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CANADIAN BEE JOURNEY

by EVA CRANE

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1. INTRODUCTION

Three earlier visits to Canada from the United States (1954, 1957, 1964) had shown me that Canada ranks among the most progressive honey-producing countries of the world. It is also one of the most productive, on the basis of the honey yield per colony, and consistently shares with Australia the first world place for national average yield*. I had seen beekeeping in small sections of Ontario and British Columbia, and heard sporadic accounts of what was going on elsewhere; but Canada is 3 200 miles across and 2 900 miles from north to south [5 300, 4 800 km.], and I met very few Canadians who had seen the more remote areas. One such area, Peace River, seemed to be an El Dorado as far as beekeeping was concerned, but I had been able to get very little first-hand information about it.

I was therefore very pleased to receive an invitation from the beekeepers of Canada to travel through their country from coast to coast in June 1965, when beekeeping activity would be at its height. I covered about 5 000 miles by road (and many more by air) attended a number of beekeepers' meetings and took part in various other programmes, and visited nearly all the scientific institutes where bee research is being done.

This report will not cover my own route chronologically, but will start in Ontario, move eastwards through Québec to two of the Maritime Provinces (New Brunswick and Nova Scotia) and the Atlantic, and then west from Ontario through the Prairie Provinces (Manitoba, Saskatchewan, Alberta), to British Columbia via Peace River, and so to the Pacific coast.

Geographical background to Canadian beekeeping

Geological factors which are most important in determining—and limiting—Canadian beekeeping are: (1) the Canadian Shield, (2) the extensive central plains, which include the prairies, and (3) the Cordilleran mountains which include the Rockies, the Pacific coastal ranges and the area to the east in their rain shadow. Fig. 1 defines these regions.

The Canadian Shield covers almost half Canada, and continues south of the U.S. border in States from Minnesota to Maine. It consists

* A statement in *Bee World* last year (page 75) that Canada's honey yield per hive *was* the highest national average in the world brought a vigorous protest from Australia. But in Australian statistics the figure used is the number of *productive* hives, amounting to some three-quarters of the total number; *unproductive* hives are those used for queen rearing, solely for pollination in orchards, etc., i.e. not kept for honey production. In Canadian statistics, as in most others, the *total* number of hives is used. The entries in *World Honey Crop Reports* [*Bee World* 47 : 41–42 (1966)] show that if the total number of hives is used in Australia, as in Canada, then Canada takes first place, but if only productive hives are counted in Australia, then the Australian average is the higher.

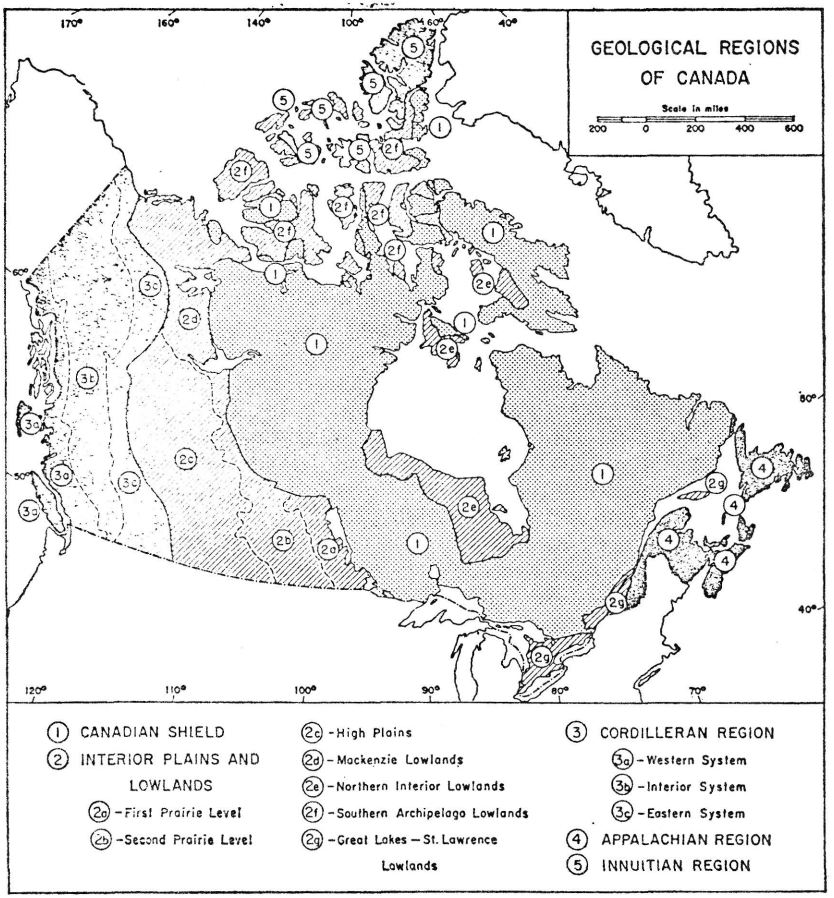

FIG. 1. Geological map of Canada
From *Canada Year Book*, 1965. 1 cm. represents about 400 km.

of very old Precambrian rocks, giving poor drainage, and much of it is barren land, unamenable to agriculture and carrying not much more than scrub vegetation. These areas are largely uninhabited except by trappers and hunters, and mining settlements, and in general it is not beekeeping country at all.

Flanking the Shield to the south-west are plains and lowlands, many with good agricultural soils overlying the relatively new and soft rock; these include the wheat belt which runs across the southern part of the prairies. Much of the best beekeeping country in Canada today lies in these plains, between the wheat belt and the Shield, and especially within a hundred miles or so of the Shield (Sections 5 and 6). In general the honey yields increase with increasing latitude, as for instance in Sweden (Roswall, 1950).

The mountain ranges which constitute the Cordilleran region run roughly parallel to the Pacific coast. There are very sharp changes in

climate and vegetation as one travels east from the coast; in particular the annual rainfall can change within a hundred miles from over 100 inches [250 cm.] a year near the coast to below 10 inches in the semi-desert area lying in the rain shadow of the coastal ranges.

Because of these geological and other factors, only a small fraction of Canada's land is available for beekeeping. Something like 45% (in general Shield country) is uncultivated and largely inaccessible; it is rough grassland, scrub or swamp, known as muskeg. A further 48% of the land is covered by forests, all but 6% of which is coniferous. This makes Canada one of the great wood and paper producing countries of the world, but it yields little for beekeeping except in felled areas, which can be very productive if accessible by road (Section 7), or where access can be obtained by air (Section 6). Honeydew production from the coniferous forests seems to be unexplored and unexploited. Only $7\frac{1}{2}$% of Canadian land is used for agriculture, and a quarter of this is taken up by grain crops, notably wheat. But this $7\frac{1}{2}$% is larger than France, or the Ukraine, and three times as large as Britain.

The area of Canada which is available for beekeeping is thus confined to say 5%: agricultural land where grain crops are not the only vegetation, together with those fringes of the forests and waste lands which produce bee forage and are accessible.

Present-day Canadian beekeeping

Table 1 shows what riches Canada offers in the small proportion of her land where bees are kept. Before discussing this Table, it must be emphasized that Canada is a new and rapidly developing country, so that the direction and rate of change of any statistic are as important as the figure itself. Not only is the total population increasing, doubling itself in perhaps 17 years; there is a continuing internal shift of population—including beekeepers (Section 6)—mainly from east to west. New areas are being opened up, and some of these are among the most productive for beekeepers, at any rate for a time.

A good summary of Canadian beekeeping conditions and achievements has already been published in *Bee World* (Jamieson, 1958). In general bees are kept in Canada as a commercial proposition, for honey production. Because the bulk of the honey comes from agricultural crops (mostly legumes, but also rape, mustard and buckwheat), honey yields are very sensitive to changes in agricultural practices. For instance the introduction and rapid spread of sweet clover (*Melilotus*) after the First World War gave a great boost to honey production; the spread of the weevil that attacks it (*Sitonia cylindricollis*) led farmers to grow other crops instead, with a corresponding loss in honey production in Ontario and other sweet-clover areas.

The new seed-growing areas in northern Alberta and Saskatchewan (Sections 5, 6) are now giving some of the highest seed and honey yields in all Canada. But this might be changed in the future, for some reason quite outside the control of beekeepers; at least one beekeeper raised with me the problem of safeguarding the future. This would seem an impossible task, and it may be that the great resilience of the Canadian people will enable them to adapt their beekeeping to changes that are forced upon them, if and when the need arises.

TABLE 1. Statistics relating to Canadian beekeeping

	Area (1 000 sq. miles)[1]	Area of agricultural land (1 000 sq. miles)[1]	Population in (1 000s) 1961[1]	No. honeybee colonies[2] (1 000s) 1964	No. beekeepers 1964[2]	Total honey yield (tons) 1964[2]	Honey yield/hive (lb.)[2] average 1955–1964	Honey yield/hive (lb.) 1965 estimate (or 1964)[2]	No. colonies/beekeeper[3] 1964	No. colonies/sq. mile[3] agricultural land 1964
Ontario	344	29·0	6 236	130·0	2 560	4 900	71	70	51	4·5
Québec	524	22·2	5 259	48·9	1 880	1 160	63	56	26	2·2
New Brunswick	27·8	3·4	598	1.5	270	43	64	(63)	5·6	0·4
Nova Scotia	20·4	3·5	737	3·4	280	88	66	(58)	12	1·0
P.E. Island	2·2	1·5	105	0·7	70	23	76	(83)	9	0·4
Newfoundland	143	0·085	458							
Manitoba	211	28·4	922	46·0	810	2 610	137	133	57	1·6
Saskatchewan	220	100·7	925	39·0	1 550	2 450	130	165	25	0·4
Alberta	249	73·8	1 332	83·9	1 450	4 360	130	160	54	1·1
B.C.	359	7·0	1 629	28·9	1 890	713	83	150	15	4·1
Yukon and N.W. Territories	1 459	0·013	38							
Total	2 560	270	18 238	382	10 760	16 347	94	112	35	1·4

1 sq. mile = 2·59 sq. km.

