DOMINION OF CANADA
DEPARTMENT OF AGRICULTURE
DOMINION EXPERIMENTAL FARMS

BEE DIVISION

PROGRESS REPORT OF THE DOMINION APIARIST

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

FOR THE YEARS 1931, 1932 and 1933

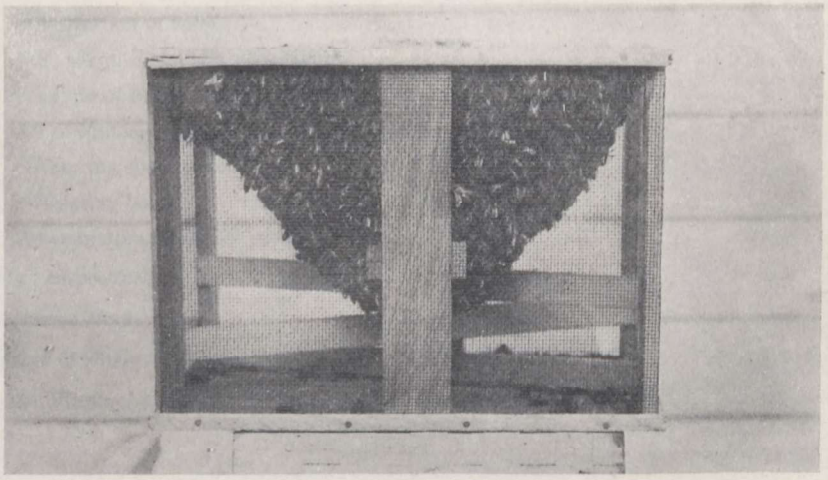

FIG. 1.—A two-pound package of bees as it was received after a four days' train journey.

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REPORT OF THE BEE DIVISION

1931-1933 INCLUSIVE

INTRODUCTION

This report summarizes briefly the work done by the Experimental Farms apiaries during the years 1931 and 1933 inclusive. In the past the data collected at each apiary were published separately in the reports of the Farms at which the different apiaries were situated, but for economical reasons and for the convenience of those especially interested in beekeeping, it was thought better to bring the data concerning all the apiaries together into one report.

GENERAL

Following a steady increase in production during previous years, the peak was reached in 1931, when the total honey crop of Canada amounted to 29,666,097 pounds. Drought conditions during 1931, 1932 and 1933, together with severe winter-killing of major honey-producing plants in many parts of the Dominion, particularly in the Eastern Provinces, caused a heavy reduction in the crops of 1932 and 1933, these crops amounting to 19,470,500 pounds and 19,543,500 pounds respectively, a decrease of approximately 10,000,000 pounds. This reduction, however, had a beneficial effect on the marketing situation in that it enabled the producers to dispose of their accumulated surplus at increased prices. During the three years under consideration, the export markets remained quite satisfactory. In fact the amount of honey exported in 1933 exceeded that of any previous year and prices were slightly in advance of those previously obtained. During the same period more package bees than ever were imported from the Southern States, indicating that more and more interest is being taken in this particular branch of agricultural work.

EXPERIMENTAL WORK

Italian versus Caucasian Bees

OTTAWA.—For the purpose of testing the merits of these two races of bees under identical conditions of flow and management, a small out-apiary is maintained in a good honey-producing area six miles from Ottawa. This apiary consists of four colonies of Italian and four colonies of Caucasian bees, which are housed in permanently packed ten-frame hives of Langstroth dimensions and remain on the same site winter and summer. During the active season the apiary is visited once every nine or ten days, except when for special reasons supers are needed or requeening is to be done. In the fall the bees are fed by placing a deep super of clover honey on top of the hive and protecting it with lift and packing. Slatted windbreaks are placed around the apiary at the time of feeding or shortly after, and the bees are seldom seen again until the following spring.

No outright loss of colonies has occurred during the three-year period under consideration, but at the first examinations in the spring the Italian colonies were found to be the stronger in bees and brood, in spite of the fact that the Caucasians are considered to be the hardier bees.

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During 1931 and 1932 the Italians made no preparations for swarming, but in 1933 four of the five colonies developed queen cells but were prevented from swarming by manipulation. In 1931 and again in 1933 three of the Caucasian colonies built queen cells and one colony swarmed in 1931. During 1932 no colony made preparations for swarming. While the tendency towards swarming was slightly stronger in the Caucasians than in the Italians, in all cases but one, swarming was prevented by manipulation.

As the crop produced is the final criterion of value, table No. 1 is presented to show the production of the two races during the three years.

TABLE 1.—HONEY PRODUCTION OF ITALIAN AND CAUCASIAN BEES

Race of bees	Number of colonies	1931		1932		1933	
		Total crop	Average crop	Total crop	Average crop	Total crop	Average crop
		lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.
Italians	4	1,125 0	281 4	510 0	127 8	836 8	209 2
Caucasians	4	911 0	227 12	387 0	96 12	669 12	167 7
Difference		214 0	53 8	123 0	30 12	166 12	41 11

The above table shows that under conditions such as exist in the vicinity of Ottawa, the Italian bees showed themselves superior to the Caucasians as honey gatherers and, furthermore, they proved to be equally as hardy under severe winter conditions as the darker race of bees.

This question of races of bees has created considerable interest in the prairie provinces, therefore, in order to test their comparative merits under prairie conditions this project is also being started in the apiary at Brandon.

A Test of Hives of Different Sizes

OTTAWA.—A seven-year test to determine the comparative value of the ten-frame Langstroth hive, the ten-frame Jumbo hive and the Modified Dadant hive was completed at Ottawa in 1931.

Twenty-four colonies of Italian bees were housed in these hives, eight colonies in each size of hive. All the colonies were standing in the same apiary and were working under identical conditions during the whole period. During the winter months all colonies were packed in quadruple cases with four inches of planer shavings between the hives and the bottom and side walls of the cases and with an 8-inch cushion of the same material between the tops of the hives and covers of the cases.

During the summer months each colony was examined once every nine or ten days, depending upon weather conditions, in order to control swarming and to provide room for brood and nectar when necessary.

Table No. 2 shows the average strength of the colonies at the first and last examination of each season, together with the number of colonies from which swarms issued and the average crop produced by each group.

TABLE 2.—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
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
1931							
Langstroth	8	Outside	5·5	0	91	0	.....
Jumbo	8	"	4·4	0	87	12	....
Dadant	8	"	5·7	1	94	12*	....

* Highest crop.

Table No. 2 shows that the average colony strength of each group when packed away for winter was excellent and that it was also fairly good the following spring. It is true that considerable variation in strength existed between individual colonies of each group. Where this occurred, however, the weaker colonies were strengthened with bees and brood from the stronger ones. No direct loss of colonies occurred during the seven years.

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The table also shows that in so far as crop production was concerned the honours were about equally divided, no one group having a decided advantage over the others in wintering.

In the manipulation of the colonies it was found that the ten-frame Langstroth hive was not large enough in itself to provide sufficient room for a prolific queen, therefore, it was necessary to supply the queens in these hives with a double brood chamber. This was done by adding either a shallow or deep super, without a queen excluder, to the regular hive. This super was left as part of the brood chamber for the entire active season.

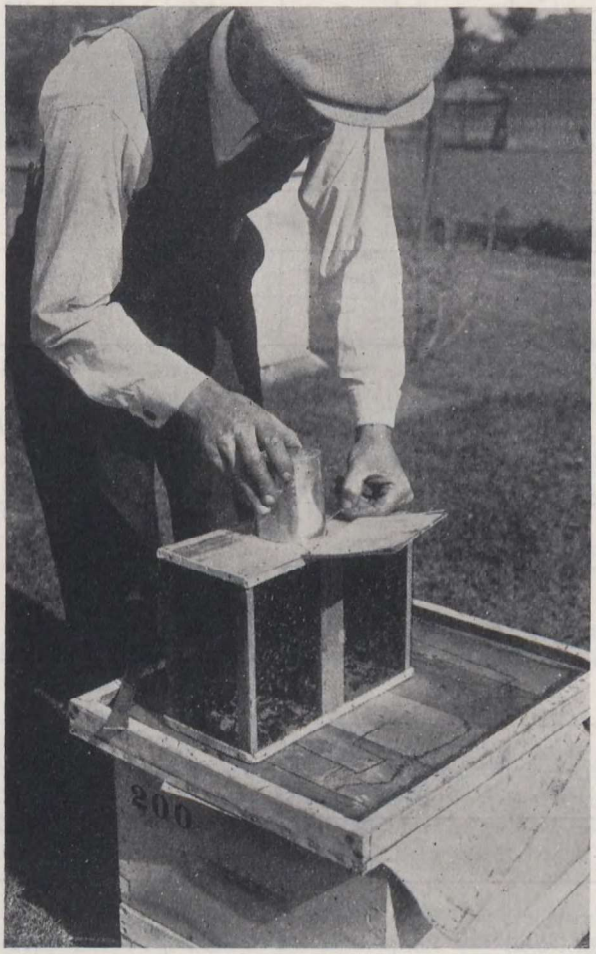


FIG. 2.—Removing the feeder can from a package of bees.

The full-depth Langstroth supers were used for the storage of nectar above the Langstroth and Jumbo hives, but special supers were used with the Dadant hive as this hive is of a width different from the standard. As the honey supers used over the Langstroth hives were of the same size as the hive itself it was possible to interchange combs between broodnest and supers when necessary. This was impossible in the other hives because of the difference in size of the brood chamber and supers.

The results of this project indicate that under Ottawa conditions the size of hive has little or no influence on wintering or the amount of honey produced, for no group showed a decided advantage over the others. The hive is merely the tool of the beekeeper and with a proper system of management one kind can be made equally as successful as the others.

LACOMBE, ALBERTA.—A six-year test with Langstroth and Jumbo hives shows that the average yield from the Langstroths was greater than that from the Jumbo hives and that the former were much more easily manipulated. It also shows that two brood chambers were necessary when using the Langstroth hive.

LENNOXVILLE, QUEBEC.—The eight-frame, ten-frame and twelve-frame Langstroth hives were used in comparison with the Jumbo over a period of three years with very little difference between the yields, the Jumbo hive giving the least.

MORDEN, MANITOBA.—In a test with ten-frame Langstroth and ten-frame Jumbo hives no consistency of yields was obtained. One size of hive appears to have no advantage over the other.

