noted that the percentage of set in the bee tent more than doubled that of the wire gauze tent.

As in 1927 and 1928, so in 1929, the check bushes had the highest set. This is only what might be expected, for they had advantages over all the other bushes. First, the bushes of this group were free to the visits of all kinds of insects, whereas in the other groups where insects played a part there were either honey-bees or smaller insects than honey-bees but not both. Then the insects not only were in greater number in the check bushes but also were working under normal conditions; that is, they were not hampered as were the insects in the tents. And having free range of the plantation and thus access to a greater variety of pollen they had a better chance of cross-pollinating. Furthermore, the check bushes had the advantage of direct sunshine and air drainage which the tented bushes did not receive.

To determine the part that wind plays in cross-pollination the vaselined slides previously mentioned were used with the check bushes. They consisted of pieces of glass 3 inches long by 1 inch wide, smeared on one side with vaseline and then attached to a stake which was located between the two rows of bushes. As the prevailing wind at Ottawa is from the west four slides were made to face west and four east; thus it was hoped that some pollen borne by the wind would adhere to them.

On examining the slides microscopically, it was found that there was not more than an average of 4 grains of pollen adhering to each slide which amount may be considered as negligible. This test, therefore, indicates that wind plays very little part in the cross-pollination of black currants.

Coming next to the "Wire Gauze Tent" that permitted only insects smaller than honey-bees to enter, we find that this group produced the third highest set, which though slightly less than what it produced last year was not half of what was made by the group in the "Bee Tent" which came second. The bushes in this tent were the same ones used last year and were subjected to conditions of sunlight and air circulation nearer to normal than any other of the tented bushes owing to the tent being constructed of wire gauze screening on three sides. As this tent contained two bushes of different varieties which came into bloom at the same time and which were visited by insects, one would expect to find a set of approximately the same size as last year's and that is exactly what happened. Though the set was slightly less than in 1928, to be exact 4·7 per cent lower, it may be accounted for by the fact that insect pollinators did not seem to patronize this bloom as much as they did last year. According to the preceding calendar it will be noted that though the honey-bees worked well in their tent, smaller insects than honey-bees were observed at work in the "Wire Gauze Tent" on but two occasions.

In the "Bee Tent" the set was very much higher this year than it was in either 1927 or 1928. This increase may be accounted for, to a large extent, by the fact that the honey-bees worked the bloom in greater numbers than ever before noticed. In this tent the abnormal condition under which the bees were working was well illustrated by the number of bees which should have been working but which were seen beating themselves against the roof of the tent in their endeavours to escape; this however, was not so noticeable as in the preceding years. Comparing the percentage of set in the "Bee Tent" with that of the "Impervious Tent" which was constructed exactly similar but in which there were no insects, we find that the presence of the honey-bees was responsible for a 41 per cent greater set.

In the "Impervious Tents," which excluded all insects, the percentages of set were the lowest of all the groups and this year they were slightly lower than last. When a set is produced without the presence of insects, one naturally suspects that there was one or more other factors at work such as wind or self fertility. The results of this experiment for both 1928 and 1929 show that the Impervious Tent containing two bushes had a higher percentage of set than did the Impervious Tents containing 1 bush each.

This slight difference may be attributed to wind causing the branches of one bush to brush those of the other and bring about a slight amount of cross pollination. In the second case, where there was no chance of pollen being transferred from one bush to the other owing to each bush being separately tented, the set was occasioned by self-fertility alone.

QUEEN BREEDING

A sure method of swarm control is to destroy all queen cells and dequeen the colony; and then nine days later to again destroy all cells and requeen it with a young laying queen.

In order to have young queens on hand about the first week in July to test out modifications of this method of swarm control, queen breeding at Ottawa was started as near to the middle of June as possible. This year it was begun on June 17, when the first batch of cells was grafted and continued on until August 10, when the last batch was put through. During this period, the frequency of grafting was determined as far as possible, by the speed of mating. When the bees of a mating-box had been queenless for a sufficient period after the removal of a mated queen, they were given a ripe cell or virgin queen.

The grafting methods used were those of previous years which consisted in priming a wax lined wooden cell cup with a drop of royal jelly diluted with an equal volume of water and then transferring a two-day-old larvæ into it.

The matings were from single and double mating-boxes, and the top supers of normal colonies which were entirely separated from the rest of the hive by either the quilt or a specially constructed division board. With the use of the quilt, the hive cover should be raised slightly to provide an entrance but with the specially constructed division board no entrance above is required. The "Queenless Broodless" method of starting the cells was again used this year. The procedure with this method is to feed the colony for two or three days prior to giving the grafted cells. Then on the third day, the day on which the cells are to be grafted, the hive is opened, the queen found and set aside, and all the bees shaken in front of a new hive on the old location which has previously been equipped with two frames of pollen and honey and eight drawn combs. This hive is then closed and the bees allowed to remain quiet for two or three hours to realize their queenless and broodless condition. The queen

with the brood and a few bees is next placed into the old hive which is faced in the opposite direction and allowed to remain there while the cells are being started.

After the cells are grafted, they are given to the queenless broodless colony and remain there until the following day; then they are removed and given to the finishing colony. This colony also undergoes a certain amount of preparation which consists in raising emerging brood to a top super and if nothing is coming in, in feeding the bees of the colony for two or three days prior to giving the started cells.