1 lb. = 0·454 kg.

[1] Canada Year Book 1965

[2] Canadian Beekeepers' Council (1965)

[3] Calculated from 1 and 2

Canada can be divided into four beekeeping regions (Table 1): (1) Ontario, with the most hives and a medium honey yield; (2) Québec and the Maritime Provinces, with the lowest honey yield, which would however be considered very good in most European countries; (3) the Prairie Provinces, with about twice the honey yield obtainable elsewhere; (4) British Columbia, which has a wider variety of conditions than the rest of Canada put together.

ONTARIO

One in three of all Canadians lives in Ontario, and about one-third of the honeybee colonies are found there also. Both the people and the bees are concentrated in the south of the Province (Fig. 2); much of the rest is Shield country. Because of its relatively high population of bees, Ontario has always led the country in total honey production. It was the first Province to set up a Honey Co-operative (in 1923), and this now handles 2 000 tons of honey a year. Honey crops have been lower in Ontario since the 1930s, because of the replacement of alsike clover

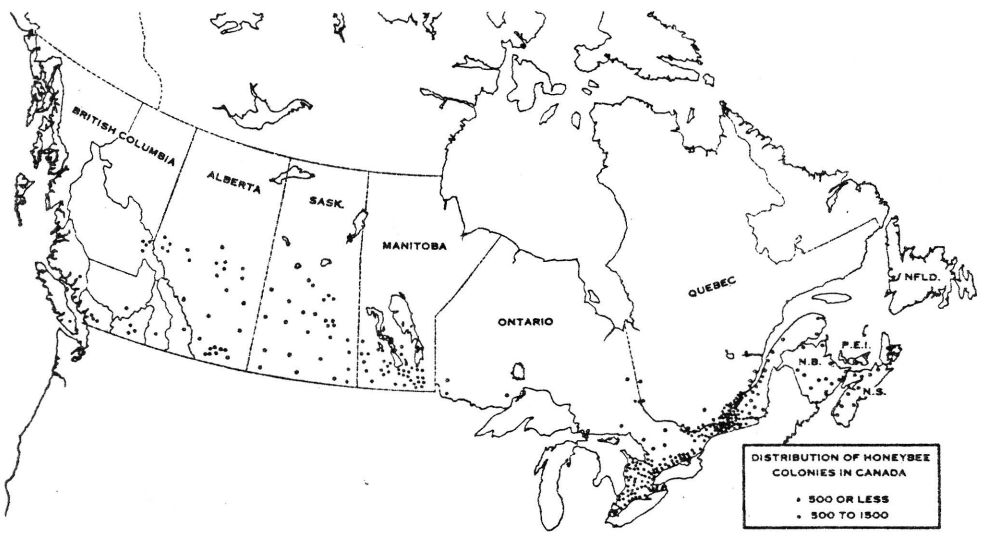

FIG. 2. Distribution of colonies of bees in Canada
From C. A. Jamieson, *Bee World* 39(9) : 232 (1958). Each circle represents up to 500 colonies, and each dot 500–1 500 colonies.

(*Trifolium hybridum*) and sweet clover (*Melilotus*)—mentioned above—by more alfalfa (*Medicago sativa*) and bird's-foot trefoil *Lotus corniculatus*. Hay balers and forage harvesters were introduced during the same period, and these speeded up the removal of hay. The number of colonies has never returned to its high level, although in some years the honey yield per colony from alfalfa can be as high in Ontario as in Western Canada.

Ontario is the best known of all the Canadian Provinces; details of its beekeeping are available (e.g. Townsend & Burke, 1952), also an excellent review of past and present Canadian bee research (Arnason,

1966). This section will therefore only deal with new developments I saw during my visit.

Bee research

Much of the Canadian bee research has always been concentrated in Ontario, at Ottawa which is the seat of the Canadian Federal Government, and at Ontario Agricultural College, now the University of Guelph.

The Canadian Department of Agriculture has maintained Experimental Farms in various Provinces ever since 1887, all of which have carried out bee research from time to time. In 1959 these were reorganized, in view of the expansion of the country and the scientific development of agriculture. The Experimental Farms are now Research Stations, with well equipped modern buildings and more highly qualified staff. But the headquarters of the Canadian Department of Agriculture Research Branch in Ottawa is still called the Central Experimental Farm. It lies within the parkland that makes modern Ottawa one of the most beautiful national capitals.

I had visited the Bee Department there in 1953 (Crane, 1954), but Dr. C. A. Jamieson, Mr. Ed Braun and Mr. Austin have all died since then, and the present bee department is entirely new, with a new name (Apiculture Section), and in a new building. It is a vigorous, happy and cosmopolitan group of research workers, headed by Dr. T. A. Gochnauer who came from the University of Minnesota in 1961. Dr. Basil Furgala, whom I had also last met in Minnesota in 1957, was born in Manitoba of Ukrainian parentage. Dr. L'Arrivee was transferred to Ottawa in July 1965 from the Brandon (Manitoba) Research Station. He was raised in the French-speaking city of St. Boniface, Manitoba, and took his doctorate under the late Professor O. W. Park at Iowa State College. Dr. Rolf Boch came from Professor K. von Frisch's Department in Munich, as did Dr. Ana-Ruth Bisetzky who followed six months afterwards to marry him. (Mrs. Gochnauer and Mrs. Siddiqui also have doctorates.) Dr. I. R. Siddiqui was appointed to replace Mr. G. H. Austin in the study of honey sugar chemistry; he also became head of the Carbohydrate Section of the newly established Food Research Institute. The two Sections are housed together and work together on mutual problems. Dr. Siddiqui, who was born in Pakistan, is a specialist in structural polysaccharide chemistry, having worked for his doctorate under Dr. S. A. Barker at the University of Birmingham.

Subjects under present or recent study* include bee pathogens, bacterial bee diseases, and resistance to them (Dr. Gochnauer, *A.A.* 178/64, 213/65), and also bee behaviour, especially the response to scents, and their production and chemistry (Dr. Boch, 101, 921/63; 94, 215, 800/64; 531/65). This work has included the identification of isoamyl acetate as an active substance in bee venom secretion that *alerts* other bees, and of geraniol and nerolic acid as active *attractive* substances from the Nasonov gland. Nectar secretion and honey sugars in relation to legume pollination are studied by Dr. Furgala (446/62; 629, 630/63; 894/64; 59/65; 309/66); nosema, wintering and bee breeding by Dr. L'Arrivee (see Section 5, also 593/63; 629, 630/64; 175/65; 162/66); sugars in honey and royal jelly, and bacterial polysaccharides, by Dr. Siddiqui (195/66).

* Numbers in brackets are abstract numbers in *Apicultural Abstracts.*

Although the Apiculture Division is on the periphery of the land occupied by its parent organization (beekeeping usually is!), all the resources of the Department of Agriculture Research Branch are available on the same campus, and these are used to the full.

The other centre of bee research in Ontario, the Apiculture Department at Guelph, is also long established and well known. Much of its work has been on honey, since Ontario's problems in the past few decades have been concerned more with the upgrading, processing and disposal of honey than with devising beekeeping methods to get more honey. As a result of the bumper crops of sweet clover honey in the 1920s, and the need to store surplus honey from one year to the next, Dr. E. J. Dyce tackled the problems of eliminating fermentation and controlling granulation of honey, while he was at Guelph (1924 to 1940). His fundamental paper 'Fermentation and crystallization of honey' was published in 1931. It still forms the basis of processing granulated honey in Canada and the U.S., and indeed all over the world. Dr. Dyce was succeeded by Professor G. F. Townsend, under whom the Department has flourished and prospered. Much of its work has been done in close collaboration with beekeepers, to develop methods for honey processing, e.g. 60, 286/55; 167/58; also 659L/63, 'Preparation of honey for market', which gives a clear account of methods recommended, some worked out in the department, and some adapted from elsewhere. The use of benzaldehyde for removing honey from the hive (886/64) and other specialized beekeeping practices (376/63) have also been developed. Dr. M. V. Smith has worked out methods for transporting brood to America without adult bees, whose import is prohibited by legislation (881 – 883/64). He had also made fundamental studies of queen differentiation (154/64); Dr. R. W. Shuel and Dr. G. E. Dixon have added much to our knowledge of secreted brood food in relation to caste determination (607/62; 79, 95/64; 64/65). Dr. Shuel has also worked on nectar secretion in excised flowers, where conditions can be controlled (464/62; 585/63; 126, 307, 564/65). Professor Townsend and various colleagues from within and outside the departments have studied the anti-tumour activity of fatty acids, starting off with 10-hydroxy-2-decenoic acid in royal jelly (134/60; 193/61; 421, 914/63).