Package Bees as a Means of Strengthening Weak Colonies

OTTAWA, ONTARIO.—In Eastern Canada a colony of bees coming out of winter quarters in a very weakened condition is of little or no value as a producing colony the following summer. One of the methods strongly suggested for bringing such colonies up to producing strength is to unite with them a package of young but queenless bees brought from the south during the early spring.

To test the value of this method of strengthening weak colonies at Ottawa a number of weak colonies were selected each spring for the past eight years and divided into two groups. The average colony strength for each group was as nearly equal as it was possible to get it.

To each colony of Group No. 1 a two-pound package of queenless bees was added as early in the spring as weather conditions would permit. No bees or brood were added to the colonies in Group No. 2. All colonies were provided with ample stores and sufficient room for brood production, and for nectar storage at all times.

Table No. 3 presents the results for the last eight years.

TABLE 3—SUMMARY OF AVERAGES FOR PAST EIGHT YEARS

Year	Strengthened colonies						Unstrengthened colonies				
	Number of colonies assisted with 2-pound package bees	Average number of combs covered by bees before package bees added	Date package bees added	Average number of combs covered by bees at beginning of flow	Average crop produced		Number of check colonies	Average number of combs covered by bees	Average number of combs covered by bees at beginning of flow	Average crop produced	
					lb.	oz.				lb.	oz.
1926	5	2·1	April 23	9·3	49	9	5	2·5	4·3	10	2
1927	5	2·3	May 2	4·4	31	3	5	2·3	3·8	47	8
1928	5	2·6	May 5	7·6	49	1	5	2·7	6·2	23	11
1929	5	4·6	April 27	8·8	111	12	5	4·5	6·0	98	9
1930	5	2·6	April 26	12·6	151	14	5	2·6	4·0	54	8
1931	5	4·0	May 5	6·9	81	13	5	4·0	6·2	46	1
1932	4	3·5	April 26	8·4	58	0	4	3·5	7·2	44	14
1933	5	3·0	May 1	12·0	117	13	5	3·4	5·7	76	15

In Table No. 3 it will be noted that the addition of package bees did enable the colonies to build up to greater strength in time for the main honey flow

and that with one exception it assisted them to produce a greater crop of honey. Apparently, however, the value of the increase in production over the period of eight years was little more than enough to cover the cost of the packages delivered at Ottawa. The net gain for the period was approximately $5, which would be insufficient to cover the cost of the labour required to install the bees. Table No. 4 shows the profit or loss for each of the eight years.

TABLE 4.—GAIN OR LOSS FROM STRENGTHENED COLONIES

Year	Average difference in crop produced in favour of assisted colonies		Retail value of honey per pound	Approximate value of difference in favour of assisted colonies	Cost of packages plus transportation	Profit or loss in favour of assisted colonies
	lb.	oz.	cts.	$	$	$
1926	+39	7	16	+ 6 31	3 80	+ 2 51
1927	−16	5	15	− 2 45	5 05	− 7 50
1928	+25	6	15	+ 3 81	4 70	− 0 89
1929	+13	3	15	+ 1 98	4 20	− 2 22
1930	+97	6	15	+14 60	3 45	+11 16
1931	+35	12	10	+ 3 57	2 95	+ 0 62
1932	+13	2	10	+ 1 31	2 70	− 1 39
1933	+40	14	12	+ 4 91	1 95	+ 2 96

The total gain made per colony during the period of eight years was $5.25, or an average gain per colony per year of 65·6 cents. If wholesale values of honey were considered, even this small gain might have been eliminated.

MORDEN, MANITOBA.—Table No. 5 shows that in 1931 the package bees installed as separate units produced far more honey than the weak colonies assisted by packages, but that in 1932 the position was reversed. This, however, is accounted for by the heavy loss in queens in the commercial packages through supersedure which gave most of the colonies a serious setback for that year.

The strengthened group in both years greatly exceeded the unstrengthened group in production and made it quite profitable to add package bees to the weak colonies. A question arises, however, as to whether it would not be more profitable to establish the packages as separate units rather than to add them to the weakened over-wintered colonies. This question will be determined by further experimentation.

TABLE 5.—PRODUCTION OF DIFFERENT COLONIES

Year	Strengthened colonies				Unstrengthened colonies				Packages installed as separate colonies
	Number of colonies assisted with package bees	Average number of combs covered by bees on May 1	Average number of combs covered by bees on June 20	Average crop produced	Number of colonies	Average number of combs covered by bees on May 1	Average number of combs covered by bees on June 20	Crop produced	Average crop
				lb.				lb.	lb.
1931	5	1·6	7·1	131·90	5	1·8	2·7	69·43	203·16
1932	5	2·6	16·8	170·60	5	2·6	9·8	91·60	121·33

LENNOXVILLE, QUEBEC.—In a one-year test nothing was gained by adding two pounds of package bees to weak over-wintered colonies.

SCOTT, SASKATCHEWAN.—At this apiary the addition of package bees to weak colonies almost doubled the yield. Here again the test was only made one year.

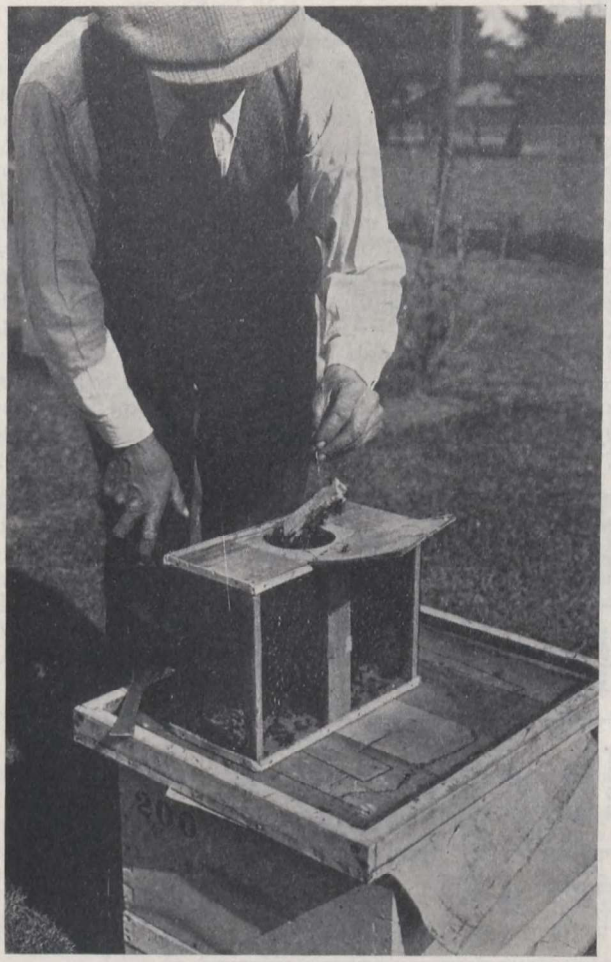


FIG. 3.—Removing the queen cage from a package of bees.

Package Bees as a Means of Starting New Colonies

MORDEN, MANITOBA.—Covering a period of eleven years, 1921 to 1931, ninety-nine two-pound packages and sixty-five three-pound packages of bees with queens were imported from southern breeders in order to determine the value of package bees as a means of starting new colonies.

The bees were ordered so as to arrive on different dates ranging from April 25 to June 8 in order to determine the comparative value of early and late shipments. All packages were housed in ten-frame Langstroth hives and upon drawn comb whenever possible.

Table No. 6 shows the number of packages received each year, the dates of arrival, together with the total and average production of both sizes of packages arriving early or late.

TABLE 6—RESULTS FROM PACKAGE BEES

Year	Total Number of packages	Dates of early arrivals	Average production early arrivals	Dates of late arrivals	Average production late arrivals	Average production early 2-pound packages	Average production late 2-pound packages	Average production early 3-pound packages	Average production late 3-pound packages	Loss of queens through:	
										Introduction	Supersedure
			lb.		lb.	lb.	lb.	lb.	lb.		
1921	1			May 26	64·75		64·75				1
1922	6	April 25	280·00			280·00					3
1923	2			May 14	72·50		72·50				2
1924	24	April 28—May 5.	26·62	May 10–12	20·53	41·85	2·58	11·39	38·47		4
1925	24			May 20—June 8.	54·15	*81·46	45·53	*64 75	20·75		1
1926	24	April 30	80·79	May 11	73·43	72·29	66·33	89·29	80·54	4	4
1927	12	April 29	133·83	May 10	93·91	48·91	136·10	218·75	51·66	5	3
1928	12	May 3	137·50	May 15	63·08	139·91	68·58	135·08	57·58	1	3
1929	33	April 30—May 4.	221·58	May 11—June 4.	170·70	226·80	165 87	195·58	190·00	6	1
1930	14	April 29	155·43	May 13	75·91	162·20	44·50	144·16	107·33	2	2
1931	12	April 28	203·16	May 11	168·50	204·50	175·33	201·83	161·66		1
Totals	164	April 25—May 5.	149·29	May 10—June 8.	84·51	155·59	91·44	111·47	78·83	18 or 10·9%	25 or 15·24%

* These packages arrived May 20 in 1925. As these were the first arrivals they are included in the early arrival column.

A summary of Table No. 6 shows that the importation of package bees for production purposes is a profitable undertaking under Manitoba conditions. The average production for the years 1923 to 1926 was considerably lower than that for the next five years. This, however, was caused by an outbreak of disease in the apiary in 1923-24 which necessitated the destruction of comb and the use of foundation on which to hive the bees.

It will also be noted that the packages which arrived early produced a far greater surplus than the late arrivals. Only on one occasion, 1927, did the late two-pound packages exceed the early arrivals in the amount of honey produced. The average production for all early packages over the eleven years was 149·29 pounds as compared with 84·51 pounds for the later arrivals.

Another point of interest is the comparison between the two sizes of packages. The greatest yields were from the two-pound packages, in spite of the fact that the three-pound packages contained the greater force of bees, indicating that the extra pound of bees was superfluous. The difference, however, was not so great in the late packages as in the early ones.

The table also shows a heavy loss of queens that came with the package bees. The loss through supersedure exceeded that at introduction, but both are excessively heavy and apparently uncontrollable, for reports from private bee-keepers often show a far greater loss. Work is being done to determine the cause of supersedure and to develop means for preventing it.