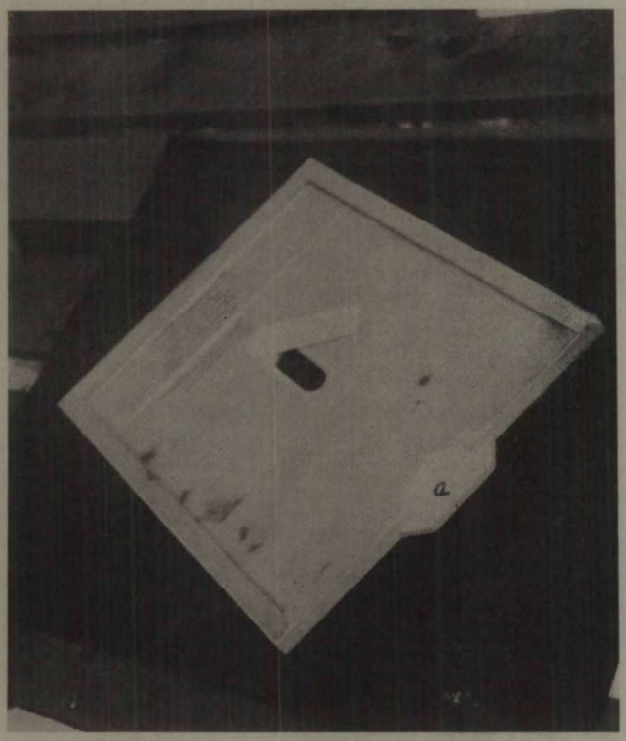

FIG. 2.—Board used beneath super from which queens are mated. Entrance at (a). Central hole to allow bees to unite after the mated queen is removed.

Of the 193 cells started by this method during the past season 156, or 80 per cent of those grafted, were finished. Some of these were placed in the mating-boxes, others into the "top supers" and the remainder into the nursery cages. Though the percentage of cells finished was good, the same cannot be said of the matings, for only 98 queens mated from mating-boxes, thirty-seven from top supers and five from normal colonies; that is but 51, 54 and 80 per cent respectively. Practically all the mated queens were used to requeen the colonies in the Ottawa yard or those in the outyard at Britannia.

TWO QUEEN SYSTEM

Nearly every year, at the first examination in the spring, we find that there are some colonies with drone producing or failing queens present or without a queen at all.

Under ordinary circumstances, this would mean that the colonies so affected must be united, for it is next to impossible to secure a queen so early in the season. To overcome this difficulty and save the colony, it has been the practice at Ottawa, for a number of years, now, to winter spare queens by the method called "The Two Queen System."

This system consists in housing two queens in one hive for the winter. As the queens must be separated, the hive is divided lengthwise by a bee-tight division board, care being taken to see that at the rabbet no space is left through which a queen might pass. This system may be started either about the time of requeening or just prior to feeding, when weak colonies are united. In the first case, the old queen which is removed from a normal colony at requeening time, is taken with two frames of brood and placed into one of the compartments of the above mentioned divided hive. In the second case, just prior to feeding, instead of uniting weak colonies, that is those covering less than five combs, they are placed into the compartments of this twin hive. Though not recommended, it is also possible to divide a normal colony and to place one half in each compartment. When this is done, however, it is absolutely essential that the old queen be removed from the hive and two strange ones be introduced; otherwise, the old queen will be permitted to live but the strange one will be killed.

By this system, during the winter of 1928-29, sixteen queens of which eight were spares, were carried over in eight of such hives, six of these doubles wintering outside and two in the cellar. At the first examination in the spring, it was found that all the queens were alive and had not some spare queens received with packages been used in place of them, four would have been required to save colonies, which later produced over 400 pounds of honey.

As the saving of these four colonies represented with honey selling at say 10 cents a pound forty dollars, it will be seen that having a few spare queens in the spring to meet such conditions is entirely worth while.

CARNIOLAN VERSUS ITALIAN BEES

At the close of the main honey flow, the six years test to determine the comparative value of Carniolan and Italian bees ended.

Considering first of all, the results of this experiment for the past season, we find that at the last examination in the fall of 1928 all colonies of both the Carniolan and the Italian groups were very strong. As these colonies were housed in double walled hives, the work of preparing them for the winter was reduced to a minimum. On September 20 each colony was given for its winter stores a deep super of honey which later, on September 28, was augmented by 2 ten-pound pails of sugar syrup. The final packing, however, was not put into place until October 22, at which time also the wind break, of a similar type to that used by the railroads, was set up.

Nothing further was seen of the bees until May 10, when at the first examination the Carniolans appeared to have more combs covered by both bees and brood than did the Italians But though on June 11, just before the beginning of the main flow the Carniolans were still the stronger, they had lost this lead before the next examination, nine days later. The flow, which this season, according to the colonies on scales, began on June 12 and ended on July 28, was much earlier than is usual in this district.

The Italian bees which took the lead on June 20, as above mentioned, retained it throughout the remainder of the season and finally harvested the larger crop The crops produced were: for the Italian group 863 pounds 8 ounces and for the Carniolan one 797 pounds 8 ounces or an average of 215 pounds 14 ounces and 199 pounds 6 ounces respectively. Though all the colonies were

wintered in two deep hive bodies which early in the spring gave ample room for brood rearing, two of those in the Carniolan group were found on June 11 to have started queen cells, and on the same date a third swarmed but was returned. Among the four colonies in the Italian group there were no attempts made to swarm throughout the season. And one colony in the Carniolan group also went through the season without making any preparations to swarm It should here be noted that this colony gave a higher crop than any other colony in the Italian group or Carniolan one In the colonies, above mentioned, that had cells present on June 11, though both queens were one year old, one superseded and the other failed and later was missing. The colony that swarmed and was returned made no further preparations to swarm but went to work and harvested the second highest crop of the Carniolan group which amounted to 219 pounds 8 ounces

In the following table will be found the Honey Crops produced in the six years:—

Comparison of Honey Crops from Carniolan and Italian Bees

Races of bees	Number of colonies	1924		1925		1926		1927		1928		1929	
		Total crop	Average crop	Total crop	Average crop	Total crop	Average crop	Total crop	Average crop	Total crop	Average crop	Total crop	Average crop
		lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Italians	4	765 4	191 5	900 0	225 0	417 0	104 4	727 8	181 14	465 8	116 6	863 8	215 14
Carniolans	4	348 0	87 0	825 4	206 5	292 8	73 2	479 8	119 14	234 0	58 8	797 8	199 6

Besides making a comparison of the races of bees, a system of management to prevent swarming was tried out. This system consisted: (1) in giving a second brood chamber when the queen needed more room, (2) in dividing the double brood chamber to facilitate the finding of the queen, and (3) in separating the queen and the brood. Though this outline is much like that of last year, the details are different.