The Department is now part of the new University of Guelph, and the long-familiar series of O.A.C. Circulars on beekeeping subjects (45/59) are now re-issued as Publications of the Ontario Department of Agriculture (726/65).

3. QUEBEC

Québec (pronounced Q'bec) stretches from Hudson Bay and the Arctic Ocean to the northern shore of the St. Lawrence River, below the Great Lakes, and then south of the River to the border with Maine and other New England States. It is the largest of the Canadian Provinces, but most of it is Canadian Shield, and the agriculturally usable part is more or less restricted to 4 or 5%, along the River. Almost all the beekeeping is carried out here too (Fig. 2).

The first settlements of Europeans in what is now Canada were made on the northern shore of the St. Lawrence, by Samuel de Champ-

lain and his successors. The French settlers arrived from 1606 onwards, and gave the name *Canada* to the riverside country between Québec City and Montreal. Three thousand were recorded in the first census (1666), and these can be regarded as the nucleus of the present Canadian nation; Québec Province is rightly called *le berceau* [cradle] of Canada. In the present century Canada has received immigrants from many language groups and as many—or more—religions (Section 5). In the main these came willingly and gratefully from their troubled homelands, and add strength and breadth to the Canadian nation.

Beekeeping in Québec is similar in principle to that in other Provinces. The French-Canadian beekeeping journal, *L'Abeille et l'Erable,* has been published from Lévis (opposite Québec City on the south side of the River) since 1919. It is the only journal covering maple syrup production along with beekeeping; this is understandable since Québec produces 90% of Canada's maple syrup, and the major part of the total world output.

One of the Canadian bee supply houses, F. W. Jones, is at Bedford in the English-speaking area of southern Québec, near the Vermont border. Mr. H. W. Jones, son of the founder of the firm, died during the International Beekeeping Congress in Vienna in 1956; the business is now run by Mr. R. W. Craighead, a grandson of the founder.

Québec has some very good beekeeping country on European standards, the average honey yield per hive being 60 – 70 lb., similar to that in Ontario (Table 1). But Québec beekeepers are very conscious of the fact that this is only half what is got in the Prairie Provinces. Some are commercial beekeepers with 200 – 600 hives or more. Others are people in full-time employment who run 40 – 200 hives as a side line, and most of the remainder are farmers who keep 10 – 40 hives; this group is getting smaller all the time, since most of the farmers who keep bees belong to the older generation. It is being partly replaced by recent immigrants, who like to keep say 4 – 10 hives, as they did before they came to Canada.

A commercial beekeeper who sells his honey retail, with a specialty-pack such as cut-comb honey, can make a living from 200 hives, but if he sells the honey in bulk he must keep at least 300. There is no Honey Co-operative in Québec, and beekeepers sell their bulk honey to such firms as that of M. Doyon near Montreal, which had just moved into new premises and was setting up the honey-processing plant for the new season's crop.

I also spent an afternoon with a B.R.A. member M. J. E. Benoit who, appropriately enough, lives in the little village of Sainte Scholastique, named in honour of the sister of Saint Benoit [St. Benedict]. I have never seen a more beautifully kept apiary and honey house; all was spotless and shining, and in its planned orderliness it was not unlike the installation of Buckfast Abbey in England. The home apiary consisted of sixty hives, all facing the same way on a hillside opposite the little village church; they were in groups of four, the centre two being set back a hive-width behind the outer two. The hives were painted aluminium, and queen excluders black so that their position could be seen instantly.

In the honey house Mr. Benoit's first step is to reduce the water

content of the honey by 1-2% (e.g. from 19% to 17%); this is a common Canadian practice. Supers are uncapped, and 12 are then stacked on three adjacent bases so arranged that a current of air from a blower-heater passes through stacks of 2, 4 and 6; the water-charged air escapes from the tops of the supers and through the vent in the roof. About 350 lb. [160 kg.] can be dealt with at once. M. Benoit's 36-frame radial extractor is so finely balanced that it runs without being bolted to its platform, and it is emptied simply by tilting it.

Some bees are still wintered in cellars in some parts of Canada, and M. Benoit's bee cellar was under his honey house: a room almost underground, with a well insulated roof, and ventilation windows on two sides. The hives are stacked in piles of four, round the walls and in the centre. The best conditions seem to be 43 – 46°F. [6 – 8°C.] and 50% humidity; these are regulated by a heater and humidifier.

Extension work in Québec was in the charge of the Provincial Apiarist, M. Henri Plourde in Québec City (shortly due to retire) and the Assistant Provincial Apiarist M. René Brasseur, who operates from Montreal. Under MM. Plourde and Brasseur are ten District Beekeepers, full-time government employees, including M. Benoit, and M. Couture in Québec City. Some have another responsibility besides beekeeping; M. L. Lambert for instance, whose area is just north of the river from Ottawa, spends his summers on beekeeping and his winters on maple syrup production. Each District Beekeeper is given seasonal help by temporary Bee Inspectors, most of whom are themselves commercial beekeepers.

I am most grateful to the Provincial Apiarists for taking me round as much of the Province as was possible in the time available, and also to M. Jean Chabot, Economic Botanist to the Quebec Department of Agriculture, for much information on Québec bee plants (see Chabot, 1948).

4. THE MARITIMES

Québec extends to the mouth of the St. Lawrence on both shores, but behind the coastal strip of the south shore is New Brunswick, itself connected to the long Nova Scotia peninsula by an isthmus that forms one of the heads of the Bay of Fundy. Off the other side of this isthmus is tiny Prince Edward Island, a rich fruit-growing area. The fourth of the Maritime Provinces, Newfoundland, lies across the St. Lawrence estuary. It is largely covered by coniferous forests, and so little beekeeping is carried out there that it does not appear in the official estimates (Table 1). In the other three the honey yields are among the lowest in Canada (but still 60 – 70 lb. per colony), and beekeeping is more often a hobby or side line than a commercial occupation. The 'low' honey yields in Nova Scotia are to some extent offset by a 75-cent subsidy on colonies of package bees.

Coniferous forests cover much of New Brunswick and Nova Scotia, which also have large areas within the Canadian Shield, as does Maine in the United States; all three have many characteristics in common. One of the most interesting of these is blueberry production. The Annapolis valley of Nova Scotia, just inland from the southern shore of the Bay of Fundy, is orchard country, and here some people combine apple growing with beekeeping. Mr. William Foote, for instance, has

400 hives; like other apple producers in the valley, the varieties he grows are Mackintosh, Northern Spy and Red Delicious, small uniform red apples with a thick skin, which sell well under present-day marketing conditions. Most trees are on Malling rootstock 7 or 9, some on 5. These varieties have replaced others of better flavour and texture, whose size, appearance or other characteristics do not fit in so well with modern marketing techniques. It was sad to see many Annapolis orchards derelict; the Valley has still not recovered from the cessation of the apple export trade in the last war.

For recognition of honeybees as pollinators of both tree fruits and berries, beekeepers in Nova Scotia owe much to their Provincial Apiarist, Endel Karmo. Mr. Karmo was an Estonian, who escaped when the Russians annexed his country in 1948, and after various vicissitudes arrived in Nova Scotia with his Estonian wife in 1948, to take up his present post.

I arrived in Nova Scotia on June 6, on the first hot day of the year. Spring comes later in the Maritimes than in many parts of Canada: in Nova Scotia I passed a sign: 'You are now exactly half-way between the Equator and the North Pole'. At a latitude of 45°, this is no further north than Bordeaux, Zagreb or the Danube delta, but it is much more northern in character, owing to the cold Labrador current which—so happily for the British Isles—diverts the Gulf Stream eastwards across the Atlantic.

The 1965 season was very backward, and the apple blossom was not yet over; it was in fact so late that the apple overlapped the blueberry flowering. For me this was most convenient, but for the Nova Scotia beekeepers it was certainly not, because colonies ordered for blueberry pollination were still needed in the apple orchards. About half the hives in the Province had to be moved within a few days, and every beekeeper I met seemed to be spending his nights trucking bees, in order to try to fulfil his own contracts, or to help out another beekeeper. This heavy demand for pollinating colonies is due in no small measure to Mr. Karmo's demonstration of the value of bees in increasing the blueberry crop. Pollination fees are $7 – $9 a hive for either apple or blueberry pollination.

Two types of blueberry are grown, and are dealt with quite differently. High-bush blueberries (*Vaccinium ovatum*) form bushes from 4 to 8 feet high according to variety [1·2 – 2·4 m.], and are cultivated on the same lines as other bush fruit. They also are grown in British Columbia (Section 7), and form larger fruits than low-bush with a higher yield per acre also. The low-bush blueberry (*Vaccinium angustifolium*) is an indigenous plant which seems to appear almost anywhere that land is cleared, in large areas of the Maritimes. It is cultivated by removing first the brushwood and then competing weeds as they appear. It forms clonal growths about 9 inches high [23 cm.], the shoots fruiting in their second year; a sort of pruning is done by burning the growth after fruiting, and crops are biennial. Wise growers leave stretches of woodland or scrub beside their blueberry fields, because bumble bees are the best pollinators, especially large species whose weight shakes the pollen off the anthers on to their bodies as they move about among the flowers. Where honeybees are needed, hives

are taken in at the rate of one per acre [2½ per hectare]. An average crop is two tons per acre [5 per hectare]; blueberries fetch $250 – $350 per ton. The low-bush blueberry fields in the Nova Scotia 'back-lands' were my introduction to Canada this time: within twelve hours of leaving home in England I was watching bumble bees working the blueberry flowers—and a ruby-throated humming bird getting nectar from golden currant (*Ribes aureum*).