KAPUSKASING, ONTARIO.—Two-pound and three-pound packages of bees imported from the Southern States during the month of May have given highly satisfactory results in Northern Ontario. The package bees were released on both drawn comb and foundation. The results from the latter method are highly important to the beginner who has no drawn comb available, but only foundation on which to release his bees when they arrive.

Table No. 7 shows the average production of package bees as compared with over-wintered colonies for 1931 and 1932, and the average for four years.

TABLE 7.—AVERAGE PRODUCTION OF PACKAGE BEES AND OVER-WINTERED COLONIES

Year	Number of colonies	Average yield of 2-pound packages released on comb	Average yield of 3-pound packages released on comb	Average yield of 2-pound packages released on foundation	Average yield of over-wintered colonies
		lb.	lb.	lb.	lb.
1931	4	113·5	121·5	108 + 31·5 new combs	236·0
1932	4	199·2	186·7	140·9 + 30 new combs	258·0
4 year average	.....	129·3	132·5	99·9	189·6

Over a period of four years the over-wintered colonies gave the highest yield followed by the three-pound packages and the two-pound packages released on combs. The two-pound packages released on foundation gave the lowest yield, but when it is considered that these bees built a large number of new combs, in addition to producing a surplus of honey, their performance is quite remarkable and shows that a beginner having no drawn comb on which to hive his bees may start them on foundation quite successfully, and with far less danger of his bees contracting disease. The only precaution necessary when releasing bees on foundation is that they be fed quite liberally until they become established and new nectar and pollen are available. Very little advantage was obtained from the use of the larger package, and although this coincides with the results obtained

at Morden, the lower yield in this case may have been due to one of these packages losing its queen during the flow, and another one standing in the shade during part of the day.

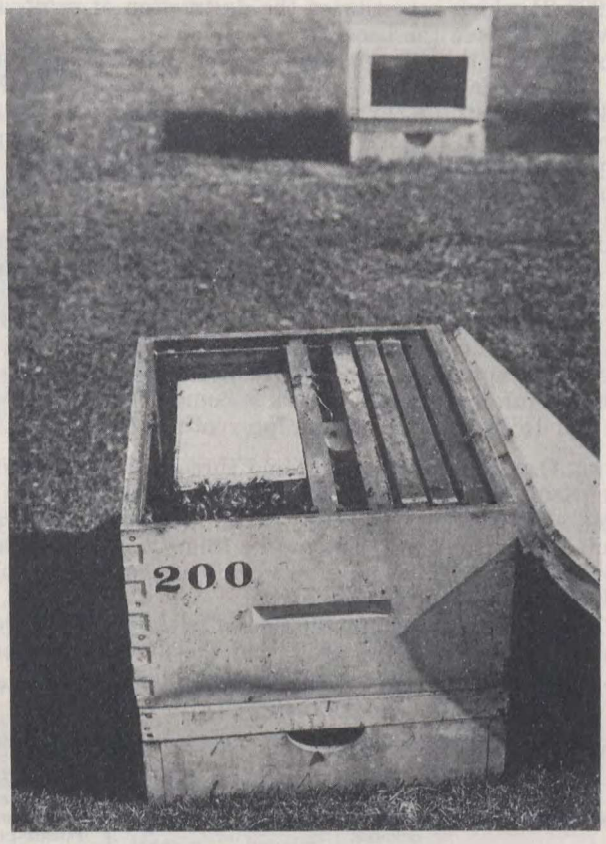


FIG. 4.—A package of bees installed in the hive. Note that the queen cage is suspended between the top bars of the frames nearest to the package.

OTTAWA, ONTARIO.—During the last seven years thirty-two two-pound packages of bees were received and established in separate hives as individual colonies. Since 1930 twelve three-pound packages, and during 1932-33 five five-pound packages were received and installed as colonies. All packages were received early in the season between April 26 and May 5 so that the bees were well established in their hives by the time the early honey flow from dandelion and fruit bloom commenced. In some of these new colonies, certain conditions developed which adversely affected the crops produced. Two colonies superseded their queens during the summer months. The queen of one colony proved to be a drone layer, therefore, had to be replaced. Another colony lost its queen from some unknown cause, while another was destroyed because of disease. In every year the packages not only built up into good colonies, but also produced a surplus of honey. In the case of all packages, however, the surplus honey was not sufficient to pay for the cost of the bees delivered at Ottawa, except in 1929, 1930 and 1933, when exceptionally heavy crops were harvested.

KENTVILLE, NOVA SCOTIA.—Ninety-three two-pound and three-pound packages of bees were successfully established as separate units at this station for

orchard pollination purposes. Unfortunately most of these colonies were so severely depleted in population through poisoning after being established that little can be said as to their value as honey producers. There were, however, a few colonies each year that escaped poisoning and which produced in one year an average of 46·8 pounds.

SCOTT, SASKATCHEWAN.—Good yields have been obtained from package bees, but the problem of supersedure of queens is a serious one.

Package bees have been imported in fewer or greater numbers to practically all of the experimental apiaries, and in all cases have been successfully established. The yields of honey from such packages, however, vary in different parts of Canada. In the Prairie Provinces, Northern Ontario and in localities where the main flow comes late in the season, package bees do far better than in those localities where the flow comes early in the season. The reason for this is that in those regions where the flow lasts well into August and even into September, the packages have a longer time in which to build up a greater field force of bees before the flow ceases, than they do in places where the main flow is over by the latter end of July or early August.

Package Bees versus Over-wintered Colonies

MORDEN, MANITOBA.—Package bees are now being brought into Canada in large numbers each year, especially into the Prairie Provinces. Because of their cheapness and the high average crops which package bees will produce in these provinces, the practice of killing bees in the fall and replacing them with packages the following spring has largely developed. In order to determine whether such practice is more economical than carrying bees through the winter a project was started at Morden in the fall of 1925 and concluded in 1932.

In carrying out this project the total cost of feeding, housing, and packing the bees for winter was taken into consideration, together with all labour costs connected with the preparation for winter and the removal from winter quarters the following spring, as well as any winter losses that might occur. In the case of packages, the cost of the packages, transportation charges, feeding and care of the bees when installed, together with any losses that might occur were also recorded. All of the over-wintered colonies used in this experiment were wintered outside in packing cases and interest on the original cost of the cases was allowed at 6 per cent.

Table No. 8 shows the total number of over-wintered colonies and packages used each year for seven years, together with the total costs incurred and total value of production, honey and bees.

TABLE 8—OVER-WINTERED VERSUS PACKAGE BEES

Winter of	Over-wintered colonies			Package bees		
	Number of colonies	Total cost	Total value of production	Number of packages	Total cost	Total value of production
		$	$		$	$
1925–26	21	124 15	563 38	24	167 69	289 19
1926–27	21	123 66	307 53	12	102 07	206 70
1927–28	22	153 82	624 20	12	86 93	181 87
1928–29	31	145 25	503 70	33	191 89	796 46
1929–30	31	141 69	621 42	14	91 61	169 90
1930–31	31	113 87	486 52	12	64 17	200 70
1931–32	31	101 86	306 12	6	31 12	54 60
Totals	188	904 30	3,385 87	113	735 48	1,899 42
Total profit			2,481 57			1,163 94
Average profit per colony			13 19			10 30

It will be seen that over the whole period of seven years the over-wintered colonies gave an average gain of $2.89 in excess of the package bees.

In order that the average yields of the two groups may be compared, Table No. 9 is given below.

TABLE 9.—PRODUCTION AVERAGES

Winter of	Over-wintered colonies		Package bees	
	Number of colonies	Average production	Number of packages	Average production
		lb.		lb.
1925-26	21	150 34	24	77·11
1926-27	21	125·21	12	113·87
1927-28	22	175·12	12	100·29
1928-29	31	156·10	33	198·45
1929-30	31	209·00	14	121·35
1930-31	31	179·84	12	185·83
1931-32	31	126·61	6	129·33

In Table No. 9 it will be noted that in three of the seven years the package bees exceeded the over-wintered colonies in production. In two of these years, however, the margin in favour of the package bees was very slight.

In view of the above it would appear to be slightly more profitable to carry bees through the winter than to kill them and to restock the apiary with packages the following spring, especially if there are suitable winter quarters for the bees, and when considering the proposition over a long period of years. While admitting that there is always an element of risk in wintering, it has been proved beyond doubt that bees can be wintered quite safely and with a minimum of loss, if properly prepared. While the price of package bees is still quite reasonable, it has advanced by approximately 50 per cent over 1933 prices, and furthermore, there is just as great, if not a greater risk, of loss, in package bees than in over-wintered colonies, through the supersedure of queens. In fact a large number of packages fail to become producers the first season for that reason alone. Loss of queens through introduction, loss or weakening of packages because of unsatisfactory transportation or through late arrivals of packages are important factors that must be taken into consideration when deciding upon the economy of killing bees in the fall and replacing them with packages the following spring.

CHARLOTTETOWN, PRINCE EDWARD ISLAND.—The records kept for one year at this apiary gave the following results:—

TABLE 10.—OVER-WINTERED VERSUS PACKAGE BEES

Year	Over-wintered colonies		Package bees	
	Expenditures	Returns	Expenditures	Returns
1931	$45 00	$32 00	$39 47	$21 80

These records were kept for three over-wintered colonies and four two-pound packages, but instead of keeping the actual cost of wintering, the market value of over-wintered colonies in the spring of the year was used as compared with the market value of package bees delivered and housed at the same time. The value of returns as shown in the above table is the value of the honey produced and shows that the over-wintered colonies gave a net return of $10.67 as compared with $9.87 for the packages.

STE. ANNE DE LA POCATIERE, QUEBEC.—Over-wintered colonies outyielded package bees by over 100 per cent.

TABLE 11—YIELD OF DIFFERENT COLONIES

Number of colonies	Type of colony	Average yield
2	2 pound packages	17 pounds.
2	3 pound packages	25 pounds.
2	Over-wintered colonies	51 pounds.

LENNOXVILLE, QUEBEC.—In a one-year comparative test the package bees slightly outyielded the over-wintered colonies.

LETHBRIDGE, ALBERTA.—While package bees proved highly satisfactory at this station, it was found that over a period of several years it was more profitable to carry bees through the winter than to destroy them in the fall and restock with packages in the spring. In the first place the cash outlay was less, while the over-wintered colonies afforded a means of increase which the packages did not.