As the colonies wintered in double brood chambers, they had ample room for brood rearing and on May 30 they were each given a deep super for the storage of honey On June 20, all double brood chambers were divided to facilitate the finding of the queens; that is, the upper half of each brood chamber was raised to the top of the hive with an excluder below while the lower half also was shut off from the rest of the hive by an excluder. On July 6 all the queens were put below in supers of empty combs and the brood chambers they were last in were placed above them with excluders between. With the queens so close to the supers of raised brood, it was found that no queen cells were started in five out of eight colonies in the experiment. As the four Carniolan queens which were introduced to their respective colonies on July 17, 1928, were all young ones and as two of the three which did not respond to this system failed very early in the season, one is lead to suspect that a large percentage of the imported queens do not wear so well as do those reared in this country, despite the fact that these queens at the first examination on May 10 headed strong colonies.

Summarizing the work of the past six years, we find that one group of bees wintered as well as the other During the first winter the Carniolans were in the cellar, while the Italians wintered outside; then both groups were outside in quadruple cases for the next three winters and in double walled hives for the last two. In the spring at the first examination, though each group lead in

strength for three out of the six years, the Carniolans seemed to start to build up earlier than did the Italians, but throughout the season the Italians seemed to settle down to work better as shown by their uniform increase in strength. In so far as swarming is concerned, though a double brood chamber of twenty Langstroth combs should be large enough for the most prolific queen, it was found that the swarm preparations of the Carniolan group were not only more persistent but also far exceeded those of the Italian group. It will be seen therefore, that while the Carniolans were wasting a great deal of their energy in making preparations to swarm that the Italians were foraging ahead with well-directed efforts in gathering and thus producing the higher crop in each of the six years of the experiment.

PACKAGE BEES AS AN AID TO WEAK COLONIES

Does it pay to assist weak colonies in the spring by the addition of package bees? In order to answer this question, in so far as it applies to this locality, the experiment to determine to what extent such treatment increases the honey crop and weather it is a profitable one was continued during the past season. The first step in this experiment was taken toward the end of the main honey flow of the previous season when a number of two-frame nuclei, "the weak colonies," were made. These nuclei which built up to five frames came through the winter without loss, and when examined on April 27, the bees in each covered approximately 4½ combs. On April 29, two days later, 12 two-pound packages were received from the south in excellent condition. The instructions for the shipment of the queens with these packages were this year similar to those of last year, namely that six of the queens should be shipped in dry cages without attendants and that the other six should be in provisioned cages and have attendants Of these queens, which were received in seemingly good condition, there were remaining at the end of the season, on July 24, six of the former and but one of the latter This shows up the dry method of shipping queens in a very favourable light

Regarding the bees of the packages we would say that upon their arrival they were immediately placed in the cellar and fed a thin sugar syrup which was painted on the wire screening of the cages. They were then left for a time in the cellar to quiet down after which they were taken out into the apiary and united to the weak colonies. Five of the packages received were used to assist weak colonies. The method of uniting them was: first, to place the combs covered by the weak colony at one side of a ten-frame standard hive, leaving sufficient room for the placing of the shipping cage along side. After the feeder can and queen cage were removed, the shipping cage was inverted and placed in the space left for it, care being taken to raise it slightly so that the bees could leave and unite with those of the weak colony. This they did without any trouble arising. It should here be stated that both the assisted and unassisted weak colonies were located far from their original location that neither one nor the other could be favoured by any drifting or returning. The unassisted weak colonies or check colonies, of which there were five, were equal in strength to the assisted ones before the addition of the packages. Of the seven remaining packages, though five replaced winter losses and two became new colonies, all are considered as straight packages in the following table of results.

The results of the different groups are shown in the following table:—

RESULTS FROM DIFFERENT GROUPS

Assisted colonies							Unassisted colonies							Straight packages						
Number of colony	Number of combs covered by bees on April 27	Weight of bees added	Number of combs covered by bees on June 11	Number of combs covered by brood on June 11	Crop		Number of colony	Number of combs covered by bees on April 27	Weight of bees added	Number of combs covered by bees on June 11	Number of combs covered by brood on June 11	Crop		Number of colony	Number of combs covered by bees on April 27	Weight of bees added	Number of combs covered by bees on June 11	Number of combs covered by brood on June 11	Crop	
		lb.			lb.	oz.			lb.			lb.	oz.			lb.			lb.	oz.
204	5	2	9½	8½	175	8	200	5	0	6	5	119	8	209	.....	.....	6	5	101	0
206	5	2	9	7	85	8	214	5	0	6	6	59	0	241	.....	.....	7	6	85	8
220	5	2	9	8½	106	8	249	5	0	5	4	79	8	246	.....	.....	6	5	107	0
236	5	2	9	7	151	8	259	4	0	7	6	144	0	264	.....	.....	10½	9	79	8
251	3	2	7½	5	40	0	280	3½	0	6	5	91	0	267	.....	.....	7	6	107	0
.....	....	....	....	....	.....		.....	....	....	....	....	.....		289	.....	.....	5	4	83	8
.....	....	....	....	....	.....		.....	....	....	....	....	.....		291	.....	.....	8	7	101	0
Total of Group.	23	10	44	36	559	0		22½	0	30	26	493	0		.....	.....	40½	42	664	8
Average....	4·6	....	....	....	111	12		4·5	....	....	....	98	9		.....	.....	.....	....	94	14

In considering the above table, we must bear in mind that the main honey flow began on June 12. Commencing, then, at the first of the season, we notice that on April 27, three days prior to the addition of the 2 pound packages, that the number of combs covered by the assisted and unassisted groups were practically the same, there being but a difference of half a comb between them. On June 11, one day before the flow began, it will be seen that the two groups were proportionally of the same strength. Although in the number of combs covered the assisted group had slightly increased the lead given it by the addition of about ten combs of bees, the number of combs of brood was exactly ten combs greater than those of the unassisted group. Next, comparing the crops of the two groups, we find what one would expect to find that the assisted group had produced the greater crop, but the excess is disappointing. As the difference between the crops of the two groups is but 66 pounds or an average of 13 pounds 3 ounces, the question as to what extent such treatment increases the honey crop is answered. To answer the second question as to whether the addition of package bees to weak colonies is profitable, we had only to figure out that 13 pounds 3 ounces of honey when sold at 15 cents a pound gives $1.98 or less than the cost of a package, to say nothing of the express charges, etc.