Apart from the work on blueberry pollination there has not been much bee research in Nova Scotia, and there is no bee research department. But in New Brunswick, on a beautiful site above the Saint John river is one of the Federal Agricultural Research Stations mentioned in Section 2. Dr. G. W. Wood is in charge of research on blueberry insects. One thing he has managed to do experimentally in greenhouses is to produce parthenocarpic blueberry fruits by spraying the flowers with gibberellic acid. The beekeepers are somewhat relieved that this treatment has not yet succeeded in the field, because the introduction of (seedless) blueberries which needed no bees to pollinate them would reduce the income they get from hiring out colonies.

The Provincial Apiarist from New Brunswick is Mr. D. F. Pinnock, whose help and advice are obviously much appreciated by the beekeepers there. I was able to meet a good many of these at a banquet and meeting at Fredericton; as in other parts of north America, they think nothing of going 100 – 150 miles to a bee meeting, after their day's work is finished.

CANADIAN BEE JOURNEY*

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5. THE PRAIRIE PROVINCES

The average honey harvest in the three Prairie Provinces over the last ten years has been around 120 – 130 lb. per colony [55 – 60 kg.]; in 1965 the yield was 126 lb. in Manitoba, 154 lb. in Saskatchewan and 176 lb. in Alberta [50, 70, 80 kg.]. How are these high yields obtained, what is the honey like, and what happens to it after it has been extracted? Also what happens to the bees, since the beekeepers here buy fresh packages each spring?

These were some of the questions I hoped to find answers to, as I travelled west from the comparatively densely populated agricultural area of Ontario, which lies in the southern tip of the Province immediately north of Lake Erie and Lake Ontario. To the west and north of this is a thousand miles, still in Ontario, of almost uninhabited 'shield' country, discussed on page 55, before one reaches the Prairie Provinces and the next settled area, around Winnipeg in Manitoba. Until the Trans-Canada Highway was opened in 1960, this 'thousand-mile gap' could be crossed only by rail or by air, as there was no through highway, and Canada was divided into three almost separate sections—east of Ontario, the Prairie Provinces, and—cut off by the Rockies—British Columbia.

The Prairie Provinces were named after the great areas of grassland, where wheat is now grown so successfully, but these areas cover no more than the southern third or so of the provinces, and the best bee country is not this wheat belt. It lies in a belt of indigenous mixed woodland, now largely cleared and used for agriculture, between the prairies proper and the northern coniferous forests. This 'honey belt' shifts further north as one goes west (Fig. 3).

Manitoba

Manitoba extends north of the U.S. border to the sixtieth parallel (about 700 miles), but the northern 80% is taken up by 'shield' and Lake Winnipeg, and the settled area is only about 130 miles from north to south. The city of Winnipeg, in the centre of this region, is aptly called the gateway to the west; through this gateway have streamed waves of migrants from eastern parts of Canada and from overseas. Some migrated in search of wealth—or subsistence—and others in search of freedom to follow their political or religious beliefs. Some migrants settled in Manitoba itself, whose inhabitants are perhaps more varied in national origin than any other part of north America. This is exemplified by the number of religious denominations represented; in one village of only eight hundred inhabitants I saw eight churches, including the United Church of Canada, Anglican, Lutheran, Greek Orthodox, Greek Catholic and Roman Catholic; Menonites and Mormons attended churches in a neighbouring village.

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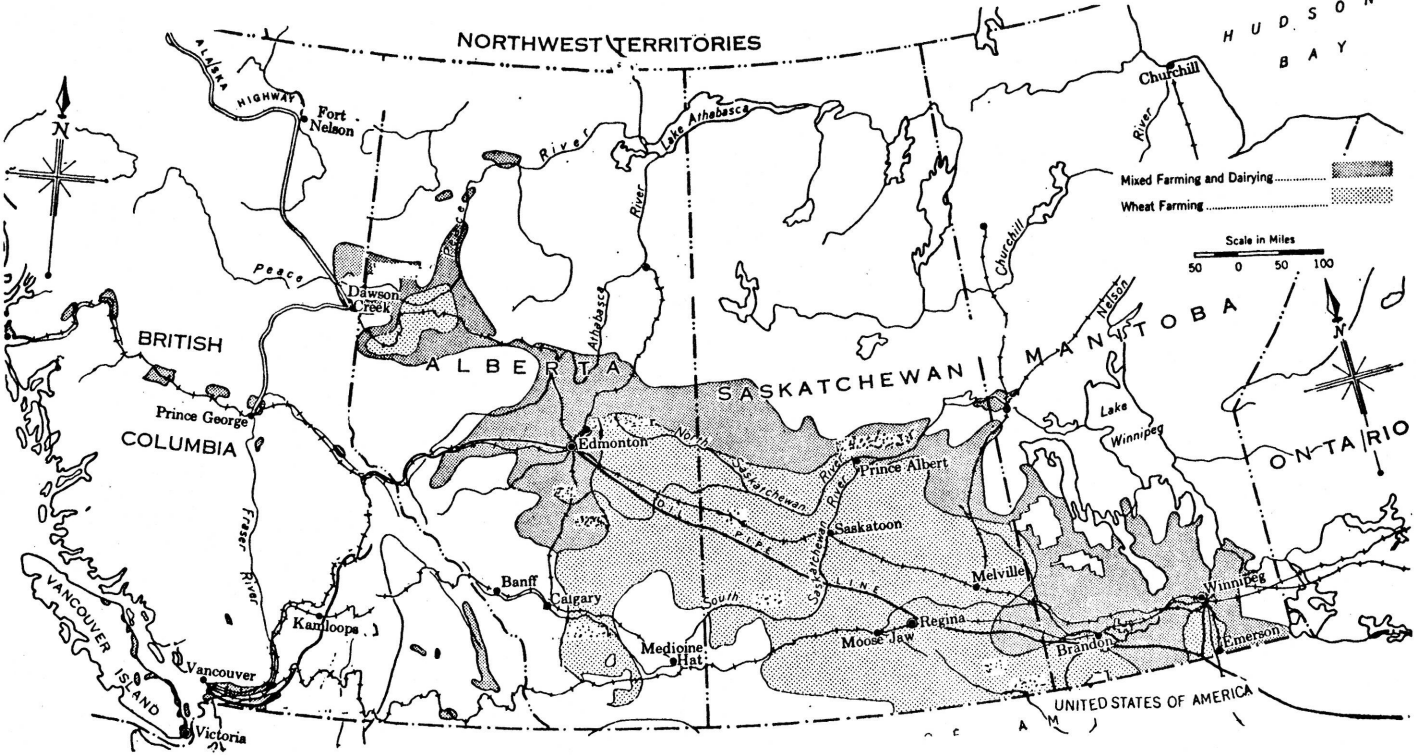

FIG. 3. Map of Western Canada, showing the limits of agricultural land; compare with Fig. 1 (geology) and Fig. 2 (distribution of colonies of bees). From *Facts on Canada*, 1963

As far as honey is concerned, Winnipeg is the gateway to the east, the route now being by truck to Port Arthur and thence by ship down the St. Lawrence Seaway, to the eastern Provinces and to Europe. My own travels in Canada ended at Winnipeg, too, after a memorable beekeepers' picnic in Assiniboine Park.

In each of the three Prairie Provinces the beekeepers have set up their own co-operative to process and pack the honey they get. The largest and oldest of these is the Manitoba Honey Co-operative in Winnipeg. It packs about 2000 tons of honey a year under names which include Clover Crest and Kraft, and also serves in some ways as a clearing house for all three Prairie Co-operatives. These together provide substantial competition to the Ontario Co-operative (page 59); if and when the two groups combine, Canada's position as a honey exporter will be considerably strengthened.

Frank Garland, the imaginative and dedicated manager of the Manitoba Co-operative, showed me over his plant, housed in a modern building built for the purpose in 1960*. Since my visit, he has been joined by Don Robertson, the Provincial Apiarist for Manitoba, from whom I learned a lot about the conditions and economics of Manitoba beekeeping (see Robertson, 1960).

The process described in the footnote is used to produce granulated or creamed honey, which most Canadians eat. Much of the honey is sold in plastic containers, labelled 'pasteurized, homogenized honey'; the transparency of glass does not have the same advantage as for liquid honey; indeed if frosting occurs it may be a disadvantage.