Increase, Times and Methods

MORDEN, MANITOBA.—Twelve colonies were used for this experiment as follows:—

(*a*) As soon as all colonies became strong in the spring, all capped brood with adhering bees was removed and placed in a new hive and a young queen introduced.

(*b*) At the commencement of the honey flow the old queen with two frames of brood and one frame of honey with adhering bees were removed from the colonies and placed in a new hive and a young laying queen was introduced to the parent colony.

(*c*) When the colonies became strong in the spring all uncapped brood with adhering bees was placed in a new hive and a young laying queen introduced to it.

(*d*) Two frames of bees and one frame of honey were removed and placed in a new hive and a young laying queen introduced.

(*e*) All brood with adhering bees were removed from the colonies and placed in a new hive with a young laying queen.

(*f*) Undivided colonies of uniform strength as checks.

The first divisions were made on June 10, and again on June 19. Table No. 12 shows the results:—

TABLE 12—RESULTS OF DIFFERENT METHODS OF INCREASE, 1931

Group	Number of colonies in group	Number of divisions made from each colony	Crop from parent colonies	Crop from new divisions	Total crop, parent and division	Average crop per colony, parent and increase
			lb.	lb.	lb.	lb.
A	2	1	337·00	103·00	440·00	220·00
B	2	1	111·75	183·50	295·25	147·62
C	2	1	192·50	201·00	393·50	196·75
D	2	1	336·00	154·50	490·50	245·25
E	2	1	124·00	328·50	452·50	226·25
F	2	None	312·50	.....	312·50	156·25

TABLE 13.—SUMMARY OF RESULTS FOR PAST SIX YEARS

Year	Methods of making increase					Checks
	A	B	C	D	E	F
	lb.	lb.	lb.	lb.	lb.	lb.
1926	389·50	304·75	531·75	.....	.....	221·25
1927	319·75	432·25	500·25	.....	.....	301·00
1928	473·00	369·00	471·75	.....	.....	203·25
1929	534·00	582·00	541·00	*1,072·25	.....	346·50*
1930	630·50	219·00	471·50	343·75	431·25	561·25
1931	440·00	295·25	393·50	490·50	452·50	312·50
Number of colonies in experiment	12	12	12	8	4	13
Total production of parent colony plus increase	2,786·75	2,202·25	2,909·75	1,906·50	883·75	1,945·75
Avergae production of parent colonies plus increase	232·22	183·52	242·47	238·31	220·93	149·67
Average yield of parent colonies	151·62	104·66	167·68	155·68	66·56	.....
Average yield of parent colonies divided early	148·45	103·04	171·87	189·33	82·50	.....
Average yield of parent colonies divided late	159·79	106·29	180·16	225·83	50·62	.....
Average yield from the increase	80·60	78·93	74·79	82·62	154·37	.....
Average yield from increase made early	90·12	100·70	91·33	107·50	218·50	.....
Average yield of increase made late	71·08	57·25	58·25	112·83	90·25	.....

* Four colonies were used under "D" and three under "F" in 1929. In all other groups and years two colonies were used.

Summarizing Table No. 12 it is quite evident that a substantial increase was made in production by dividing the colonies before the main honey flow. The average yields per colony in all methods were sufficiently increased to pay for the extra labour involved in making the increase. Considering the time element there appears to be little difference in the crops secured, although it will be noted that with one exception, the parent colonies divided late gave higher yields than those divided early, but that the late increases, also with one exception, gave a lighter crop than the early increases.

LETHBRIDGE, ALBERTA.—Division of colonies was made at this Station with two objects in view: (1) to increase the number of colonies, and (2) to increase honey yields.

(1) To increase the number of colonies.—Three methods were used:—

(*a*) Moving from the parent colonies the queens with two combs of brood with adhering bees during the first week of the main honey flow and placing them in a new hive on a new stand. Over 13 per cent of the parent colonies swarmed and the average yield was slightly more than 110 pounds while 82 per cent of the new colonies were strong enough for the following winter.

(*b*) As soon as the colonies were strong enough in the spring a second brood chamber was added and the queen allowed to occupy both chambers until the second week of the main honey flow when the top chamber containing all the uncapped brood of the colony with adhering bees, but without the queen, was moved to a new stand. A young laying queen was added to this new colony. Eighty-two per cent of the new colonies thus made built up into strong colonies for the following winter while the parent colonies produced an average of 114 pounds of surplus honey. The outstanding feature of this method was that 20 per cent of the colonies swarmed out.

(*c*) The most successful method used and one that called for the least manipulation of colonies was to remove from the colonies most of the capped brood with adhering bees and the old queen as soon as the season was far enough advanced for the colonies to require the first honey super, usually during the first week in June. The parent colony was requeened with a young laying queen at the time the brood and old queen were removed. During the nine years of the project an average of 95·6 per cent of the new colonies thus formed were strong enough for the following winter, while the parent colonies stored an average of 124 pounds of surplus honey and only 2·2 per cent of them made preparations for swarming. This method of making increase is very simple and easy and offers the beekeeper a means whereby he may increase the number of colonies kept without interfering very much with his honey crop or depending upon distant breeders for his bees.

The division of colonies before the honey flow is dependent upon three factors for success:—

(*a*) Normal colony conditions during spring and early summer.

(*b*) Available young queens, and (*c*) a honey flow that comes or continues late in the season. In Eastern Canada and British Columbia, where the main flow comes early from alsike clover and lasts for a comparatively short period, the division of colonies before this flow is not advisable. Under such conditions the increase is best made about two weeks after the flow starts so that the new colonies may build up on the latter end of this flow and any later flows that might occur.

(2) To increase honey yields without increasing colonies: As soon as the colonies became strong enough in the spring to require an additional chamber to the hive three or four combs with adhering bees were removed from each colony and placed in a new hive. Care was taken not to remove the queen or to split the brood nest. The combs removed were replaced with new combs. An extracting super was now placed above the original brood chamber and on top of the super an ordinary floorboard was placed. The opening underneath the floorboard was closed so that no bees could fly from the top of the lower hive. The super containing the combs and bees taken from the lower hive was filled out with drawn comb and placed on top of the floorboard, and a young laying queen introduced. Each of the two hives on one base had its own entrance, in other words, the increase made was placed above its parent instead of upon a new stand. About six weeks later when the main honey flow was on, the old queen was removed from the lower hive and the floorboard between the two hives was replaced with a double sheet of newspaper which the bees removed in a short time and then intermingled peacefully. By this method the strength of the colony was greatly increased, because in addition to the bees and brood of the original queen, there was added to the colony the six weeks' production of bees and brood from the young queen. Furthermore, the original colony was requeened with a young queen at an important time of the season.

This method, tested over a period of seven years, increased the annual average over check colonies by 14·3 per cent and is especially adapted to small apiaries where increase in colonies is not desirable.

Detecting Preparations for Swarming

The ten-frame Langstroth hive body is not large enough for a prolific queen during the height of brood production in the summer months, therefore, it is necessary to add an additional chamber just before the first chamber becomes filled with bees, brood and stores in the spring.

In the first place, the addition of this second chamber assists in the prevention of swarming, as it relieves to a great extent the congestion of the brood nest.

It also assists greatly in reducing the manipulation of colonies during the swarming season. It had been observed that colonies in which the queen had been allowed the use of two brood chambers would build some of their first queen cells along the lower edges of the upper set of combs and that if cells were not present on these combs there would seldom be any in other parts of the hive. Therefore, a very large percentage of the preparations for swarming could be detected by merely tipping the upper super, while if no cells were seen by tipping there was little or no immediate danger from swarming.

LETHBRIDGE, ALBERTA.—During the last seven years 170 colonies in double brood chambers were used to determine to what extent this method of detecting preparations for swarming could be relied upon. The colonies were all given a shallow super above the original brood chamber early in the season, May or early June. Swarm cells were built along the lower edges of the upper set of combs in 70 of the 170 colonies under observation. In 21 of the colonies cells were built on the lower set of combs and not on the upper set. These cells were left to determine whether or not they were swarm or supersedure cells. Of the 21 colonies, 19 superseded their queens without swarming, while two of them superseded but swarmed out with the young queen. The remaining 79 colonies showed no inclination to swarm. Thus only 1·18 per cent of the colonies under observation swarmed out and these were from supersedure cells.

AGASSIZ, BRITISH COLUMBIA.—This experiment has been carried on at Agassiz for several years and experience to date indicates that if no queen cells are built on the lower edges of the upper set of combs no further examination of the colony for swarming is necessary, and furthermore, if no more than three cells are found on the upper combs, the chances are in favour of these being supersedure cells rather than swarming cells. If many cells are found the colony must be treated for swarming.

FREDERICTON, NEW BRUNSWICK.—Of thirty colonies under observation at this station, swarm preparations were detected in twenty-seven by tipping the super, one colony superseded its queen, and two did not build cells of any kind.

CHARLOTTETOWN, PRINCE EDWARD ISLAND.—Shows 100 per cent of preparations for swarming detected by tipping the super.

LENNOXVILLE, QUEBEC.—Over a period of five years, Lennoxville reports from 87 per cent to 100 per cent efficiency for the method.

KAPUSKASING, ONTARIO.—During the past four years twenty-three colonies have been observed and in all colonies where drawn comb was given in the super all swarming preparations were detected by tipping the super. Where foundation was used in the supers all cells were built below, hence to be successful drawn comb must be used in the second chamber.

SCOTT, SASKATCHEWAN.—The method proved highly successful at this station with the use of deep supers rather than the shallow super.

LACOMBE, ALBERTA.—In all cases swarm cells were detected by tipping.

The results obtained from all of the above tests indicate that where the queen is allowed to establish her brood nest in two chambers instead of one, practically all preparations for swarming may be detected by merely tipping the upper super and looking for queen cells along the lower edges of the upper set of combs. If no cells are present on these combs the colony may be closed with the knowledge that there is little or no immediate danger of swarming. If cells are seen by tipping the upper super, then the colony must be treated for swarming. This method of looking for swarming preparations certainly reduces the amount of

labour in the apiary, for it has been estimated that by this method one may examine ten colonies in the same amount of time that is required to examine one colony by the old method, comb by comb.