In our last year's report, attention was called to the fact that it was a poor year and that there was but the price of a 5 pound pail of honey or 75 cents profit. This year in this locality the crop was a really good one but instead of a profit being made by the assisted colonies as was expected, they made a loss; that is, they only paid for slightly more than half the cost of the 2 pound packages.

Attention is next directed to the results of the straight packages which harvested slightly less than did the unassisted weak colonies. It will be seen that they were profitable, for 94 pounds 14 ounces at 15 cents will give $14.23.

As the weather during the month of May and the first half of June was unfavourable to the building up of colonies it would seem that the package bees did little more than provide extra heat which in turn stimulated their queens to slightly increase the brood production.

COMPARISON OF DIFFERENT SIZED HIVES

The comparison of different sized hives to determine to what extent the size of the hive affects the work of the colony was continued this year. The three different sized hives, which were used and for which advantages are claimed by those favouring them, were the 11-frame Dadant, the 10-frame Jumbo and the 10-frame Langstroth. In this experiment there were eight of each of the above styles of hive or three groups containing in all twenty-four hives.

As in the preceding years, so in this year, the colonies in these groups were run on a commercial basis, special note being taken regarding their building up propensities, swarming and crop production.

Reviewing the work in connection with this experiment from the beginning of the beekeeper's year, we would say that half of the colonies in each group were requeened towards the end of the main flow. From then until the winter preparations began, each colony had in addition to the brood chamber a super of stores, as in this district there is little or no fall flow. After all colonies were reduced to single brood chambers, they were weighed on September 24 to determine the amount of stores needed. On September 26 the hives were placed in four colony cases and were packed underneath with 3 inches of planer shavings and about the sides with 4 inches, the top packing being left off until after the colonies were fed. Feeding began on September 27 when all received a two to one sugar syrup after which on October 1 the top or final packing was put in place. Besides being protected from the cold weather by the winter cases, the colonies were also protected from the piercing winds by wind-breaks which surrounded the apiary on all sides.

Considering the manner in which the colonies came through the winter, we find on September 26, 1928, when the last examination was made that the Dadant, Jumbo, and Langstroth groups covered an average of $9\frac{1}{4}$, $8\frac{1}{2}$ and $8\frac{5}{8}$ combs respectively, and on May 10, 1929, at the first examination that the number of combs covered was $5\frac{1}{2}$, $6\frac{7}{8}$ and $6\frac{7}{8}$.

The manner of wintering having been determined, the colonies low in strength, of which there were some in each group, were given assistance in order that all should start as alike in strength as possible for the producing season.

The procedure throughout the season was to examine all the colonies every eight, nine or ten days, at which time notes were taken as to their strength, building up propensities, swarming tendencies and anything which might have a bearing on results.

When it was found early in the season that any colony of the Langstroth group was in need of room for brood rearing a second brood chamber was given. As both the Dadant and the Jumbo hives are supposed to be large enough for the most prolific queen, no additional room for brood rearing was given to colonies in either of these groups.

In the following table will be seen the strength in bees and brood of the different groups at the periodic examinations during the season:—

COMPARISON OF THE STRENGTH OF GROUPS

Date	Average number of frames covered by bees			Average number of frames of brood		
	Langstroth	Jumbo	Dadant	Langstroth	Jumbo	Dadant
June 11	9·2	9·1	7·6	7·6	6·2	6·0
" 19	10·6	9·6	8·4	8·8	7·0	6·5
" 27	13·8	11·0	10·6	9·3	7·5	6·8
July 5	16·7	17·2	14·2	11·6	7·9	7·3
" 15	20·2	20·9	16·5	10·2	8·3	7·7
" 24	18·7	18·9	14·9	7·9	8·3	7·1

From the above figures it will be seen that the Langstroth group lead in the number of frames covered by bees from June 11 to 27 and in the number of frames of brood from June 11 to July 15. Then the Jumbo group took the lead in both bees and brood and retained it during the remainder of the season. Though attention is called to the fact that the Langstroth frames are shallower than those of the other hives by approximately 2 inches, it does not necessarily follow in all cases, that there was more brood present in the larger combs.

During the season swarm preparations were begun in the Dadant and Jumbo groups but none in the Langstroth; that is, in three colonies of each of the first two mentioned groups queen cells were found and destroyed. This treatment prevented any further attempts to swarm in all but one colony, a Jumbo, which cast a swarm on July 15.

Although the crops in this district for the past 3 years have been poor, this year's crop was a good one.

Considering the crops produced, we find that the largest crop was harvested by the Jumbo group with the Langstroth group second. The amount produced by the Jumbo colonies was 1,162 pounds 4 ounces, by the Langstroth ones 929 pounds 12 ounces and by the Dadants 798 pounds, or an average of 145 pounds 4 ounces, 116 pounds 3 ounces, and 99 pounds 12 ounces respectively.

In the following table will be found the results of this experiment for the past five years:—

COMPARISON OF HIVES

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.	
1925							
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

*Highest crop.

STRENGTH OF FIELD FORCE

Since the ultimate object of all the preparations made during the year in the apiary is to secure as great a force of field bees as possible to harvest the crop, tests were continued this year to determine what the approximate number of bees in such a force would be. This experiment, which has now run for the past five years, is based on the principle that field bees will return to the location to which they have become accustomed.