Some honey is, however, packed and sold liquid. This is pasteurized in the way described above, and is then filter-pressed through diatomaceous earth, cooling more slowly, only to 130°F. [54°C.] after 3 minutes. It is bottled straight away, at this temperature. The filter press has to be taken down for cleaning every few days (it would be interesting to analyse the residue kept back by the filter). The resultant liquid honey has a long shelf-life (i.e., does not granulate); similar liquid honey is sold all over the United States, and is able to compete visually with processed or synthetic syrups on display in supermarkets. To me, as to most European beekeepers, including a French group (Borneck *et al.*, 1964) which published a valuable and detailed report on Canadian honey-processing methods, it is a poor emasculated sort of honey. As

* The plant normally runs for 7½ hours a day, but can go on for 13 hours at a stretch if necessary. Honey is delivered in 'barrels' of 100 lb. [45 kg.] or 650 lb. Before the honey is processed, these barrels are pre-heated in a room maintained at 100°F. [38°C.], then moved to a warmer room at 175°F. [80°C.] where they are turned upside down so that the honey drains out and flows away immediately, cooling as it goes. From the basement it is pumped up to the main plant, and strained through an O.A.C. strainer (Townsend, 1954). The strainer here is mounted upside down, so that it always empties when the input is switched off, even if it had been clogged up. The strained honey is pumped through APV plate heat-exchangers for pasteurization. The temperature of the honey goes from 110°F. to 170°F. and back to 110°F. [43°, 77°, 43°C.] within three minutes; this includes the straining process. Further rapid cooling to 57°F. [14°C.] is achieved by using Votators; these are drums cooled on the outside by ice-cold water, in which the honey congealing on the inner surface is continuously scraped off by floating blades, allowing more honey to get cooled (Food Processing, 1961). After cooling in twin 6-inch Votators [15 cm.] the honey is seeded and cooled further (to 83°F., 28°C.) in a single 10-inch Votator. It then flows on to the bottling machinery.

the French report says: 'Is it possible still to consider as honey a product from which precisely those constituents have been extracted which make honey different from the other sweetening products?'

This situation is common to most of north America. The subject was discussed at a meeting I attended in Ontario, and there I felt impelled to put the European point of view: that honey tastes better, and can be regarded as of higher quality, if the trace materials are left in it, and not removed by excessive heating and filtering under pressure. I did this with some diffidence, realizing that honey preferences vary greatly from country to country, and that what is despised in one is almost certainly the favourite in another. To my surprise I found that this point of view got much support, and that in British Columbia there is already a strong move to market honey in a form much less severely processed. Indeed one problem before the Ontario meeting was to find a description for this honey which was not pejorative to the more usual pasteurized and seeded or filter-pressed honey. British Columbia is fortunate in having plants whose honey will remain liquid for long periods (Section 7), whereas rape (*Brassica napus*), a fairly common honey plant in the Prairie Provinces, produces honey which granulates very quickly indeed.

One Manitoba beekeeper I visited was Jim Isaac, who with his wife is building up a honey business. He had 450 colonies, from packages bought in Alabama or Mississippi; he finds 2½ lb. packages the best. Before they are hived the bees are treated with Fumidil B in syrup, from a pressure spray; they get three doses altogether. All the hives are kept within about 15 miles [25 km.] of the house. In the sparsely populated countryside of western Canada I got accustomed to gauging the productiveness of the bee forage from the area used by any one beekeeper, which could range from say 80 to 20 000 square miles. In many places there was no overlapping, territories being mutually respected. But in a really good area territories could overlap, or even coincide, without detriment to honey yields.

Like most other beekeepers I met in the west, Jim Isaac was having bear trouble. In his area there is an active wild-life conservation programme, and the approved procedure is to telephone the Natural Resources Department, which sends someone to set a trap-cage. When the bear is caught it is marked and released some miles away; if it returns again, it is then shot.

In Winnipeg, the Entomology Department of the University of Manitoba has a lively group of bee research workers under Dr. Cameron Jay, who is himself occupied with problems encountered in commercial apiaries such as drifting (1965/66) and losses in package bees (1965), and the laboratory rearing of bees. John Harcus, a Manitoba graduate, was just starting studies on incubator queen rearing and queen-worker differentiation. Eric Nelson from Wisconsin was doing experiments in the indoor flight room (Jay, 1964). These were producing interesting records of regular cycles of foraging activity even under constant 'daylight', and of the circumstances that initiate flight from the hive. They were also producing problems—in sanitation, and in the elimination of *everything* that could invalidate experimental results by serving as orientation markers for the bees; even electric light switches and cables were giving trouble.

Chris Plowright, from England, was developing methods for rearing bumble bees in order to study queen-worker differentiation; these are described in No. 3 1966 *Journal of Apicultural Research.* By keeping the nest boxes in a hot room (29°C.), the bees were able to do without nesting material, and the nests were therefore always visible. I saw the species *terricola, rufocinctus, vagans, perplexus* and *ternarius*, but others had also been reared in this way.

The oldest bee research establishment in Canada is in south-west Manitoba, at Brandon. Work started in 1890 at the Government Experimental Farm there; this is now a Research Station of the Canada Department of Agriculture. The apiary was a picture piece when I saw it, beautifully tended, with rose bushes as markers to help the bees to find their hives. The work was then largely being wound up under the present policy in the C.D.A. of centralizing research in each subject. Dr. J. C. M. L'Arrivee, who had been in charge for nearly ten years, was shortly moving to Ottawa; Mr. John Geiger was remaining to finish off some of the work in progress. Records of colony populations and weights have been kept for many years; these are of special interest because the area is one of many in the west that give an exceptionally rapid spring build-up of colonies, and a high honey yield, all within an active season of about 4½ months.

The late Professor A. V. Mitchener published long-term records of the swarming and forage cycle in Manitoba (1949, 1955), and also an account of beekeeping there since its start in 1888 (1957).

Saskatchewan

Saskatchewan is the least densely populated of the Prairie Provinces; its flower emblem is the lovely orange-red Prairie Lily, *Lilium philadelphicum.* The limit of agricultural settlement extends further north than in Manitoba. Beyond it is the 'pioneer fringe', and then a land of forests and lakes which in places seem to epitomize a child's picture of American Indian country.

The Saskatchewan Honey Co-operative, at Tisdale, was in the charge of Roy Pugh. In this capacity, and in his earlier one as Secretary of the Canadian Beekeepers' Council, Mr. Pugh has been a real friend and adviser to Canadian beekeepers; he has now retired, and Mr. H. McPhail is appointed in his place at the Co-operative. This was formed in 1954 and, like those elsewhere, works closely with the beekeepers, whose honey is sold under the trade names Sasco, Honey Boy and Bear Brand. Honey is blended to Pfund 16, and packed with 18 – 18·4% water content; drier honeys are humidified or blended. The process is similar in principle to that in Manitoba, but different methods are used (see Borneck *et al.*, 1964). Exports are rising, and the plant has capacity to expand from the present 1000 – 1500 tons a year to 2000.

At a banquet in the Civic Centre in Tisdale, I had the pleasure of meeting Mr. Baines, President of the Saskatchewan B.K.A.; there were perhaps two hundred at this banquet, forty being full-time beekeepers who between them run 20 000 colonies and produce around 1500 tons of honey a year. Catering was done by a local women's organization to raise funds for the church; the excellence of this scheme—with regard to both food and service—led me to introduce a similar one for the

B.R.A. at Hill House, where the Young Wives' Group has proved itself quite equal to its Canadian counterparts.

The Province of Saskatchewan is crossed by two mighty rivers, the North and South Saskatchewan, and I rarely seemed to be far from one of them. They join just west of Prince Albert to form the Saskatchewan River, whose waters drain finally into Hudson Bay.

I visited several honey-producing apiaries around Nipawin, a village on the Saskatchewan river near the northern limit of agricultural land. Here conditions seem almost designed to make bees prosper and store a large surplus, and there must be ten thousand colonies in the area. It is cleared forest land, with thickets of aspen (*Populus tremuloides*), birch (*Betula*), willows (*Salix*) etc., which are left here and there for soil conservation. These provide sheltered spring apiary sites. In summer the colonies are moved on to the cleared land, which is planted each year with legumes—alfalfa, alsike clover and sweet clover (*Medicago, Trifolium hybridum, Melilotus*). Many of the common weeds are also excellent bee plants: fireweed (*Chamaenerion angustifolium*), and sow thistle (*Sonchus arvensis*) and dandelion (*Taraxacum*), both introduced from Europe. Dandelion is widespread in north America: in places as far apart as Nova Scotia, Colorado and Oregon I have seen tracts of land yellow all over, as far as the eye could see, and full of nectar for the bees.

One of the Nipawin beekeepers was Bill Hamilton, nephew of the late William Hamilton, beekeeping instructor in the West Riding of Yorkshire, who wrote *The art of beekeeping*. Bill Hamilton runs about a thousand colonies and—unusual in this part of the world—processes and bottles his own honey. His method of dealing with the clogging-up problem when straining honey is to use a very long nylon sleeve which can be wound up bit by bit on to a spool when clogging occurs.

I found Nipawin a stimulating place mentally; Mr. Hamilton was very knowledgeable, and almost next door lived Dr. D. F. Peer, whom I had last met in 1953 in Madison, doing research work under Dr. C. L. Farrar—whose methods of management he both practises and preaches (1937, 1944, 1958). Don Peer left his career in bee research several years ago, because he could get a much higher income by producing honey. More than almost anyone I met, he seemed to have thought out the biological and economic implications of colony development and honey production in the near-optimum conditions in parts of the Prairie Provinces. The physiology and behaviour of honeybee colonies living in *difficult* conditions have been so much studied and written about—especially in Europe—that one gets to regard this as normal, and a standard from which other circumstances must be judged. To be shaken out of this state of mind, and to find places where the foraging capacity of the colonies was continuously stretched to the limit, was a most refreshing experience, and one that opened up many new trains of thought.