Swarm Control by Dequeening and Requeening

LETHBRIDGE, ALBERTA.—Colonies that had already made preparations for swarming by having larvae in queen cells were immediately treated by destroying these queen cells and at the same time removing the queens. Nine days later all queen cells were again destroyed and a young laying queen introduced. This method of control was the most effective of any tried, for only 5 per cent of the colonies so treated showed any further preparations for swarming. The main objection to the method is that it leaves the colony queenless for a period of nine days, thereby later reducing the force of bees available for field work, and this in turn adversely affecting the crop produced.

CHARLOTTETOWN, PRINCE EDWARD ISLAND.—Five colonies treated by the above method did not make further preparations for swarming.

STE. ANNE DE LA POCATIÈRE, QUEBEC.—Of sixty-three colonies treated by dequeening and requeening, 7·6 per cent swarmed after treatment, thus showing that the method is not 100 per cent efficient.

KAPUSKASING, ONTARIO.—At Kapuskasing twenty colonies were treated and only one colony showed any further tendency towards swarming.

LACOMBE, ALBERTA.—This method of treatment was very effective.

Although the method has not proved 100 per cent effective, a very large percentage of those colonies that have already made preparations for swarming can be prevented from actual swarming through treatment by the dequeening and requeening plan and with very little effect upon the honey crop.

Separation of Queen and Brood

By this method the colonies that have already made preparations for swarming by having larvae in queen cells are treated by removing all combs of brood from the brood chamber and placing them in another chamber on top of the hive, above the honey supers. The old queen is left below on a set of empty combs with a queen excluder above them. A second queen excluder is placed beneath the super containing the brood so as to prevent any virgin queen that might emerge from getting below.

CHARLOTTETOWN, PRINCE EDWARD ISLAND.—Of sixteen colonies treated by the above method four made further preparation.

STE. ANNE DE LA POCATIERE, QUEBEC.—Fifty-four colonies were treated and 37·1 per cent swarmed after treatment, but the average crop produced was $17\frac{3}{4}$ pounds higher than from those treated by dequeening and requeening.

KAPUSKASING, ONTARIO.—The treatment was only 67 per cent successful.

LACOMBE, ALBERTA.—The method proved as effective as dequeening and requeening.

The treatment of colonies by separating the queen and brood is a very simple method of swarm control and disturbs the morale of the colony much less than does dequeening and requeening. It is especially adapted for districts where the honey flow is heavy and of short duration, for usually under such conditions the swarming season is also short. The chief reason why the separation of queen and brood is not so effective as dequeening and requeening over

a long period is that in the former the old queen is left in the colony, while in the latter method the colony is requeened with a young laying queen. Colonies headed with old queens are more inclined to swarm than those having young queens.

Methods of Supering

The orthodox method of supering a colony is to add the new super immediately above the brood chamber or chambers and below the supers already present. With a normal crop of honey and the colony several supers high, the tearing down of the colony only for the purpose of giving a new super, involves a considerable amount of very heavy labour.

OTTAWA, ONTARIO.—In order to ascertain whether or not other methods of supering but requiring less labour would be just as efficient as the one already outlined, two other systems were tried during 1932 and 1933 as follows:—

(1) New supers added between the brood chamber or chambers and the supers already present above. Common practice.

(2) New super added above last one given, and

(3) New super added below the brood chamber and above the supers already present below.

Table No. 14 shows the production for each group for both years.

TABLE 14.—PRODUCTION UNDER DIFFERENT METHODS OF SUPERING

Year	Average crop produced					
	Group No. 1		Group No. 2		Group No. 3	
	lb.	oz.	lb.	oz.	lb.	oz.
1932	56	5	70	8	38	0
1933	134	13	162	11	103	10
Average for the two years	95	9	116	10	70	13

As this experiment has only been carried on for two years no conclusions can be drawn from the results given.

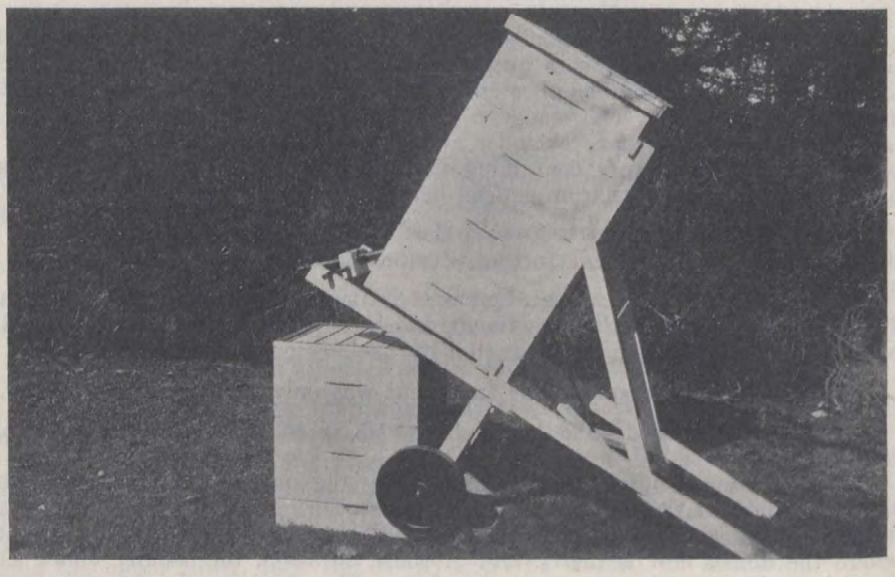


FIG. 5.—A super lifter capable of moving supers containing over 300 pounds of honey from the hive at one time. Devised by the Bee Division.

Sterilization of Combs

The object of this experiment is to test the efficiency of various solutions and gases that are being recommended for the sterilization of combs affected with American foul brood.

MORDEN, MANITOBA.—In 1931 an out-apiary of six colonies was established at a distance of 7½ miles from the station apiary at Morden, and also at a safe distance from any private apiary. This apiary is known as No. 1. These colonies were inoculated on May 28 by placing a comb heavily infected with American foul brood in the centre of each brood nest. Infection was general throughout all combs by June 25 and a general weakening of the colonies was noticed by July 4. Second brood chambers containing foundation were given on July 9 and by July 18 five out of the six queens were laying in the newly drawn combs.

All colonies were dequeened on August 22 and the bees destroyed by cyanogas on September 12 and all infected material was stored in a bee-tight house for treatment. Samples of the infected comb from each colony were sent to the Dominion Agricultural Bacteriologist at Ottawa for examination and all samples showed the presence of the causative organism (Bacillus larvae). It is interesting to note that this organism was also recovered from queen and drone larvae as well as from queen pupae that had died in the infected hives.

Sixty of the infected combs were prepared for treatment by first carefully uncapping every cell and dissolving out the honey by suspending the combs in water. These combs were then divided into three groups and treated as follows:—

Group A—Twenty combs suspended for 48 hours in a solution consisting of 80 parts water and 20 parts commercial formalin.

Group B—Twenty combs suspended for 48 hours in a solution consisting of 40 parts water, 40 parts alcohol and 20 parts commercial formalin.

Group C—This group of twenty combs was suspended in water and into this water chlorine gas was released slowly for approximately 64 hours, and the combs were allowed to remain in the water for 19 hours after the gas was closed off.

The combs treated with formalin solutions were well shaken after treatment and allowed to air. The combs treated with chlorine were also well aired. Two samples of dried scales were taken from each group of treated combs and sent to Ottawa for culturing. All the samples submitted gave negative results.

The brood chambers, supers, floorboards and covers were thoroughly scraped and scorched with a blow torch.

In the spring of 1932 the treated material, combs, hives, etc., were taken to another location (Apiary No. 2) and six combless packages of bees imported from Alabama were installed on the treated combs. Considerable fanning by the bees was noticed in all groups upon hiving but this continued longest in Group C, the chlorine treated combs. Sugar syrup was fed to the bees until sufficient nectar was available in the fields.

Careful weekly examinations were made during the summer to watch for reinfection.

One package in Group A died on May 28 and was replaced immediately, and although this package started off vigorously, it also died by July 25. The cause of death was not discovered, but it was thought to be poisoning from residues of formalin deposited in the cells after the combs were treated.

Both colonies in Group C showed reinfection in a few cells during the summer months and were immediately moved back to Apiary No. 1 where six other colonies were being inoculated for 1933. No reinfection occurred in Groups A and B.

The experiment was continued in 1933. One hundred and twenty infected brood combs were carefully uncapped and washed clean of honey and then treated as shown in Table No. 15.

TABLE 15—TREATMENT OF COMBS

Number of combs treated	Type of comb	Solution used	Per cent formalin in solution	Date of treatment	Outside maximum and minimum temperature during treatment	Number of hours combs in solution	Length of time combs left to air before giving to bees	Number of combs broken from treatment
					F.		days	
20	Brood.....	Water formalin.....	7·44	April 13....	40°—21°	48	14	2
20	"	" "	7·44	" 15....	57°—27°	48	12	2
20	"	Alcohol formalin.....	8·73	" 13....	40°—21°	48	14	1
20	"	" "	8·73	" 15....	57°—27°	48	14	2
40	"	Chlorine.....	.....	" 20....	73°—26°	Gas on 64½ hours Gas off 19½ hours	5	19 wires

The brood combs were treated in the same manner as in the previous year, and the hive bodies, floorboards, covers, etc., were thoroughly scraped and scorched with a blow torch.

On April 29 twelve packages of bees were installed on the treated combs in Apiary No. 2 and were fed sugar syrup until new nectar was available in sufficient quantity for the maintenance of the colonies. Careful weekly examinations were made of each colony during the summer months.

At the time of installing the bees considerable fanning at the entrance of all three groups was observed. This was more pronounced in Group C, and continued in this group for eleven days.

Bees dying from other than natural causes were in front of the hives in Groups A and B. Sacbrood was present in all colonies after brood rearing had commenced, but this disappeared after the main honey flow started. The brood was patchy in all groups, whereas it was regular and compact in the normal colonies. In some colonies the bees tore down the cells of the combs and rebuilt them. This was particularly noticeable in Groups A and C.

Two packages in Group A died, but were immediately replaced. One package in Group B and two in Group C became weak but were strengthened with package bees early.

Reinfection occurred in three colonies, one in each group, but the source of infection in the colony in Group B is in doubt, as this colony was given by mistake a set of super combs that was not definitely known to be free of disease.