The first test of this season was made on July 10, which date coincides with the first test made in 1928. At this time the bees were working heavily on alsike, White Dutch and sweet clover from which they were harvesting approximately 8 pounds a day. The second and third tests were made on July 17 and 23 on which days the bees were still working on the above mentioned sources.

The details of the procedure, which were similar to those employed in the preceding years, were as follows: On the day preceding the test, the colony was prepared by placing the queen with two frames of brood and eight empty combs into a super which was placed above the hive but which was separated from it by a queen excluder and a bee-escape.

Early next morning, the hive was drawn backward several feet and turned so that it faced at right angles to the direction it formerly did. Then the super containing the queen was removed and set on the old stand with sufficient supers added to give it the appearance of the old hive.

Before any field bees had a chance of leaving the parent colony, it was weighed. As all the preparations were made without disturbing the bees, they flew directly to the field and later returned to the new hive on the old location, thus gradually depleting the field force of the parent colony until all were gone. The first thing next morning, the weight of the parent colony was again taken. From the difference obtained between the first and last weighings the number of field bees was figured, allowing 5,000 bees to the pound.

In the following table, the figures for the five years during which this experiment ran, are set forth for comparison.

STRENGTH OF FIELD FORCE

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

In the above table it will be seen that the figures over the five year period during which this experiment ran are fairly consistent and that the average field force contained 33,461 bees. Attention is called to the fact that this average figure coincides with that obtained by other investigators. It must be remembered, however, that the above figures are approximate since they are calculated from weights taken by a scale which read to quarter ounces.

TOP ENTRANCE HIVES

Further work in connection with the testing of the "Top Entrance" hive was done during the past season. This work began on June 12 when four strong colonies were equipped with top-entrance boards. Each hive consisted of the brood chamber above and three deep supers below.

Examinations were made every nine or ten days at which time in addition to the ordinary notes taken, special note was made of the amount of brood

present and where it was located. Last season much trouble was experienced at the examinations by incoming bees searching for the entrance which had been removed to get at the lower chambers. This season a special stand was used on which the brood chamber was placed after it had been examined to catch the returning bees. This method worked fairly well but it necessitated extra work in moving the stand from one colony to another. As the season advanced it was found that the queen extended her brood nest into the lower chambers until it was scattered in several supers. In one case every chamber in the hive contained brood. This, as can well be imagined caused much trouble in sorting the combs when the crop was removed.

FIG. 3.—Hives fitted with top entrance.

Though last season considerable trouble was experienced when the entrances were lowered in the process of removing the crop by robber bees finding the entrance more quickly than did the bees of the colony, this season there was no such trouble.

In the following table is shown the crops produced by colonies in "Top Entrance" hives and in lower entrance ones during the past three years:—

AVERAGE CROPS OF TOP ENTRANCE AND LOWER ENTRANCE HIVES

1927				1928				1929			
Top entrances		Lower entrances		Top entrances		Lower entrances		Top entrances		Lower entrances	
lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
88	12	99	11	35	0	50	6	80	10	120	0

In the above table it will be seen that in each of the three years of the test the colonies in "Top Entrance" hives harvested less than did those in the lower entrance ones.

MIDDLE ENTRANCE HIVES

Tests were continued during the past season to determine how an entrance located above the brood chamber, the middle entrance, compares with one given below. In this experiment, there were four different kinds of entrances tried, which were all so constructed that though queens, drones and worker bees could leave the hive, only workers could enter the supers. On June 12, the experiment began with the giving of the middle entrances to eight colonies, there being two

FIG. 4.—Hives fitted with middle entrances.

to each style of entrance. The usual nine or ten day examinations were made during the season when careful note of each colony's condition was taken. Though one colony swarmed owing to what was thought to be too small an entrance and another had the front of the hive occupied by brood and the back part by honey, the remainder acted normally and harvested all together a crop of slightly higher average than that produced by the lower entrance hives. The average crops were 129 pounds 6 ounces and 120 pounds 0 ounces respectively.

WINTER CASES WITH UPPER ENTRANCES

As the results of wintering in an upper entrance case were so satisfactory for the winter of 1927-28, it was decided to increase the number of colonies when continuing this experiment last winter.

On September 26, twelve colonies, or eight more colonies than last year, were placed into winter cases and fed, after which on October 11 they were given upper entrances and top packing. Though a couple of colonies showed signs of restlessness during the winter, they all came through in good condition and on May 10, at the first examination, they averaged 6·0 combs covered by bees, which was practically the same as those colonies in lower entrance cases.

Again, it was noticed that there were fewer dead bees below the upper entrances than there were at the lower ones.

This experiment is being continued during the winter of 1929-30.

BROOD COUNT

This experiment was referred to in last year's report as being under way. It is a continuation of the "Brood Count" work formerly done by this division in which both open and capped brood were considered but differs from it in that it has to do with only capped brood.

The object of this experiment is to determine from day to day the actual number of young bees that emerge in a normal colony. With this object in view, work was begun early in the season but owing to complications arising it was not properly under way until June 21. At this time, to determine the temperature in the brood chamber of a normal colony, a hole was drilled through the wall of the hive and a chemical thermometer was inserted.

In this experiment the brood of two normal colonies was used at a time.

One lot of brood was placed into a super with wire gauze bottom and set over the brood chamber of a strong colony to be incubated by the heat from it. The second lot was placed into a home-made electrical incubator controlled by a thermostat to incubate there. As it was found that the temperature of the brood chamber in which the chemical thermometer was placed was 96° F. with but few variations, the thermostat of the incubator was set to give that temperature.

Daily counts of the young bees which had emerged in 24 hours were made, between June 21 and August 25, from seven batches of brood. Also at the end of each batch, when all had emerged, counts were made of the dead bees remaining in the cells.