Here and elsewhere in the west I got the idea that in most years the conditions are so good for bees (see Section 6) that nothing can prevent the colonies developing fast and getting a lot of surplus honey. Factors that are given emphasis in much European beekeeping and research—strain of bee, freedom from disease, type of hive, methods and skill of management—seem comparatively irrelevant here, *except in a*

poor year. Then the good beekeeper with healthy colonies of a suitable strain will get his harvest (less than usual, but fetching a higher price), whereas the less skilled beekeeper with less healthy and less suitable bees will get little or no honey. Similarly in a bad year two-queen colonies get relatively more honey than single-queen colonies. The Canadian entries for 1965 in the World Honey Crop Reports elsewhere in this issue show that western Canada did in fact have a bumper honey crop in 1965—over twice the long-term average.

Don Peer uses two-queen colonies on Dr. Farrar's system (Peer, 1965). He gets 2-lb. packages about 23rd April, and uses two per hive, the division board between them being later replaced by a queen excluder. By 23rd June or so the 16 000 bees in the two packages have produced 70 000 or 80 000; by July there are 90 000 or 100 000 in each hive. A thousand or more hives, in apiaries of 25 – 35, are spread over an area perhaps 50 × 30 miles, parts of which are also used by other beekeepers.

During my visit Dr. Peer gave a party for seed producers and local officials, to discuss pollination problems, and to show them round his honey house; this was a model plant, which made a great impression on all the visitors. I was distressed to learn that, although it is only just completed, it will shortly be destroyed when a dam is built across the river.

In the whole of my trip no one introduced the subject of killing the bees at the end of the season, and I think it is a job that most beekeepers do not relish. I finally persuaded Doug McCutcheon to show me how it is done; he was the Provincial Apiarist of Saskatchewan, but has since (like Don Peer) changed to commercial honey production. The colonies are killed with cyanide, either from a gas cylinder fitted with a tube which is inserted into each hive entrance in turn, or as a paste made from calcium cyanide, which is ladled out—with great caution—on to a strip of card and pushed inside the entrance. A few of the more careful beekeepers kill or cage the queen three weeks before killing the bees, so that there is no brood in the hive then, but most do not bother.

Mr. McCutcheon drove me from Saskatoon along the South Saskatchewan river to Prince Albert to visit Carl Meilicke, a beekeeper who immediately made me feel at home, and whose wife had baked a wonderful saskatoon pie. I knew the saskatoon bush (*Amelanchier canadensis*) from my visit to British Columbia in spring 1957, when bees were working it hard. Only now did I discover that it produced edible fruit, like a large blackcurrant, which was quite delicious.

Mr. Meilicke took us to an apiary above the Saskatchewan river, and near the only log house I saw on this visit to Canada. On the high ground were acres of nectar-producing scrub and woodland, and the flats down by the river were covered with willow and other spring forage. Mr. Meilicke's was the first honey house in which I saw a honey-wax separator installed instead of a strainer. It is a centrifuge which works on the same basis as a cream separator, with a series of knives to scrape the wax off the gauze of the cylinder. Honey and cappings are put together into the separator, and Mr. Meilicke believes it to be more efficient than any form of gravity strainer, besides eliminating clogging-up problems.

From the Meilicke's home Everett Hastings took us through Prince

Albert—the most northerly city in Saskatchewan—and on into the forest beyond the settled area to visit his mating apiary. The apiary, near Candle Lake, was 22 miles [35 km.] inside the forest, and presumably safe from other drones—but safe from bears only by reason of a high electric fence. Mr. Hastings, one of the few queen rearers in Canada, has bred Caucasians for many years: this is his summer work; he winters his breeding stock at Birch Hills, also in Saskatchewan, but has recently been using the Canadian winter time to do queen rearing in Australia!

I shall long remember the evening I was at Candle Lake; we explored beaches and bays and creeks in the setting sun, finding in the backwaters water lilies that moose like to eat; there were killdeers and gulls at the water's edge and a solitary loon just off shore. Mergansers flew overhead, and a local fisherman complained that wood duck had nested in his cabin chimney, so he couldn't light a fire. . . . When the sun set, it left a huge golden sky behind the dark firs.

Alberta

Going west from Saskatchewan into Alberta, one has almost 'rounded' the Canadian shield, and the settled area consequently extends much farther north—to the Peace River country, discussed in Section 6. The present section deals with the southern half of Alberta.

The Rocky Mountains dominate the extreme south of the province; east of the mountains themselves the prairies are subject to chinooks —warm dry westerly winds that evaporate the snow and leave the soil exposed to greater temperature variations than where the snow lies. As well as having important economic consequences, this affects the local populations of bumble bees. A visit had been planned to Pincher Creek in the foothills of the Rockies, as well as to Lethbridge on the prairies, so that I could see the bumble bees of both habitats. Heavy rain prevented the visit to Pincher Creek—and, alas, the proposed barbecue there—but Dr. G. S. Hobbs gave me a very good insight into his work on these bees at the main laboratory in the Federal Research Station at Lethbridge. In the wooded foothills, where the soil temperature is stabilized by the snow cover, *Bombus* species hibernate only a few cm. under the ground; *Bombus* species on the prairies, however, must winter 15 cm. or so down, to escape the temperature variations of the surface soil there (Hobbs, 1964, 1965).

The native bumble bees of Alberta have proved unsuitable for commercial use as pollinators, because they are so successfully parasitized by cuckoo bees (*Psithyrus*). Gordon Hobbs' other great interest derives from this fact; it is the propagation and 'domestication' of *Megachile rotundata*. This leaf-cutter bee is a native of Asia, first recorded in north America (Virginia) in 1937; it is very adaptable, and reached the other side of the continent by 1954. It cannot survive unaided as far north as Alberta, because of the cold winters; in Dr. Hobbs' view this is one of the bee's great advantages, because it minimizes problems of parasitization and disease. The chief parasite in Alberta is a chalcid *Melittobia chalybii*; this emerges a few days before the bees do, and can be fairly easily killed off in the 'bee batteries' Dr. Hobbs uses. These batteries are blocks of wood in which 3000 parallel holes are drilled, about 6 mm. in diameter and 11 cm. long, to simulate

the hollow stems *Megachile* likes to nest in. The batteries of nests, containing pupating bees, are wintered at a controlled temperature and put into an incubator in spring, at a date calculated to prepare them for emergence just when flowering commences in the alfalfa they are to pollinate. One battery per acre [2½/ha.] is put out into the alfalfa plots, together with a tray containing 3000 bees from the incubator, at the point of emergence. Half these bees will be males, which mate with the females as soon as these emerge, and each female fills 1, 2 or 3 holes with leaf-cells, an average of 2 – 11 cells per hole. Only one generation is reared in the summer, compared with two or three further south, but a five-fold increase in population can be reckoned on each year. When I was at Lethbridge on 25th June, Dr. Hobbs had 12 000 bees in the incubator just due to emerge; he was in a state of considerable frustration because it had rained without ceasing for three days and he therefore could not get them out into the alfalfa fields. At the University of Guelph in Ontario, and near Kamloops in British Columbia (Section 7), batteries of paper straws were being used as an alternative to drilled blocks of wood; by a happy coincidence the diameter of drinking straws is acceptable to *Megachile* for a nesting hole.

The Provincial Apiarist of Alberta is Jack Edmunds. I owe it to him that I saw so much of interest in Alberta, and it was my fault—not his—that I did not see twice as much. With him and his family I spent a very happy weekend in a cabin near Banff, and sampled the wonderful opportunities Canadians have for holidays among the spectacular Rocky Mountain scenery. I also at last caught sight of one of the bears I had heard so much about, walking free, and not pursued by a beekeeper with gun or trap.

In Edmonton I was very pleased to meet Professor and Mrs. Brian Hocking again, and also Mr. and Mrs. Bill McEwen. But I had far too short a time there to see all I wanted to. North of Edmonton, in rather sparsely settled country, is the indistinctive watershed between Hudson Bay and the Arctic. Beyond lie 150 miles of rough forest and muskeg —peat bog and sporadic scrub with no human habitation whatsoever— and then the richer farmland of the Peace River country.

6. PEACE RIVER REGION

The Peace River is part of a river complex that flows through mountains, lakes, forests and tundra, 3000 miles from its beginnings in British Columbia to the Arctic Ocean. The 'Peace River Region' is a broad fertile valley roughly 150 miles [250 km.] across and slightly longer, from Fort St. John and Dawson Creek in British Columbia to Peace River (town) and High Prairie in Alberta. Rainfall and summer temperatures are not very different from those around Edmonton, but the winters are considerably colder.

Settlement of this island of fertile land did not really start until 1906; in 1911 the population was 1200. In 1915 a railway from Edmonton was completed, and later a road. In 1942 the Alaska Highway was built from Dawson Creek to Fairbanks in Alaska—1523 miles in seven months, an incredible achievement. In 1965 there was still no finished road or rail connection with the rest of British Columbia (or indeed with the Pacific coast south of Alaska), but a road was being

built, and I was driven along it the whole way between Dawson Creek and Vancouver, nearly 1000 miles.