So far, reinfection has occurred each year in those combs treated with chlorine and one year in those treated with water formalin. The reinfection that occurred in the alcohol formalin group cannot be definitely traced to the treated combs.

The Effect of Sunlight on a Colony

OTTAWA, ONTARIO.—Five colonies of bees are housed in ten-frame Langstroth hives that have glass panels in both ends of the hive so that light may penetrate the brood chamber. During the four years these hives have been under observation it would appear that considerable energy is wasted by the bees in trying to leave the hive by the windows, for at all times large numbers were observed racing up and down the glass apparently making an effort to escape in that direction.

Brood rearing was carried on normally, for at all times there was practically the same amount of brood present as in the check colonies.

During the season of 1933 the bees in the lighted hives produced an average of 10½ pounds more than did the check colonies in ordinary hives, but this was the first time during the four years that they succeeded in doing so.

SUMMERLAND, BRITISH COLUMBIA.—At no time have the lighted hives exceeded the check colonies in production, and in every case where an unlighted super was given without a queen excluder the queen would leave the lighted chamber for the darkened one.

To date the lighted hive has shown no advantage over the unlighted one.

The Use of Tartaric Acid in Sugar Syrup

Beekeepers are continually being advised to add a small amount of tartaric acid to sugar syrup when feeding such syrup to bees as winter stores. The claims made for the use of tartaric acid are that it prevents the regranulation of the syrup and assists the bees to invert the sugar. At Ottawa a considerable amount of sugar had been fed to bees every winter without adding tartaric acid and without any apparent injurious effect on the bees; therefore, to determine whether or not any improvement might be secured through the use of the acid two colonies were selected in the fall of 1930 and all combs containing stores were removed from them and replaced with empty comb. These colonies were then given sugar syrup consisting of two parts sugar and one part water. To the syrup of one colony tartaric acid was added at the rate of one level teaspoonful to every twenty pounds of sugar fed. Enough food was given to permit of samples being taken later for the Chemistry Division to make tests for invert sugar.

In the fall of 1931 a third colony was added to the group and to the syrup given to this colony 10 per cent of honey was added. In the fall of 1932 the group consisted of seven colonies and table No. 16 shows the syrups fed and the percentages of invert sugar present at different dates after feeding for the three years 1930, 1931, and 1932.

TABLE 16.—TABLES OF INVERSION

Colony number	Kind of syrup given	Percentages of invert sugar present					
		Oct. 9, 2 days after feeding	Oct. 14, 7 days after feeding	Oct. 22, 15 days after feeding	Oct. 30, 23 days after feeding	Nov. 5, 29 days after feeding	
		%	%	%	%	%	
1	Sugar syrup plain	0·032	31·7	34·6	43·7	47·29	
2	Sugar syrup + tartaric acid	27·3	52·7	53·3	55·46	55·13	

1931

		Before feeding	One week after feeding	Two weeks after feeding	Three weeks after feeding	Four weeks after feeding	Five weeks after feeding
1	Sugar syrup plain	0·0	33·9	38·0	35·3	36·2	39·5
2	Sugar syrup + tartaric acid	0·9	12·8	Granulated in combs	.....	.....	.....
3	Sugar syrup + 10 per cent honey	7·1	32·9	35·8	32·7	33·1	39·9

1932

1	Sugar syrup made with hot water	0·30	31·4	31·0	32·0	40·4	39·4
2	Sugar syrup made with hot water and powdered tartaric acid	0·87	12·5	Granulated in combs	.....	.....	.....
3	Sugar syrup made with hot water + crystallized tartaric acid	1·67	14·9	Granulated in combs	.....	.....	.....
4	Sugar syrup made with hot water + 10 per cent honey	16·73	50·2	57·7	55·5	53·8	55·6
5	Sugar syrup made with boiling water	0·23	36·5	33·5	38·2	36·7	34·9
6	Sugar syrup made with boiling water + powdered tartaric acid	17·44	66·4	66·6	64·8	65·5	65·4
7	Sugar syrup made with boiling water + crystallized tartaric acid	28·75	65·8	67·3	67·3	66·7	66·7

In examining the above table slight variations in the percentages of invert sugars at different dates will be noticed. No explanation of these differences can be given other than that the samples were taken from different combs on the different dates, and it is quite possible that inversion was not uniform in all parts of the hive.

The main feature of the experiment was that in no case where a straight solution of sugar and water was given to the bees did the solution recrystallize in the combs and, furthermore, although the inversion of sugar may not have been quite so great in the plain syrup as it was in those containing acid, it was equally as progressive, showing that the bees required no assistance in so far as the inversion of sugar was concerned.

The second point of note is that in 1931 and again in 1932 certain syrups containing the tartaric acid recrystallized in the combs and it should be stated that this recrystallization was fairly solid throughout. These particular samples

were made by first bringing the water to a boil, then removing it from the fire and stirring in the required amount of sugar and acid until all was apparently dissolved. In those samples in which no recrystallization occurred the sugar and acid were stirred in while the water was boiling and left to boil for a few moments after the sugar and acid had dissolved. It is quite possible that in the unboiled solutions a few crystals of the acid remained undissolved, thus causing the rapid recrystallization. It is, therefore, advisable when using tartaric acid in the syrup that the syrup be boiled for a few minutes to dissolve all the acid.

The addition of 10 per cent of honey instead of tartaric acid gave almost as high a percentage of inversion as the acid and required no boiling, nor did it cause recrystallization.

From the above, however, it would appear to be unnecessary to add acid or any other agent to a two-to-one solution of sugar syrup as winter food for bees.

Over-wintered Colonies versus Package Bees for Pollinating Purposes

OTTAWA, ONTARIO.—It has been claimed that honey bees are necessary in fruit orchards during the blossoming period in order that a good commercial set of fruit may be secured, and orchardists have been advised either to buy or rent bees for that purpose. Purchased bees are usually package bees imported from the south in time for the fruit bloom and such packages are strongly advocated for orchard purposes by the producers of them. Rented bees are almost exclusively over-wintered colonies which some nearby beekeeper is willing to place in an orchard during the period of bloom.

To test the comparative value of normal over-wintered colonies and package bees for pollinating purposes, an experiment was begun in 1932 and continued through 1933 by importing from a reliable southern breeder a number of two-, three- and five-pound packages of bees and checking them against a number of average over-wintered colonies by making actual counts of bees leaving the colonies at different times during the period of bloom.

The package bees arrived approximately three weeks before the first apple blossoms opened and were in excellent condition, there being very few casualties in transit. The package bees were housed in protected hives so as to be under similar conditions as the over-wintered colonies which were still in their packing cases. After the package bees were housed the total force of bees in each over-wintered colony was weighed and the approximate number of bees present estimated by using the generally accepted figure of 5,000 bees to a pound.

The forces of both over-wintered colonies and package bees were again weighed and estimated at the beginning of the blossoming period.

It should be stated here that the winter of 1931-32 was an exceptionally hard one on bee life and the colonies were far below normal strength during the period of fruit bloom. In 1932-33, however, the bees wintered well and came out in the spring in a normal condition.

Special traps were constructed to entrap the bees as they returned from the field to the hives, and these traps were well tested before any counting was commenced. It was found that returning bees would enter these traps without any hesitation. Sufficient traps were made so that trapping could be done in all groups of colonies simultaneously. One colony in each group was selected and a trap placed on each of the selected colonies at the same time. At first the traps were left in place for two minutes, then removed and the bees in the trap counted. It was soon discovered, however, that a four-minute period was better than a two-minute one and this period was used in all future counts. At the end of the trapping period the traps were taken to the honey house and the trapped bees from each colony were counted. One man counted the total number of bees and a second man counted only those bees that carried

pellets of pollen. After these bees were released the traps were placed over a fresh set of colonies, one in each group. In all, 250 trappings were made, one hundred from over-wintered colonies, and fifty from each group of packages.

Table No. 17 shows the average number of bees trapped per colony in each group during ten counts of four minutes each, together with the average number of pollen carriers in the counts, and the averages per colony per minute.

TABLE 17.—NUMBERS OF BEES TRAPPED

Group	Number of colonies in group	Year	Average number of bees trapped in 10 counts of 4 minutes each	Average number of pollen bearers trapped in 10 counts of 4 minutes each	Average number of bees trapped per minute	Average number of pollen bearers per minute
Over-wintered colonies	4	1932	1,515	351·75	37·9	8·8
	6	1933	3,184	965·	79·6	24·1
Five-pound packages	2	1932	1,789	285·5	44·7	7·1
	3	1933	2,200	534·0	55·0	13·3
Three-pound packages	2	1932	1,552	428·5	38·8	10·7
	3	1933	1,560	405·0	39·0	10·1
Two-pound packages	2	1932	329	118·5	8·3	3·0
	3	1933	1,055	364·0	26·4	9·1

At the time of arrival in 1932 the three-pound and five-pound packages of bees exceeded the over-wintered colonies in strength, but at the commencement of the fruit bloom only the five-pound packages exceeded them in strength. In 1933 the five-pound packages exceeded the over-wintered colonies in strength only upon arrival, and by the time fruit bloom opened all but two of the over-wintered colonies were stronger in bees than the strongest of the packages and only one of the packages exceeded the strength of the weakest colony. It should be remembered here that at the time the packages arrived, all of the over-wintered colonies contained brood and that young bees were emerging in these colonies every day, while the packages could not add to their strength for at least 21 days after their queens were released. As a matter of fact, the package bees dwindled in strength from the time they arrived until after fruit bloom had opened. This was due to the original bees dying off before there were young ones emerging to take their place.

Examining the table it will be seen that in 1932 the five-pound packages sent out the largest force of field bees and were followed by the three-pound packages, the over-wintered colonies and the two-pound packages respectively. The average difference between the force of the five-pound packages and the over-wintered colonies was approximately 275 bees per colony. In 1933, however, the over-wintered colonies led by an average of approximately 984 per colony. They also exceeded the packages in number of pollen carriers.

An effort was also made to trap and count the out-going bees, but it was noticed that during the four minute periods when the traps were set, although the bees entered the traps freely, many of them found their way out and returned to the hives.