The counts of the first two batches of brood began on June 22 and lasted for thirteen days, or until July 4, but the results were rather disappointing, as the percentage of dead present was very high. From the batch of brood above the normal colony, 4,610 bees emerged while 5,927 died in their cells. In the incubator the results were slightly better, as 5,621 emerged and 4,370 died. From the above it will be seen that had all emerged, the daily average emergence would have been 878 and 832 respectively.

As it was thought that the heavy mortality in the incubator was caused by lack of moisture, pans of water to overcome this difficulty were installed.

The second two batches of brood ran for fifteen days, that is, from July 9 to 23, and were more encouraging, though there was still a high death rate. From the combs above the normal colony 17,636 bees emerged and 5,207 were removed dead, while in the incubator 20,907 emerged and 3,071 died. Figuring the above, we find that had all emerged the average daily emergence would have been 1,903 and 1,998 respectively or nearly 2,000 a day.

The third sets were counted for fifteen days, from July 25 to August 8. During this period there were a number of cold nights which seemingly affected the emergence above the normal colony. Here the emergence was 8,102 and the dead 6,968; while in the incubator 15,557 emerged and 2,679 died. Figuring as before, we make the average emergence 1,255 and 1,519 respectively.

Owing to the nights becoming too cool to continue hatching brood above the normal colony, this method of incubation was abandoned but the incubator was used for one more batch which ran for sixteen days, from August 10 to 25. During this period 11,770 emerged and 3,452 died. Again, had all emerged the daily average would have been 1,268.

For comparison's sake, the above figures are tabulated below:—

DAILY EMERGENCE OF YOUNG BEES

Location	June 22 to July 4				July 9 to July 23				July 25 to August 8				August 10 to August 25			
	Alive	Dead	Total	Average	Alive	Dead	Total	Average	Alive	Dead	Total	Average	Alive	Dead	Total	Average
Above normal colony.	4,610	5,927	10,537	878	17,636	5,207	22,843	1,903	8,102	6,968	15,070	1,255	.....	.....	.....	.....
In incubator.	5,621	4,370	9,991	832	20,907	3,071	23,978	1,998	15,557	2,679	18,236	1,519	11,770	3,452	15,222	1,268

From the above work it will be seen that all the capped brood does not emerge within the twelve-day period, as there was brood seen emerging on the thirteenth, fifteenth and sixteenth days. Then there is the question as to whether all the capped brood does emerge under normal conditions or whether there is a high percentage of it that dies. It is hoped that work with reference to this question will be taken up next season.

As it is interesting to see the variations in emergence, the accompanying chart shows what was found between July 9 and 23 by actual count.

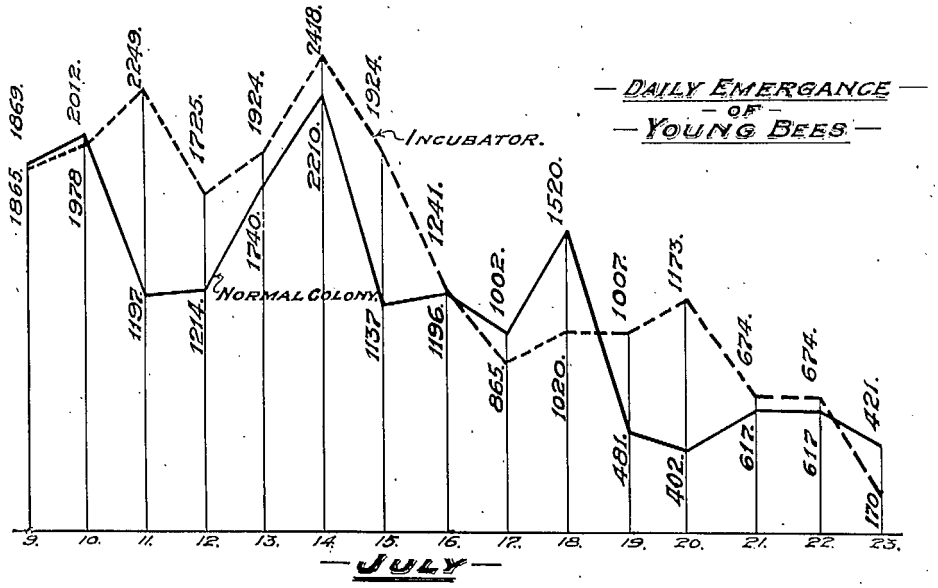

FIG. 5.—Chart showing daily emergence of young bees, solid line in normal colony, broken line in incubator.

It would seem from the chart that the first seven days' count is likely correct, but that the latter part, where there is a falling off in emergence, is not correct owing to lack of moisture or drying of the brood. Steps to overcome this difficulty will be taken next season when the experiment will be continued.

EVAPORATION OF NECTAR

An experiment to determine the amount of evaporation which takes place in the nectar harvested by a normal colony was started at the first of the main flow. Four colonies on scales were used.

The procedure in this experiment was to take the weights of the colonies during the flow, the first thing in the morning and again the last thing at night; thus it was hoped to get the gains made during the day and learn something about the evaporation during the night.

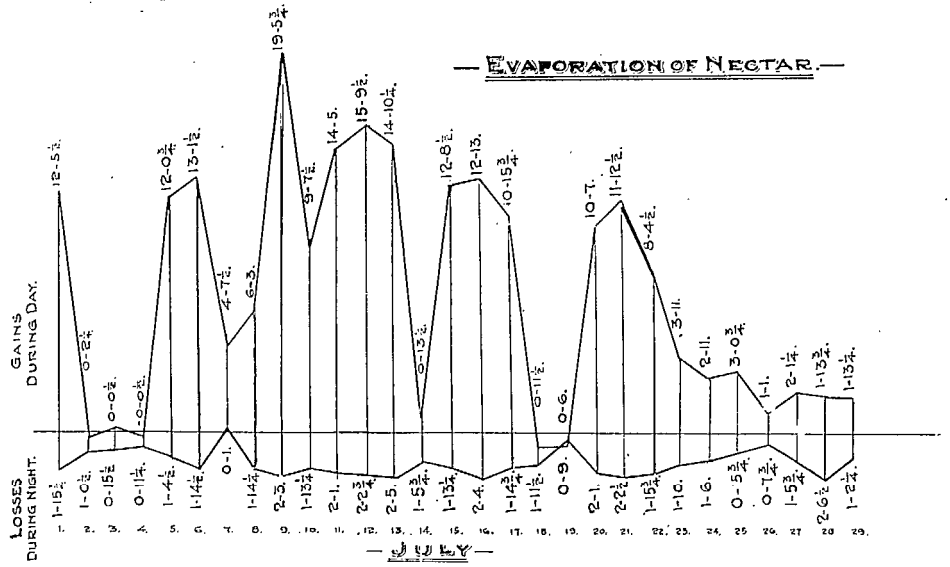

FIG. 6.—Chart showing daily gains and nightly losses made by a colony on scales during July, 1929.