Readers may well be wondering what all this has to do with bees. Even beekeepers living in the region seemed astonished that I had come 6000 miles from home to visit them, and that it had been a long-standing ambition of mine to do this. The Peace River Region is one of the most recently cleared and settled in Canada; it is the only one where new settlers can 'homestead' i.e. acquire land free of charge by clearing it themselves. Much of the freshly cleared land is 'grey wooded soil', not suitable for wheat, and legumes are the only crop that use it to advantage, and enrich it. The summer climate is excellent for seed production, so legumes are sown each year; if a farmer is too late to sow legumes, he sows rape instead (*Brassica napus*)—also a good honey plant. Plants grows very fast in the long summer days, and the honeybee colonies prosper correspondingly. In the best part of the region a thousand colonies can be kept within a radius of 5 miles [8 km.]. Packages are installed in the middle of April, a second brood chamber is put on in May, and perhaps a third in June. The legumes start yielding heavily in the last week in June, and continue until the first killing frosts at the end of August or in the first few days of September. A likely average yield is around 200 lb. per hive; the average for one apiary might be as high as 500 lb. [100, 250 kg.].

I was constantly fascinated by the ecological aspects of plant growth and colony development in these regions of long summer days and intense solar radiation. The main honey-producing plants were familiar to me, but here they grew much more rapidly—like the honeybee colonies—and also seemed to secrete more, or more concentrated, nectar. Similar conditions must exist in parts of Siberia, but I have not seen them.

Two factors are noteworthy. Firstly, honeybees are not indigenous to Canada, nor are most of the honey-yielding plants. Secondly, the system of honey production in these northern regions is entirely dependent on the use of package bees. This is perhaps a suitable place to emphasize some of the differences between package-bee beekeeping and permanent-colony beekeeping. The differences had been familiar to me in theory for many years, but I did not fully realize the following practical implications until I saw the system in operation.

Firstly, there is no continuity from one year to the next. The bees that occupy a hive from April until August have no relationship to the bees in the hive the year before, or the year after. The colony has no continuing entity, with its own characteristics of foraging behaviour, disease resistance and so on. There is less problem of disease transmission from year to year, since the low winter temperatures help to sterilize the combs (and eliminate wax moths), and the area is empty of bees. In the beekeeping regions I have written of, frosts start around 1st September and continue until 30th May, or later, and the average January temperature is between 0 and 10°F. [−12 to −18°C.)]. Most of the disease that occurs, the bees bring with them each spring, and since packages contain no brood, brood diseases which occur arise from contaminated combs. Nosema is a troublesome disease, and the long journey in confinement does not help. Ideally package bees should be accepted only from apiaries known to be nosema-free; but since all the

packages are wanted at about the same date, the package-bee producers are under very great pressure to get the queens reared and mated and the packages made up. When it comes to the point, the beekeeper would rather have *any* packages than none, since his whole livelihood depends on having bees for the honey-producing season. I discussed these problems with many beekeepers, and the best results seem to follow when the Canadian beekeeper and his U.S. bee supplier work in close collaboration, almost in partnership. The journey itself is a strenuous and responsible undertaking, for both bees and beekeeper. It is usually made by truck, but charter planes are being tried. Often one beekeeper will specialize in this aspect of the work and make several journeys, fetching his own and neighbouring beekeepers' packages.

Another interesting and rather curious aspect of this system of beekeeping is that it is almost an antithesis of the principles of acclimatization. Much has been written about the need to use in any area strains of bee that have developed there (or under similar conditions elsewhere), and about the unfortunate results that occur if bees from a different type of environment are introduced. But here every queen and all the workers that constitute the initial colony are reared in a region with a mild winter, early spring and long summer season. These colonies store their honey in a region with a very late spring and a short and intense summer season, with long summer days. There is no genetic feed-back to the queen-rearing apiary, since the colonies are killed off each September*. Every year fresh 'unacclimatized' colonies are brought in—and produce several times as much honey as if they had keen kept where they were reared.

I was rather troubled at some aspects of the beekeeping industry based entirely on package bees. Firstly there is this dependence on genetic stock produced elsewhere, without reference to colony performance in the region in which the bees spend the summer, and subject to disease legislation of another country. Secondly a generation of beekeepers is coming into being which has no experience of wintering bees, of queen rearing, or of bee breeding for their own conditions. These are extreme statements, to which there are exceptions. A few beekeepers do winter colonies; Everett Hastings in Saskatchewan has for years been rearing Caucasian queens, and he and others winter some colonies; a few beekeepers go south to work in queen-rearing yards for some of the 7½ months each year when they have no bees.

Agricultural problems of the Peace River Region are studied at the Canada Department of Agriculture Research Station at Beaverlodge. I saw new strains of legumes in the experimental plots (*Medicago, Melilotus, Trifolium hybridum,* tetraploid *T. pratense, Lotus corniculatus*), and also magnificent wind-breaks of *Caragana arborescens*, the Siberian pea tree, in hedges 8 feet high whose flowers were being worked by both honeybees and bumble bees.

The average January temperature is −10°F. [−22°C.]; one day in the previous year it had reached −90°F. [−68°C.]. Dr. P. Pankiw is responsible for the beekeeping work, and he has tried wintering colonies in cold-rooms at temperatures between 30 and 45°F.; he finds the best to be 40 ± 2° [5°C.], relative humidity being kept at 70 – 75%. In early

* I have, however, recently been told that some U.S. queen rearers go north when their own season is over, and may take breeder queens back with them.

spring, colonies kept at any temperature between 30° and 60°F. [−1° and 16°C.] reared brood at about the same rate, but colonies in daylight (whose bees could fly) reared brood about twice as fast as those in darkness. Access to pollen gave no increase beyond this, but length of daylight was important: colonies on a 16-hour 'day' reared more brood than those on only a 9-hour 'day'. Dr. Pankiw is also trying to breed a strain of lucerne that honeybees pollinate readily. He has produced one strain whose flower has no 'standard' (the large petal), and bees cannot work this variety *without* pollinating it.

I have a lively remembrance of the beekeepers I visited in this pioneer Peace River country. They made me so welcome, and everywhere I saw something different. Near Beaverlodge I breakfasted with Jack and Marie Smith, whose twin sons put on a rodeo for me in their own corral. Mr. Smith's bee truck is converted from an insulated cattle truck; he makes five trips to California each spring, bringing back 2000 packages each time, for himself and neighbouring beekeepers. One of the front wheels was driven on to a bear trap to open it, so that I could see how it worked; I dare not voice my sympathy with the animal caught in such a trap, since the bears do so much damage. They pull the hives to pieces in the apiaries (and many old bears are adept at negotiating an electric fence); then, in order to eat the honey in comparative peace away from the bees, some bears will carry supers off into the woods and demolish them there. So the beekeeper cannot salvage much that is useful, of bees, or hives, or combs.

Near the town of Peace River we visited Raymond Wood's honey house, where Jack Edmunds wanted to see a new 120-frame automatic radial extractor. It takes ten minutes for each run, and will extract over a ton of honey an hour. From a vantage point nearby there was a most impressive view of the river, in a rift three miles wide, flowing away northwards through endless forests towards Great Slave Lake, which drains into the Arctic through the Mackenzie River.

At Grimshaw, John Woodburn was building his own honey house (40 × 80 ft.); this brought home to me the great shortage of labour here—beekeepers have to do most of their construction jobs themselves, and Mr. Woodburn was no exception.

Near the south-east corner of the Peace River area is a French-speaking community. Here the beekeepers were also having bear trouble, and Marcel Larocque had already gone out with a shooting party when I arrived at Girouxville. I met him at breakfast next morning, and also Gerard Paradis, whose new honey house was one of the most luxurious I have ever seen.

Further north, at Fairview, we called on Don McCulloch, who was in real trouble. He knew that bears were in at least three of his bee yards. But he uses a two-seater plane to get to the apiaries, and the plane was out of action as he had failed to clear a fence when last landing it. A mechanic was busy on repair work, but until this was done Mr. McCulloch could not reach the bees.

All these beekeepers live in Alberta's section of the Peace River region, but the western part is in British Columbia. Here, at Dawson Creek, the starting point of the Alaska Highway, I received what seemed to me the warmest welcome I have ever had. It was perhaps the first 'bee visit' by anyone outside North America, and it was made the

occasion of a get-together for beekeepers from all around, who brought great baskets of food with them for the crowd to eat; the mayor and other civic officials came along too. There was a half-hour television programme—with no rehearsal—and by the end of the day the town had learned, to its amazement, that it was important as a centre of one of the world's richest honey-producing areas. At lunch the mayor explained how much they needed more settlers to work the land.

The meeting itself was held in the hot-room (but with the heat switched off) of Homer Park's honey house; Mr. Park lives in California, and the plant is run by Henri Hudon, a Canadian. Our directions for reaching it were 'follow the Alaska Highway to the first blinkers [lights], then turn right'. When I saw the signpost pointing along the Highway, I realized why I had been told there would be no time to follow it right through: Fort Nelson 300, Whitehorse 918, Fairbanks 1523 miles.

One of my chief memories of the Peace River region is the clearness of the atmosphere and the range of visibility—50 miles or so from even a slight rise—and the enormous expanse of sky above. Life must be hard there in the long and severe winters, and in spring when the snows melt, but in high summer I found it an exciting and invigorating place.