Wintering Spare Queens

At the first examination of colonies in the spring, one or more are usually found queenless or containing queens which if left with the colony would render it useless as a producing colony. Spare queens at this time of the year would

be of great value to the beekeeper as such queens could be used to requeen any colony that needed it. In the spring or early summer new queens can only be obtained from southern breeders and valuable time would be lost waiting for these queens to arrive. It has been demonstrated at Ottawa and several of the Branch Farm apiaries that two queens may be successfully carried through the winter in a single hive. Two simple methods of making up such double colonies have been followed: (1) by establishing two nuclei in one hive during the main honey flow, and (2) by bringing two weak colonies together in one hive when preparing the colonies for winter. When placing the bees in the single hive a solid division board must be placed between the two groups of bees so that the bees of one compartment cannot reach the bees on the other side. Otherwise one of the queens will be killed.

OTTAWA, ONTARIO.—During the last three years thirty-two queens were wintered in divided hives with a loss of only three.

FREDERICTON, NEW BRUNSWICK.—Eighteen spare queens wintered during past six years and none were lost.

At other apiaries spare queens have been wintered successfully and profitably used the following spring.

When one of the queens is removed for introduction to another colony the division board is removed from the divided hive and the bees of the two sides will unite without danger to the remaining queen.

Should none of the spare queens be needed to replace others in the spring, these double colonies are allowed to build up until one or both compartments are nearly filled with bees and brood. A new hive is then prepared and the combs with the queen and all the bees from one side of the divided colony are transferred to it, the division board removed and both hives filled up with drawn combs.

Wintering Bees

At all apiaries bees are being successfully wintered outside in packing cases that hold one or more colonies. There are three precautions, however, that must be taken in order to make outside wintering successful in Canada, and they are: (1) The colonies must be strong in young bees when going into winter quarters; (2) the bees must be supplied with an abundance of wholesome stores to carry them through the winter and the following spring, and (3) the bees must be adequately protected from extreme fluctuating temperatures and from cold driving winds. To neglect any one of these three factors is to nullify the benefits of the others.

LETHBRIDGE, ALBERTA.—At this station an experiment in wrapping colonies for winter instead of packing them in cases is being conducted. The method is to first fill the stand upon which the colony stands with planer shavings to protect the colony from ground frost. The colony is then slightly tipped forward so that no moisture may run in at the entrance, and the entrance is reduced to about 4 inches. A single thickness of ordinary building paper is then wrapped around the colony and the joints well overlapped. A single thickness of tar paper is wrapped over the building paper. Both layers of paper are carefully folded over the top of the hive. It was found necessary to place a mat or cushion above the frames beneath the hive cover to absorb any moisture that might be given off by the bees.

Table No. 18 shows the average results of wrapped colonies as compared with packed colonies for six years.

TABLE 18.—WRAPPED VERSUS PACKED COLONIES—SIX-YEAR AVERAGE

—	—	Packed in 1—colony case	Packed in 2—colony cases	Packed in 4—colony cases	Wrapped singly in paper
6-year average	Stores consumed in pounds	36	35	31	32
	Per cent winter losses	33·3%	19·1%	10·4%	8·7%

Over the period of six years it will be noted that the least loss occurred in the wrapped colonies, and that the amount of stores consumed by them was, with one exception, less than in the cases.

It should be borne in mind that the apiary in which the wrapped colonies were wintered was well protected from cold driving winds on all four sides, which is a very important factor in outdoor wintering. It is only in well-protected apiaries that such wrapping can yet be recommended.

MORDEN, MANITOBA.—An experiment in wrapping colonies with " balsam wool " and covering with waterproof paper was started at this station in 1931-32, when ten colonies were wrapped with two layers of " balsam wool," each layer one-half inch thick. The balsam wool was then covered with waterproof paper and an entrance for the bees supplied. Ten colonies were again wrapped for the winter of 1932-33. One colony perished each year.

Compared with the colonies wintered in single, double and quadruple cases, the percentage loss was the least in the balsam wool packed colonies, and the average strength of the colonies that survived was greater than those packed in the cases.

Examination of Disease Samples

OTTAWA, ONTARIO.—During the last three years 243 samples of dead brood were received for diagnosis. Of these, 125 samples were found to be infected with American foul brood and 29 with European foul brood, while in the remaining 89 samples no evidence of disease was found.

HONEY INSPECTION

The past year, 1933, showed a marked revival of interest on the part of export shippers in this particular form of service rendered by the Division, and a general improvement in the quality of honey going to export was also noticed.

During the twelve months just passed, 916,240 pounds of honey were inspected as against 216,540 pounds inspected in 1932, an increase of over 320 per cent. Of the 916,240 pounds inspected, only 7,620 pounds, or 0·831 per cent, were rejected as unfit for export. This is a striking fact in view of the following Table No. 19.

TABLE 19.—INSPECTED HONEY

Year	Total honey inspected	Per cent rejected
	lb.	
1928	1,114,340	5·8
1929	911,880	13·0
1930	422,866	5·73
1931	409,700	34·9*
1932	216,540	3·1
1933	916,240	0·831

* The extremely high rejections of 1931 were due to the fact that the inspector discontinued the sorting of shipments that year.

It is obvious that producers are recognizing, more than ever, the need of better methods of handling and packing honey. They have already accomplished a great deal along this line, as shown by the small percentage of rejections this year. There is even a trend towards centralized packing in some quarters, which augurs well for the industry. One large group of producers in Ontario are already planning to operate on this principle during the coming year. Centralized packing would seem to be the only way in which any uniformity in Canadian honey can be attained.

The beekeepers of Canada have accepted the grading regulations drawn up by this Division, governing the export of Canadian honey.

When these regulations came up for discussion at the annual convention of the Ontario Beekeepers' Association, the opportunity was taken to point out to Ontario beekeepers, and to representatives of other provincial organizations, the difficulties the beekeeper must overcome to produce a honey that would grade under the new regulations. It was pointed out that more than 50 per cent of the honey inspected this year for export would have been rejected, at the time of inspection, had the new regulations been in effect.

Despite this fact, strong representations have been made to enact legislation making these regulations compulsory, and it would seem that the beekeepers of Canada are solidly behind any move that will improve the quality of Canadian honey moving to export.

EXHIBITION WORK

Exhibition of apiary products was confined to the Central Canada Exhibition at Ottawa during the last three years. The idea stressed at these exhibitions was the necessity for greater care in preparing honey for the markets. At the 1933 exhibition one feature of the exhibit was the use of honey in cooking and a sheet of six recipes was given to any person who desired one. Several such sheets were distributed and many requests were later received for copies. It would appear from the interest shown by the public in new uses for honey that more work along this line is warranted and that it would be well received. Therefore, it is hoped to start such work this coming winter.

EXPERIMENT ON THE STORAGE OF HONEY

This experiment, started in 1929, in an effort to determine the optimum storage conditions for honey, and to discover what relation, if any, existed between the physical, chemical and biological properties of honey, and its keeping qualities, is still incomplete.

With the exception of samples stored at uncontrolled temperatures, changes in condition have been very gradual.

Eighteen samples, representative of the crops of various honey-producing areas of the Dominion, were obtained for this experiment. Each sample comprised forty-six ½-pound jars filled from the same tank. One jar of each sample was used for physical, chemical and microbiological analyses, and the remaining forty-five jars were divided into five groups of nine jars each and placed in storages at 40°F., 50°F., 60°F., 70°F. and at uncontrolled temperatures ranging from below zero to over 100°F.

One jar in each group placed in storage was left uncovered, the remaining eight being closed with metal screw-caps lined with cardboard.

Daily records of temperatures and humidities are kept and all changes in the physical condition of the samples are recorded throughout the year.

The following table indicates the spoilage of the samples to date:—

TABLE 20—SPOILAGE OF HONEY SAMPLES

—	Number of samples fermented									
	40°F.		(Storage temperatures) 50°F		60°F		70°F.		Uncontrolled	
	Closed	Open	Closed	Open	Closed	Open	Closed	Open	Closed	Open
Prior to 1933.....	0	0	0	0	2	2	5	5	18	16
Jan. 30, 1933 to Dec. 31 1933....	0	0	0	0	0	0	0	0	0	0
Totals.....	0	0	0	0	2	2	5	5	18	16*
Per cent spoilage.....	.....	.....	.....	.....	11·1	11·1	27·7	27·7	100·0	100·0*

*This figure is based on 16 open samples only, as two open samples were destroyed by mice at an early stage in the experiment.

It is now more than four years since these honeys were extracted, yet those samples stored at 40°F. and 50°F. are still sound. The only apparent physical change occurring in any of the samples stored at these temperatures is a slight flocculence and this occurs only in three samples at 40°F. and in four samples at 50°F.

At 60°F. there has occurred a slight amount of fermentation, but at 70°F. this has more than doubled.

At uncontrolled temperatures all samples had definitely fermented by the end of 1932.

It will be noted in the table that no definite spoilage occurred during the past year, which bears out a statement made later in this report to the effect that the early period of storage is the period of greatest yeast activity and consequently of greatest spoilage.

From the results obtained so far it would seem obvious that storage temperatures of 50°F. or lower are absolutely safe for the keeping of honey. With higher temperatures and with fluctuating temperatures, the samples show a correspondingly greater tendency to ferment.

As pointed out in previous reports, higher temperatures tend toward an apparent darkening of the colour of samples, and a condition of flocculence. The lower storage temperatures, for the most part, maintain the samples in their original and normal condition.

Since no spoilage has occurred at 50°F. and only slightly over 11 per cent spoilage has occurred at 60°F. after four years in storage, it would seem safe to conclude that a storage maintained at any temperature between these two points would be satisfactory from a practical standpoint, and should ensure a minimum of loss.

FERMENTATION OF HONEY

This experiment was started with 211 samples of the 1929 crop, gathered from all parts of the Dominon.

For comparison, a further 132 samples of the 1931 crop were placed in the same storage in the fall of 1931.