The accompanying chart shows graphically these gains by day and losses by night. Further work will be done on this project next season.

DISEASE

Fewer samples of brood for examination were received this year than for the past three years. During the year there were in all forty samples received of which sixteen were infected by American foulbrood, seventeen by European foulbrood and seven in which no disease was found present.

There is no charge for making these examinations and a beekeeper is well advised, when he discovers any abnormal brood in his yard, to send a sample of it to the Bee Division, Central Experimental Farm, Ottawa, for analysis.

Such a sample should never be sent in a tin box unless it contains many nail holes to provide ventilation; otherwise it will arrive in too filthy a condition to do anything with. As a package addressed to this Division goes through the mail free of charge, all that is necessary is to address it plainly and mark it O.H.M.S. in the upper right hand corner where stamps are usually placed, not forgetting, of course, to state the name and address of the sender.

In the following table will be found the number of samples handled during the past nine years:—

SAMPLES OF DISEASE EXAMINED

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

WINTERING

The number of colonies wintered by this division during the year 1928-29 in the apiary at Ottawa and the out-yard at Britannia was one hundred and seventeen.

Of those at Ottawa, ninety-five were wintered outside in various kinds of cases and fourteen were placed into the cellar. In the outyard at Britannia, eight colonies passed the winter in double-walled hives.

The first step in preparing the bees for the winter was made toward the end of the main honey flow, when it was seen to that each colony was headed by a vigorous queen in order that there might be as great a force of young bees as possible produced before the cold weather set in. Then in late September, feeding was begun, at which time all colonies received sufficient stores to carry them through the winter and early spring.

OUTSIDE WINTERED COLONIES, 1928-29

On September 24, all outside colonies were weighed and two days later, on September 26, they were placed into their winter cases. The kinds of cases used were the four, the two and the one colony cases besides which there were permanently packed hives. In the four-colony cases of which there were seventeen, sixty-eight colonies were housed; in the 6 two-colony, twelve, and in the one-colony, fifteen.

The last mentioned group contained: four Kootenay, one Krause and six Ottawa cases also two Chrysler and two Special double-walled hives.

When the hives were placed in the winter cases on September 26, they were under and side packed with planer shavings after which they were fed. Each colony was given an amount of sugar syrup to make up what was deficient in the stores of the hive, but no colony received less than 3 ten-pound pails of syrup.

There were, however, five exceptions, two of which received honey and three a special product called "Nulomoline" later to be reported on. When feeding was completed, on October 11, the top packing of 6 to 8 inches of planer shavings was put in place.

The winter of 1928-29 may be termed a mild one and though the colonies as a whole wintered well, there was a loss of five colonies. Four of these died from the effect of too much packing; they being wintered in a case with 6 inches of packing about the sides; the other loss being one of the group fed "Nulomoline."

At the Britannia yard all colonies were wintered in two hive bodies, the lower one being a special permanently packed hive with 4 inches of shavings about the sides. Each of these colonies received natural stores on September 20 when a full depth super of approximately 58 pounds of honey was given; later, on September 28, this amount was supplemented by two 10-pound pails of sugar syrup.

Further protection was given in the form of windbreaks. These were temporary board fences similar to those used by the railway companies. They protected the apiary on the north and west from the cold piercing winds.

At the first examination on May 10 the average number of combs covered by bees was 6·3.

The special product "Nulomoline," an invert sugar, referred to above, was fed to three colonies, each receiving approximately 5 ten pound pails full. On March 25, it was noticed that there was very heavy mortality of bees about the case containing these three colonies, and later in the spring one of the colonies was found dead. At the first examination, on May 10, one of the

remaining colonies was mediumly strong and the other weak. As this product was not only inferior to sugar syrup but also was more costly, it is not recommended as a food for bees.

One of the four-colony cases in the apiary at Ottawa was constructed large enough to allow for 6 inches of packing about the sides, and has for the last two winters contained colonies in two deep hive bodies.

During the winter of 1927-28, it was noticed that the bees in this case were very uneasy, and in the early spring, that there was a heavy mortality about the case. Last winter, the bees were again noticed to be very restless and in the spring the four colonies, all in the same case, were found dead.

The bad wintering is attributed to the excessive packing causing the bees to carry on brood rearing late in the fall in the place of clustering and resting as other colonies were doing.

CELLAR WINTERED COLONIES, 1928-29

The weather in November was very unfavourable to bee-flight, there being but four days on which any bees flew and but one, November 14, on which they flew well.

The cellar colonies of which there were but 14 were weighed on September 24 and two days later, on the twenty-sixth they received the first of their food. All colonies were given sugar syrup, as this is considered the safest food for bees wintered in the cellar, and on November 20 they were carried into the cellar.

During the twenty-two weeks that they were confined there, the temperature maintained was approximately 45 degrees Fahrenheit. On April 22, one hundred and fifty-three days after the bees were placed into the cellar, they were removed without loss and set on their summer stands.

At the first examination, on May 10, the average number of combs covered by bees was 6·1.