7. BRITISH COLUMBIA

I had visited British Columbia in 1957, and ever since then I had wanted to go back to see more of the Province. Once again I was fortunate in having Jack Corner the Provincial Apiarist as my guide, and British Columbia certainly never had a more effective champion.

Dawson Creek is being linked with Prince George, and thence with Vancouver 1000 miles away, by the new Hart Highway, which was still being surfaced in June 1965. It is cut through uninhabited land, and when one left the car there was absolute silence except for the birds—and John Corner knew exactly where to go to see a handsome Stellar's jay. There were flowers in plenty, including a lovely orange and yellow columbine (*Aquilegia formosa*) and, down by the Fraser river, the orchid *Cypripedium montanum*. The Hart Highway crosses the Rockies by the comparatively low Pine Pass; this was the route by which the early explorers and settlers came to British Columbia, since they could not cross the high mountains and wide rivers further south.

There has been road access from the south to Prince George for many years; the Cariboo trail came as far north as Quesnel and Barkerville in the 1858 gold rush. Here one enters beekeeping country again, and at Quesnel, a little frontier-type town named after Fraser's first lieutenant, the beekeepers from around had gathered together for a lunch and meeting, which I very much enjoyed.

This upper Fraser valley is wooded, with Engelmann spruce, Douglas fir, balsam and junipers—and western red cedar, which is exported to England for hives, but seems never to be used for this purpose in Canada. Beekeeping depends mostly on the roadside fields and verges, and on the drier open land to the east. John Chandler lives 200 miles south of Quesnel at Lillooet, where the Cariboo trail starts; he has around 900 hives, some as far as 70 miles from Lillooet, and he is the only beekeeper in the area. The honey here comes from a wider variety of plants than in the Prairie Provinces, and is more aromatic—

in some ways like honeys from the Mediterranean regions. In the drier parts I was delighted to find flowers of Indian paintbrush (*Castilleja*) which I had last seen in Arizona. John Corner also found me some handsome blooms of Canada's only cactus—*Opuntia fragilis*—which looks rather like a yellow variety of the Arizona hedgehog cactus, *Echinocereus rigidissimus*. These encounters made me realize that the dry regions east of the Pacific coastal mountains have much in common, even at latitudes a thousand miles apart.

From Cache Creek we made a detour to even drier country at Kamloops on the Thompson river, to see the 'bee beds' there. These are experimental plots of alkaline soil, lined with plastic sheet and heated electrically, into which soil plugs containing prepupae of the alkali bee had been embedded. The prepupae had been sent from Oregon, where the alkali bee (*Nomia melanderi*) had proved an extremely efficient pollinator of alfalfa (Crane, 1957). This was their first 'rearing' in Canada for the purpose. Emergence is timed by temperature control to coincide with flowering, but the season was late, and no bees had yet emerged from the soil. In nearby fields were mobile shelters about 6 ft. high × 3 ft. wide, with batteries of drinking straws, ready for the *Megachile rotundata* just emerging from pupation trays below (see Section 5).

From the alfalfa fields by the river, the distant landscape looked much as it must have done when the first settlers arrived with their wagons in 1862. The hills around yield stones such as opal, jade and amethyst; these were of less interest to the settlers than gold, but are now eagerly sought by amateur 'rock hounds', of whom Mr. Bill Huxley, chairman of the local beekeepers' association, is one.

The Thompson river joins the Fraser at Lytton, south of Cache Creek, and here the Fraser gorge leads south to Hope and out into the broad Fraser valley. Much of this is in John Chandler's territory, and there cannot be two other men who know this country as well as he and John Corner do.

The lovely Fraser valley sweeps west from Hope, to Chilliwack and on to the sea beyond New Westminster and Vancouver. In the valley, at Pitts Meadows, we had a beekeepers' meeting at the Austrings' blueberry farm. Mr. Austring left his home in the Lofoten Islands in 1902, when he was 17, and now produces 200 tons of blueberries* a year, and cranberries as well. The bees were still on the fields for pollination; for the convenience of visiting beekeepers there were also two little huts, one marked QUEENS and the other DRONES.

In a restaurant high above the river in New Westminster, I had a happy lunch-time interlude with friends I had not seen since 1957; Mr. and Mrs. Percy Hodgson of Hodgson's Bee Supplies, Harry Bird (the firm's manager) and his wife, and Mr. and Mrs. Bender; Otto Bender used to edit *Westfälische Bienenzeitung*.

From Vancouver I crossed to Vancouver Island, to see the beekeeping there. I was surprised to find that the Island is subject to dry easterly winds, and that the annual rainfall in Victoria is less than half that in Vancouver on the mainland. Much of the honey contains only 15 to 16% water; it comes mostly from fireweed, which grows luxuriantly in recently felled areas of the coniferous forests which cover most

* high-bush blueberry, *Vaccinium corymbosum*, not *ovatum* as stated on page 64.

of the Island. Fireweed (rosebay willowherb, *Chamaenerion angustifolium*) gives large honey yields in many parts of Canada; for instance after a forest fire near Valley View in Alberta, one apiary produced an average of 150 lb. [70 kg.] per hive in ten days; 25 lb. a day is reckoned a good 'take' in Manitoba. On Vancouver Island the flow is worth working for 2 – 10 years after felling. The honey is almost white and does not granulate, so it can be sold liquid without filter-pressing; it is also very suitable for packing round cut-comb honey. These characteristics of fireweed honey, and its low water content on the Island, perhaps explain why some of the beekeepers in British Columbia are unwilling to subject their honey to the processing required by, say, rape honey.

Mr. and Mrs. Warren, of 'Babe's Honey Farm' near Victoria, have 750 colonies, run on a two-queen system; the average yield is about 220 lb. a year [100 kg.]. In addition to fireweed the bees work maple (*Acer*), blueberry (*Vacciniium*), dandelion (*Taraxacum*) and an indigenous shrub with *Erica*-like flowers called sallal (*Gaultheria shallon*). Their chief difficulties are access to the fireweed sites—and damage by bears.

The small part of the Island I saw was extremely beautiful, with wooded tidal inlets reminiscent of Norway, and a show of broom finer than I have ever seen except in the Cevennes. There was a lot of *Arbutus menziesii*, a summer-flowering tree with a more pronounced trunk than *A. unedo*, and the clearings and roadsides were full of wild flowers; mechanical spraying of verges with weed killers has fortunately not reached Vancouver Island yet.

8. CONCLUSIONS

The foregoing account is a record of impressions from a month's visit to the country and in no sense a systematic account of Canadian beekeeping. Attempts have nevertheless been made to synthesize some aspects of beekeeping that are of special interest. This interest stems partly from the identity of the plants from which the high Canadian honey yields are obtained. They are not sub-tropical jungle or eucalyptus forests confined to restricted areas of the world, but plants familiar throughout the temperate zones, which in many places give a much smaller honey harvest. Climate and latitude are the underlying causes of the high Canadian yields, coupled with facilities for large-scale cultivation, the need to grow legumes to enrich the soil and the profitability of growing them for seed, and the importation of 200 000 lots of package bees each year.

Most of my hosts and guides were enthusiastic about the work they do and the country they live in, and I came to share their enthusiasm. The beekeeping I have described must not be taken by potential immigrants as a blue-print for their first few years in Canada. Like beekeepers in any other country, those in Canada have their difficulties. The impression I got in June was that the chief hindrances to *beekeeping* were bears, and the clogging up of the honey strainer, but this may well not be a balanced judgement.

Canadian beekeepers undoubtedly have many assets: a richly endowed land, whose summer climate and vegetation are well suited to honeybees; a neighbouring country which can supply fresh bees each

spring; highly developed mechanical aids to beekeeping; a good network of educational and extension services; and competent research departments for bees and beekeeping, which have facilities for co-operation with scientists in other fields such as botany and chemistry.

I have never travelled in a country where I met with more real kindness and hospitality, and many people besides those already mentioned helped me on my way and added to the interest and enjoyment of my journey. I should like to mention especially Mr. and Mrs. G. Vant Haaf of Victoria, Ed Bland of Saskatchewan, John King, Secretary of the Canadian Beekeepers' Council, Paul Boutette of the Canadian Broadcasting Corporation; and in Winnipeg Miss Aileen Garland, who stimulated my interest in Canadian history, and Mrs. Isobel Garland and Mrs. Evelyn Roberts, whose combined strength of purpose brought about my one and only concentrated shopping trip.

I owe a great deal to the various beekeeping organizations which are linked together through the Canadian Beekeepers' Council. The Provincial Associations together covered the cost of my travels, through the Canadian Association of Apiculturists. The C.A.A. represents the Provincial Apiarists and others concerned with extension work; its Secretary Dr. S. C. Jay made the arrangements for my programme, and I am especially grateful to him for all the work involved in doing this. Among the many mementoes I brought home were two brooches from beekeepers of British Columbia, one of silver and the other of jade and gold from the Fraser river, which is perhaps the part of all Canada I remember most vividly.

In any country beekeeping is part and parcel of the wider aspects of life, economic, political and ethnological. Canada is a nation of voluntary immigrants from many parts of the world, and their descendants, with half its population less than twenty-five years old. It seems to me to be a land of much promise for those in harassed circumstances elsewhere who are willing to become Canadians in the true sense—who, instead of striving to keep apart within a framework of their former culture, give what they bring, including their children, to add to the strength of their adopted country. This is how a new nation is properly made.

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