The following tables summarize the observations made on these two sets of samples during the past year:—

The 211 samples of the 1929 crop have now been in storage four years and the rate of spoilage for the fourth twelve-month storage period, in relation to province of origin, is illustrated in the table below:—

TABLE 21—RATE OF SPOILAGE OF HONEY SAMPLES

Province	Number of samples received	Number of samples fermented Dec. 31 1932	Number of samples unfermented Dec. 31 1932	Fermentation during 1933 after months in storage												Total samples fermented past 12 months	Per cent fermentation past 12 months	Number of samples fermented past 4 years	Per cent fermentation past 4 years	Number of samples unfermented Dec. 31 1933
				37	38	39	40	41	42	43	44	45	46	47	48					
																	%		%	
Prince Edward Island	3	.....	3	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	33·3	1	33·3	2
Nova Scotia	6	3	3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	50·0	3
New Brunswick	2	.....	2	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	50·0	1	50·0	1
Quebec	50	19	31	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	1	2	6·4	21	42·0	29
Ontario	59	30	29	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	30	50·8	29
Manitoba	38	6	32	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	3·1	7	18·4	31
Saskatchewan	26	3	23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3	11·5	23
Alberta	5	1	4	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	20·0	4
British Columbia	22	2	20	.....	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	5·0	3	13·6	19
Totals	211	64	147	.....	.....	5	.....	.....	.....	.....	.....	.....	.....	.....	1	6	4·08	70	33·1	141

The following table indicates location and source in relation to fermentation during the past four years in storage:—

TABLE 22.—RATE OF SPOILAGE ACCORDING TO LOCATION AND SOURCE OF SAMPLES

Source	Number of samples received	Fermented samples									Total samples fermented	Per cent samples fermented
		Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia		
												%
All clovers	154	.....	1	.....	10	20	6	2	1	2	42	27·27
Clovers and basswood	12	.....	.....	.....	2	5	.....	.....	.....	.....	7	58·33
Clovers and buckwheat	7	.....	1	.....	1	1	.....	.....	.....	.....	3	42·85
High per cent buckwheat	8	.....	.....	.....	4	1	.....	.....	.....	.....	5	62·50
Fireweed	5	.....	.....	.....	1	.....	.....	.....	.....	.....	1	20·00
Mixed	12	.....	1	.....	2	.....	.....	1	.....	1	5	41·66
Undetermined	12	1	.....	1	1	3	1	.....	.....	.....	7	58·33
Clematis vulgaris	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Totals	211	1	3	1	21	30	7	3	1	3	70	33·1

The rate of spoilage of the 132 samples of the 1931 crop has been much more rapid than that of the 1929 crop samples. Of the latter samples only 33·1 per cent were definitely fermented after four years in storage, whereas 45·4 per cent of the 1931 samples were fermented after *two* years in storage.

The rate of spoilage of the 1931 samples during the second twelve-month storage period, in relation to province of origin, is shown in the following table:—

TABLE 23.—RATE OF SPOILAGE OF 1931 SAMPLES DURING THE SECOND TWELVE-MONTH PERIOD

Province	Number of samples received	Number of samples fermented Dec. 31 1932	Number of samples unfermented Dec. 31 1932	Number of samples fermented after months in storage												Total samples fermented past 12 months	Per cent fermentation past 12 months	Total samples fermented past 2 years	Per cent fermentation past 2 years	Number of samples unfermented Dec. 31 1933
				13	14	15	16	17	18	19	20	21	22	23	24					
																	%		%	
Prince Edward Island	3	1	2	....	....	....	....	1	....	....	....	....	....	....	....	1	50·0	2	66·6	1
Nova Scotia	11	7	4	....	....	....	....	1	....	....	....	....	....	....	....	1	25·0	8	72·7	3
New Brunswick	5	3	2	....	....	....	....	....	....	....	....	....	....	....	....	.....	.....	3	60 0	2
Quebec	27	15	12	....	....	1	....	1	1	....	....	....	....	....	....	3	25·0	18	66·6	9
Ontario	26	13	13	....	1	1	....	1	....	....	....	....	....	....	....	3	23·0	16	61·5	10
Manitoba	23	4	19	....	....	2	....	1	....	....	....	....	....	....	....	3	15·8	7	30·4	16
Saskatchewan	14	1	13	....	....	1	....	....	....	....	....	....	....	....	....	1	7·7	2	14·2	12
Alberta	9	0	9	1	....	....	....	....	1	....	....	....	....	....	....	2	22·2	2	22·2	7
British Columbia	14	2	12	....	....	....	....	....	....	....	....	....	....	....	....	.....	.....	2	14·2	12
Totals	132	46	86	1	1	5	....	5	2	....	....	....	....	....	....	14	16·2	60	45·4	72

Location and source of the 1931 samples, in relation to fermentation during the two-year storage period, are indicated in the table below:—

TABLE 24.—LOCATION AND SOURCE OF THE 1931 SAMPLES

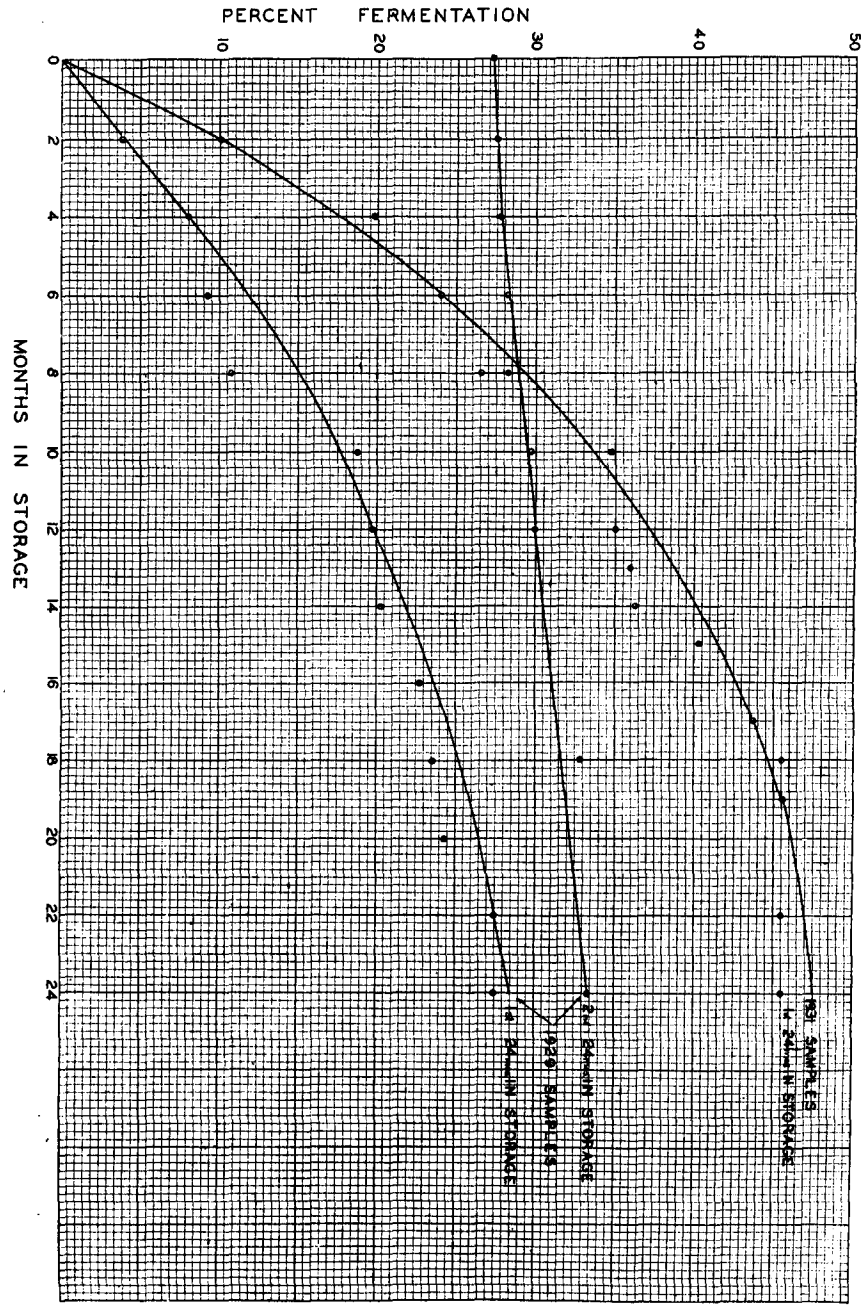
Source	Number of samples received	Fermented samples									Total spoilage	Per cent spoilage
		Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia		
All clovers	95	1	5	2	13	13	5	2	1	1	43	45·2
Clovers and basswood	2	....	....	....	1	....	....	....	....	....	1	50·0
Clovers and buckwheat	2	....	....	....	1	1	....	....	....	....	2	100·0
High percentage buckwheat	1	....	....	....	1	....	....	....	....	....	1	100·0
Mixed	28	1	3	1	2	1	2	....	1	1	12	42·8
Undetermined	3	....	....	....	....	1	....	....	....	....	1	33·3
Snowberry	1	....	....	....	....	....	....	....	....	....	....	.....
	132	2	8	3	18	16	7	2	2	2	60	45·4

Following is a comparison of some of the features of the two groups of samples:—

TABLE 25.—DETAILS OF SPOILAGE OF HONEY SAMPLES

Number of samples	Crop	Average per cent moisture	Average per cent nitrogen	Titratable acidity cc's. in NaOH per 100 gms. honey	Yeast count		Per cent spoilage in storage						
					Per cent of samples containing less than 1 to 1,000 per gm.	Per cent of samples containing 1,001 to over 100,000 per gm.	After 6 months	After 12 months	After 18 months	After 24 months	After 30 months	After 36 months	After 48 months.
		%	%		%	%	%	%	%	%	%	%	%
211...	1929	18·3	0·038	16·7	66·5	33·5	9·4	19·9	23·7	27·4	28·4	30·3	33·1
132...	1931	18·4	0·033	21·9	45·4	54·6	24·2	34·8	45·4	45·4	.....	.....	.....

It will be noted in the above table that the averages of per cent moisture and per cent nitrogen almost parallel each other for the two crops, whereas titratable acidity and average yeast counts are considerably higher for the 1931 crop than for the 1929 crop. It will also be noted that spoilage during the first twelve-month storage period is much higher for the 1931 crop than for the 1929 crop. Total per cent spoilage of the 1929 crop, even after four years in storage, is considerably lower than the spoilage of the 1931 crop after twelve months in storage. This point is better illustrated in the following figure, which shows the curve of per cent fermentation for each two-year storage period.



In view of the results shown in the above figure, it would seem beyond doubt that the tendency of honeys to ferment varies with the season.

A further point of interest, and perhaps the most important, is the fact that in both years' samples the period of greatest fermentation was the first twelve months in storage. After that period the rate of spoilage is greatly diminished.