COLONIES WINTERED IN 1929-30

While there are 114 colonies wintering outside this year there are none being wintered in the cellar owing to practically the whole cellar being given over to another experiment. As in other years so this year, the procedure in preparing the bees for the winter was: to weigh the hives, to place them into the cases, to pack them underneath and about the sides, to feed the colonies and finally to put the top packing into place. The majority of the cases in use are similar to those used last year, namely the four, two and one colony; there are, however, a few new designs such as a double-walled hive of very simple construction and cases made of ten-test. Besides which there is a cotton tent enclosing a single colony case on scales to get the daily losses in weight throughout the winter.

Further tests are also being made with upper entrance cases.

HONEY INSPECTION

This division has continued to inspect that honey being exported from Canada. The total amount of honey inspected during 1929 amounted to 911,880 pounds.

In order to standardize the quality being shipped to the export trade it was found necessary to regrade at least 29 per cent of the honey inspected, while more than 13 per cent of this honey was actually unfit to be placed on any except a manufacturers' market on account of its dirty or otherwise unsatisfactory condition.

A colour chart which is designed for use in grading granulated honey has been developed. This chart greatly facilitates the grading of honey in the granulated form. However, where there is doubt as to the grade of a honey it is necessary to liquefy it and grade it in the liquid form.

GRADES AND REGULATIONS GOVERNING HONEY FOR SALE ON DOMESTIC MARKETS

This division was requested to proceed to draw up grades and regulations governing the sale of honey on the domestic markets. The work entailed the acquisition of a great deal of information. First it was necessary to obtain the opinions of the beekeepers' representatives in each province and especially the recommendations of those provinces which had asked for the establishment of grades, in order to ascertain what form the regulations should take and what standards they wished applied.

The following questionnaire was sent to the beekeepers' representatives in each province:—

1. Is the classification of honey into colour classes desirable?
2. Is grading for quality within such classes desirable?
3. If one or both are desirable, how many classes or grades are needed?
4. Is it advisable to allow the beekeeper to do his own grading according to set standard and to have government inspectors to see that it is enforced, or to have the government do the actual grading?

The acts and regulations governing the Acts of the Live Stock Branch, the Fruit Branch and the Dairy Branch which are concerned with the sale of those products on the domestic markets were carefully reviewed and the officials of each branch directly connected with the operation of those Acts were consulted.

It was then decided to approach the retail and wholesale trade in order to ascertain what their reactions might be to the establishment of a system of grading on honey. To this end a preliminary inquiry into these traders' opinions was made. A fairly extensive report on these opinions was obtained by personal interviews with individuals in Montreal, Toronto and Ottawa. The result of these inquiries was encouraging. Practically all these traders were strongly in favour of any action that would encourage more orderly marketing of honey.

With the foregoing information on hand standards for Canadian honey and regulations concerning its sale on domestic markets are being drafted.

EXPERIMENTAL

An extensive survey of the qualities and properties of Canadian honeys and the effect of certain environmental influences on its keeping qualities was commenced. This work is being done in conjunction with the Bacteriology and Chemistry Divisions.

To this end a large number of samples of honey were obtained from representative honey producing districts in the Dominion. These samples are to be analysed both biologically and chemically while their duplicates are being stored under observation.

Seventeen samples, each divided in forty-eight parts, were obtained from seventeen branch Farms. These samples are to be analysed both biologically and chemically and stored under various controlled conditions.

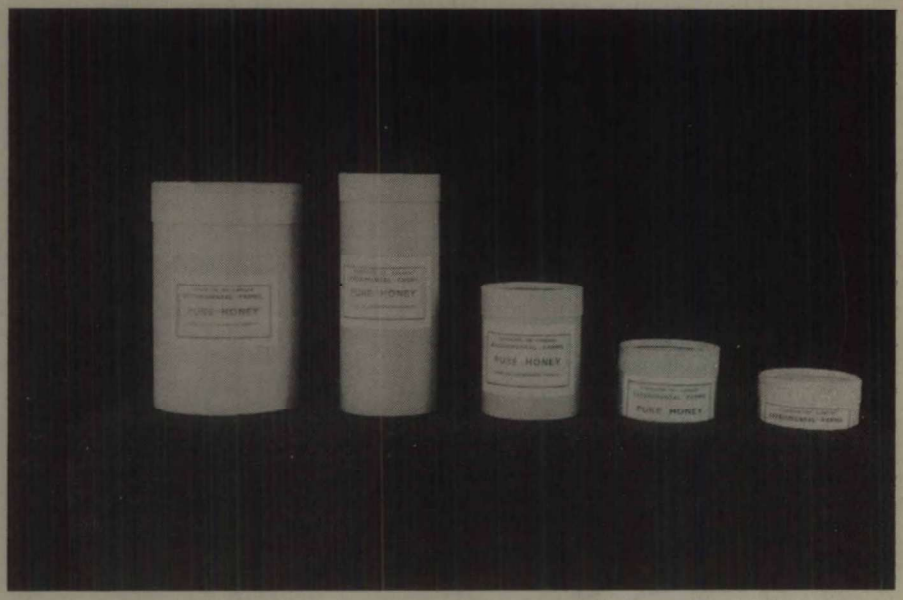

FIG. 7.—Fibre containers for honey.

The suitability of the above illustrated containers for honey was tested out by this division. They appear to be wholly satisfactory from the standpoint of honey containers. It remains to be established whether this form of package for honey would be popular on the market.

The prices on this type of container in the small sizes—½ pound, 1 pound and 2 pound—compare favourably with those of other containers.

MISCELLANEOUS

During the year a visit was paid to some of the branch Farm apiaries in Eastern Canada, and a few days 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 of Quebec, Ontario, Manitoba and Saskatchewan also at various other beekeepers' meetings. Assistance was also given at Short Courses held at Guelph, Winnipeg, Saskatoon and Regina. During the year 24,997 apiary reminders were sent out as well as other information pertaining to beekeeping. A reprint of Bulletin No. 33, " Bees and How to Keep Them," was also found necessary, and a manuscript for a new pamphlet entitled " Package Bees and How to Install Them " was prepared and submitted.

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